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DEMANDS OF DOMESTIC WATER CONSUMPTION IN HARYANA: A CASE STUDY OF BAHADURGARH CITY

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Abstract

A household must have access to safe drinking water for sanitation and overall health of the household members. Variables with functions in time and space both have an impact in this context. The amount of domestic water use differs between urban and rural areas according to living conditions and demand of the residents. Not all regions are equally endowed with sufficient water resources. When all other conditions are held constant, some regions are sufficiently endowed with both surface and ground water supplies, making water access easier. On the other hand, certain places must make significant investments in order to have the water needed to sustain life. Making sure that residents have timely and convenient access to drinkable water has grown to be a significant problem. The reason is that there are many variables that affect the quality and quantity of water needed for human health and recreation, especially when trying to estimate the amount of water that would be needed at any one time at the household level. In this context, this paper is an attempt to identify the determinants of domestic water consumption in Bahadurgrah city which is an important city of Haryana. Accordingly, the city is experiencing an increase in population and number of households which is bound to drive an increase in domestic water demand. Based on a primary survey, the present study noted income and household member an important drive of domestic water consumption in addition to seasonal influence on domestic water demand.

***Keywords**: Drinking water supply, domestic demand consumption, Income Group*

Introduction

Domestic water use is typically the most significant resource in an urban setting, and from a socioeconomic perspective, its management results in decisions that are frequently very divisive (Corbella & Pujol, 2009). It is clear that the industrial, urban, and agricultural sectors are competing for water. Future domestic water demand will necessitate even more water due to population expansion (Hanjra & Qureshi, 2010).

It is vital for professionals in charge of water management to be aware of the specifics of the use and real consumption of water since the allocation of water resources has the potential to escalate tensions and disputes within a community (Kumar & Goyal, 2020). Furthermore, it is crucial to establish a water management strategy that is adaptable, efficient, and compatible with its surroundings without impeding on social or economic progress (Pahl-Wostl, et al., 2007). Conserving water is one tactic used to address this challenge (Mitchell, 2005). It focuses on initiatives and productivity levels that could fit into a way of life. In addition to lessening the effects of water shortages, the structural efficiencies associated with new housing and higher densities in urban development can provide long-term benefits by lowering the costs associated with expanding the infrastructure (Wilderer, 2004).

Residential areas utilize varied amounts of water, although it should be noted that higher-income areas use more water than lower-income areas do on average. Another crucial consideration is the size of the household (Worthington & Hoffman, 2008). Designing a pricing strategy for the water supply requires an understanding of the elements impacting the demand for water for home use. The key factors that can influence demand, such as water price, income, and household composition, are significant predictors of residential water demand, which has been a significant research area for a long time (Jorgensen, et al., 2009). This study's objective is to identify the factors that influence water use in Bahadurgrah city households using explanatory variables from a model. Additionally, the per-person water use in households is noted. This helps create knowledge and information about factors that affect water use at the household level in an Indian Class I city.

Study Area

Bahadurgarh is well known as the "*Gateway of Haryana".* Bahadurgarh city is situated on Delhi-Hisar National Highway number 10 at a distance of 2 Kilometers from Tikri border (Delhi). Bahadurgarh city is a municipal council located in Jhajjar district, Haryana, India. The Najafgarh town and Nangloi, which are important settlements of National Capital Region (NCR) Delhi, are located at a distance of 10 kilometers and 14 kilometers respectively. The responsibility of the municipal council is to look after the development and administration of the city as well as the

council handles the in2frastructure of Bahadurgarh. The city is divided into 31 wards. It is not only a tehsil but also a subdivision of Jhajjar district.

The total area of city is 30.5 sq. km. which supports total population 170767 (Census of India, 2011). In present time, Bahadurgarh is a municipal council city in Jhajjar district, Haryana. This city is divided into 31 wards. The 31stward comprises of two villages Sankhol and Parnala. Former Parnala, Sankhol and Hassanpur were included as outgrowths of Bahadurgarh city. Some villages had been entirely merged with the towns. Sankhol was merged with Bahadurgarh city during 2011 Census.

Objective

To determine the various factors that drive the domestic water demand in Bahadurgrah city situated in the proximity of Delhi NCT.

Database & Research Methodology

The present work is built on the fundamental facts. Primary data have been acquired via an extensive field survey. A planned zone and an unplanned zone have been established as the two study regions for the city. Subhash, Mahaveer Park, and Sainik Nagar are regarded as unplanned zones, whereas Omax City, sector 3A, and 13 have been utilised as planned zones. On the basis of a questionnaire, data for the main survey was acquired through in-person interviews. The respondents who have been singled out are housewives. The data has been presented using the relevant graphs. For the current study, field surveys have been conducted to determine the domestic water consumption patterns in Bahadurgrah city in relation to per capita income, the cost of water, and other factors. In this study, the effects of different socioeconomic and household factors, such as income level, average house size, average floor size, household size, population size in the surveyed nuclear and joint families, availability of a green lawn in the home, and characteristics of the storage water tank, have been examined in relation to the demand for domestic water. The homes were surveyed in order of lower to higher income, depending on the neighbourhood and monthly household income.

Result and Discussion

According to consumer living situations, residential water use varies between urban and rural places (Gatersleben & Vlek, 2008). The quantity of water varies depending on a variety of factors, including cultural norms, settlement patterns, supply types, and water sources. Making sure that people have prompt and easy access to drinking water has become a major issue (Lee & Schwab, 2005).

The reason is that there are several factors that might impact the quality and quantity of water required for human health and leisure, especially when attempting to predict how much water a household would need at any one moment (Nauges & Whittington, 2010). Unfortunately, it has been determined that a lack of data is the primary barrier to an accurate and sufficient estimation of water demand, particularly in developing countries (Ayanshola et al., 2010). This study intends to evaluate the predictability of residential water usage in a growing metropolitan region as well as the variables that influence them. Planning and designing water demand in a way that is results-driven will surely benefit from this. The effect of home size on domestic water usage cannot be disregarded. It implies that as households grow, domestic water use will probably rise as well. The findings of Keshavarzi et al. (2006) and Ayanshola et al. (2010), who discovered that home size was one of the factors impacting residential water consumption, are comparable to the findings of this study. Table 1 lists the surveyed household characteristics in each sampling location for the corresponding income classes.

Table 1: Type of surveyed families residing in the surveyed house, 2023

Unit	**Type of Family (In %)**							
	LIG		**MIG**		**HIG**		**AIG**	
	Nuclear	**Joint**	**Nuclear**	**Joint**	**Nuclear**	**Joint**	**Nuclear**	**Joint**
Sector	53.76	45.30	60.65	40.40	57.14	50.86	57.50	50.50
Colony	61.90	38.05	57.85	43.20	60.50	38.58	60.00	41.00
Village	58.75	41.24	60.00	40.00	51.10	51.10	58.33	40.67
Total	**60.51**	**39.49**	**57.75**	**50.25**	**58.90**	**41.10**	**60.33**	**40.67**

Source: primary survey, 2023

Low Income Group

Most of the residents of the low-income group homes in the sector, colony, and village are nuclear families. 53.76% of dwellings in sector areas, 61.90% in colony areas, and 27% in village areas belong to nuclear families in this income bracket. A total of 190 homes, or 61.51 percent of the low-income group's housing stock, are nuclear homes. In contrast, combined families make up 39.39% of the homes in the lower income category. Out of these houses, 45.23% are in a sector, 38.5% are in a colony, and the remaining 41.24 % are in a village.

Medium Income Group

The majority of homes in the middle-income level are home to nuclear families. In the sector, the colony, and the village, nuclear families make up 57.75 percent, 57.85 percent, and 60 percent, respectively, of the housing stock. There are 125 such nuclear homes overall, or 57.75 percent of the study area's medium-income group homes. On the other hand, 50.25 percent of the housing in the middle-income category is occupied by joint families. The colony (43.15) is where the majority of joint families in this income bracket reside, followed by houses in the sector (40.35%), and villages (40%).

High Income Group

A greater percentage of homes in the high-income category are only occupied by nuclear families. In high-income groups, nuclear families make up 58.90% of all the sampled homes. Out of these, the colony has the highest proportion of houses (60.50%) compared to the villages (50%) and the sector (25.9%). (57.14 per cent). On the other side, joint families make up 41.10 percent of all homes, with the majority of these homes (50 percent) located in villages, followed by sectors (50.86 percent) and colonies (38.58 per cent).

Average Income Group

Overall, a greater percentage of sampled homes in the research region are made up of nuclear families (60.33%) than joint families (40.67 per cent). When it comes to homes with nuclear families, the colony has the highest percentage of these homes (60%) followed by the village (58.33%) and the sector (57.5%), while when it comes to homes with joint families, the sector

has the highest percentage of these homes (50.5%), followed by the village (40.67%) and colony (50.5%). (40 per cent).

Population size in surveyed nuclear and joint families

The total population of the tested 600 homes, which was determined by the primary survey, is one of the main factors influencing household water consumption. The survey's results in this area have been compiled in Table 2.

Table 2: Population size in surveyed nuclear and joint families, 2023

Unit	LIG Population		MIG Population		HIG Population		AIG Population	
	Nuclear	Joint	Nuclear	Joint	Nuclear	Joint	Nuclear	Joint
Sector	90	130	125	160	50	60	250	355
Colony	550	609	315	443	105	126	983	1176
Village	110	131	20	30	08	14	137	185
Total	**750**	**900**	**460**	**633**	**163**	**200**	**1370**	**1716**

Source: primary survey, 2023

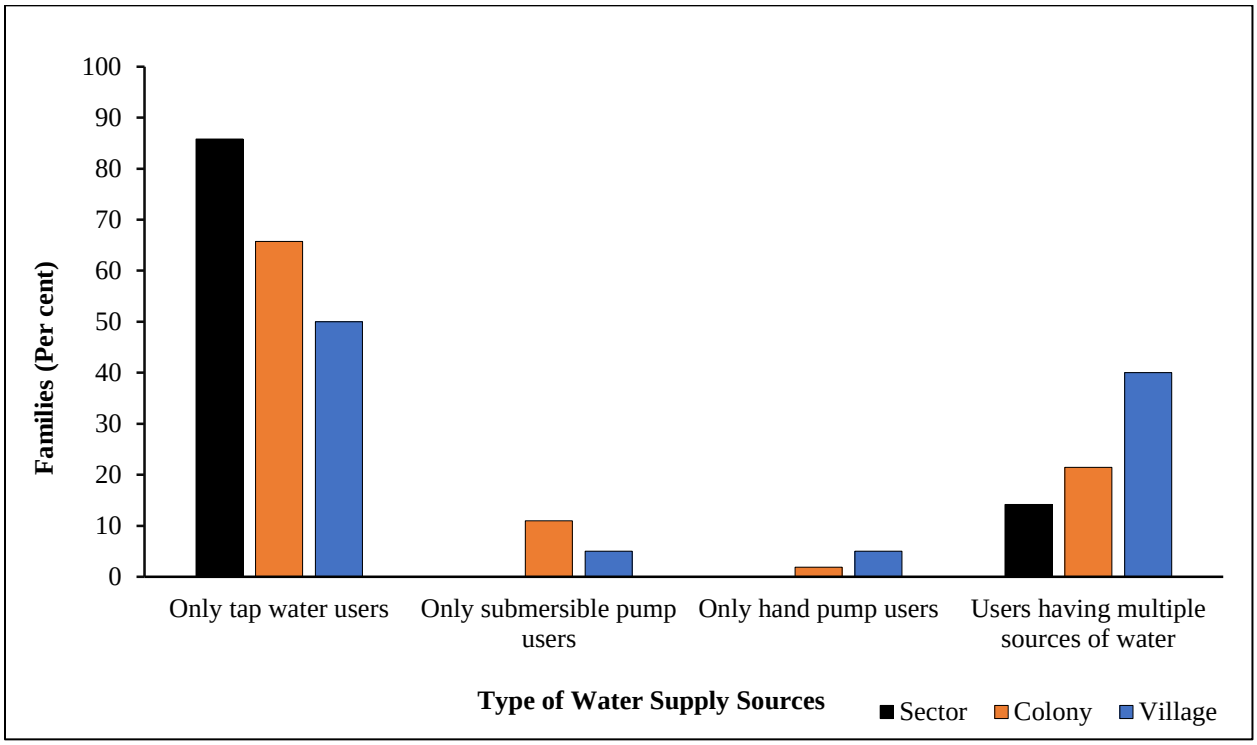
The total lower income category comprises 1,576 persons in the analysed population, of whom 750 live in nuclear families and 900 in joint families. The biggest percentage of nuclear families in this income range are concentrated in colony houses (550), followed by villages (110) and sectors (170). (90). On the other hand, the majority of mixed-family residents are situated in colony (609) and sector (131). (130). 1,095 persons make up the sample population for the medium income group, with 460 of them living in nuclear families and the other 633 in joint families. Colony homes (315) have a larger proportion of persons living in nuclear families than sectors (125) and villages do (20). On the other hand, joint-family households are most prevalent in colonies (443), with lower populations seen in villages (160). (30). There are 362 people in the high-income group overall, 163 of whom are living in nuclear families and 200 of them are living in mixed families. Colonies (105), sectors (50), and villages are where the majority of persons with nuclear families are found to dwell (8). The greatest population among joint family dwellings is seen in colony (126) followed by sector (60) and village (14).

Table 3: Families having type of water supply sources, 2023

Units	Number of Families			
	Only tap water users	Only submersible pump users	Only hand pump users	Users having multiple sources of water
Sector	85.85	00	00	14.20
Colony	65.70	10.90	1.95	21.40
Village	51.10	05.05	5.03	40.00
Total	**68.19**	**08.17**	**1.90**	**25.20**

Source: primary survey, 2023

Figure 1: Families having Type of Water Supply Sources in Bahadurgarh, 2023



Source: primary survey, 2023

The primary survey identified a variety of water supply sources for the families, and as a result, the sector, colony, and village utilisation rates were calculated and divided into four categories: only tap water users, only submersible pump users, only hand pump users, and users with multiple sources of water. Overall, it was determined that 68.19% of households solely used tap

water, while the second-largest percentage of households used different sources of water (25.20 percent). Users of hand pumps and submersible pumps were found to be less frequent, at 8.17% and 8.17%, respectively. In terms of the accessibility of each water source across the sector, colony, and village, it was discovered that homes in the sector (85.85%) solely utilised tap water while the other 14.20% had access to numerous sources. The biggest share of families in the colony (65.70%) solely used tap water, followed by those using diverse sources of water (21.40 per cent). Submersible pumps were utilised more frequently than hand pumps, with just 1.91 percent of homes using hand pumps as their sole source of water access (10.90 percent of households using solely submersible pumps). 50% of the households are in the village.Clearly, tap water is found to be the major source of water across all households irrespective of sector, colony and village.

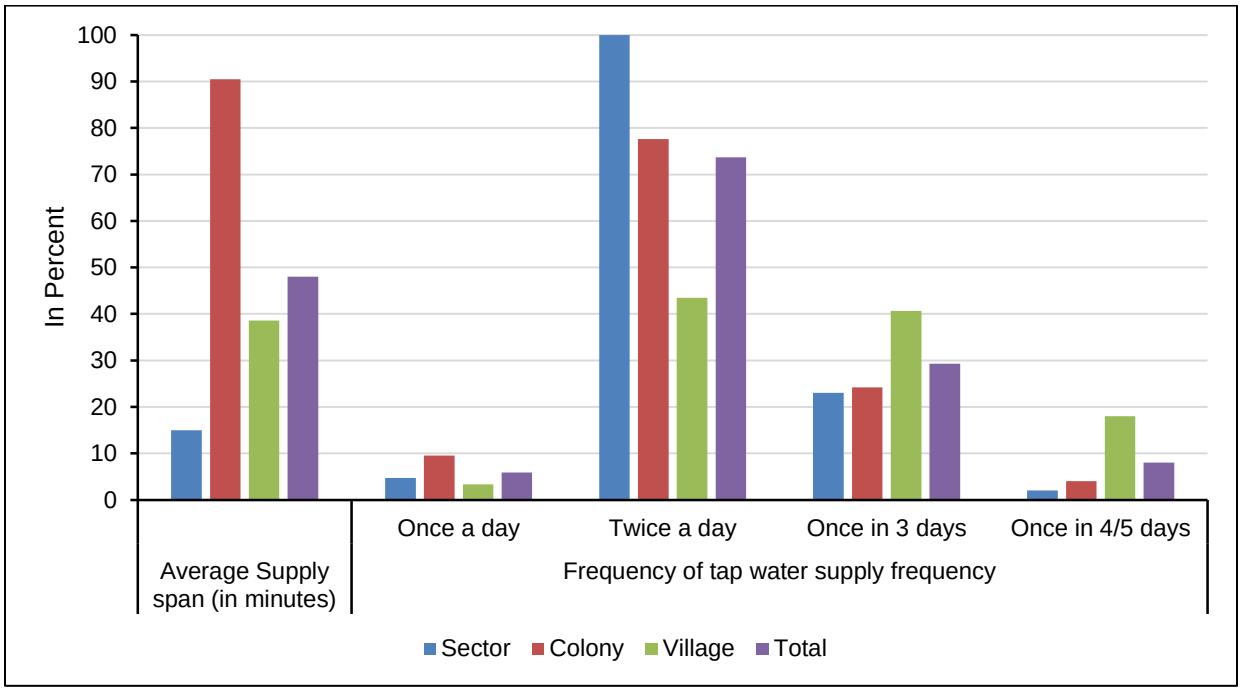
Table 4: In Bahadurgarh, the supply of tap water will last until 2023.

Units	**Average Supply span (in minutes)**	**Frequency of tap water supply frequency**			
		Once a day	**Twice a day**	**Once in 3 days**	**Once in 4/5 days**
Sector	15.00	4.75	100	23.00	2.00
Colony	90.51	9.52	77.62	24.21	4.05
Village	38.58	3.37	43.44	40.67	18.00
Total	**48.03**	**5.88**	**73.69**	**29.29**	**8.02**

Source: primary survey, 2023

The average duration of water supply in the study area was found to be 48.03 minutes which is highest in sector households (150 minutes) as compared to colony (90.51 minutes) and village (38.58 per cent) households. Frequency of water supply on the other hand was found to be better in terms of twice a day (73.69 per cent) as compared to once a day (5.88 per cent), once in 3 days (29.29 per cent) and once in 4/5 days (8.02 per cent). In the sector households the frequency of water supply was found to be twice a day where 100 per cent households confirmed to receiving water supply twice a day.

Figure 2: Duration of Tap Water Supply and Average Water Consumption in Bahadurgarh City, 2023



Source: primary survey, 2023

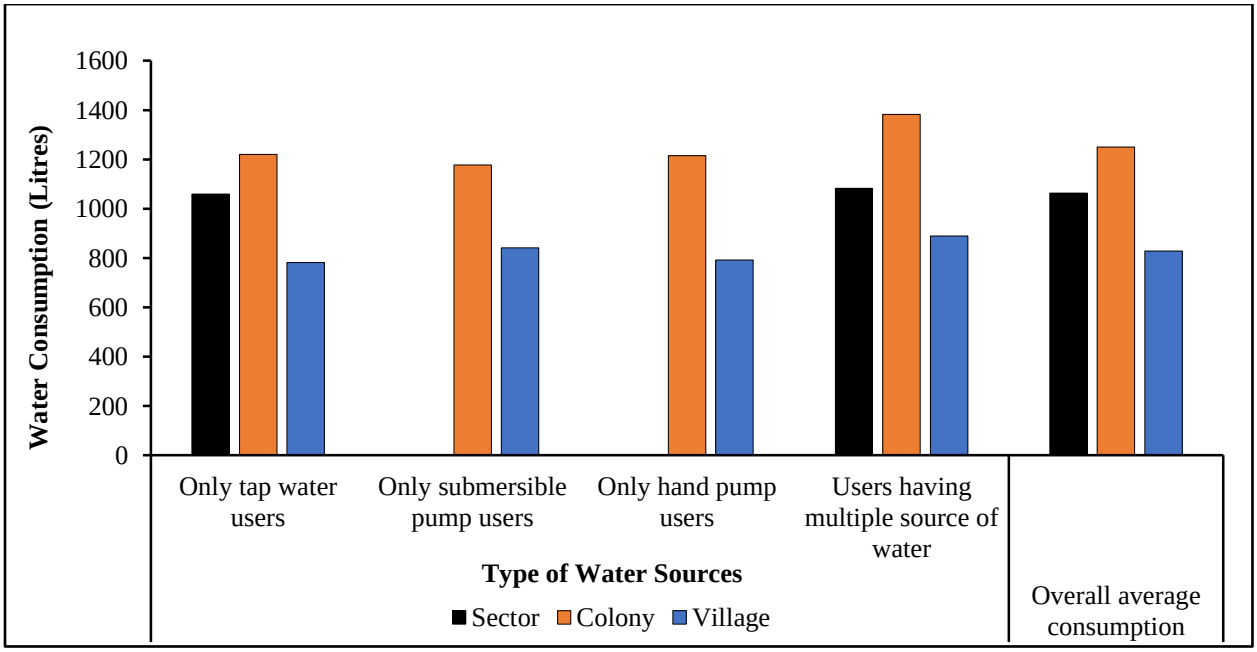
In colony areas, the situation of water supply was found to be moderate where 77.62 per cent households received water supply twice a day and 9.52 per cent households received water supply once a day and there were 4 per cent households that received water once in 4/5 days. On the other hand, in village households the water supply was found to be inadequate with a frequency of once in 3 days noted by 41 per cent of households and once in 4/5 days noted by 20 per cent households.

Table 5: Average daily water use per household throughout the summer, based on the number of water sources available

Units	Average consumption of water (in litres)				Overall average consumption
	Only tap water users	Only submersible pump users	Only hand pump users	Users having multiple source of water	
Sector	1080	03	0	1080	1060
Colony	1180	1180	1212	1380	1253
Village	780	848	795	896	830
Total	**1146**	**1160**	**1100**	**1254**	**1170**

Source: primary survey, 2023

Figure 3: Average Net Consumption of Water in Summer Season as Per Availability of Number of Water Source/s, 2023



Source: primary survey, 2023

In terms of length and regularity of water supply, sector families' water supply is evidently considerably superior (Table 4 & Fig.3). The average amount of water used by a family per day during the summer was 1170 litres, with colony households using the most (1253 litres per day per family), sector households coming in second (1060 litres per day per family), and village households coming in third (1060 litres per day per family) (830 litres per day per family). Water

consumption per family per day during the summer was found to be greater in homes with various water sources (1254 litres per day per family), with colony families consuming the most water (1382 litres) on average.

When it comes to submersible pump users, the second-highest average water consumption is found to be 1160 litres per day per family, whereas colony homes use more water on average (1180 litres per day per family) than village residents do (848 litres per day per family).

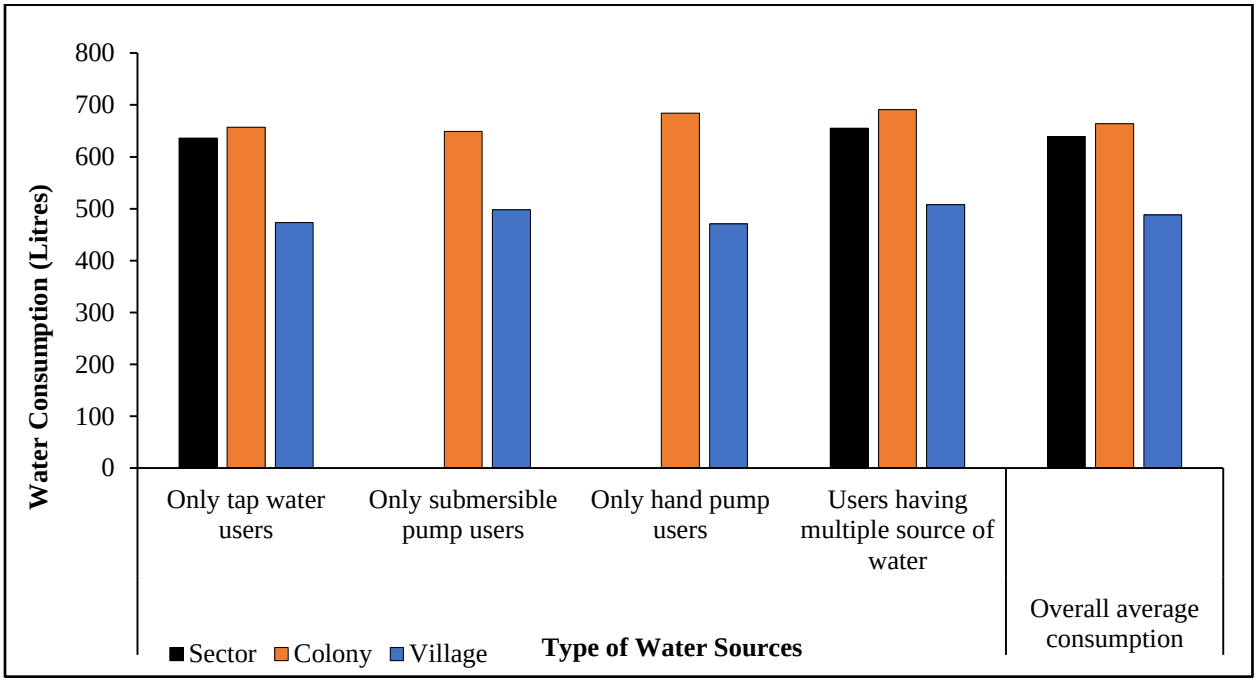
According to tap water consumers, colony families use more water on average (1180 litres per day per family) than sector households (1080 litres per day per family) or village households (1146 litres per day per family). These households have the third highest average water consumption (780 litres per day per family). The average water consumption in this respect is calculated to be 1100 litres per day per household, which is greater in a colony (1212 litres per day per family) than in a village (795 litres per day per family) due to the low number of hand pump users (Table 5).

Table 6: Average consumption of water for per family per day in winter season as per availability of quantity of water source, 2023

Units	**Average consumption of water (in litres)**				**Overall average consumption**
	Only tap water users	**Only submersible pump users**	**Only hand pump users**	**Users having multiple source of water**	
Sector	630	0	0	650	645
Colony	663	55.68	678	686	658
Village	473	487	470	508	488
Total	**638**	**55.68**	**576**	**653**	**641**

Source: primary survey, 2023

Figure 4: Average Consumption of Water in Winter Season as Per Availability of Quantity of Water Source in Bahadurgarh City, 2023



Source: primary survey, 2023

The average amount of water used by a family each day during the winter was 641 litres, with colony houses using the most (658 litres per day per family), sector households coming in second (645 litres per day per family), and village households coming in third (645 litres per day per family) (488 litres per day per family). In the winter, households with multiple water sources used an average of more water per family per day (653 litres), and colony households used the most (686 litres per family per day), compared to sector households (650 litres per family per day) and village households (508) litres per family per day.

The second-highest average water consumption is found to be among those who use submersible pumps, with an average consumption of 55.68 litres per day per family; colony homes use more water on average (678 litres per day per family) than village residents do (470 litres per day per family). In terms of those who use tap water, the third highest average water consumption is found to be 638 litres per day per family, with colony households using an average of 663 litres

per day per family as opposed to sector households using 630 litres per day per family and village households using 638 litres per day per family (473 litres per day per family).

The average water usage in this respect is calculated to be 576 litres per day per household and is greater in colonies (678 litres per day per family) than in villages (470 litres per day per family) due to the low number of hand pump users (Table 6 & Fig. 4).

Conclusion

A rise in the demand for more water services might be brought on by increases in household income brought on by economic expansion. Having an adequate supply of water offers several advantages, including advantages for productivity, time savings, and health, even if domestic water consumption makes up a very minor fraction of a household's overall water use. Despite the fact that the bulk of the family reported getting tap water twice daily, it was still not enough to meet all of their needs. On the other hand, it was determined that just a quarter of the research region had access to tap water. It was discovered that joint families consume more domestic water concurrently with an increase in household members. Moreover, an increase in Accordingly, it is reported that homeowners have been using several water sources within their homes to meet the domestic water demand if they can afford to do so. Numerous households were found to be using hand pumps and tap water as part of the study. The homes with the highest average usage were those with several sources of water. Additionally, the impact of the seasons was noted on domestic water use, which was discovered to be relatively lower in the winter.

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