



DETERMINANTS OF DOMESTIC WATER CONSUMPTION IN ROHTAK CITY, HARYANA

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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 Rohtak 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 Rohtak 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

Rohtak city is located on the intersection of 28°54' N latitude and 76°35' E longitude, at a distance of 75 kilometers to the north-west of Delhi, the National Capital of India. Rohtak is the administrative headquarters of a district and a tehsil by the same name. Rohtak city is situated in the National Capital Region (NCR). According to The Regional Plan 2021 of NCR, Rohtak city has identifies the regional centre with the population of ranging from 3 lakh to 10 lakh. Due to its location in the close vicinity of the National Capital, the urban landscape of Rohtak has undergone change from time to time. According to the Census of India 2011, Rohtak city is the third largest city of Haryana state. Rohtak is a Class-I city with a population of 3, 73, 133 at the time of 2011 census. In 2010, Municipal Committee of Rohtak was up-graded to Municipal Corporation (MC). According to the MC limit the total area of the city was 11039.15 hectares in 2010.

Objectives

To determine the various water use cases that drive the domestic water demand in Rohtak city located in the State of Haryana.



Database & Research Methodology

The basic data are the foundation of the current work. From a thorough field survey, primary data have been gathered. The city has been split into two study areas, one of which is a planned zone and the other is an unplanned zone. Sectors 1, 2, 3, 4, and 14 of HUDA are considered planned zones, whereas Dev colony, Janta colony, and Prem Nagar are considered unplanned zones. Additionally, the city was split into grids by drawing lines from East to West and North to South in both zones at the same distance. Through the use of a systematic sampling approach, the intersections of grids (existing colonies) have been selected as sample colonies. Households from such colonies have been located. Colonies with close to 500 families have been polled by creating a list of houses and choosing them at random intervals. Information for the primary survey was gathered through personal interviews based on a questionnaire. The housewives have been the target demographic. The target audience has been given a questionnaire in order to collect first-hand information. Graphs that are appropriate have been used to display the data. In order to ascertain the home water consumption patterns in Rohtak City in relation to income, price, and other water demand shifting factors, field surveys were done for the current study. A preliminary questionnaire survey was conducted to aid the study process. This study has been examined the effects of various socioeconomic and household factors i.e., income group, average size of the house, average number of floors, number of families residing in the surveyed house, population size in surveyed nuclear and joint families, availability of green lawn in the house, characteristics of storage water tank on the demand for domestic water.

Depending on the neighbourhood and monthly household income, the residences were polled in order of lower to higher income.

Result and Discussion

The amount of domestic water used differs between urban and rural areas according to consumer living conditions (Gatersleben & Vlek, 1998). The amount of water varies according to cultural norm, settlement pattern, supply type and water source, among other factors. Making sure that people have timely and convenient access to drinkable water has grown to be a significant problem (Lee & Schwab, 2005). 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 (Nauges & Whittington, 2010). Unfortunately, a lack of data has been identified as the main obstacle to accurate and sufficient water demand estimation, particularly in developing countries (Ayanshola et al., 2010). This study aims to assess the factors that affect home water use in a developing urban area and the accuracy of their forecasts. This will undoubtedly help with water demand planning and design that is focused on results. One cannot ignore the impact of household size on domestic water use. It suggests that domestic water use will probably increase with household size.

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

Unit	Type of Family (in %)							
	LIG		MIG		HIG		AIG	
	Nuclear	Joint	Nuclear	Joint	Nuclear	Joint	Nuclear	Joint
Sector	23 (54.76)	19 (45.24)	34 (59.65)	23 (40.35)	12 (57.14)	9 (42.86)	69 (57.5%)	51 (42.5%)
Colony	140 (61.95)	86 (38.05)	83 (56.85)	63 (43.15)	29 (60.42)	19 (39.58)	252 (60%)	168 (40%)
Village	27 (58.70)	19 (41.30)	6 (60)	4 (40)	2 (50)	2 (50)	35 (58.33%)	25 (41.67%)
Total	190 (60.51)	124 (39.49)	123 (57.75)	90 (42.25)	43 (58.90)	30 (41.10)	356 (59.33)	244 (40.67)

Source: Based on the primary survey conducted by the researcher

Figures in the table are in absolute (and percentage) of surveyed household

This result is comparable to those made by Keshavarzi et al. (2006) and Ayanshola et al. (2010), who found that home size was one of the factors affecting residential water demand. The surveyed household characteristic in each of the sampled area for respective income groups has been tabulated in table 1.

The essential characteristics of sampled houses are as follows:

Low Income Group

The low-income group houses in Sector, Colony and village have mainly nuclear families. Nuclear families in this income group comprise 54.76 per cent of houses in sector areas, 61.95 per cent in colony areas and 27 per cent in village areas. Overall, nuclear houses in the low-income group include 190 houses which is 61.51 per cent of the low-income group houses. On the other hand the joint families consist of 39.39 per cent of houses in the lower income group. Among these houses 45.23 per cent are located in sector, 38.05 per cent are located in colony and the other 41.30 per cent are located in village.

Medium Income Group

Majority of the houses belonging to medium income group have nuclear families. Nuclear families in the medium-income group comprise 57.75 per cent of houses located in the sector, 56.85 per cent of houses in the Colony and 60 per cent in the village. In total such nuclear houses are 123, which is 57.75 per cent of medium-income group houses in the study area. On the other hand the joint families belonging to medium income group comprise of 42.25 per cent of the medium income group houses. Most of the joint families in this income group are located in colony (43.15) followed by 40.35 per cent houses in the sector and 40 per cent houses located in the village.

High Income Group

In the high-income group as well higher share of houses consists of nuclear families only. Nuclear families in high-income groups comprise of 58.90 per cent of the total samples houses. Out of these the highest share of houses are located in colony (60.42 per cent) as compared to those located in villages (50 per cent) and sector (57.14 per cent). On the other hand the joint families consists of 41.10 per cent of the houses out of which highest share of houses are located in villages (50 per cent) followed by sector (42.86 per cent) and colony (39.58 per cent).

Average Income Group

Overall from the sampled houses in the study area higher share of houses consists of nuclear families (59.33 per cent) as compared to joint families (40.67 per cent). Among the houses with nuclear higher proportion of such houses are located in Colony (60 per cent) followed by village (58.33 per cent) and sector (57.5 per cent) while among the houses with joint families higher share of such houses are located in Sector (42.5 per cent) followed by village (41.67 per cent) and colony (40 per cent).

Population size in surveyed nuclear and joint families

Based on the primary survey the total population of sampled 600 houses was recorded that is among the primary driver for domestic water demand. Findings of the survey in this regard have been tabulated in Table 2.

Table 2: Population size in surveyed nuclear and joint families

Unit	LIG Population		MIG Population		HIG Population		AIG Population	
	Nuclear	Joint	Nuclear	Joint	Nuclear	Joint	Nuclear	Joint
Sector	87	132	123	161	42	59	252	352
Colony	553	607	317	443	113	126	983	1176
Village	107	140	22	29	8	14	137	183
Total	747	879	462	633	163	199	1372	1711

Source: Based on the primary survey conducted by the researcher

The total population of the sampled population belonging to lower income group is 1,626 out of which 747 are residing in a nuclear family house and 879 in a joint family house. Population belonging to nuclear family in this income group is mainly concentrated in colony houses (553) followed by village (107) and sector (87). On the other hand the population residing in joint family is also mainly concentrated in colony (607) followed by village (140) and sector (132). Among the medium income group the total sampled population is 1,095 out of which 462 reside in a nuclear family house and the other 633 reside in a joint family house. Populations residing in nuclear family are mainly located in colony houses (317) as compared to sector (123) and village (22). On the other hand, populations residing in joint family are also located mainly in colony

(443) followed by lower number of populations living in sector (161) and village (29). The total sampled population of high income group is 362 out of which 163 reside in a nuclear family house and 199 reside in a joint family house. Among the populations belonging to nuclear family majority of them are found to be living in colony (113) followed by sector (42) and village (8). Similarly, among the joint family houses also higher population is noted to be living in colony (126) followed by sector (59) and village (14).

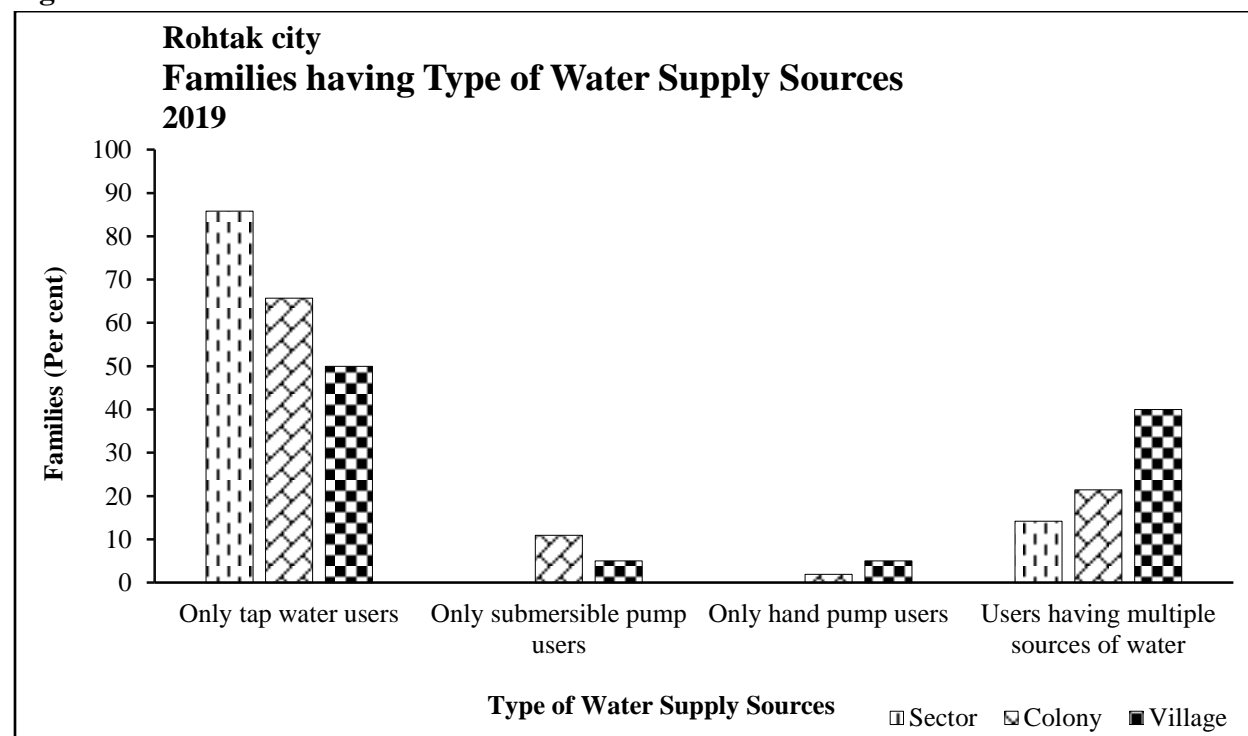
Table 3: Families having type of water supply sources

Units	Number of Families			
	Only tap water users	Only submersible pump users	Only hand pump users	Users having multiple sources of water
Sector	103 (85.83)	-	-	17 (14.17)
Colony	276 (65.71)	46 (10.95)	8 (1.91)	90 (21.43)
Village	30 (50.00)	3 (5.00)	3 (5.00)	24 (40)
Total	409 (68.17)	49 (8.17)	11 (1.83)	131 (21.83)

Source: Based on the primary survey conducted by the researcher

Figures in the table are in absolute (and percentage) of surveyed household

Figure 1



Source: Based on Table 3.

During the primary survey various source of water supply to the families have been noted and accordingly the utilization rate has been determined across the sector, colony and village categorized under four water sources i.e. only tap water users, only submersible pump users, only hand pump users and users having multiple sources of water. Overall, the majority of households were found to be using only tap water (68.17 per cent) and second largest share of households were found to be using multiple sources of water (21.83 percent). Users of submersible pump and hand pump were found to be lower and determined to be 8.17 per cent and 1.83 per cent respectively. In terms of each of the water sources accessibility across sector, colony and village; it is found that households located in the sector (85.83 per cent) only used tap water while the other 14.17 per cent households had other multiple sources of water. In the colony households also the majority share of households (65.71 per cent) utilized only tap water followed by households using multiple sources of water (21.43 per cent). Utilization of submersible pumps was comparatively higher where 10.95 per cent households used only submersible pumps to have water access and also users of hand pump were highest in the colony area but were being used only in 1.91 per cent of the households. In the village area, 50 per cent of the households utilized only tap water followed by 40 per cent households using multiple source of water. Use of submersible pumps and hand pump were lower in village households. Clearly, tap water is found to be the major source of water across all households irrespective of sector, colony and village.

Table 4: Duration of tap water supply

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	150	-	120 (100)	-	-
Colony	87.51	40 (9.52)	326 (77.62)	-	17 (4.05)
Village	39.58	-	-	25 (41.67)	12 (20)
Total	98.23	40 (6.67)	446 (74.33)	25 (4.17)	29 (4.83)

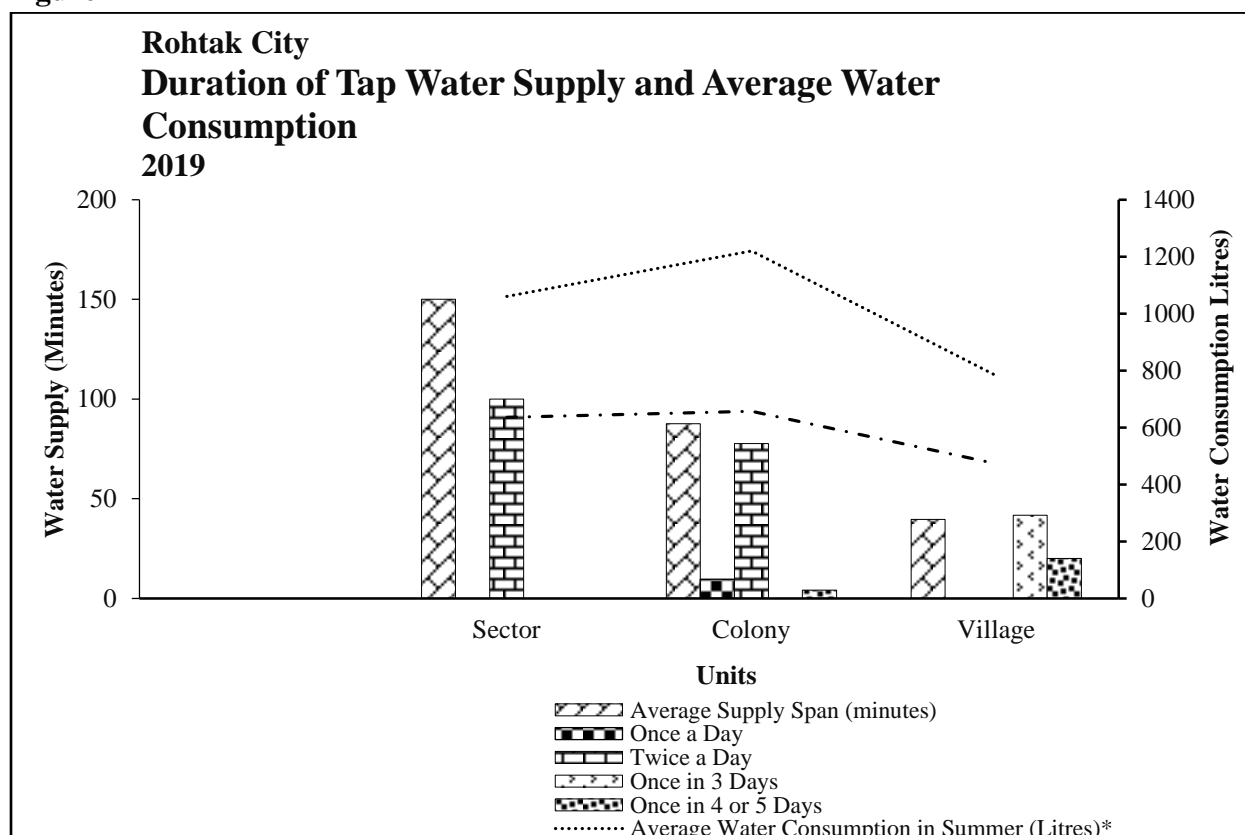
Source: Based on the primary survey conducted by the researcher

Figures in the table are in absolute (and percentage) of surveyed household

The average duration of water supply in the study area was found to be 98.23 minutes which is highest in sector households (150 minutes) as compared to colony (87.51 minutes) and village (39.58 per cent) households. Frequency of water supply on the other hand was found to be better in terms of twice a day (74.33 per cent) as compared to once a day (6.67 per cent), once in 3 days (4.17 per cent) and once in 4/5 days (4.83 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. 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.

Figure 2

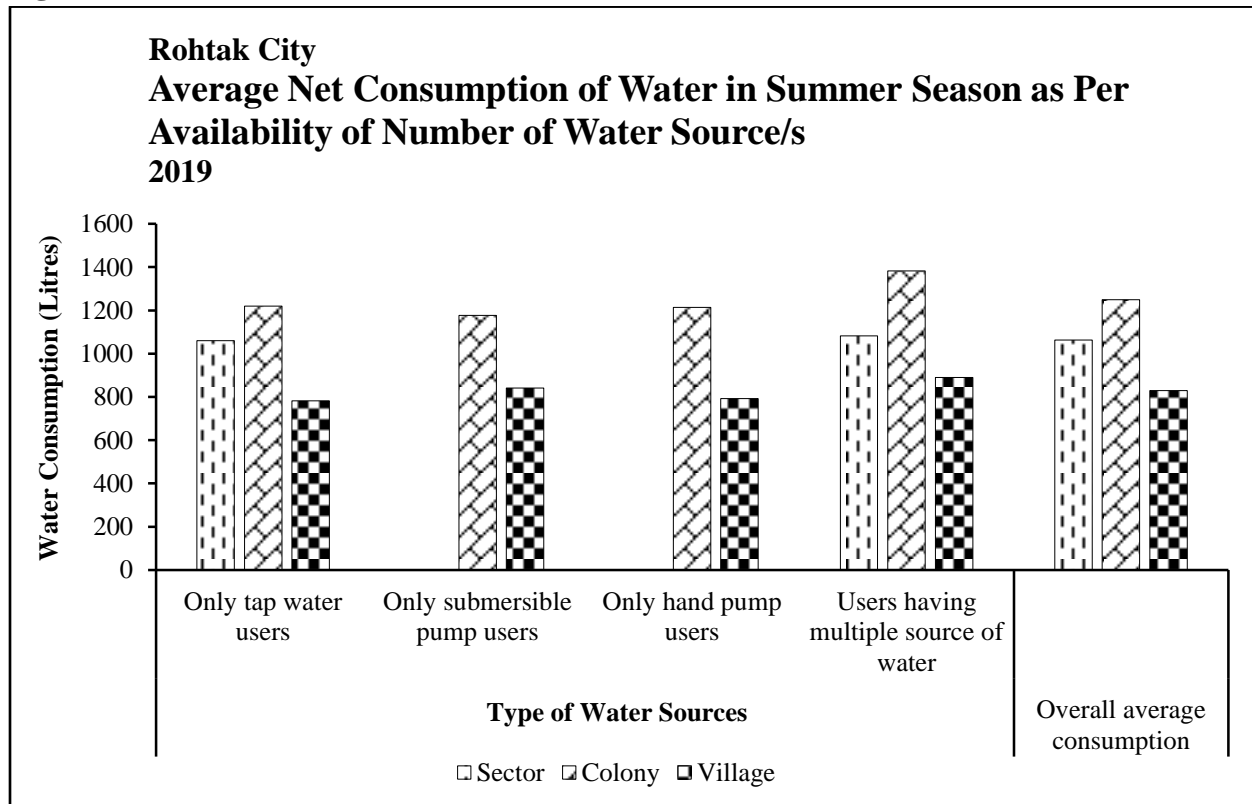


Source: Based on Table 4

Table 5: Average consumption of water for per family per day in summer season as per availability of quantity of water source

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	1060	-	-	1083	1063
Colony	1220	1178	1215	1383	1250
Village	782	842	792	890	829
Total	1148	1157	1099	1254	1170

Source: Based on the primary survey conducted by the researcher

Figure 3

Source: Based on Table 5.

Clearly, the water supply is found to be much better in sector households both in terms of duration and frequency of water supply (Table 4 & Fig.3). During the summer season it has been noted that the average consumption of water per family per day was 1170 liters per day out of which highest average water consumption is noted in colony (1250 liters per day per family) followed by sector households (1063 liters per day per family) and village households (829 liters per day per family). Average consumption of water per family per day during summer season was found to be higher in households using multiple source of water (1254 liters per day per family) which was found to be highest for colony households (1382 liters per day per family) as compared to sector households (1083 liters per day per family) and village households (890 liters per day per family). Second highest average water consumption is found to be in terms of submersible pump users where average water consumption is determined to be 1157 liters per day per family where the average consumption of water is higher for colony (1178 liters per day per family) as compared to village households (842 liters per day per family).

Third highest average water consumption is found to be in terms of tap water users where average water consumption is determined to be 1148 liters per day per family where the average consumption of water is higher for colony (1220 liters per day per family) as compared to sector

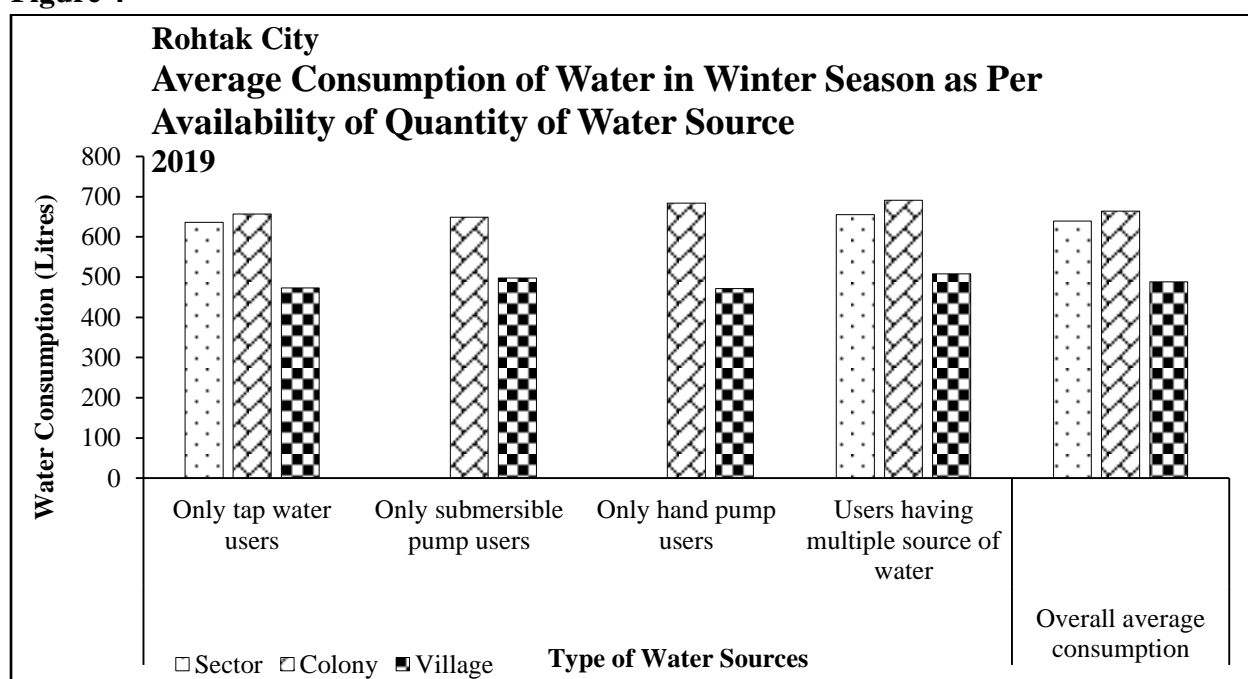
households (1060 liters per day per family) and village households (782 liters per day per family). Users of hand pump are lowest in number and therefore, the average water consumption in this regard is determined to be 1099 liters per day per family which is higher in colony (1215 liters per day per family) as compared to village (792 liters per day per family) (Table 5).

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

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	636	-	-	655	639
Colony	657	649	684	691	664
Village	473	498	471	508	488
Total	638	640	626	653	641

Source: Based on the primary survey conducted by the researcher

Figure 4



Source: Based on Table 6

During the winter season it has been noted that the average consumption of water per family per day was 641 liters per day out of which highest average water consumption is noted in colony (664 liters per day per family) followed by sector households (639 liters per day per family) and



village households (488 liters per day per family). Average consumption of water per family per day during winter season was found to be higher in households using multiple source of water (653 liters per day per family) which was found to be highest for colony households (691 liters per day per family) as compared to sector households (655 liters per day per family) and village households (508) liters per day per family). Second highest average water consumption is found to be in terms of submersible pump users where average water consumption is determined to be 640 liters per day per family where the average consumption of water is higher for colony (684 liters per day per family) as compared to village households (471 liters per day per family). Third highest average water consumption is found to be in terms of tap water users where average water consumption is determined to be 638 liters per day per family where the average consumption of water is higher for colony (657 liters per day per family) as compared to sector households (636 liters per day per family) and village households (473 liters per day per family). Users of hand pump are lowest in number and therefore, the average water consumption in this regard is determined to be 626 liters per day per family which is higher in colony (684 liters per day per family) as compared to village (471 liters per day per family) (Table 6 & Fig. 4).

Conclusion

Economic growth-induced increases in household income could lead to a rise in the demand for more water services. Despite the fact that domestic water use accounts for a very small proportion of a household's overall water use, having a sufficient supply has many benefits, including advantages for productivity, time savings, and health. Even though the majority of the family indicated that they received tap water twice daily, it was still insufficient to cover all of their needs. On the other hand, it was discovered that the availability of tap water was restricted in one-fourth of the study area. It was found that the domestic water consumption is higher among joint families and simultaneously with the increase in household members. At the same time, increase in income also results in increase in water demand. Accordingly, it is noted that if the households can afford they have been making use of multiple water sources within the households to suffice the domestic water demand. As part of the study it has been found that many households were making use of tap water along with hand pump. Eventually, such households which had multiple source of water had the highest average consumption. Alongside, effects of seasons were noted on domestic water consumption that was found to be comparatively lower during winters.



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