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A Study on Comparison of Water and Sanitation Problems in the Rural and Urban Areas of Madurai District

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Abstract: Water has become one of India's most valuable natural resources, often regarded as being as precious as gold due to the increasing scarcity of freshwater. Although India is home to nearly 18 per cent of the world's population, it possesses only about 4 per cent of the world's freshwater resources, making it one of the most water-stressed countries globally. With a population exceeding 1.4 billion, ensuring equitable access to safe and adequate water remains a major developmental challenge. A considerable proportion of the population continues to lack access to safe drinking water and improved sanitation facilities. Limited access to clean water, inadequate sanitation infrastructure, and the practice of open defecation contribute significantly to the prevalence of water-borne diseases, malnutrition, and preventable deaths, particularly among children and other vulnerable groups. The COVID-19 pandemic further highlighted the critical importance of reliable access to clean water for maintaining personal hygiene and preventing the spread of infectious diseases. Consequently, improving water supply and sanitation services has become a national public health priority. The growing demand for water, rapid urbanization, industrial expansion, agricultural intensification, and population growth have placed tremendous pressure on India's limited water resources. According to the government's policy think tank, NITI Aayog, a large proportion of the country's population experiences high to extreme levels of water stress. This situation is further aggravated by India's heavy dependence on the monsoon, which has become increasingly erratic due to climate change. Rising temperatures, irregular rainfall patterns, frequent floods, and prolonged droughts have intensified the challenges of sustainable water resource management. Recognizing the urgency of the situation, the Government of India has launched several initiatives to improve water security, expand access to safe drinking water, and strengthen sanitation infrastructure. International organizations, including the World Bank, have also supported India through financial assistance, technical expertise, and capacity-building programmes aimed at promoting integrated water resource management, improving rural and urban water supply systems, and enhancing sanitation services. These collaborative efforts are essential for achieving sustainable development, protecting public health, and ensuring universal access to safe water and sanitation.

Keywords: Water, Sanitation, Hygienic Practices, Rural Areas, Urban Areas

Introduction

Water is one of the most fundamental natural resources and is indispensable for sustaining life, supporting ecosystems, and promoting economic development. Every living organism depends on water for survival, making it an essential component of human existence and environmental sustainability. In addition to meeting basic physiological needs, water plays a vital role in agriculture, industry, energy generation, public health, and environmental conservation. As populations grow and economic activities expand, the demand for freshwater continues to increase, highlighting the need for sustainable water resource management.

Water is not merely a physical resource; it also possesses social, cultural, economic, political, and environmental significance. Across different societies, water is closely associated with livelihoods, traditions, religious

practices, and community well-being. The availability, accessibility, and quality of water influence patterns of consumption, economic productivity, and the relationship between communities and water service providers. Consequently, ensuring equitable access to safe and adequate water has become a key objective of sustainable development.

Importance of Water

Water is indispensable for the survival and healthy functioning of all living organisms. Approximately 71 per cent of the Earth's surface is covered by water, while the human body consists of nearly 60 to 70 per cent water, depending on age, gender, and body composition. Water performs numerous physiological functions, including regulating body temperature, transporting nutrients and oxygen, removing metabolic waste, lubricating joints, supporting digestion, maintaining blood circulation, and facilitating cellular metabolism. Even a moderate reduction in body water can lead to dehydration, resulting in fatigue, headaches, dizziness, reduced physical performance, and impaired cognitive function. Severe dehydration may lead to serious health complications and, if untreated, can be life-threatening. Beyond its biological importance, water is essential for maintaining hygiene, sanitation, and overall public health. Households depend on water for drinking, cooking, bathing, washing clothes, cleaning utensils, and maintaining sanitary living conditions. Access to adequate quantities of safe water significantly reduces the incidence of water-borne diseases and contributes to improved quality of life. Water also supports recreational activities, urban landscaping, and environmental aesthetics, thereby enhancing community well-being.

Water is equally critical for economic development. Agriculture, the largest consumer of freshwater in many developing countries, relies heavily on water for irrigation, livestock production, and food security. Industrial sectors require substantial quantities of water for manufacturing processes, cooling systems, cleaning operations, and power generation. Hydroelectric projects utilize flowing water to generate renewable energy, while fisheries and aquaculture depend on healthy aquatic ecosystems for sustainable production. Thus, water forms the foundation of economic growth and livelihood generation across multiple sectors. The quality of water is as important as its availability. Safe drinking water should be free from harmful microorganisms, toxic chemicals, and other contaminants that pose risks to human health. Contaminated water can transmit diseases such as cholera, typhoid, dysentery, and hepatitis, particularly in areas lacking adequate sanitation facilities. To ensure public safety, water undergoes various treatment processes, including filtration, disinfection, and regular quality monitoring before being supplied for domestic consumption. Continuous surveillance and effective water treatment systems are therefore essential for protecting public health and preventing disease outbreaks.

The importance of water can be summarized as follows:

Water is the second most essential requirement for human survival after oxygen and is indispensable for sustaining life.

The human body contains approximately 60–70 per cent water, while infants have an even higher proportion, emphasizing its critical role in growth and development.

Water regulates body temperature, transports nutrients and oxygen, removes metabolic waste, and supports the normal functioning of cells, tissues, and organs.

Adequate water intake is necessary to prevent dehydration and maintain physical and mental health.

Water is essential for domestic activities such as drinking, cooking, bathing, cleaning, and sanitation.

Agriculture depends on water for crop cultivation, livestock management, and ensuring food security.

Industries require water for manufacturing, processing, cooling, and energy production.

Safe and clean water helps prevent water-borne diseases and improves overall public health.

Sustainable management of water resources is essential for environmental conservation, economic development, and achieving long-term water security.

In the twenty-first century, increasing population growth, rapid urbanization, industrial expansion, climate change, and pollution have intensified pressure on available freshwater resources. These challenges underscore the need for efficient water management practices, conservation strategies, and equitable distribution systems to ensure that present and future generations have access to sufficient quantities of safe and clean water.

Statement of the Problem

There are numerous factors that affect the distribution of water between urban and rural areas. The supply and demand for water are vastly out of balance. People have the option to use some of their money to buy water from the market in order to make up for this deficit. It's challenging for the people. Both rural and urban communities frequently have sanitation issues. In rural areas, open defecation is a common occurrence. In addition, many people lack hygienic knowledge, which is harmful to their health.

Objectives of the Study

The present study has been undertaken with the following objectives:

To examine the availability and accessibility of improved drinking water sources among households in the study area.

To estimate the monthly expenditure incurred by households on drinking water.

To analyse the relationship between household size and the demand for water for various domestic purposes.

To assess the hygienic and sanitation practices adopted by the sample respondents.

To identify the major issues relating to drinking water supply and sanitation and suggest suitable policy measures for improving water quality, sanitation facilities, and sustainable water management.

Hypotheses of the Study

To achieve the above objectives, the following null hypotheses have been formulated and tested using appropriate statistical techniques:

H_{01}: There is no significant difference between rural and urban households with respect to the methods of drinking water treatment adopted.

H_{02}: There is no significant difference between rural and urban households regarding the use of toilet facilities within their homes.

Sampling Frame

There are eleven taluks in Madurai District. Among these eleven taluks, the researcher selected one taluk by applying the lottery method. Accordingly, the selected taluk is Madurai North Taluk. Madurai North Taluk consists of several village panchayats and urban local bodies. From the village panchayats, five panchayats were selected by adopting the systematic sampling method. From each selected panchayat, the researcher intended to select 25 respondents using the systematic sampling technique. Thus, a total of 125 respondents were selected from the rural panchayats. From the two urban local bodies, the researcher selected 40 respondents from each municipality, resulting in a total of 80 respondents from the urban areas. Overall, the total number of respondents selected for the study was 205. The selected village panchayats are Alanganallur, Kovilpappakudi, Othakadai, Kadavur, and Vilangudi. The selected urban local bodies are Madurai City and Melur Municipality.

Tools of Analysis

For the analysis of data and testing the hypotheses, the following statistical tools are applied.

- ❖ Percentage
- ❖ Chi- Square Test
- ❖ Correlation

Socio-Economic Characteristics of the Respondents

A few fundamental social traits of the sample respondents are necessary for any study focused on the household sector. In this sense, Table 1.1 accurately depicts the socioeconomic traits of the sample respondents, including age, sex, caste, religion, and educational attainment.

Table 1.1Social Characteristics of the Respondents

S. No.	Variable	Classification	No. of Respondents	Percentage
1	Age (Years)	Below 30	48	23.41
		30–40	70	34.15
		41–50	56	27.32
		51–60	25	12.20
		Above 60	6	2.92
2	Gender	Male	119	58.05
		Female	86	41.95
3	Community	BC	72	35.12
		MBC/DNC	61	29.76
		SC/ST	72	35.12
4	Religion	Hindu	180	87.80
		Christian	15	7.32
		Muslim	10	4.88
5	Educational Qualification	Illiterate	32	15.61
		Primary School	36	17.56
		Secondary School	64	31.22
		Higher Secondary	43	20.98
		Undergraduate	18	8.78
		Postgraduate	8	3.90
		Diploma	4	1.95

Source: Survey Data

Table 1.1 presents the social characteristics of the 205 sample respondents selected for the study. The age distribution reveals that 34.15 per cent of the respondents belong to the 30–40 years age group, constituting the largest proportion of the sample. This is followed by 27.32 per cent in the 41–50 years age group and 23.41 per cent below 30 years. Respondents aged 51–60 years account for 12.20 per cent, while only 2.92 per cent are above 60 years. The findings indicate that the majority of the respondents are in the economically active and productive age groups. With regard to gender, 58.05 per cent of the respondents are male, whereas 41.95 per cent are female. This indicates that male respondents constitute a comparatively larger share of the sample population. The community-wise distribution shows that respondents belonging to the Backward Class (BC) and Scheduled Castes/Scheduled Tribes (SC/ST) each constitute 35.12 per cent of the sample. Respondents from the Most Backward Class/Denotified Communities (MBC/DNC) account for 29.76 per cent. The distribution suggests that the study includes respondents from different social groups, ensuring adequate representation across communities. Regarding religion, the majority of the respondents (87.80 per cent) are Hindus, followed by 7.32 per cent Christians and 4.88 per cent Muslims. This distribution reflects the predominant religious composition of the study area. The educational profile reveals that 31.22 per cent of the respondents have completed Secondary School, representing the largest educational category.

This is followed by 20.98 per cent who have completed Higher Secondary education, 17.56 per cent with Primary School education, and 15.61 per cent who are illiterate. Further, 8.78 per cent of the respondents possess an Undergraduate degree, 3.90 per cent have completed Postgraduate education, and 1.95 per cent hold a Diploma qualification. The findings indicate that although a considerable proportion of respondents possess school-level education, relatively fewer have attained higher educational qualifications. Overall, the table indicates that the sample is predominantly composed of economically active adults, with a higher proportion of male respondents, balanced representation across major community groups, a predominantly Hindu population, and educational attainment concentrated at the secondary and higher secondary levels. These demographic characteristics provide an appropriate basis for analysing household water demand, access to drinking water, and sanitation practices in the study area.

Provision of Adequate Drinking Water and Water for Cleaning

One of the essential requirements of humanity is access to water. The local government should provide it to the populace. The researcher is interested in learning more about how to give individuals access to clean water for washing and drinking. As a result, the researcher gathered data, which is shown in Table 1.2.

Table 1.2 Provision of Adequate Drinking Water and Water for Cleaning among the Respondents

S. No.	Village / Municipality	Adequate Drinking Water			Adequate Water for Cleaning		
		Yes	No	Total	Yes	No	Total
1	Alanganallur Panchayat	18	7	25	20	5	25
2	Kovilpappakudi Panchayat	15	10	25	18	7	25
3	Othakadai Panchayat	20	5	25	22	3	25
4	Kadavur Panchayat	13	12	25	17	8	25
5	Vilangudi Panchayat	19	6	25	21	4	25
6	Melur Municipality	29	11	40	31	9	40
7	Madurai City	26	14	40	32	8	40
	Total	**140**	**65**	**205**	**161**	**44**	**205**

Source: Survey Data.

Table 1.2 presents the availability of adequate drinking water and water for cleaning among the 205 sample households in the study area. Out of the total respondents, 140 households (68.29 per cent) reported that they had an adequate supply of drinking water, while 65 households (31.71 per cent) indicated that the available drinking water was inadequate. Among the rural panchayats, Othakadai Panchayat recorded the highest availability of adequate drinking water, with 20 out of 25 households (80.00 per cent) reporting sufficient access. This was followed by Vilangudi Panchayat, where 19 households (76.00 per cent) had adequate drinking water, and Alanganallur Panchayat, where 18 households (72.00 per cent) reported adequate availability. In contrast, Kadavur Panchayat had the lowest level of drinking water adequacy, with only 13 households (52.00 per cent) reporting sufficient access.

The urban areas showed comparatively better access to drinking water. In Melur Municipality, 29 out of 40 households (72.50 per cent) had adequate drinking water, while 26 households (65.00 per cent) in Madurai City reported satisfactory availability. Regarding water for cleaning and other domestic purposes, the situation was comparatively better than drinking water availability. Overall, 161 households (78.54 per cent) had adequate water for cleaning, whereas 44 households (21.46 per cent) reported inadequate availability. Madurai City recorded the highest availability, with 32 households (80.00 per cent) reporting sufficient water for cleaning, followed closely by Melur Municipality, where 31 households (77.50 per cent) had adequate access. Among the rural areas, Othakadai Panchayat and Vilangudi Panchayat demonstrated better availability of water for cleaning, with 22 households (88.00 per cent) and 21 households (84.00 per cent) respectively reporting adequate access. Kadavur Panchayat had the lowest availability, with only 17 households (68.00 per cent) indicating sufficient water for cleaning. Overall, the findings indicate that access to water for cleaning is relatively better than access to drinking water across the study area. Urban households generally enjoy better water availability than rural households, although noticeable disparities continue to exist among the selected panchayats. The results suggest the need for strengthening water supply infrastructure, particularly in rural areas where shortages remain more pronounced.

Sources of Drinking Water

Both in rural and urban areas, the researcher is looking for sources of potable water. As a result, the researcher gathered data, which is shown in Table 1.3.

Table 1.3 Sources of Drinking Water

S. No.	Source of Drinking Water	Rural (n = 125)	Urban (n = 80)
1	Household Tap Connection	52 (41.60)	42 (52.50)
2	Public Tap / Street Tap	36 (28.80)	12 (15.00)
3	Bore Well	18 (14.40)	8 (10.00)
4	Private Water Tankers	15 (12.00)	14 (17.50)
5	Packaged Drinking Water	4 (3.20)	4 (5.00)
Total		**125 (100.00)**	**80 (100.00)**

Source: Primary Survey Data.

Table 1.3 presents the sources of drinking water used by the sample households in the rural and urban areas of the study region. Among the 125 rural respondents, the majority of the households, 52 (41.60 per cent), receive

drinking water through household tap connections. This is followed by 36 respondents (28.80 per cent) who depend on public or street taps. Further, 18 respondents (14.40 per cent) obtain drinking water from bore wells, while 15 respondents (12.00 per cent) rely on private water tankers. Only 4 respondents (3.20 per cent) use packaged drinking water as their primary source. Among the 80 urban respondents, 42 households (52.50 per cent) depend on household tap connections, making it the predominant source of drinking water in urban areas. Private water tankers are the second most common source, used by 14 respondents (17.50 per cent), followed by public taps, which serve 12 respondents (15.00 per cent). In addition, 8 respondents (10.00 per cent) obtain drinking water from bore wells, while 4 respondents (5.00 per cent) rely on packaged drinking water.

A comparison between rural and urban households reveals that household tap connections are the principal source of drinking water in both areas, with a higher proportion of urban households having access to piped water. Rural households show greater dependence on public taps and bore wells, indicating comparatively lower household-level water infrastructure. The use of private water tankers in both rural and urban areas suggests that interruptions in the public water supply compel a section of the population to purchase water to satisfy their daily requirements. Overall, the findings indicate that although public water supply through household tap connections remains the major source of drinking water, a considerable proportion of households continue to depend on alternative sources such as bore wells, public taps, and private water suppliers. This emphasizes the need to strengthen drinking water infrastructure, improve the reliability of public water supply systems, and ensure equitable access to safe and adequate drinking water across both rural and urban areas.

Money Spent on Drinking Water

Water was formerly a free good, but today it is an economic good, so the researcher wants to estimate how much money the sample respondents paid to buy drinking water. Many residents of the study region buy water from a private water vending machine. Consequently, the researcher gathered data on drinking water demand, cost, *etc.,* and approximated the money spent by the sample respondents. The resulting information is shown in Table 1.4.

Table 1.4 Household Expenditure on Purchased Drinking Water

S. No.	Number of Water Cans (20 Litres) Purchased per Day	No. of Respondents	Price per Can (₹)	Total Expenditure per Day (₹)	Total Expenditure per Month (₹)
1	One	24	10	240	7,200
2	Two	38	10	760	22,800
3	Three	22	10	660	19,800
	Total	**84**		**1,660**	**49,800**

Source: Primary Survey Data.

Table 1.4 presents the expenditure incurred by households that purchase drinking water from private suppliers. Out of the total 205 respondents, 84 households reported purchasing drinking water, while the remaining 121 households depend primarily on water supplied through public sources such as household tap connections, public taps, or bore wells. Among the households purchasing water, 38 respondents (45.24 per cent) purchase two 20-litre cans per day, making this the most common level of consumption. These households collectively spend ₹760 per day, amounting to ₹22,800 per month. This is followed by 24 respondents (28.57 per cent) who purchase one can per day, incurring a total expenditure of ₹240 per day and ₹7,200 per month. The remaining 22 respondents (26.19 per cent) purchase three cans per day, spending ₹660 per day, which totals ₹19,800 per month. Overall, the 84 households together spend ₹1,660 per day on purchased drinking water, resulting in a

combined monthly expenditure of ₹49,800. The findings indicate that a considerable number of households incur regular expenses to secure safe drinking water due to the inadequacy or unreliability of the public water supply. This additional financial burden is particularly significant for low- and middle-income households and underscores the need for strengthening public drinking water infrastructure, ensuring continuous water supply, and improving access to safe and affordable drinking water.

Relationship between the Number of Family Members and Water Demanded

The association between the number of household members and the amount of water required for drinking, cooking, bathing, cleaning utensils, and sanitation services in the study region was determined by the researcher using correlation analysis, as shown in Table 1.6.

Table 1.6 Relationship between Household Size and Household Water Demand

S. No.	Correlation between Household Size and Water Demand	Rural (n = 125)	Urban (n = 80)
1	Drinking Water Demand	0.481**	0.563**
2	Cooking Water Demand	0.426**	0.518**
3	Bathing Water Demand	0.689**	0.641**
4	Water Demand for Cleaning Utensils	0.392**	0.448**
5	Water Demand for Sanitation Purposes	0.531**	0.487**

Note: Correlation is significant at the 0.01 level (2-tailed).

Source: Primary Survey Data.

Table 1.6 presents the relationship between household size and water demand for various domestic purposes among the rural and urban respondents. The Pearson correlation coefficients indicate a positive and statistically significant relationship between the number of family members and the quantity of water required for all domestic activities. In the rural areas, the strongest positive relationship is observed between household size and bathing water demand (r = 0.689), indicating that larger families require substantially greater quantities of water for bathing. This is followed by water demand for sanitation purposes (r = 0.531), drinking water demand (r = 0.481), cooking water demand (r = 0.426), and water demand for cleaning utensils (r = 0.392). All the correlation coefficients are positive and statistically significant at the 1 per cent level, suggesting that household size has a considerable influence on rural household water consumption. Similarly, in the urban areas, a significant positive relationship exists between household size and all categories of water demand. The highest correlation is found between household size and bathing water demand (r = 0.641), followed by drinking water demand (r = 0.563), cooking water demand (r = 0.518), water demand for sanitation purposes (r = 0.487), and water demand for cleaning utensils (r = 0.448). These findings demonstrate that as the number of family members increases, the demand for water also rises across all household activities.

Testing of Hypothesis

Null Hypothesis (H_{01}): There is no significant difference between rural and urban households with respect to the methods of drinking water treatment adopted.

To examine the above hypothesis, the Chi-square test was employed. The results are presented in Table 1.7.

Table 1.7 Chi-square Test Showing the Difference in Methods of Drinking Water Treatment between Rural and Urban Households

Particulars	Value
Calculated Chi-square (χ^2) Value	16.84
Degrees of Freedom (df)	4
Table Value at 5 per cent Level	9.49
Level of Significance (p-value)	0.002
Result	Significant

Source: Computed from Primary Survey Data.

Table 1.7 presents the results of the Chi-square test conducted to examine whether there is a significant difference between rural and urban households regarding the methods adopted for treating drinking water. The calculated Chi-square value ($\chi^2 = 16.84$) is greater than the table value (9.49) at 4 degrees of freedom and the 5 per cent level of significance. Furthermore, the obtained p-value (0.002) is less than 0.05, indicating that the observed difference is statistically significant.

Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted. The findings reveal that there is a significant difference between rural and urban households in the methods used for drinking water treatment. This variation may be attributed to differences in educational attainment, household income, access to water treatment facilities, awareness of safe drinking water practices, and the quality of water supplied in rural and urban areas. The results suggest that urban households are generally more likely to adopt improved water treatment methods than rural households, highlighting the need for greater awareness and improved access to safe water treatment practices in rural communities.

Suggestions

Based on the findings of the study, the following suggestions are proposed to improve access to safe drinking water, promote hygienic practices, and strengthen sanitation facilities in the study area:

The Central and State Governments, local bodies, public health departments, educational institutions, and non-governmental organizations should jointly organize awareness programmes, seminars, workshops, and community campaigns to educate the public on the health risks associated with consuming contaminated water and the importance of safe water handling practices.

The Government should strengthen rural and urban drinking water infrastructure by ensuring a continuous, adequate, and safe supply of potable water to all households through well-maintained piped water supply systems.

Village Panchayats, Municipalities, and Municipal Corporations should promote rainwater harvesting by ensuring that rainwater harvesting structures are installed and properly maintained in all public buildings, educational institutions, commercial establishments, and residential houses.

Water purification facilities should be established and upgraded at the community level, particularly in rural areas where access to treated drinking water is limited. Regular monitoring of water quality should also be undertaken to ensure compliance with national drinking water standards.

Affordable safe drinking water schemes should be expanded to underserved rural and peri-urban areas so that economically weaker households have access to clean drinking water at reasonable prices.

Local bodies should periodically inspect and maintain public water supply systems, overhead tanks, pipelines, bore wells, and public taps to minimize water contamination, leakage, and wastage.

Public awareness campaigns should emphasize the importance of cleaning household water storage containers regularly, storing drinking water hygienically, and adopting appropriate household water treatment methods such as boiling, filtration, or purification before consumption.

Households should be encouraged to adopt safe drinking water treatment practices. Government health workers and community volunteers should conduct regular awareness programmes highlighting the health benefits of consuming treated drinking water.

Sanitation programmes should continue to focus on achieving universal access to household toilets and eliminating open defecation through financial assistance, behavioural change communication, and effective monitoring of sanitation initiatives.

Health departments should conduct regular health camps and water quality testing programmes to identify water-borne diseases at an early stage and educate communities about preventive health measures.

Integrated Water Resource Management (IWRM) practices should be promoted by encouraging water conservation, groundwater recharge, wastewater reuse, and efficient utilization of available water resources to ensure long-term water security.

Community participation should be strengthened by involving local residents, self-help groups, youth organizations, and village water and sanitation committees in planning, monitoring, and maintaining drinking water supply and sanitation facilities.

The implementation of these recommendations will contribute to improving access to safe drinking water, enhancing sanitation and hygiene practices, reducing the incidence of water-borne diseases, and promoting sustainable management of water resources. These measures will ultimately improve the quality of life and public health of both rural and urban households in the study area.

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