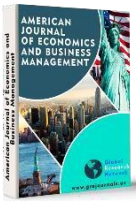

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*Article*

# Socio-Economic Determinants of Household Water Consumption: A Case Study

**P. Sudha*[1], V. Pradeep[2], M. Mohamed Sameer Ali[3], S. Suman Rajest[4], R. Regin[5]**

1,2,3,4. Dhaanish Ahmed College of Engineering, Chennai, Tamil Nadu, India
5. SRM Institute of Science and Technology, Ramapuram, Chennai, Tamil Nadu, India
* Correspondence: sudhap@dhaanishcollege.in

**Abstract:** Water is one of the most essential natural resources, playing a critical role in public health and economic development. However, the rising demand for water has placed immense pressure on urban water supply systems, leading to environmental issues such as over-exploitation of water resources and disruptions in ecological and economic balance. Understanding the behavior of domestic water consumers is key to managing demand effectively and developing targeted strategies for sustainable water usage. This study focuses on household water consumption patterns in Chennai city. Primary data was gathered through a structured questionnaire from 50 urban households. The analysis, conducted using both quantitative and qualitative methods, revealed that water usage is influenced by several socio-economic factors. These include income levels, family size, education, age of household members, and the number of water taps within the home. Households with lower incomes tended to consume less water, and living standards played a significant role in determining overall usage. The study's findings offer valuable insights for policymakers and urban planners seeking to design efficient water conservation strategies tailored to the unique demographic and economic profiles of households in Chennai. Ultimately, this research supports efforts toward sustainable water management in urban settings.

**Keywords:** Family Size, A Domestic Water Consumption, Substantial Reductions, Domestic Water Consumption, Crucial for Health and Wealth

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## 1. Introduction

Household water consumption is influenced by multiple factors, such as climate, seasonal changes, socioeconomic status, and demographic characteristics. This study focuses exclusively on the socio-demographic factors influencing water use [35]. While numerous research projects have highlighted the ongoing water shortage and the rising residential water usage, there is a notable gap in studies examining domestic water consumption patterns, especially when satisfying household water demand is a central goal of policy interventions and programs aimed at drought mitigation or domestic water management [36]. This research seeks to analyze domestic water consumption patterns in the household sector in Chennai city, investigating various aspects that influence how water is used and accessed in urban settings [37].

Half of the world's population now resides in cities, and it is expected that nearly 60 percent of people will be urban dwellers within the next two decades [38]. Urban growth is accelerating, especially in developing countries, with cities gaining an average of five million new residents each month [39]. This rapid urbanization presents numerous

challenges, with water supply and sanitation being among the most critical and urgent [40]. According to the 2011 Census of India, the country's population reached 1.21 billion, with an increase of 181 million people over the previous decade. Although only 31.16 percent of India is classified as urban, the urban population in India, at 377 million, is already larger than the total population of the United States, the third most populous country in the world [41].

Data from the 2011 Census reveals that around 70 percent of Indian households have access to tap water, but only 62 percent have access to treated tap water [42]. Consequently, nearly 40 percent of urban households do not have access to a public water supply and must rely on alternative sources [43]. Moreover, not all households with public water supply access enjoy it within their premises; only 49 percent have piped water connections within their homes [44]. While there was a steady increase in the percentage of households accessing improved drinking water from 1990 to 2008, a decline was observed in 2011 [45]. This decline is attributed to the refinement of data collection methods, which now distinguish between treated and untreated tap water [46]. Previously, all tap water was considered improved, and a similar categorization change occurred for water drawn from wells [47]. When untreated tap water and uncovered wells are included in the improved category, the proportion of households with access to improved water sources reaches approximately 98 percent [48]. Comparing the 2001 and 2011 Census data shows that nearly 18 million additional households gained access to tap water, but the overall distribution across different sources has changed only marginally [49]. These statistics, however, do not capture the poor quality of water service in slum areas, where the distance between the water source and home and the use of shared facilities continue to present serious challenges [50].

India is endowed with 14 majors, 44 medium, and 55 minor river basins. The major river basins account for around 83 to 84 percent of the total drainage area in the country [51]. When combined with the medium river basins, they cover approximately 91 percent of the total drainage area [52]. Water availability in the Indian subcontinent is largely shaped by climatic and geographic factors, including seasonal rainfall, the monsoon system, and terrain characteristics [53]. These natural variables collectively ensure that India has adequate freshwater resources to fulfill the needs of agricultural, industrial, and domestic sectors [54]. However, the spatial and temporal distribution of water remains uneven, limiting availability in specific geographic regions and during certain periods of the year [55]. Additionally, governmental policies and economic incentives have significantly influenced how water resources are distributed and consumed throughout the country [56].

The situation in Chennai exemplifies the complex nature of urban water management. As one of India's largest metropolitan areas, Chennai has experienced rapid urban expansion, population growth, and increasing demands on water infrastructure [57]. The city has faced severe water shortages in recent years, prompting widespread concern and media coverage [58]. During periods of drought, Chennai's reservoirs and water bodies have dried up, and authorities have been forced to truck in water from distant locations to meet demand [59]. Water rationing and supply cuts have become commonplace, severely affecting daily life [60]. In such a context, studying domestic water consumption patterns and understanding the socio-demographic variables that influence them is of critical importance [61].

In urban areas like Chennai, the disparity between water-rich and water-poor neighborhoods is stark. Residents in more affluent parts of the city may enjoy consistent access to piped water, private wells, and storage tanks, while those in informal settlements or lower-income areas often depend on public taps, tankers, or shared facilities [62]. Socio-demographic factors such as income, education level, family size, and housing type play a major role in determining access to and usage of water [63]. Larger households may consume more water, but also tend to develop coping mechanisms to manage limited

resources [64]. Education level can influence awareness and practices related to water conservation, hygiene, and the use of safe water sources [65]. Income levels dictate the ability of households to invest in water storage, filtration systems, or alternative sources such as bottled water [66].

The seasonal variability of rainfall and the reliance on monsoons further complicate water planning in Chennai. Water consumption typically rises during the summer months when temperatures are higher and rainfall is scarce [67]. Rainwater harvesting systems, which have been promoted by the government, offer a potential solution, but adoption rates remain inconsistent [68]. Many residents still depend heavily on groundwater sources, which are increasingly depleted and contaminated [69]. Over-extraction has led to declining water tables, increased salinity, and a growing dependence on desalination plants and imported water [70].

Government initiatives to improve water access and management include policy reforms, infrastructure investments, and awareness campaigns [71]. Chennai has seen the implementation of smart water meters, digital billing systems, and efforts to monitor leakage and reduce non-revenue water [72]. However, systemic challenges such as corruption, lack of coordination among agencies, and insufficient funding continue to hinder progress. Effective urban water governance requires not only technological solutions but also community engagement, transparency, and long-term planning.

In the, water is an indispensable resource that underpins human development, economic productivity, and social well-being. Urban centers like Chennai face mounting challenges in ensuring reliable, equitable, and sustainable water access for all residents. While population growth and urbanization strain existing infrastructure, thoughtful policy measures, investment in technology, and a deeper understanding of domestic water consumption patterns can pave the way for more resilient water systems. This study contributes to the growing body of knowledge on urban water management by focusing on the socio-demographic determinants of household water use, offering insights that can inform policy and practice in addressing one of the most pressing issues of our time.

Review of Literature

Domestic water consumption across seven major Indian cities remains significantly lower than the Bureau of Indian Standards (BIS) norms [3]. This shortfall in consumption is largely attributed to the limited water supply, which has not kept pace with rapid urban population growth and escalating demand [4]. Through household surveys that assessed water availability, accessibility, and conservation practices, it was concluded that most households operate below the recommended consumption norms [5]. Despite these low levels of use, respondents generally expressed satisfaction with their existing supply [6]. This contentment is believed to stem from the adaptive behavior of residents, who have moderated their expectations and adjusted their water needs to match the limited and often unreliable supply provided by municipal or other local water authorities [7].

The correlation between household income levels and domestic water consumption shows that middle- and high-income groups are responsible for greater water use, especially due to amenities like gardens, multiple bathrooms, and car washing [8]. Education and higher tariffs are considered potential interventions to alter excessive consumption behaviors. As cities expand and urbanize, there is a direct positive impact on domestic water use [9]. This urban expansion leads to improved access to water infrastructure, which, combined with rising incomes, further boosts consumption [10]. Strategies focused on disseminating information and public education are recommended to encourage water conservation and efficient use, which would be particularly effective among higher-income groups accustomed to greater levels of water use [1].

Future water consumption patterns are expected to shift based on the government's investment in sanitation and hygiene education [11]. As awareness of sanitation improves, individuals are more likely to adopt better hygiene practices, which, in turn, will increase domestic water demand. Water consumption significantly varies based on household

water infrastructure [12]. For instance, fully plumbed homes consume nearly three times more water than those with only a yard tap. This highlights the role of infrastructure in shaping water use behaviors [13]. The presence of water-use appliances such as dishwashers, washing machines, and indoor plumbing contributes to increased consumption [14]. Planning for future water demand must account for changes in household amenities and improvements in living standards [2].

Economic variables, water pricing, and policies have a significant influence on domestic water consumption patterns in urban areas [16]. Projections indicate that by 2030, urban water demand will rise significantly and match current rural consumption levels [17]. Raising water awareness, especially among women and children who often manage domestic water use, is vital. Socio-economic factors such as income, education, and household size play key roles in determining water consumption patterns [18]. Effective domestic water projects must integrate education, equitable pricing strategies, and community engagement [19]. Additionally, long-term water planning must consider the growing urban population and its implications on future water demand and sustainability in resource-limited regions [15].

The rise in water consumption is closely linked to increased use of water-related appliances in lower-income urban households [21]. These appliances include flush toilets, washing machines, and dishwashers. Changes in housing types, household sizes, and the growing acceptability of water-intensive lifestyles contribute to rising demand in Asian cities [22]. It is necessary to evaluate how market penetration of water-efficient devices, alternate water sources, economic growth, and employment opportunities affect domestic water usage. Lifestyle changes are a major driver of increased water demand in urban sectors [23]. Urban planners and policymakers must consider these evolving factors when planning for water distribution, infrastructure investment, and demand management in rapidly urbanizing areas [20].

Water security is essential not only for environmental sustainability but also for economic growth and social stability. Households are generally willing to pay more for a consistent and high-quality water supply, which is an important consideration for policymakers designing appropriate water tariffs [24]. Household income levels and the education level of the head of the family are significant predictors of willingness to pay [25]. Currently low water tariffs fail to influence consumer demand, limiting the effectiveness of price-based conservation strategies. Better tariff structures could help enhance service delivery while also promoting responsible water use behaviors across diverse socioeconomic groups [26].

Access to water is insufficient if the supply is not continuous and the quality is poor. Survey data reveal that a significant number of urban households do not receive water on tap and instead rely on shared or distant water sources [27]. A reliable, 24-hour water supply with high cleanliness standards is essential for meaningful access [28]. Perception-based data are instrumental in capturing user satisfaction and system performance. Service reforms are necessary to ensure equitable, uninterrupted water delivery, especially in informal settlements and slum areas, where infrastructural challenges persist [29].

Municipal water systems must be dynamic and proactive to meet increasing urban demand [30]. Water demand management, wastewater recycling and reuse, conservation programs, and efficiency improvements should be central to policy frameworks [31]. Infrastructure development alone is not enough; complementary efforts in revenue management, governance structures, and policy design are crucial for sustainable urban water systems [32]. Consumer satisfaction is also important in shaping effective water management strategies [34]. Integrating these elements will support the delivery of adequate water supply and ensure long-term resilience in urban areas, particularly under conditions of rapid population growth and environmental stress [33].

## 2. Materials and Methods

Research methodology refers to the logical, systematic approach a researcher adopts to conduct their study. It outlines the plan and procedures necessary to gather, analyze, and interpret data that will lead to the resolution of a research problem. A well-crafted methodology ensures the reliability and validity of the research findings and serves as a roadmap that guides the researcher throughout the project. It encompasses decisions on what data will be collected, the sources of that data, and the techniques employed to collect and analyze it. This structured approach not only enhances the legitimacy of the study but also makes the process more manageable and effective, enabling the researcher to stay focused on the research goals.

In the context of the present study, which focuses on analyzing water consumption patterns in the household sector with special reference to Chennai city, the research methodology plays a critical role. Chennai, like many other rapidly urbanizing cities, faces significant challenges related to water availability, usage, and management. As a result, the study aims to delve into how households in Chennai consume water, the factors influencing their consumption patterns, and the potential for promoting water conservation practices.

Water is one of the most vital resources for sustaining life, yet only about 0.3% of the Earth's water is usable for human needs. A considerable portion of the global population already suffers from inadequate access to clean drinking water, and this crisis is expected to worsen as population growth, climate change, and human activities continue to stress existing water resources. As a result of pollution, mismanagement, and inefficient usage, water scarcity is no longer just a looming threat—it is a present reality in many parts of the world, including urban centers like Chennai. This dire situation underscores the urgency to examine water use patterns at the household level and to promote more conscious and sustainable consumption behaviors.

The current research takes a comprehensive approach to identify key determinants of household water use in Chennai. It evaluates various factors that influence water consumption, including the use of water-efficient appliances, the prevalence of water conservation practices, and the impact of psychosocial and socio-demographic variables. By understanding these variables, the study aims to offer insights that could inform the design of more effective water demand management strategies. One of the unique aspects of this research is its integration of both individual-level and group-level psychological determinants, moving beyond traditional studies that have largely focused on infrastructure and demographic characteristics alone.

Furthermore, the study aims to understand the segmentation of domestic water use, breaking down usage into categories such as bathing, cooking, cleaning, gardening, and sanitation. Each of these categories has different water requirements, and a detailed analysis helps to define what constitutes a reasonable or expected level of consumption for a household. In addition, the study investigates the contrast between water usage in urban and rural settings, especially in terms of source availability and the mechanisms of water supply. This includes exploring differences in access to piped water, tanker supply, borewells, and other local sources. Such comparisons are essential for understanding how water infrastructure and resource availability shape consumption behavior.

Another important objective is to highlight the role of planning in ensuring the economic and sustainable use of limited water resources. Efficient water planning requires an understanding of both current consumption patterns and potential areas for conservation. The study identifies ways in which individual households can contribute to water conservation, such as by adopting low-flow fixtures, reusing greywater, fixing leakages promptly, and engaging in mindful consumption practices. These individual efforts, when multiplied across communities, can lead to significant reductions in water demand. Finally, this research provides insights into the actual utilization patterns of water across different types of households in Chennai. By studying how households of

various sizes, income levels, and educational backgrounds use water, the study seeks to offer tailored recommendations for reducing consumption and improving efficiency. In conclusion, this research aims to contribute valuable knowledge that can support both policymakers and the general public in making informed decisions about sustainable water use at the household level.

**Research Design**

A research design serves as the foundational blueprint for conducting a study, outlining the overall strategy and specific methods that will be used to gather, analyze, and interpret data. It ensures that the research questions are effectively addressed and that the data collected are valid, reliable, and suitable for achieving the intended research objectives. A well-structured research design helps maintain clarity and consistency throughout the research process, providing a logical sequence to the work being undertaken. In this study on the analysis of water consumption patterns in the household sector, with a special reference to Chennai city, the research design includes both sampling strategies and data collection methods. The sample design chosen was convenient sampling, which involves selecting respondents based on their accessibility and willingness to participate. This non-probability sampling technique is commonly used when time, resources, and access are limited. The researcher selected 50 respondents from Chennai city who were available and agreed to participate. While this method is easy to implement and cost-effective, it may introduce bias and limit the generalizability of the findings.

The sample size, which refers to the number of individuals or data points included in a study, was fixed at 50 for this research. Sample size plays a significant role in determining the accuracy and reliability of the research outcomes. Although a larger sample generally allows for better generalization of findings to the broader population, practical constraints such as time and resources sometimes necessitate smaller sample sizes. In this case, a sample of 50 respondents provides a preliminary insight into household water consumption patterns, though it may not fully capture the diversity of water use across the entire Chennai city. The study relied primarily on primary data for its analysis. Primary data refers to information collected firsthand by the researcher for a specific research purpose. In this study, the researcher used an interview schedule to collect data directly from respondents through face-to-face interaction. This method allowed for in-depth responses and clarification of questions where needed. Additionally, informal discussions and direct observations were used to supplement the interview data, offering a more comprehensive understanding of the respondents' water use behaviors. These qualitative methods helped capture not only factual information but also attitudes, perceptions, and contextual factors affecting household water consumption.

The period of the study extended from January 2024 to March 2024, with the actual data collection carried out during February 2024. This three-month window was sufficient for planning, collecting, and organizing the data needed for the research. The limited timeframe, however, also posed certain constraints on how extensively the data could be gathered and analyzed, especially given the variability in water use that may occur across different seasons. As with any research, this study is subject to certain limitations that need to be acknowledged. First, the focus is exclusively on the household sector, which means findings cannot be generalized to other sectors such as industrial, commercial, or agricultural water use. Each of these sectors has distinct patterns and determinants of water consumption that were not considered in this study. Second, the sample size of 50 respondents, while informative, is relatively small and may not adequately represent the wide variation in household water use across the entire urban landscape of Chennai. A larger and more randomized sample would have enhanced the representativeness of the data. Finally, the study may also be affected by recall bias, as it relies on self-reported information from respondents. Human memory can be inaccurate or selective, particularly when respondents are asked to estimate water use or recall specific behaviors. Despite

these limitations, the study offers useful insights into domestic water use and lays the groundwork for further research in this critical area.

## 3. Results

Data interpretation is the process of reviewing data and arriving at relevant conclusions using various analytical research methods. Data analysis assists researchers in categorizing, manipulating data, and summarizing data to answer critical questions.

**Table 1.** Gender of Household Water Consumption in Chennai City.

| No. | Gender | Frequency | Percentage |
|---|---|---|---|
| 1 | Male | 20 | 40 |
| 2 | Female | 30 | 60 |
| **Total** | | **50** | **100** |

In the above table 1 shows the Gender composition of the water consumption in household sector in Chennai city. Out of 50 respondents 40 present (20) of the respondents are male and 60 persent (30) of the respondents are female. We can observe that female about 60% (30) consume water more than male about 40% (20). Female tend to consume more water in the households of Chennai metropolitan city.

**Table 2.** Age of Household Water Consumption in Chennai City.

| No. | Marital Status | Frequency | Percentage |
|---|---|---|---|
| **1** | Below 20 Yrs | 4.0 | 8.0 |
| **2** | 20 – 30 Yrs | 10.0 | 20.0 |
| **3** | 30 – 40 Yrs | 13.0 | 26.0 |
| **4** | 40 – 50 Yrs | 17.0 | 34.0 |
| **5** | Above 50 Yrs | 6.0 | 12.0 |
| **Total** | | **50** | **100** |

In the above table 2 shows the age of the house hold sector, Among 50 respondents 8 persent of the respondents are in the age group of below 20 years, 20 persent of the respondents are in the age group of 20 -30 years, 26 persent of the respondents are in the age group of 30-40 years, 34 persent of the respondents are in the age group of 40-50 years, 12 persent of the respondents are in the age group of above 50 years, we can say that people of the age 40-50 yrs. consume more water than other age groups. From the findings of the above tables, we can say most of 40-50 yrs. age group are married (Tables 3 and 4).

**Table 3.** Educational Qualification of Household Water Consumption in Chennai City.

| No. | Educational Qualification | Frequency | Percentage |
|---|---|---|---|
| **1** | Primary Level | 2.0 | 4.0 |
| **2** | Higher Secondary | 3.0 | 6.0 |
| **3** | Graduate | 10.0 | 20.0 |
| **4** | Professionals | 20.0 | 40.0 |
| **5** | Others | 15.0 | 30.0 |
| **Total** | | **50** | **100** |

**Table 4.** Volume of Water Consumption by Household Water Consumption In Chennai City.

| No. | Volume Level | Frequency | Percentage |
|---|---|---|---|
| 1 | Less than 50 L | 5.0 | 10.0 |

| | | | |
|---|---|---|---|
| 2 | 50 – 100 L | 5.0 | 10.0 |
| 3 | 100 – 150 L | 8.0 | 16.0 |
| 4 | 150 – 200 L | 12.0 | 24.0 |
| 5 | Above 200 L | 20.0 | 40.0 |
| **Total** | | **50** | **100** |

## 4. Discussion

The analysis of household water consumption in Chennai metropolitan city reveals several key insights based on demographic, socio-economic, and behavioral patterns. It is observed that female members in households tend to consume more water than males, with approximately 60% of water usage attributed to women, compared to 40% by men. This higher consumption may be due to the fact that women are generally more involved in domestic chores such as cooking, cleaning, and washing. In terms of marital status, married individuals account for about 72% of the water consumption, while unmarried individuals make up the remaining 28%. This difference can be attributed to the greater number of responsibilities in married households, such as caring for children and managing various household tasks that require water.

Age also plays a significant role, with the 40–50 age group consuming the most water. This trend aligns with the observation that a large portion of this age group is married and has families, leading to increased water needs. Educational background appears to influence water use as well; professionals tend to consume more water compared to those with different educational qualifications. This may reflect lifestyle differences, such as increased use of appliances or different hygiene practices. Occupational status further supports this pattern, as professionals make up about 40% of the water consumption, with the remaining 60% spread among other occupational groups.

Family type is another determining factor in water consumption. Nuclear families consume more water than joint families or single individuals. While joint families have more members, their collective approach to resource sharing may lead to more efficient water use. Single-person households use the least water, primarily because their individual needs are minimal. Housing status also impacts water consumption, with people living in rented residences using more water (60%) than those in owned homes. This could be due to differences in water conservation attitudes or infrastructure availability. Regarding sources of water, households primarily rely on lakes and rivers. A small portion of the population, around 10%, depends on rainwater and water tankers. When it comes to storage, water tanks are the most common method (used by 40% of respondents), while traditional methods like clay pots are less prevalent (used by only 8%). Rainwater harvesting, despite its benefits, is practiced by only 10% of the population, indicating a lack of interest or awareness among most residents. Much of the rainwater simply seeps into the ground without being captured for reuse.

The quality of water varies across the city. Around 40% of respondents find the water quality to be good, while excellent quality water is more often found in the outskirts. However, being a coastal city, Chennai experiences poor water quality in areas near the shoreline due to saline intrusion and pollution. An alarming finding is that 90% of households in Chennai do not have water meters installed. Without meters, it is difficult to monitor and regulate water consumption, leading to potential wastage. In terms of consumption volume, about 40% of the population uses more than 200 liters of water per day, while only 10% use less than 50 liters. Living arrangements also influence water use; people residing in apartments (44%) tend to consume more water than those living in other types of housing. Family size matters too, with households having 2–4 members showing higher water consumption, likely due to collective needs without the efficiencies of larger or smaller family structures.

Geographic differences are also evident, with residents of East Chennai consuming more water than those in other regions of the city. Despite these challenges, many Chennai residents are increasingly aware of the need to conserve water for sustainable development. One notable lifestyle trend is the rising use of washing machines. About 50% of respondents use washing machines occasionally, primarily driven by professional commitments and time constraints. To reduce water consumption at home, several measures can be adopted. These include avoiding unnecessary toilet flushing, using low-flow or dual-flush toilets, and switching to foaming soap that reduces rinsing needs. Installing tap aerators and using only as much water as needed for bathing are effective strategies. Greywater from bathing can be reused for gardening or car washing. Households are encouraged to avoid washing clothes unnecessarily and to run washing machines with full loads to save up to 10 liters per wash. Taps should be turned off while brushing teeth, as a running tap can waste about 16 liters per minute. Detecting and fixing leaks, both indoors and outdoors, is crucial. When washing dishes, it is better to use a rinse-hold setting or a bowl instead of running water continuously. The same applies to washing fruits and vegetables. In many developing countries, water systems are unmetered. Entire neighborhoods or housing blocks often lack meters, making it difficult to assess water usage accurately. This lack of metering hinders the identification of water losses due to broken pipes and unchecked wastage. Implementing water metering is essential for effective water management and conservation efforts.

## 5. Conclusion

In conclusion, reducing household water usage is not only achievable but also essential for ensuring environmental sustainability, promoting financial savings, and addressing the growing global issue of water scarcity. Every household, regardless of size or location, can contribute meaningfully by adopting simple yet impactful water conservation practices. Whether it's switching to efficient dishwashing techniques, installing smart water meters, using low-flow fixtures, or choosing drought-resistant plants for landscaping, each measure plays a vital role in saving water. Additionally, educating children and family members about the importance of water conservation fosters a culture of responsibility and sustainability. Small behavioral changes—like turning off taps while brushing, fixing leaks promptly, using full loads in washing machines, or reusing greywater—can cumulatively lead to significant water savings. These actions also help reduce utility bills, offering financial benefits alongside environmental ones. Though the solutions discussed are not exhaustive, they serve as a strong foundation for developing more comprehensive water-saving habits within households. Importantly, the responsibility of conserving water does not rest solely on government initiatives or large-scale infrastructure changes. It begins at the individual level—within our homes, our daily routines, and our choices. The future of water security depends on our collective efforts today. Every drop of water saved is a step toward a more sustainable and resilient world. Let us recognize the value of this precious resource and pledge to make a difference—one thoughtful action, one mindful habit, and one drop at a time.

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