WATER USE PATTERNS OF DIFFERENT DOMESTIC ACTIVITIES IN THREE DIFFERENT AREAS OF DHAKA NORTH CITY CORPORATION

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ABSTRACT

Rapid urbanisation has a big impact on urban water supply, especially in Dhaka North City Corporation. The aim of this research is to provide insights into domestic water use patterns and find out the per capita water use in three selected locations of Dhaka North City Corporation (DNCC), namely, West Dhanmondi, Lalmatia and Pirerbag. Data have been collected through questionnaire surveys in the selected areas. According to the Bangladesh National Building Code (BNBC-2020), for moderate apartments (<2000 sft), the average domestic water use per capita per day is 180 litres per capita per day (lpcd), but the results of this study show that, for the middle-income group households in Dhaka North City Corporation, the average domestic water use per capita per day is 308 lpcd. The outcomes of this research will contribute to a better understanding of the current water use patterns to promote sustainable urban development and help achieving targets 6.1, 6.2 and 6.4 of the United Nations Sustainable Development Goals (SDGs) by 2030 in Dhaka North City Corporation.

Keywords: *Domestic waater use patterns, Water use per capita per day, Dhaka North Ciity Corporation, Sustainable Development Goals 6.*

1. INTRODUCTION

Dhaka, the capital city of Bangladesh, is facing a severe water crisis due to rapid urbanisation and population growth. Domestic water use, which includes water for drinking, cooking, washing, and sanitation, is a significant contributor to this crisis. Despite being a water-rich country, Bangladesh faces several challenges in providing its population with a safe and reliable water supply. In Dhaka, these challenges are further compounded by inadequate infrastructure, water quality issues, and many residents' lack of access to piped water. So, for efficient resource management, an in-depth knowledge of water use patterns is required. Understanding all aspects of water use in households in the context of Dhaka North City Corporation, a megacity undergoing rapid urbanisation, is crucial.

According to the World Health Organization (WHO), individuals require 50 to 100 litres of water per day to fulfil basic needs encompassing drinking, personal sanitation, clothing washing, food preparation, and personal and household hygiene (UN, 2010; UN, 2018). It aligns with the standards set by the Bureau of Indian Standards (BIS), which suggests a minimum of 70-100 litres per capita per day for urban communities, excluding flushing requirements, which raises per capita demand to 115-145 litres (Udmale, 2016).

However, it is noteworthy that water consumption patterns can deviate significantly from these estimates. A study conducted by the Brac Institute of Governance and Development (BIGD) at Brac University found that homes in formal settlements in Dhaka use an average of 310 litres of water per person per day, more than double the estimates as mentioned earlier (Siddiquee & Ahamed, 2020). Moreover, following the Bangladesh National Building Code (BNBC-2020), moderate-sized apartments (<2000 sq ft) are estimated to have an average domestic water use of 180 litres per capita per day (lpcd).This study contributes to the existing literature by analysing household members' daily per capita water usage and identifying the various water consumption patterns in three different areas of Dhaka North City Corporation, i.e., West Dhanmondi, Lalmatia, and Pirerbag. These regions are renowned for having a diverse demographic and socioeconomic diversity. It will additionally assist in improving comprehension of the current state of affairs, encourage the planning and design of sustainable urban development, and help Dhaka North City Corporation to achieve targets 6.1(Safe Drinking Water), 6.2 (Sanitation and Hygiene), and 6.4 (Water Use Efficiency and Sustainability) of the UN Sustainable Development Goals (SDGs) by 2030.

1.1 Objectives of the study

The objectives of the study are as follows:
- To determine domestic water use per capita per day in Dhaka North City Corporation.
- To determine the water use patterns of different domestic activities.

2. METHODOLOGY

A survey is used as the descriptive research approach in this study. A questionnaire survey was conducted to examine the residential water use patterns and individual characteristics in the three selected study areas. The authors asked the participants how much water they use for cooking, bathing, washing, and other household activities to derive the volume of water used for different purposes. A questionnaire was prepared to collect data from the people living in the households located in the study areas (see Appendix 1). Based on different research, the following domestic activities were considered for this research (see table 1):

Table 1: Different domestic water use activities

No.	Activities	Definition
01.	Drinking	It is defined as water that is used or intended to be utilised by humans for drinking. (Utami, 2023) (Sultana, 2022) (Crouch, 2021) (Njoku, 2022)
02.	Cooking	Refers to the water used to prepare foods including meat, fish, and vegetables. Usually, it is drained and thrown away instead of being consumed. (Utami, 2023) (Sultana, 2022) (Crouch, 2021) (Njoku, 2022)
03.	Bathing	Refers to water that is commonly utilised in a bathtub or shower for body cleaning or soaking and for personal hygiene purposes (Utami, 2023) (Sultana, 2022) (Crouch., 2021)
04.	Laundry	Refers to the water used to wash clothes by hand or in a machine. (Utami, 2023) (Sultana, 2022) (Crouch, 2021)
05.	Dish washing	It is the term used to describe the water use for cleaning cookware, cutlery, and cookware. (Utami, 2023) (Crouch, 2021)
06.	Religious cleansing (ablution purpose)	Refers to the water used for ablution, the process of washing oneself as part of a religious practice or ritual. (Utami, 2023) (Sultana, 2022)
07.	Handwashing	Generally, refers to the water use for handwashing, a vital component of personal hygiene to stop the transmission of disease. (Utami, et al., 2023) (Sultana, 2022) (Crouch, 2021)
08.	Toilets	This term is usually used to describe the water use to flush garbage down the drain. (Sultana, 2022) (Crouch, 2021)
09.	Gardening	Water that is used exclusively to grow plants in a garden or other maintained area. (Crouch, 2021) (Njoku, 2022)
10.	House cleaning	Typically includes water usage for various tasks, such as mopping floors & cleaning surfaces. (Crouch, 2021)
11	Unanticipated event	Refers to an unexpected event or circumstance that results in a sudden or significant increase in water use. E.g., Pandemic

2.1 Study Areas

The survey was conducted in three selective localities of Dhaka North City Corporation. There are West Dhanmondi, Lalmatia, and Pirerbag (Table 2). These areas are known for their diversified population and varied socioeconomic structure. Figure 1 illustrates the selected study areas where the survey was conducted.
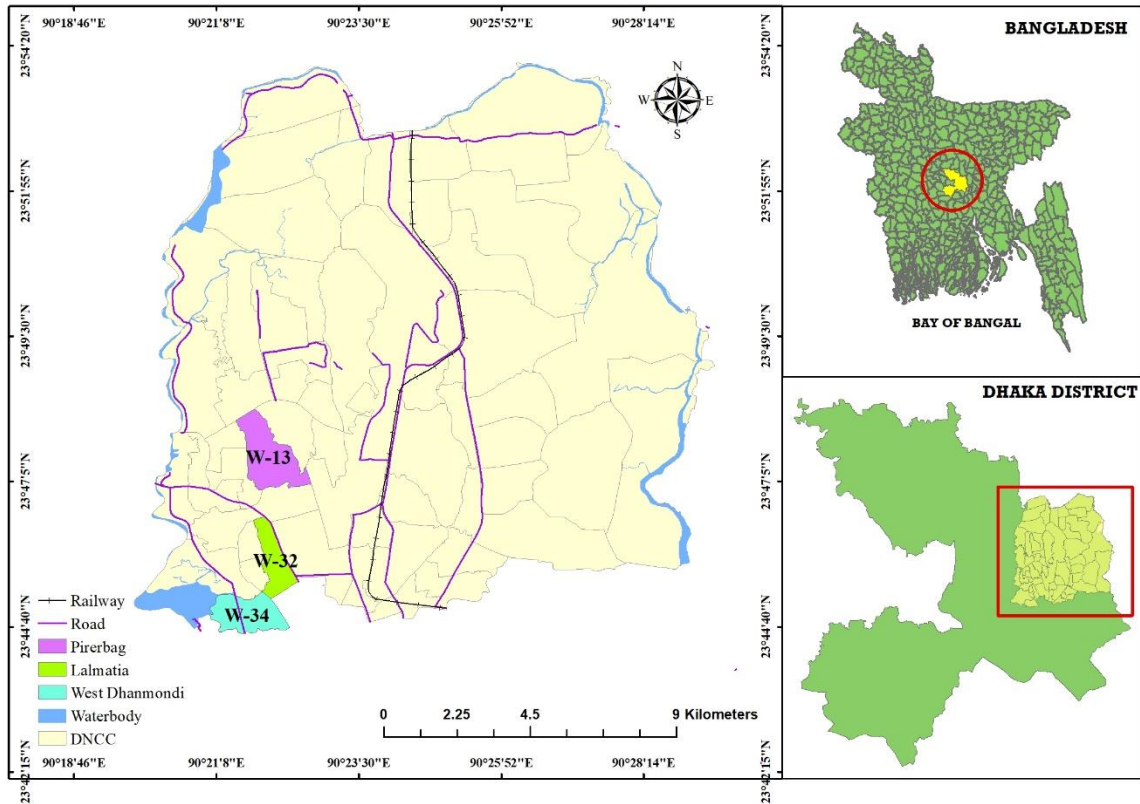
Figure 1 : Dhaka North City Corporation Map

Source: Map drawn by authors, 2023

Table 2: Study areas

Study area	Ward number	Building storey	Number of flats per building	Average flat size	Longitude and latitude
West Dhanmondi	34	6-storied	16	1300	23°45'05.4"N
		8-storied	18		90°21'36.5"E
		10-storied	28		23°45'05.4"N
Lalmatia	32	7-storied	13	1200	23°45'23.9"N
		8-storied	16		90°22'04.3"E
		10-storied	22		23°45'24.2"N
		12-storied	28		90°22'05.3"E
Pirerbag	13	8-storied	15	1200	23°47'08.0"N
		8-storied	16		90°22'24.8"E
		9-storied	18		90°22'00.8"E
		12-storied	23		23°47'39.0"N

Source: Field Study Survey, 2023

3. ANALYSIS AND RESULTS

This study investigated domestic water use patterns and per capita consumption in three distinct localities within the urban landscape: West Dhanmondi, Lalmatia, and Pirerbag. We collected data on daily water usage activities, including drinking, cooking, dishwashing, bathing, sanitation, laundry, handwashing, house cleaning, ablution, gardening, and car washing. During the survey, one hundred eighty families and seven hundred and twenty-seven participants were interviewed. Data were compiled from a representative sample of households within each locality over a fixed period. We utilised structured questionnaires and direct measurement methods to obtain accurate water use data. Our analysis involved comparing the average water usage across different activities and establishing per capita water consumption rates.

The survey aimed to determine the study area's household demographic composition. 180 of the 213 households that were contacted responded. The response rate was 84%. The average number of family members per household was four. The gender distribution of the 730 household members under observation was 43.28% female (n = 316) and 55.34% male (n = 404). The observed people's age distribution was almost evenly divided between adults (18 years of age and older) and minors (6–17 years of age), with 357 adults making up 48.90% of the population and 373 kids making up 51.10%. One of the limitations of this study is the non-participation of 33 homes, which could introduce non-response bias. A detailed analysis was done to assess this feature's importance.

3.1 West Dhanmondi

Based on the data obtained from the field study, the water use patterns of different domestic activities in West Dhanmondi are presented in Figure 2.
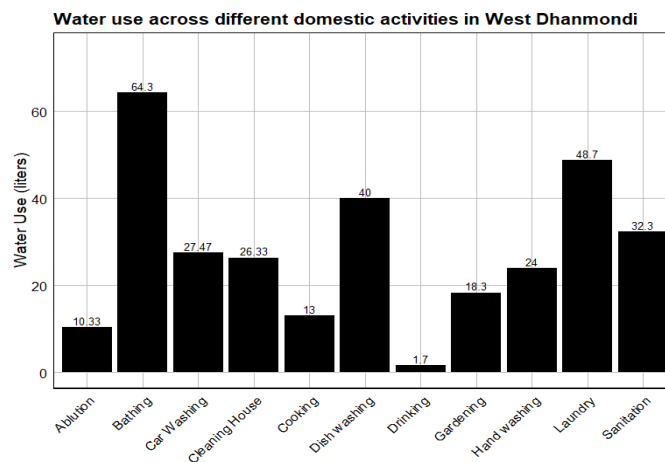

Figure 2 : Water use for different activity in West Dhanmondi
Source: Data collected through a field survey , 2023

Figure 2 shows that, in West Dhanmondi, the average per capita per day is 306.4 litres. Bathing uses the highest amount of water (64.3 litres) among all domestic water activities, followed by the activities of laundry (48.7 litres) and dishwashing (40 litres).

3.2 Lalmatia

Based on the data obtained from the field study, the water use patterns of different domestic activities in Lalmatia are presenated in figure 3.
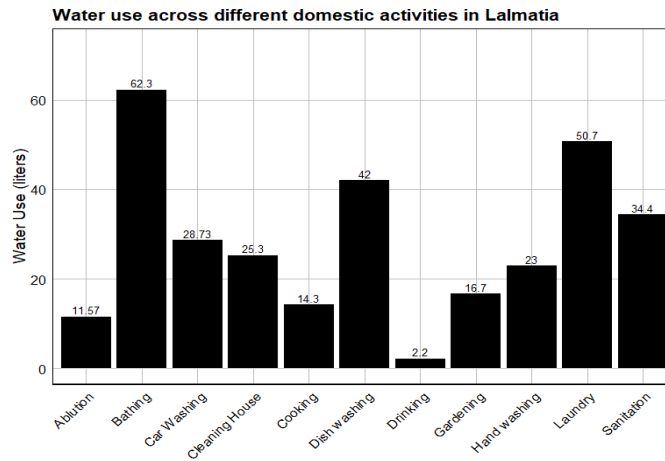
Figure 3 : Water use for different activity in Lalmatia
Source: Data collected through a field survey , 2023

Figure 3 shows that the average per capita per day is 311.2 litres. According to the data, bathing uses the highest amount of water (62.3 litres) among all domestic water activities, followed by laundry (50.7 litres) and dishwashing (42 litres).

3.3 Pirerbag

Based on the data obtained from the field study, the water use patterns of different domestic activities in Lalmatia are presented in figure 4.
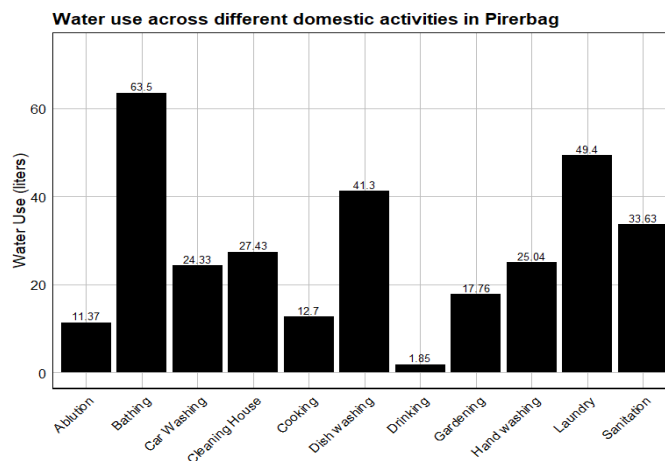

Figure 4 : Water use for different activity in Pirerbag
Source: Data collected through a field survey , 2023

Figure 4 shows that the average water use per capita per day is 308.37 litres. According to the data, bathing uses the highest amount of water among all domestic water activities (63.3 litres).

Table 3: Domestic water use (lpcd) in three study areas located in Dhaka North City Corporation

Activity	Location		
	West Dhanmondi	**Lalmatia**	**Pirerbag**
Religious cleansing (ablution purpose)	10.33	11.57	9
Bathing	64.3	62.3	65
Car washing	27.47	28.73	24.33
House cleaning	26.3	25.3	27.43
Cooking	13	14,3	12.7
Dish Washing	40	42	41,3
Drinking	1.7	2.2	1.85
Gardening	18.3	16.7	17.76
Handwashing	24	23	25.04
Laundry	48.7	50.7	49.4
Sanitation	32,3	34.4	33.63
Total water use in litres per capita per day (lpcd)	306.4	311.2	308.37

Source: Field Study, 2023

Table 3 compares the water use for various domestic activities in three selected areas of Dhaka North City Corporation, namely, West Dhanmondi, Lalmatia, and Pirerbag. The activities include religious cleansing (ablution purpose), bathing, car washing, house cleaning, cooking, dishwashing, drinking, gardening, handwashing, laundry, and sanitation. Water use by each activity was measured in litres per capita per day (lpcd).
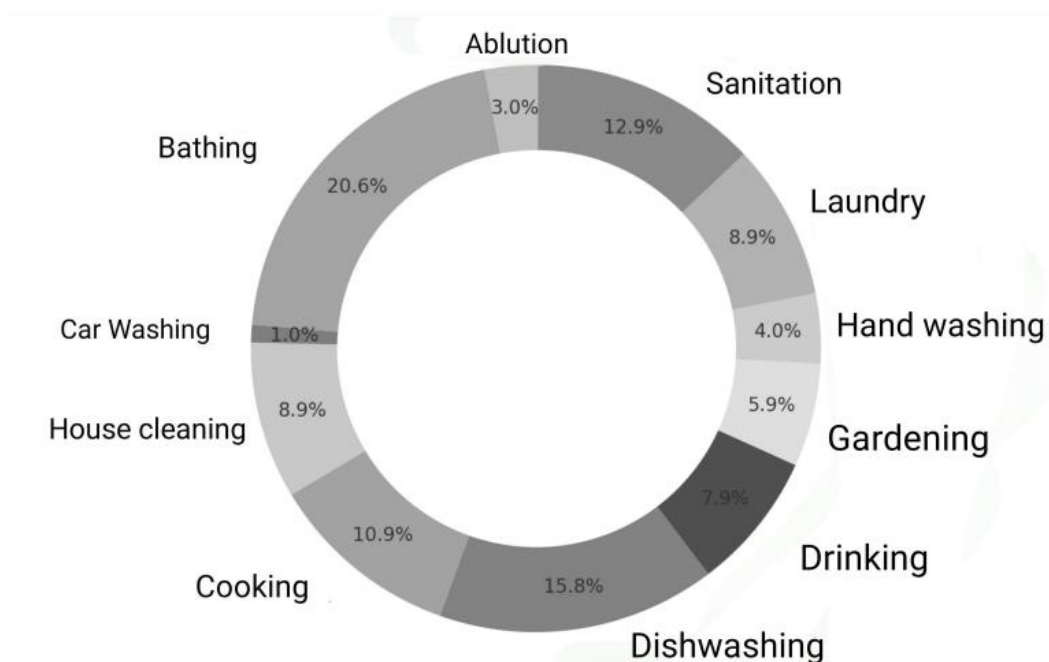

Figure 5 : Water use for different domestic activities in Dhaka North City Corporation
Source: Field Survey, 2023

Figure 5 illustrates the distribution of average water use for different domestic water activities across the study areas. It was observed that bathing and laundry constituted the central portions of water use, with significant differences noted between localities. For example, West Dhanmondi showed a higher propensity for water use in gardening, whereas Lalmatia and Pirerbag exhibited increased water usage for sanitation and house cleaning. The per capita water use patterns indicate variances amongst the localities, reflecting the demographic and socio-economic factors at play. In West Dhanmondi, a high-density area with a blend of old and modern housing, the per capita use was estimated at 306.4 litres per day. In Lalmatia area water use per capita per day is 311.3 litres per day. Contrarily, in Pirerbag, an area undergoing rapid urbanisation, water use per capita per day is 308.37 litres.

4. DISCUSSION

The field study reveals that among the various domestic activities in the three study areas located in Dhaka North City Corporation, the highest water consuming domestic activity is bathing (20.6%) (see Figure 5). After bathing, the second highest used water activity is dishwashing (15.8%). The third highest water use activity is sanitation (12.9%), and the fourth highest water use activity is cooking (10.9%) follwed by car washing (8.9%) and house cleaning (8.9%) activities.

Table 3 summarises the daily water use in the three study areas based on the data from the field study. The result shows the daily water use per capita in the three areas of Dhaka North City corporation, namely West Dhanmondi, Lalmatia and Pirerbag. The residents of these three study areas use around 308.65 litres of water per capita per day. However, according to the Bangladesh National Building Code (BNBC-2020), for moderate apartments (<2000sft), the average domestic water use is 180 litres per capita per day (lpcd). It is interesting to note that the field study data is significantly higher than that of Bangladesh National Building Code (BNBC-2020). Moreover, according to a study by Brac University's Brac Institute of Governance and Development (BIGD), households in Dhaka's official settlements use an average of 310 litres of water per person per day more than twice as much as previously estimated (Siddiquee & Ahamed, 2020), and our result shows a nearby value.

The findings of this research have practical relevance to facilitate water conservation initiatives and approaches as the city continues on its rapid urbanisation trajectory. The average water use in the three study areas is 308.65 litres per person per day (lpcd). This indicates the need for focused policies to increase domestic water use efficiencies in Dhaka North City Corporation.

5. CONCLUSION

This research analysed water use patterns of different domestic activities in three selected areas of Dhaka North City Corporation (DNCC), namely, West Dhanmondi, Lalmatia and Pirerbag. The findings reveal that in the three study areas of Dhaka North City Corporation, the average domestic water use is 308.65 litres per person per day (lpcd) (see Table 3). However, according to the Bangladesh National Building Code (BNBC-2020), for moderate apartments (<2000 sft), the average domestic water use per capita per day is 180 litres per capita per day (lpcd). The findings of this study emphasise the importance of a context-specific understanding of water use patterns of different domestic activities in Dhaka North City Corporation. The outcomes of this research will contribute to a better understanding of the current domestic water use patterns to promote sustainable urban development and help achieving targets 6.1, 6.2 and 6.4 of the United Nations Sustainable Development Goals (SDGs) by 2030 in Dhaka North City Corporation.

ACKNOWLEDGEMENT:

REFERENCES

BNBC, (2020). Bangladesh National Building Code 2020. Housing and building Research Institute, Bangladesh Retrieved from https://mccibd.org/wp-content/uploads/2021/09/Bangladesh-National-Building-Code-2020.pdf [Accessed 14 nov,2023]

BRAC Institute of Governance and Development [BIGD], 2017. The State of Cities 2017: Housing in Dhaka. BRAC University, Dhaka

Crouch, M. L., Jacobs, H. E., & Speight, V. (2021). Defining domestic water consumption based on personal water use activities. AQUA — Water Infrastructure, Ecosystems and Society, 70(7). doi:10.2166/aqua.2021.056

Moya-Fernández, P., López-Ruiz, S., Guardiola, J., & González-Gómez, F. (2021). Determinants of the acceptance of domestic use of recycled water by use type. Sustainable Production and Consumption, 27, 575-586. doi:10.1016/j.spc.2021.01.026

Njoku, P. O., Durowoju, O. S., Uhunamure, S. E., & Makungo, R. (2022). Investigating the Attitude of Domestic Water Use in Urban and Rural Households in South Africa. Water, 14 (2), 210. doi:10.3390/w14020210

Siddiquee, M. S., & Ahamed, R. (2020). Exploring Water Consumption in Dhaka City Using. Environmental Processes, 7, 1255–1275. doi:10.1007/s40710-020-00462-3

Sultana, R., Nahar, N., P. Luby, S., Swarna, S. T., Gurley, E., Tamason, C. C.& Jensen, P. K. (2022). Measuring Water Quantity Used for Personal and Domestic Hygiene and Determinants of Water Use in a Low-Income Urban Community. International Journal of Environmental Research and Public Health 19 (23), 15656. doi:10.3390/ijerph192315656

Utami, R., Geerling, G., Salami, I., Notodarmojo, S., & Ragas, A. (2023). Mapping domestic water use to quantify water demand and water-related contaminant exposure. International Journal of Environmental Health Research. doi:10.1080/09603123.2022.2163986

Appendix A: Questionnaire survey regarding Water Use Patterns of Different Domestic Activities in West Dhanmondi, Lalmatia, and Pirerbag of Dhaka City.

Questions		
1. Total number of household members from each of the following age/gender groups?	1. Men, adult (18 years, or above)	|__|__| person(s)
	2. Women, adult (18 years, or above)	|__|__| person(s)
	3. Children, male (below 18 years)	|__|__| person(s)
	4. Children, female (below 18 years)	|__|__| person(s)

2. How much is the family's monthly income? (TAKA)

□ Below 60,000   □ 60,000-70,000   □ 70,000-80,000   □ 80,000-90,000   □ Above 1,00,000

3. Housing Ownership

o Owns an flat	o Rent an flat

4. How much do you pay for water supply per month?

5. How many litres of water do you drink in a day?

6. How many litres of water do you use each day for cooking purpose?

7. How many litres of water do you use each day to wash your dishes?

8. How many litres of water do you use to take a bath in a day?

9. How many litres of water do you use per day for sanitation purpose?

10. How many litres of water do you use each day for laundry?

11. How many litres of water a day do you use to wash your hands?

12. How many litres of water do you use each day for cleaning house?

13. How many litres of water do you use for ablution/religious purpose in a day?

14. Do you have a garden on your balcony or roof? If no, then go to question no.16

□ Yes   □ No

15. How many litres of water do you use for gardening in a day?

16. Do you own any Car? If yes, then answer the question number 17

□ Yes   □ No

17. How many litres of water do you use for Car washing in a day?