



STATUS OF DOMESTIC WATER DEMAND IN HARYANA: A CASE STUDY OF ROHTAK CITY, 2021

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Abstract

Water is one of our most basic needs and is necessary to preserve our standard of living. Water is a good that is socially sensitive, thus it must be used effectively and efficiently to ensure its sustainability. Supply-side interventions may not be as successful as they formerly were due to the increased use of water. Due to the rapid population growth, technological advancements, and economic growth, there is a constant increase in the need for water resources. Water demand management has received greater attention from academics than only supply side management. Water demand management in relation to water supply makes it feasible to estimate how much of the increase in water demand may be satisfied by effective and efficient use of present water supplies. The notion of "domestic water demand" is commonly understood to be the amount of water required for various residential uses. The present paper aims to study the domestic water demand in Rohtak city located in the state of Haryana. The study is based on primary survey and for the purpose of the study city has been split into two study areas, one of which is a planned zone and the other is an unplanned zone. Some selected variables have been taken for the present study i.e., 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. In Rohtak city, the domestic water demand has been determined to be a function of income group. Many households have been noted to lack adequate water supply based on their household characteristics. Finding sustainable solutions will require an effective, affordable and ecologically acceptable integrated approach.

Keywords: Water Demand, Family Population Size, Joint Family, Water Resource, Green Lawn

Introduction

The effective and efficient use of the water resources that are now accessible is essential for the sustainability of socially sensitive products like water. The intensive use of water has expanded internationally, and supply-side policies' effectiveness is in doubt (Ellison et al.,



2012). Due to rapid population growth, technical advancements, and economic expansion, there is a constant increase in the demand for water resources. Water demand management has recently received more attention from researchers than supply-side management (Parker & Wilby, 2013). Water demand management concerning water supply enables us to estimate how much the increase in demand for water could be met by effective and efficient use of existing water supplies. Forecasts of projected demand are necessary for planning the provision of future water supplies. The quantity of water needed for various residential applications is typically referred to as "domestic water demand." A crucial concern for the reliable operation, planning, and administration of an urban water supply system is the correct prediction of water demand for cultural, social, residential, and economic aspects (Kim et al., 2007).

Different water usage makes up the domestic water demand. These applications can be separated into two categories: discretionary uses and those covering daily necessities (or non-discretionary uses) (Willis et al., 2013). Water usage for drinking, sanitation, bathing (using the hand basin, shower, bath, and washing machine), and cooking tasks are all considered basic requirements (kitchen sink and the dishwasher). Other non-essential uses of water, such as irrigation and outdoor activities, are covered by discretionary requirements. However, many fundamental water demand now come with a sizable discretionary component due to the move toward non-materialistic wants (Koutiva & Makropoulos, 2016), such as taking a shower or a bath for relaxation rather than for hygienic reasons (Willis et al. 2013). Water demand behaviour and household water consumption are inextricably related.

Numerous home water studies have shown that a wide range of socio-demographic, cultural, and psychological factors that people are exposed to influence household water consumption. Understanding of the environment, views about how much water is consumed, knowledge of the worth of water, and faith in authority. In specifically, a survey of the literature on various social models was done by (Jorgensen et al., 2009).

The results of this study show that factors such as demographics, home features, household composition, prior water usage behaviour, perceived behavioural control, and the user's goal to conserve water indirectly all have a direct impact on water use (Jorgensen et al., 2009). According to Mondejar et al. (2011), environmental knowledge boosts attitudes toward water conservation, which lowers water use. Higher wealth and educational levels may not necessarily translate into more water conservation attitudes since lifestyle is adversely connected with water conservation attitudes. Additionally, the behaviour of the user's water consumption is connected to their general attitude toward environmental conservation (Gilg & Barr, 2006).

Environmental behaviour seems to be connected to social traits including age, economic level, and educational attainment (Gregory & Leo, 2003). Additionally, Willis et al. (2013) carried out research in Australian houses utilising a questionnaire survey and water component metering. Last but not least, the desire of the water user to invest in contemporary water technologies is crucial since water demand is directly impacted by the water technologies utilised in a household (Dolnicar et al., 2011, Hurlimann & Dolnicar, 2016). As



stated in the right to life under Article 21 of the Indian Constitution, having access to safe drinking water is a basic right in India (Ramachandriah, 2001). As a result, both in the developed and developing worlds, water resource management methods face unique problems as a result of the rising demand for water brought on by the fast rise of urbanization and population (Varis et al., 2006). Globally, rapidly urbanizing megacities have a similar concern with regards to groundwater depletion, water demand management, maintaining a minimal amount of water for daily use, and water resource planning (Sharma & Vairavamoorthy, 2009).

Study Area

In terms of population size, Rohtak district is ranked 14th in 2011. Rohtak has a density of 608, which places it in 11th place overall. In contrast, the density in 2001 was 539. The district's overall sex ratio increased from 847 in 2001 to 867 in 2011. The district is now ranked 17th out of the State's 21 districts. Rural areas have a lower Sex Ratio (852), according to the 2011 Census, than urban areas, which had a Sex Ratio of 887. The district ranks 15th overall for Child Sex Ratio (0–6 years age group) with an 820 Child Sex Ratio. The district's child sex ratio was 799 in 2001. 12.19 percent of the population are children ages 0 to 6. The scheduled caste population in the district is 20.4 percent of the total population, ranking it 11th, up from 19.1 percent in 2001. Rohtak is the fifth most literate city in the country. Compared to 2001, there were 80.2per cent more persons who could read and write in 2011. (73.7 percent).

Male population literacy rates have improved from 83.2 percent in 2001 to 87.7 percent now, and 89.9 percent in urban areas. The percentage of women who are literate has also increased. It was 62.6 percent in 2001, and it rose to 71.7 percent in 2011. Compared to the state's 35.2per cent, the Rohtak district's Work Participation Rate (WPR) is 32.6per cent. In Rohtak, men participate in the workforce at a rate of 48per cent, while women do so at a rate of 14.9per cent. In the district, the proportion of cultivators to all workers in 2011 is 27.7per cent, compared to 38.6per cent in 2001. In the district, the ratio of agricultural labourers to all other workers in 2011 was 10.6per cent, compared to 12.3per cent in 2001. Across Rohtak district, household industry workers make up 2.5per cent of the total workforce, compared to 2.9per cent in Haryana. In compared to Haryana's 52.1per cent, the district has a higher ratio of other workers to total workers at 59.3per cent.

Objectives

The main objective of the present work is to analyze the status of water demand of Rohtak City.

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., 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. The income size Criteria has been adopted from Operational Guidelines of Pradhan Mantri Awas Yojana.

Result and Discussion

Average Number of Floors in Surveyed Houses

The number of household floors is also an important parameter defining water demand. The presence of multiple floors in a household would multiply water demand as it allows for multiple families residing. Based on the primary survey, the average number of floors has been identified for households and tabulated in table 4.7 under different income groups. Among the low-income groups, the average number of floors is 2.35 in sector areas, 2.65 in colony areas and 1.40 in village areas. For the medium income group, the floor number is computed as 2.28 for households located in the sector, 2.43 for households located in Colony and 1.15 for households located in the village. Finally, for high-income groups, it is calculated to be 1.63 for households located in the sector, 1.25 for houses located in Colony and 1.09 for houses located in the village. Overall, the number of house floors is identified as 2.43 for low-income groups, 2.33 for medium-income groups and 1.35 for high-income groups.

Table 1: Average Number of Floors in Surveyed Houses

Unit	Average Number of Floors			
	LIG	MIG	HIG	AIG
Sector	2.35	2.28	1.63	2.19
Colony	2.65	2.43	1.25	2.41
Village	1.40	1.15	1.09	1.34
Total	2.43	2.33	1.35	2.26

Source: Based on the primary survey conducted by the researcher

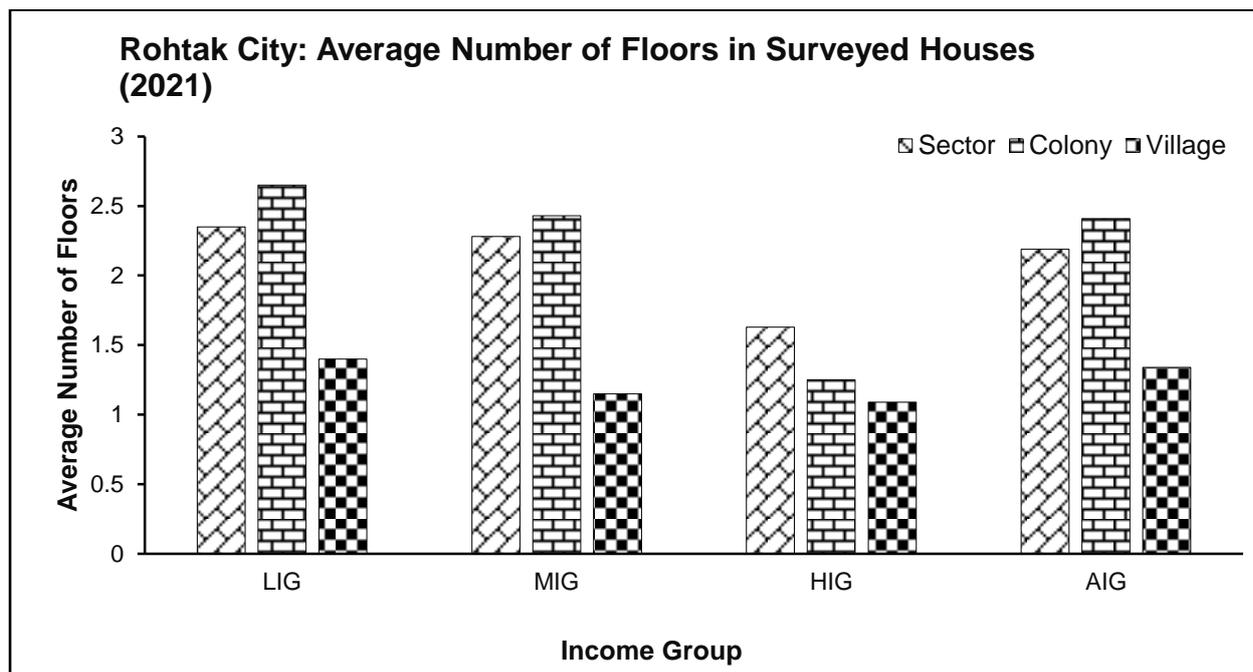


Fig. 1

Number of Families Residing in the Surveyed House

As part of the primary survey, the number of families residing in each household has also been noted. The number of families and the subsequent population of each household is an important parameter determining water demand. In total, there were 600 sampled houses and 734 sampled families. The number of families per household has been categorized as per the three income groups and an additional category that notes the average (Table 2).

Table 2: Number of families residing in the surveyed house

Unit	Number of Families												Total No. of Families	Total Sampled House
	LIG			MIG			HIG			AIG				
	1	2	3	1	2	3	1	2	3	1	2	3		
Sector	31	11	-	38	17	2	17	3	1	86	31	3	157	120
Colony	188	29	9	112	22	12	44	4	-	344	55	21	517	420
Village	46	-	-	10	-	-	4	-	-	60	-	-	60	60
Total	265	40	9	160	39	14	65	7	1	490	86	24	734	600

Source: Based on the primary survey conducted by the researcher

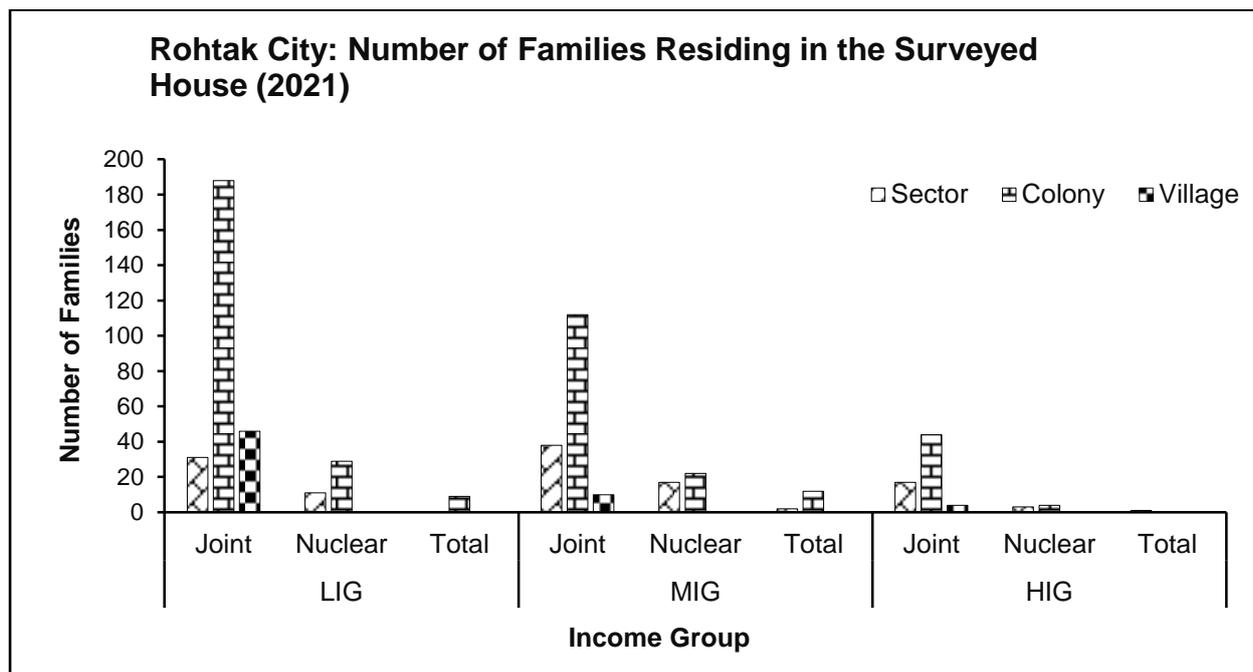


Fig. 2

Low Income Group

It consists of a total of 314 sampled houses. Out of these, 265 sampled houses have only one family, 40 sampled houses have two families per household, and nine sampled houses have three families per household. Such households with single families are primarily located in Colony (188), followed by village (46) and sector (31). Households with two families are located in Sector (11) and Colony (29). On the other hand, households with three families are only found in 9 sampled houses located in Colony (Table 2 & Fig. 2).

Medium Income Group

It consists of a total of 213 sampled houses. Out of these, 160 sampled houses have only one family residing per house, 39 houses have two families per house, and 14 houses have three families per house. Such households with single families are primarily located in colonies where 112 houses have single families, 38 medium income group houses have one family residing per house and villages where only ten houses have one family per house. Households with two families are found in Sector (17) and Colony (22), alongside houses with three families per house also located in the sector (2) and Colony (12).

High Income Group

It consists of a total of 73 sampled houses. Out of these 73 sampled houses, 65 houses have one family, seven have two families, and only one house has three. High-income houses with single families are primarily found in colonies where 44 sampled houses have one family and sector where 17 high-income houses have one family. In the villages, only four high-income houses have one family. On the other hand, high-income houses with two families are noted



in 3 houses in the sector and four in Colony. Only one high-income house located in the sector has three families in one house.

Average Income Group

Based on the primary survey of 600 sampled houses it is determined that there are 490 sampled houses that have 1 family in a single household and the remaining 110 sampled houses have more than one family per house. Out of these 110 sampled houses, 86 sampled houses have 2 families per sampled house and 24 houses have 3 families per sampled house. It has also been found that among the 490 sampled houses with single families the highest number of single-family houses is located in colony with 344 such houses and then there are 86 such houses in sector and 60 such houses located in village. At the same time, out of the total 86 houses with double families 55 of them are located in colony and 31 of them are located in sector while among the 24 houses with three families there are 21 locate in colony and 3 located in sector. Sampled houses located in village have only one family per house. In total, 734 families have been sampled residing in 600 houses. The highest number of families (517) is located in Colony. Another 157 families reside in the sector, and 60 reside in the village. Furthermore, the families have been categorized as nuclear and joint families across each income group.

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 3.

Low Income Group

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).

Table 3: 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

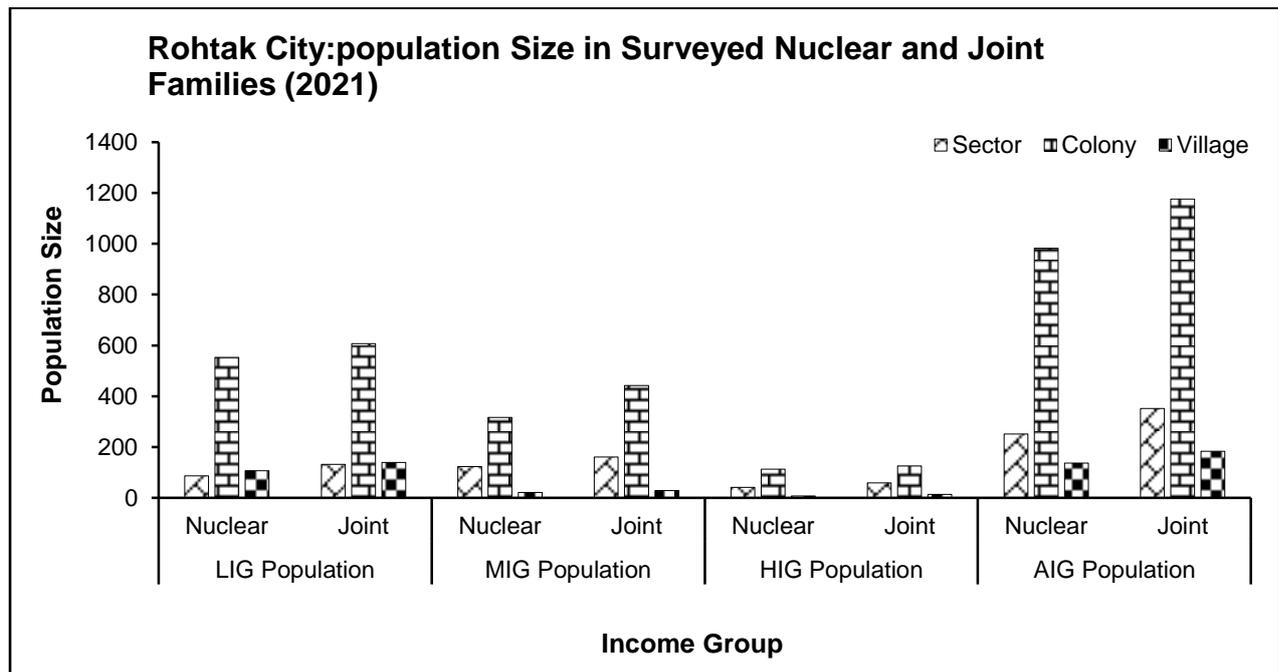


Fig. 3

Medium Income Group

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).

High Income Group

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).

Average Income Group

Based on the primary survey there are a total of 3083 sampled population; 1,372 of them are living in nuclear family houses and 1,711 are living in a joint family house. Among the populations living in nuclear family the highest population concentration is noted in colony houses (983) followed by sector (252) and village (137). On the other hand, populations who live in joint family houses are mainly concentrated in colony (1176) followed by sector (352) and village (183).



Number of Bathrooms (with & without shower) in the House

Sanitation is an important aspect of healthy living. Water has an important role to play within the households in ensuring proper sanitation and hygiene living conditions. Accordingly, the use of water for sanitation is critical and at the same one of the prime drivers of domestic water demand. The number of bathrooms within the households would require higher amounts of water. In this context, the survey identified the number of bathrooms within a house to analyse its contribution to the overall domestic water demand in the study area. Findings of the survey in regards to number of bathrooms per house have been shown in Table 4. Based on the primary survey findings, the household's characteristics in terms of the number of bathrooms distributed across income group sampled houses (Table 4 & Fig. 4).

Table 4: Number of bathrooms (with & without shower) in the house

Unit	Number of Bathrooms								
	LIG			MIG			HIG		
	1	2	3	1	2	3	1	2	3 &>
Sector	17 (40.48)	23 (54.76)	2 (4.76)	13 (22.81)	32 (56.14)	12 (21.05)	-	10 (47.62)	11 (52.38)
Colony	130 (57.52)	83 (36.73)	13 (5.75)	35 (23.97)	90 (61.65)	21 (14.38)	-	27 (56.25)	21 (43.75)
Village	33 (71.74)	13 (28.26)	-	2 (20)	7 (70)	1 (10)	-	1 (25)	3 (75)
Total	180 (57.32)	119 (37.90)	15 (4.78)	50 (23.47)	129 (60.56)	34 (15.96)	-	38 (52.05)	35 (47.95)

Source: Based on the primary survey conducted by the researcher

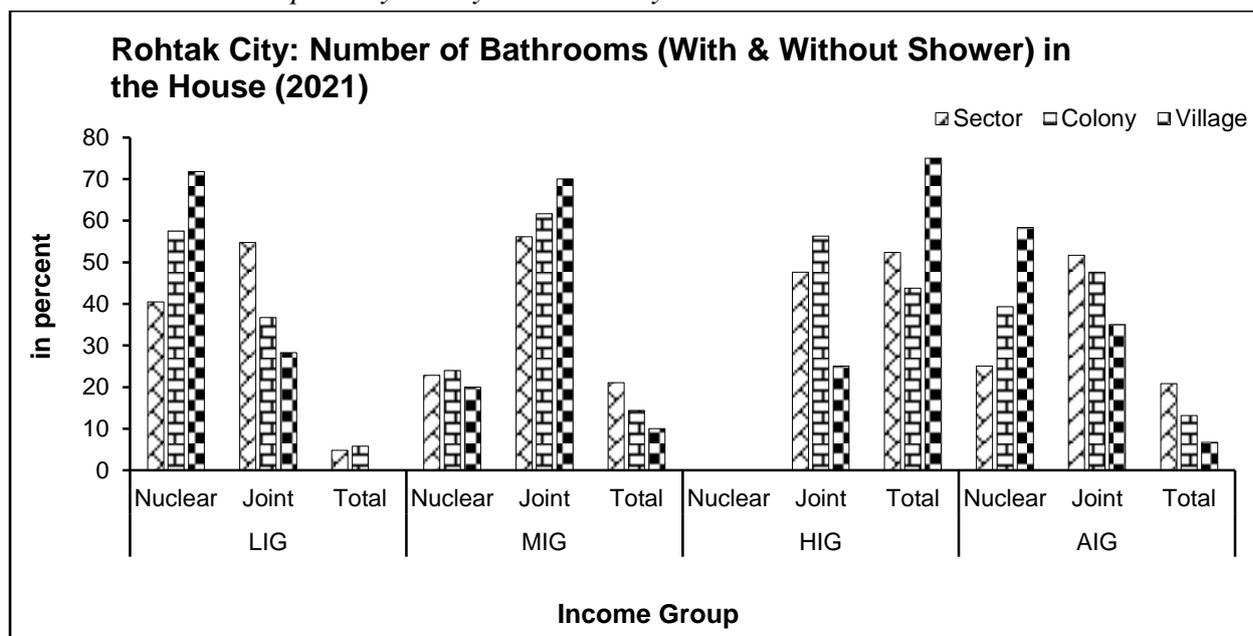


Fig. 4



Low Income Group

In the low-income group, most houses have a single bathroom and comprise 57.32 per cent of the low-income group houses. In this category, another 37.90 per cent of houses have double bathrooms, and only 4.78 per cent have triple bathrooms. Low-income group houses with single bathrooms comprise 40.48 per cent in sector houses, 57.52 per cent in colony houses and 71.74 per cent in village houses. Such medium group houses with double bathrooms comprise 54.76 per cent houses in sector, 36.73 per cent in colony areas and 28.26 per cent in the village. On the other hand, low-income group houses with three bathrooms comprise only 4.76 per cent of sector houses and 5.75 per cent of colony houses.

Medium Income Group

Houses belonging to medium-income groups have mainly double bathrooms. Such house comprises 60.56 per cent of the medium-income group houses. Another 23.47 per cent of medium-income group houses have a single bathroom, and 15.96 per cent of houses have triple bathrooms. Medium income group houses with single bathrooms comprise 22.81 per cent sector houses, 23.97 per cent colony houses and 20 per cent village houses. Houses with double bathrooms comprise 56.14 per cent of sector houses, 61.65 per cent of colony houses and 70 per cent of village houses. Houses with triple bathrooms comprise 21.05 per cent in sector houses, 14.38 per cent in colony houses and 10 per cent in village houses.

High Income Group

In the high-income group houses, 52.05 per cent of houses have double bathrooms, and the other 47.95 per cent have triple bathrooms. Houses with double bathrooms in the high-income group comprise 47.62 per cent of sector high-income group houses, 56.25 per cent colony houses and 25 per cent village houses. On the other hand, high-income group houses with more than three bathrooms comprise 52.38 per cent of sector houses, 43.75 per cent of colony houses and 75 per cent of village houses.

Availability of Green Lawn in the House

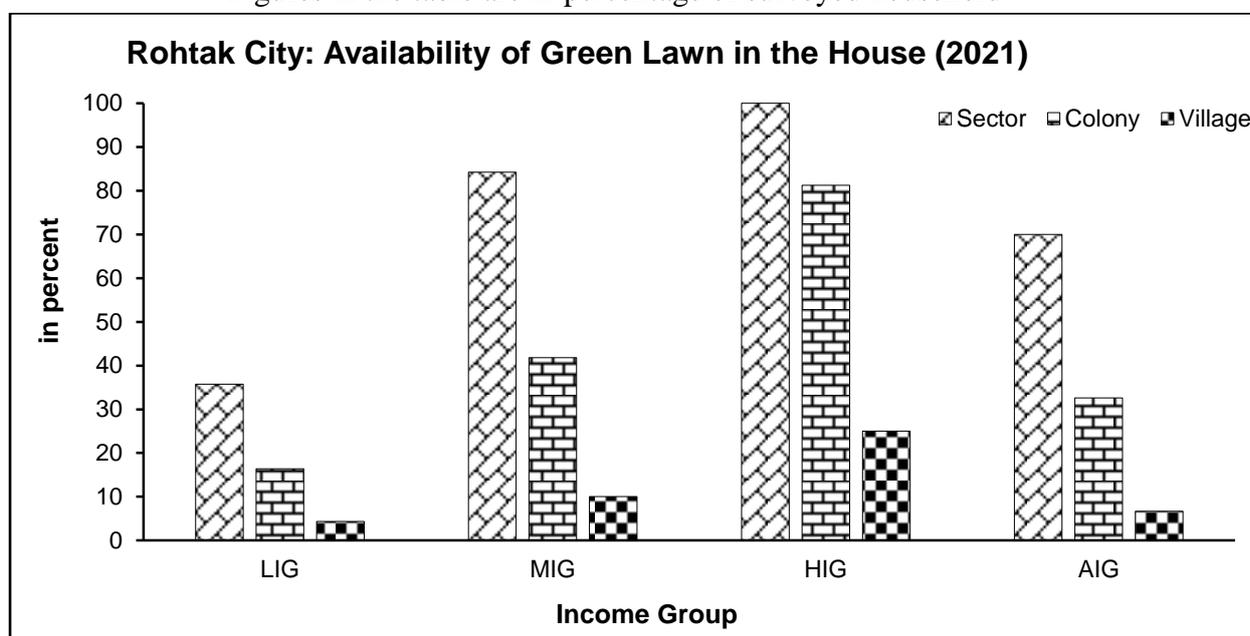
The availability of green lawns in the house premises forms a significant part of domestic water consumption. During the primary survey, it was found that 61 high-income group houses, 111 medium-income group houses and 54 low-income group houses have a green lawn in their houses. Among the high-income group houses, 21 houses in the sector, 39 houses in Colony and one house in the village have green lawns. In contrast, in the medium income group, 48 houses in the sector, 61 houses in Colony and one house in the village have green lawns. On the other hand, in the low-income group houses, 15 houses in the sector, 37 houses in Colony and two houses in the village have green lawns. Overall, in the sampled houses there are 225 houses (37.5 per cent) that have green lawn (Table 5 & Fig. 5).

Table 5: Availability of Green Lawn in the House

Units	Availability of Green lawn				Average size (in yards)			
	LIG	MIG	HIG	AIG	LIG	MIG	HIG	AIG
Sector	15 (35.71)	48 (84.21)	21 (100)	84 (70)	7.12	20.56	24.33	19.10
Colony	37 (16.37)	61 (41.78)	39 (81.25)	137 (32.62)	8.48	23.29	34.19	22.39
Village	2 (4.35)	1 (10)	1 (25)	4 (6.67)	5.74	8.17	30	12.41
Total	54 (17.20)	110 (51.64)	61 (83.56)	225 (37.5)	8	21.84	30.72	21.19

Source: Based on the primary survey conducted by the researcher

Figures in the table are in percentage of surveyed household

**Fig. 5**

Higher share of such houses with green lawns are located in sector (70 per cent). As compared to colony (32.62 per cent) and village (6.67 per cent). However, the absolute number of such houses are high in colony houses. The average size of green lawns varies from 5.74 square yards to as large as 34.19 square yards. In the low-income group houses, the average green lawn size is 7.12 square yards in sector houses, 8.48 square yards in Colony and 5.74 square yards in village houses. The average size of green lawns for medium-income group houses is 20.56 square yards in sector houses, 23.29 square yards in colony houses and 8.17 square yards in village houses. Among the high-income group houses, the average size of green lawn varies from 34.19 square yards in colony houses to 30 square yards in village houses and 24.33 square yards in sector houses. The size of green lawns has a direct impact on domestic water demand and on an average the sampled houses have green lawn spanning



across 21.19 yards with the highest average size of green lawns found in Colony houses (22.39 yards) as compared to sector (19.10 yards and village houses (12.41 yards).

Characteristics of Storage Water Tank

The supply of drinking water always requires storage, as both supply and consumption are varying. In many parts of the world, drinking water storage takes place in near-house or in-house tanks. International and numerous national standards and guidelines addressing the construction, installation and operation of domestic drinking water storage tanks are reviewed on their consideration of water quality aspects and the minimization of health risks associated with drinking water storage. This study is particularly concerned about the domestic demand in terms of storage of water and its contribution to the overall domestic water demand. Table 6 shows the number of tanks installed in each sampled house and it has been categorized across different income groups as follows.

Table 6: Storage Tank of Water

Units	Number of Water Tanks								
	LIG			MIG			HIG		
	1	2	3	1	2	3	1	2	3
Sector	32 (76.20)	8 (19.04)	2 (4.77)	50 (87.72)	5 (8.78)	2 (3.50)	14 (66.67)	5 (23.81)	2 (9.52)
Colony	177 (78.32)	34 (15.04)	15 (6.64)	103 (70.55)	37 (25.34)	6 (4.11)	36 (75)	10 (20.83)	2 (4.17)
Village	8 (17.39)	23 (50)	15 (32.61)	2 (20)	6 (60)	2 (20)	1 (25)	2 (50)	1 (25)
Total	217 (69.11)	65 (20.70)	32 (10.19)	155 (72.77)	48 (22.53)	10 (4.69)	51 (69.86)	17 (23.29)	5 (6.85)

Source: Based on the primary survey conducted by the researcher

Figures in the table are in percentage of surveyed household

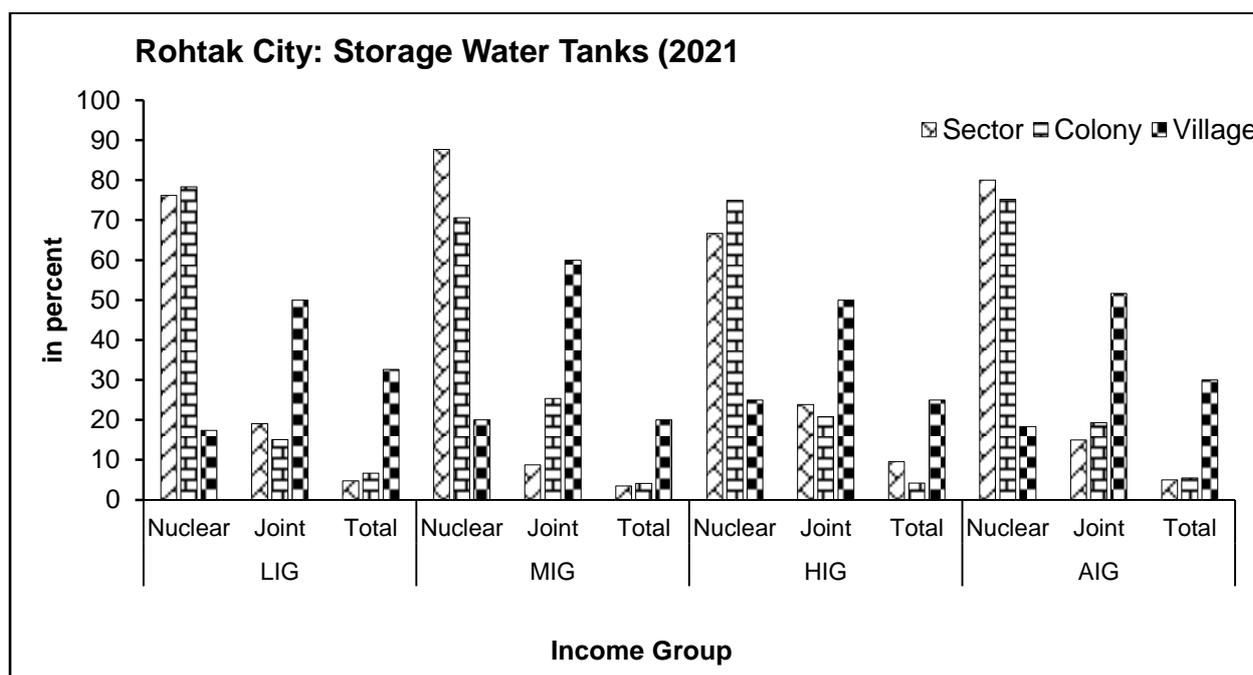


Fig. 6

Low Income Group

In the lower income group, it is found that houses with single tank comprise 69.11 per cent of the LIG houses. At the same time the houses with more than one storage tank comprise of 20.70 per cent houses with double tank and 10.19 per cent houses with triple tank. LIG houses with single storage tanks are mainly located in colony (78.32 per cent) followed by sector (76.20 per cent) and village (17.39 per cent) whereas houses with double tanks are mainly located in village (50 per cent) as compared to sector (19.04 per cent) and colony (15.04 per cent). On the other hand, houses with triple tanks are mainly found in villages (32.61 per cent). Houses located in sector and colony has very lower number of houses with three storage tanks. In the absence of regular water supply it is essential for the houses located in village to have storage tanks to ensure regular water availability to the houses.

Medium Income Group

In the medium income group, it is found that houses with single tank comprise 72.77 per cent of the LIG houses. Houses with more than one storage tank comprise of 22.53 per cent houses with double tank and 4.69 per cent houses with triple tank. MIG houses with single storage tanks are mainly located in sector (87.72 per cent) followed by colony (70.55 per cent) and village (20 per cent) whereas houses with double tanks are mainly located in village (60 per cent) as compared to sector (25.34 per cent) and colony (8.78 per cent). On the other hand, houses with triple tanks are mainly found in villages (20 per cent) whereas sector houses (3.50 per cent) and colony houses (4.11 per cent) have presence of houses with three storage tanks.



High Income Group

The high-income group houses with single tank comprise 69.86 per cent of the HIG houses. Houses with more than one storage tank comprise of 23.29 per cent houses with double tank and 6.85 per cent houses with triple tank. HIG houses with single storage tanks are mainly located in colony (75 per cent) followed by sector (66.67) and village (25 per cent) whereas houses with double tanks are mainly located in village (50 per cent) as compared to sector (23.81 per cent) and colony (20.83 per cent). On the other hand, houses with triple tanks are mainly found in villages (25 per cent) whereas sector houses (9.52 per cent) and colony houses (4.17 per cent) have lower number of houses that have three storage tanks.

Average Income Group

The average income group houses with single tank comprise 70.5 per cent of the HIG houses. Houses with more than one storage tank comprise of 21.67 per cent houses with double tank and 7.83 per cent houses with triple tank. HIG houses with single storage tanks are mainly located in sector (80 per cent) followed by colony (75.24 per cent) and village (11 per cent) whereas houses with double tanks are mainly located in village (51.67 per cent) as compared to sector (15 per cent) and colony (19.28 per cent). On the other hand, houses with triple tanks are mainly found in villages (30 per cent) whereas sector houses (5 per cent) and colony houses (5.48 per cent) have lower presence of houses with three storage tanks.

Conclusion

In Rohtak city, the domestic water demand has been determined to be a function of income group whereby the sampled households have been classified in three income groups for the purpose of the study. Other important determinants of domestic water demand were found to be households characteristics such as number of floors, rooms and bathrooms in the surveyed households and family structure such as number of families residing in each household, population size of each households, type of families whether nuclear or joint families. Households' characteristics also considered availability of green lawns and storage water tanks. Across three different classification of the study area i.e. sector, colony and village, it has been found that the colony area had the highest domestic water demand and particularly in the middle income group. All the household characteristics as well as family structure that resulted in increased households members directly affected the domestic water demand. However, in the higher income group domestic water demand was also high as compared to the population given the high utilization rate in such households and most of such households were found to have private source of water. Clearly, Rohtak city has been noting increased water demand whereby many households have been noted to lack adequate water supply based on their domestic water demand. Finding sustainable solutions will require an effective, affordable and ecologically acceptable integrated approach to meet the domestic water needs of a population that is expanding quickly. To synchronize the demand and supply gap, practical methods and procedures must be developed immediately to ensure sustainable use of the limited water resources.



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