



AN ECONOMIC ANALYSIS OF WATER CONSUMPTION AND WASTEWATER DISPOSAL AND ITS IMPACT ON URBAN HOUSEHOLDS IN COIMBATORE CITY

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ABSTRACT

Water has been recognized as the most significant factor for survival of human life and especially for domestic purposes of households. It is base for the social and economic development of the country; therefore, it increases more pressure on the water leads to overexploitation of freshwater resources and breaks the balance of water ecosystem. The study analysed the average water consumption and wastewater discharge from urban households in Coimbatore city. For this study, the west zone was selected and randomly selected the two areas. The simple random sampling method was applied to selected 52 sample households from both areas. The average water consumption of Balaji Nagar was 95 litres/day and Karuparayan kovil area water consumption was 87 litres of water/day. The study found the ground reality of both area water consumption of households less than the government norms water supply, and around 80 percent of wastewater was generated from urban households. The linear regression results show R^2 is 0.64, the results confirm the family size was the key factor determining the water consumption of households, and wastewater generation was determined by water consumption of urban households in Coimbatore city.

KEYWORDS: Consumption, Wastewater, Households, Freshwater.

1. INTRODUCTION

India is the second highest populated country in the world. The increase in population leads to demand for basic facilities such as water, food, and shelters, improve the standard of living, infrastructure development, quality of the environment, transport facilities, etc. All these demands create a path to urbanization, high growth of industrial activities, city development, urban lifestyle, and migration. Therefore, the urban population growth rapidly increased than the rural areas. According to census reports, India's urban population tremendously increased from 25.8 million in 1991 to 377 million in 2011. It leads to two self-perpetuating problems water shortage and discharge the overload of sewage. It was confirmed from the Central Pollution Control Board report 2021, that India generates 72,368 million litres of sewage per day and 20,235 MLD only treated (*Down to Earth, 2021*).

In recent decades, India facing various environmental issues among them increasing water demand, water scarcity, and wastewater management are the biggest challenges for the present and upcoming years. The increasing population will increase the water demand. Increased water demand put more pressure on water supply and water resources. It is like a chain reaction. In urban areas still, untreated sewage water is discharged into rivers, ponds, tanks, and lakes. These actions not only affect the surface water and affected groundwater quality. The Central Pollution Control Board 2009, study on water consumption and sewage disposal pattern and found out 900 cities and towns generate 70 percent of sewage which was discharged into rivers. But rivers are acts as major sources of drinking water in India. According to Ministry of urban development and central pollution control Board report, 80 percent of surface water in India is polluted due to domestic sewage, inadequate sanitation facilities, and poor sewage management. Therefore, this study analysed the average water consumption and sewage water discharge from urban households in Coimbatore city and the impact of wastewater disposal in selected study areas.

2. REVIEW OF LITERATURE

Narmilan et al. (2021) analyzed the domestic water consumption pattern and awareness about water management practices in the urban area of Batticaloa district, Sri Lanka. The primary data was used and 300 households were selected. The correlation and linear regression statistical tools were used. The study found out, that in urban areas



higher income people used more water than people with low income and most of the households are not aware of the efficient use of water.

Zheng and Kamal (2020) analysed the effect of households income on residential wastewater output in urban China. The study points out the increase in water consumption contributed to the discharge of more wastewater and urban households income also inclined the segregation of more wastewater. The study confirms the positive relationship between income and wastewater output.

Boopathi and Manikandan (2016) elucidated the issues of sustainability of drinking water, sources availability, and distance moved to fetch the domestic water. For this study, National sample survey Organisation 44th, 49th, and 54th round data were used for analysis. The study found out most of the people access the modern source more than the traditional source and above 30 percent of the urban population still access water resources from long distances.

Boopathi and Suja (2016) analysed the economic aspects of water consumption, sewage water disposal and its health impact. The study adopted stratified and proportionate random sampling to selected 140 sample. The regression was used for analysis the per capita consumption of domestic water of households and sewage disposal.

3. OBJECTIVES

- To know the socio-economic condition of Urban households and their average water consumption, wastewater generation, and sanitation facilities in selected areas of Coimbatore city.
- To examine the key factor determining the excessive water consumption of urban households and wastewater generation in the selected areas of Coimbatore city.

4. METHODOLOGY

Coimbatore City was selected for the study area of research. The Coimbatore City Municipal Corporation is decentralized into five zones namely South, North, West, East, and Central of which the west zone was selected for this study. From the west zone, randomly selected two areas was selected namely Balaji Nagar and Karupparayan Kovil. The simple random sampling method was applied. From Balaji Nagar 31 households and 21 households was selected from Karupparayan Kovil. The total 52 sample households was selected for this research. Both the primary and secondary data have been used for this study. The primary data was collected with a structured questionnaire. Secondary data was collected from Census reports, Ministry of Jal Sakthi report, CPCB, World Bank, and various Journals. The correlation and regression tools were used for data analysis.

5. RESULT AND DISCUSSION

The urban households are facing massive water shortage problems, due to the unavailability of alternative sources, poor drainage system and lack of maintenance they are consuming contaminated water. Therefore, this study provided insight into the Socio - Economic condition of Urban households and the ground reality of water consumption, facilities available for wastewater disposal, and sanitation facilities in urban areas.

Table 1. Socio-Economic condition of Urban households in selected areas of Coimbatore city

Particulars	<i>percentage in ()</i>		
	Balaji Nagar No. of sample: 21	Karuparayan Kovil No. of sample: 31	Total Total No. of sample: 52
Gender of the respondents			
Male	10 (47.6)	20 (64.5)	30 (57.7)
Female	11 (52.4)	11 (35.5)	22 (42.3)
Religion			
Hindu	12 (57.1)	26 (83.9)	38 (73.08)
Christian	9 (42.9)	5 (16.1)	14 (26.92)
Education level			
Illiterate	1 (4.8)	0 (00.0)	1 (1.90)
Primary	3 (14.2)	6 (19.4)	9 (17.30)
Secondary	10 (47.6)	16 (51.6)	26 (50.00)
Higher Secondary	6 (28.6)	5 (16.1)	11 (21.20)
Graduate	1 (4.8)	4 (12.9)	5 (9.60)
Caste			
BC	6 (28.6)	6 (19.4)	12 (23.1)



MBC	7 (33.3)	8 (25.8)	15 (28.8)
SC	8 (38.1)	17 (54.8)	25 (48.1)
Marital status			
Married	15 (71.43)	20 (64.52)	35 (67.31)
Unmarried	5 (23.81)	8 (25.80)	13 (25.0)
Widow	1 (4.76)	3 (9.68)	4 (7.69)
Occupation			
Government job	1(4.8)	1(3.3)	2 (3.8)
Daily wages	5 (23.8)	8 (25.8)	13 (25.0)
Private job	15 (71.4)	22(70.9)	37 (71.2)
Average Monthly Family Income & Expenditure			
Income	Rs. 26857.14	Rs. 20687.10	Rs. 23178.85
Expenditure	Rs. 16533.33	Rs. 14876.61	Rs. 15545.67

Sources: Primary survey (2022)

The table 1 indicates the socio-economic condition of urban households in Balaji Nagar and Karuparayan kovil. Gender of the respondents in Balaji Nagar, the majority 52.4 percent of the respondents are female and in the Karuparayan kovil area, the majority 64.5 percent of the respondents are males. And found that, the majority 57.7 percent of the respondents are male in the selected areas and 42.3 percent of the respondents are female. In both areas, the majority 73.08 percent of the respondents are belonged to Hindu religion and 26.92 of the respondents are belongs to Christianity. The Education status of the respondents in Balaji Nagar and Karuparayan kovil, shows that the majority 50 percent of the respondents have a secondary level of education, 21.20 percent of the respondents are completed higher secondary education, 17.30 percent of the respondents have primary level education, 9.60 percent of the respondents are graduates, and remaining 1.90 percent of the respondents are illiterate. In both areas, majority 48.1 percent of the respondents belong to the SC category, 28.8 percent of the respondents are belonged to MBC category and 23.1 percent of the respondents are belong to BC. The marital status shows that 67.31 percent of respondents are married, 25 percent of the respondents are unmarried and 7.69 percent of the respondents are widows. The occupation of the respondents reveals that the majority 71.2 percent of the respondents are doing the private job, 25 percent of the respondents are going daily wages works and only 3.8 percent of the respondents are government employee. In both areas, the average monthly income of the family was Rs. 23,178.85 and their monthly expenditure was Rs. 15,545.67. All the respondents are belongs to the middle-income group therefore, they incurred the expenditure based on their family income. The Balaji Nagar respondent's family monthly income was Rs. 26857.14 and expenditure was Rs. 16533.33 and Karuparayan kovil area, the respondent's family monthly income was Rs. 20687.10 and expenditure was Rs. 14876.61. When compared with both areas, Balaji Nagar respondents family income and expenditure are slightly higher than the Karuparayan kovil. The reason behind this, more income earners in Balaji Nagar than in Karuparayan kovil.

Table 2: Urban households average water consumption per day in selected areas of Coimbatore city

Area	Statistics	Drinking	Cooking	Bathing	Washing utensil	Washing cloths	Cleaning houses	Sprinkling at entrances	Non-Veg cleaning &	Pets	Ablution	Gardening	Vehicles	Total Consumption of Water
Balaji Nagar	Sum	600	720	1870	630	2205	630	435	372	84	1275	60	628	9509.00
	Mean	28.57	34.29	89.05	30.00	105.00	30.00	20.71	17.71	4.00	60.71	2.86	29.90	452.81
Karuparayan Kovil	Sum	1530	930	2640	1050	4025	935	615	428	112	1828	51	823	14967.00
	Mean	49.35	30.00	85.16	33.87	129.84	30.16	19.84	13.81	3.61	58.97	1.65	26.55	482.81
Total	Sum	2130	1650	4510	1680	6230	1565	1050	800	196	3103	111	1451	24476.00
	Mean	40.96	31.73	86.73	32.31	119.81	30.10	20.19	15.38	3.77	59.67	2.13	27.90	470.69

Sources: Primary survey (2022)



The table 2 discuss the total consumption of water per day in Balaji Nagar and Karuparayan kovil area for different purpose. In Balaji Nagar households use more water for washing clothes 105 litres, for bathing 89.05 litres of water used, and 60.71 litres of water used for ablution. On the other hand, in Karuparayan kovil area households consumed more water for washing clothes 129.84 litres, 85.16 litres for bathing, and 58.97 litres of water required for ablution purposes. In both areas, households are spend more water for washing clothes, bathing, and ablution. This indicates that households are required more water for cleaning and hygienic purposes. The Balaji Nagar households are consumed 452.81 litres of water per day for all purposes, and the Karuparayan kovil area household's water consumption is 482.81 litres.

Table 3: Urban households water consumption and wastewater disposal per day in Coimbatore city

Area	Statistics	Water consumption LPCD	Wastewater disposal litre/person/day	Percentage of wastewater Disposal/day
Balaji Nagar	Sum	2002.49	1665	
	Mean	95.36	79.29	83.15 %
Karuparayan Kovil	Sum	2701	2190	
	Mean	87.13	70.65	81.09 %
Total	Sum	4703.49	3855	
	Mean	90.45	74.13	81.96 %

Sources: Primary survey (2022)

The table 3 reveals the average litre per capita per day (LPCD) of water consumption and wastewater generated by per person per day in Coimbatore city. In Balaji Nagar, 95.36 litres of water was consumed by a person per day for drinking, cooking, bathing, washing clothes and utensils, ablution, and various purposes but it was than the government norms of water supply. After consumption, 79.29 litres of wastewater are disposed by per person/day. In Karuparayan kovil area, 87.13 litres of water was consumed by per person/day and 70.65 litres of wastewater disposed by per person/day. After the various purposes of water consumption by urban households, around 80 percent of water is converted into wastewater. This study found out that urban households have more water consumption output was a huge amount of wastewater discharge. As per the Ministry of Jal Sakthi reports, 135 LPCD is suggested as the benchmark for urban water supply. In selected areas, the present water supply was less than Government norms. However, this study found out, that while urban water supply increases it will increase the wastewater discharge. So, the Government should take a step to treat the wastewater, make awareness to people for reducing excess water consumption, and restorative water bodies in urban areas. It will help to increase the urban water supply. *In ground reality, both areas households are requirements more water for domestic purpose but, when compare to government norms of urban water supply, they are getting less water supply for consumption. The households are 10 days once or 15 days only getting water and they are facing water scarcity problem.*

Table 4: Types of water contamination, drainage facilities avail for wastewater disposal and sanitation facilities available in selected areas of Coimbatore city

Particulars	Balaji Nagar	Karuparayan Kovil	Total
	No. of sample: 21	No. of sample: 31	Total No. of sample: 52
<i>percentage in ()</i>			
Types of water contamination			
Colour	8 (38.10)	5 (16.1)	13(25.0)
Taste	9 (42.90)	14 (45.2)	23 (44.2)
Odour	4 (19.00)	12 (38.7)	16 (30.8)
Drainage Facilities			
Semi-closed drainage	4 (19.0)	15 (48.4)	19 (36.5)
Open drainage	16 (76.2)	16 (51.6)	32 (61.5)
Open place	1 (4.8)	0 (0.0)	1 (1.9)
Availability of Toilet Facility			
Yes	18 (85.7)	12 (38.7)	30 (57.7)
No	3 (14.3)	19 (61.3)	22 (42.3)

Sources: Primary survey (2022)

The table 4 shows the types of water contamination, wastewater disposal facilities, and toilet facilities available for urban households in selected areas of Coimbatore city. In Balaji Nagar, 42.90 percent of the respondents stated that the water taste is different, 38.10 percent opinion that water is changed due to leakages and sometimes sewage mixed into water and 10 percent of the respondents are feel that odour from water. In Karuparayan kovil area, 45.2 percent of the respondents are stated that changes in the taste of drinking water, 38.7 percent of the respondents felt the odour from water, and 16.1 percent of the respondents are stated colour of water was changed due to mixing of sewage water. The water supply quality is very poor in the selected area. This table concludes that the majority 44.2 percent of the respondents in both areas was reported that the water contaminated and they feel the changes in water taste.

The facilities available for household’s wastewater disposal, in Balaji Nagar majority 76.2 percent of the respondents have an open drainage system, 19 percent of the respondents have semi-closed drainage and 4.8 percent of the respondents are used an open place for disposal of wastewater from their house due to the non-availability of the drainage system. On the other hand, in Karuparayan kovil area, 51.6 percent of the respondents are using open drainage, and 48.4 percent of the households have semi drainage for disposal of the wastewater. This table indicates that the majority 61.5 percent of the respondents dispose of the wastewater into open drainage and only 36.5 percent of the respondents have a semi-closed drainage system. The drainage system available for the urban households was in a very bad condition. The Government should take steps to improve the drainage system in urban areas. In Balaji Nagar, the majority 85.7 percent of the respondents have toilet facilities available in the home, and 14.3 percent of the respondents are using the public toilet. In Karuparayan Kovil area, the majority 61.3 percent of the households does not have toilet facilities, most of them defecated in an open area due to a lack of maintenance of public toilet and 38.7 percent of the respondents have toilet facilities.

Hypothesis Testing Results

- The family size is the key factor for determine the excessive water consumption of the urban households.
- To examine the water consumption of urban households is significant to determine Wastewater generation in selected areas of Coimbatore city.

Table 5 (a): Correlation result for water consumption and family size of urban households in Coimbatore city

		Water Consumption	Family Size
Water consumption	Pearson Correlation	1	.801**
	Sig. (2-tailed)		.000
Family size	Pearson Correlation	.801**	1
	Sig. (2-tailed)	.000	

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

Table 5 (a) shows the positive correlation between the water consumption and family size of urban households and significant at 0.01 % level. It indicates that water consumption of urban households increases due to an increase in family size. When the No. of family members increase households water demand for consumption also increases.

Table 5 (b): Correlation result for water consumption and wastewater generation from urban households in Coimbatore city

		Total Water Consumption	Wastewater Generation
Total water consumption	Pearson Correlation	1	.803**
	Sig. (2-tailed)		.000
Wastewater generation	Pearson Correlation	.803**	1
	Sig. (2-tailed)	.000	

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

Table 5 (b) shows that positive correlation between the total water consumption and wastewater generation from urban households and both the variables are significant at 0.01 % level. It indicates that water consumption of urban households increases wastewater disposal. The urban households should beware of everyday water consumption. Because the excessive usage of freshwater arises the negative externality.



Linear regression Analysis

Table 6: Linear regression of water consumption and family size of urban households in Coimbatore city
 water consumption as the dependent variable

	Estimate	Std error	t- value	Significance
(Constant)	138.177	14.862	9.297	0.00**
Family size	30.721	3.249	9.455	0.00**
R squared	0.641			
Adjusted R Square	0.634			

Note: ** 1% level of Significance

$$Y = a \pm b_x + \mu$$

$$Y = 138.177 + 30.721(\text{family size}) + \text{Error}$$

Where Y= Water consumption; a = Constant, x = family size + μ = Error term.

The table 6 presents the linear regression analysis of the factor determining water consumption of urban households in Coimbatore City. The R² value is 0.641 and it reveals that 64 percent of urban households water consumption was determined by the family size (no. of family members) and statistically significant at 1 % level. It confirms that family size is the key factor determining the excessive water consumption of urban households. A positive relationship exists between water consumption and family size.

Table 7: Linear regression of wastewater generation and water consumption of urban households in Coimbatore city
 wastewater generation as the dependent variable

	Estimate	Std error	t- value	Significance
(Constant)	18.343	20.357	0.901	0.003**
Total water consumption	0.699	0.073	9.539	0.000**
R squared	0.645			
Adjusted R Square	0.638			

Note: ** 1% level of Significance

$$Y = a \pm b_x + \mu$$

$$Y = 18.343 + 0.699(\text{Total water consumption}) + \text{Error}$$

Where Y= Wastewater generation; a = Constant, x = Total water consumption + μ = Error term.

The table 7 represents the linear regression of water consumption and wastewater generation from urban households in Coimbatore City. The R² value is 0.645 and it reveals that 64 percent of wastewater generation was determined by the water consumption of urban households and it was statistically significant at 1 % level. There is a positive relationship between water consumption and wastewater generation by urban households in Coimbatore city. These results confirm that excessive water consumption of urban households will increase wastewater generation.

Wastewater segregation impacts on urban household Life

In urban cities due to high population, rapid urbanization, urban infrastructure development, improper sewage systems, and lack of awareness about the septic tank, people are discharging the wastewater into open drainage and open places. It leads to excessive mosquitoes breeding and creates a lot of health issues for people. It is the main cause of dengue, malaria, and chikungunya and people spend part of their income for different types of diseases. During rainy times sewage was blocked and sewage ran into roads and leakage pipelines sewage mixed with drinking water. According to the UNICEF and FAO report on Water in India: situation and prospects stated that in India annually around 37.7 million people are affected by waterborne diseases and 1.5 million children die due to diarrhoea and 73 million working days are lost due to waterborne diseases and face the economic burden of 600 million dollar per year.

6. CONCLUSION

The study concludes that the present water consumption of urban households is less than the Government norms. After water consumption of urban households are generates more wastewater. In urban areas, lakes act as a sink for wastewater disposal from households and it creates a negative impact on freshwater bodies in urban areas. In selected study areas, there is no proper drainage system for wastewater disposal, in Karuparayan kovil area, due to lack of maintenance of public toilets, most of the people are defecated in the open area. The Government concentrates only on building the public toilet to stop open defecation but this study found proper maintenance is a more important action for stopping open defecation. The study suggests that the corporation, should make



awareness to households about the present excessive water usage will create a water scarcity problem and it will affect future generations water consumption.

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