The Impact of Domestic Wastewater in Tirupattur Urban Region

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ABSTRACT

This study investigates the impact of domestic wastewater patterns on public health in the Tirupattur urban region, a rapidly urbanizing area facing significant challenges in water and wastewater management. The population grows the volume of domestic wastewater increases, often without proper treatment or partial disposal in the open space. This paper aims to analyze household water consumption levels, identify patterns of domestic wastewater generation, and assess the implications of wastewater quality on public health. A comprehensive survey was conducted across multiple households to gather data on water sources, domestic consumption habits, wastewater disposal methods, and the prevalence of waterborne diseases. This contamination has been directly linked to an increase in waterborne diseases, such as cholera and diarrhea, disproportionately affecting vulnerable groups such as children, elderly residents, and those with weakened immune systems. The study underscores the urgent need for infrastructure improvements, including robust wastewater treatment facilities, better water source management, and public awareness campaigns to address the health risks posed by domestic wastewater.

***Keywords**:* wastewater, consumption, health impact, water contamination, waterborne diseases.

INTRODUCTION

Domestic wastewater refers to the used water source that is generated from household activities such as bathing, cooking, cleaning, washing, and flushing toilets. It includes water from sinks, showers, bathtubs, toilets, washing machines, dishwashers, and other household appliances. Domestic wastewater is also commonly called sewage or gray water. Domestic wastewater into the environment, particularly when not treated properly, can have significant environmental, social, and economic impacts. These impacts depend on factors such as the

volume of wastewater, the quality of treatment, and the receiving environment's ability to absorb and process the contaminants.

According to the United Nations World Water Development Report (2021), nearly 80% of the world's wastewater is released into the environment without adequate treatment. This statistic highlights the widespread issue of untreated wastewater, which is a significant environmental and public health concern.The world produces approximately 359.4 billion cubic meters of wastewater annually, which is equivalent to 49 cubic meters per person per year

India has 1,093 sewage treatment plants. The government has been implementing programs and schemes to improve the wastewater and sewerage infrastructure in the country. India has a total sewage treatment capacity of approximately 39,000 MLD, while the total sewage generation is about 72,368 MLD (CPCB, 2022).Tamil Nadu's sewage generation capacity is 6,421 million liters per day (MLD). The state's total treatment capacity, including planned and proposed capacity, is 1,492 MLD. (TNPCB, 2021).

The urban population in Tirupattur heavily relies on piped water supply systems. Based on the standard calculation of 135 liters per capita per day (LPCD), with a population exceeding 80,000, the total sewage generation in Tirupattur Municipality is estimated to be 8–9 MLD (million liters per day). However, the current capacity of the sewage treatment plant (STP) serves only around 35-40% of the total sewage generated. This leaves approximately 5–6 MLD of sewage untreated, which is often discharged into open drains or nearby water bodies, contributing significantly to environmental pollution. In Jolarpettai Municipality, a small STP is under construction, with an estimated capacity of 1–2 MLD, primarily serving sewage from selected connected areas. The gap in sewage treatment capacity here is between 6–7 MLD. Vaniyambadi Municipality is constructing an STP with a capacity of around 3–4 MLD, while daily sewage generation is estimated at 6–8 MLD. In Ambur, the STP has a treatment capacity of 8 MLD, but the daily sewage generation is estimated at 9–10 MLD, leading to periodic overflows and the discharge of untreated wastewater into local water bodies. This indicates significant gaps in sewage treatment infrastructure across the region, posing environmental and health risks.

The Tirupattur urban region, like many rapidly developing areas, faces significant challenges related to domestic wastewater management and public health. As urbanization accelerates, the volume of domestic wastewater generated has increased, putting immense

pressure on existing infrastructure. Many households in the region rely on untreated or poorly treated water sources, such as bore wells and municipal water supplies, which are often susceptible to contamination. The improper disposal of domestic wastewater further exacerbates these issues, as untreated wastewater often seeps into local water systems, leading to widespread contamination. It aims to assess the consumption patterns of domestic wastewater, examining how different water usage behaviors contribute to the growing public health concerns in the region. Thisarticle seeks to highlight the need for improved wastewater management systems and public health interventions, ultimately contributing to a sustainable, healthier urban environment in Tirupattur.

OBJECTIVES:

- To assess the impact of domestic wastewater on human health within the study area.
- To analysis the domestic water consumption level in the study area.

METHODOLOGY

This is a descriptive and analytical study aimed at understanding the factors influencing domestic wastewater management in the Tirupattur urban region. The study employs a mixed-methods approach, combining both quantitative and qualitative data for a comprehensive analysis. Data was collected through surveys from households, local administrators, and wastewater management units within the Tirupattur urban region. A stratified random sampling method was used to ensure a representative sample of respondents. This approach allows for an in-depth examination of the key factors impacting wastewater management and provides valuable insights into the local challenges and needs for improvement.

REVIEW OF LITERATURE

Yasir M. Al-Mawa et. al. (2023), this paper details the characteristics and treatment of domestic wastewater. Its focus is on the untreated domestic wastewater received by Tigris River. Domestic wastewater characteristics are heavily impacted by people's lifestyles, social and cultural behaviors, water supply, and consumption. For humans to grow and develop properly, they need a reliable and sufficient water supply. Analyzing raw domestic wastewater is critical for designing an efficient and cost-effective sewage treatment system. The gap between available water supply and demand widens. Proper sanitation, particularly a decentralized strategy that can

be performed through the reuse of household effluent, can solve water supply and wastewater management problems.

BindhyWasiniPandeyet. al. (2017) water pollution creates many diseases, which spread easily during the rainy season due to bad quality of drainage as well as untreated effluent wastewater discharge into water source. Around 25 percent of all the known human illnesses occur due to environment related pollution. Nearly, 2.3 billion humans suffer from water borne diseases across the world. In many developing countries, many diseases like diarrhea, cholera, asthma, dysentery, typhoid, and enteric fever are due to poor quality of drinking water

RamendraSoniet. al. (2021), in this paper, reviewed environmental and public health issues associated with the use of untreated wastewater in agriculture. Water resources are under threat because of the growing population. Increasing generation of wastewater (municipal, industrial, and agricultural) in developing countries especially in India and other Asian countries has the potential to serve as an alternative of freshwater resources for reuse in rice agriculture, provide appropriate treatment, and distribution measures are adopted. Wastewater treatment is one of the big challenges for many countries because increasing levels of undesired or unknown pollutants are very harmful to health as well as environment.

Kavindra Kumar (2021), water scarcity is one of the major problems in the world and millions of people have no access to freshwater. Untreated wastewater is widely used for agriculture in many countries. This is one of the world-leading serious environmental and public health concerns. Instead of using untreated wastewater, treated wastewater has been found more applicable and ecofriendly option. Model showing the efficient methods for wastewater treatment and the utilization of solid wastes in fertilizers.

Saurabh S. Joshi et. al. (2020), it was observed that, out of the various parameters deliberate from different locations exceed the standard required values. Pollution of channels with contaminated substances and excessive nutrients, as well as destructive land use practices in areas surrounding freshwater ecosystems, lead to deterioration of water quality. There is also need of public education and awareness to decentralize treatment of sewage at household and apartment level which can be useful to reduce pollution of river. Due to non-availability of the adequate land and full-fledged treatment facilities, large quantity of agricultural, municipal and industrial wastewater enters into river Panchaganga through various drains and nallahs which deteriorate the quality of river water.

DATA ANALYSIS

Table-1: Area wise Contamination of water source Respondents

Contamination of water	Municipality name				Total
	Tirupattur	Jolarpettai	Vaniyambadi	Ambur	
Yes	102	47	128	104	**381**
	26.8%	12.3%	33.6%	27.3%	**100.0%**
	72.9%	78.3%	71.1%	69.3%	**71.9%**
No	38	13	52	46	**149**
	25.5%	8.7%	34.9%	30.9%	**100.0%**
	27.1%	21.7%	28.9%	30.7%	**28.1%**
Total	**140**	**60**	**180**	**150**	**530**
	26.4%	**11.3%**	**34.0%**	**28.3%**	**100.0%**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Computed from Primary Data

The above Table-1,the cross-section analysis of water contamination data across the urban-regions of Tirupattur District was analysised with following municipalitiesTirupattur, Jolarpettai, Vaniyambadi, and Ambur provides a clear picture of the widespread issue of water contamination in these areas the majority of respondents 71.9% reported contamination in their water sources, with the highest percentage in Tirupattur (72.9%) and the lowest in Ambur (69.3%). In terms of municipalities, the proportion of individuals experiencing contaminated water is relatively high across all areas, ranging from 69.3% in Ambur to 78.3% in Jolarpettai. On the other hand, 28.1% of respondents reported that their water sources were not contaminated, with the highest percentage in Ambur (30.7%) and the lowest in Jolarpettai (21.7%). While Vaniyambadi shows a significant 71.1% contamination rate, it also has a relatively higher share of households reporting clean water (28.9%). which could be attributed to underdeveloped water management systems or reliance on informal water sources like public bore wells. The contamination levels indicate that the local water supply may be insufficiently regulated or that poor wastewater management practices, are contaminating the water supply.

Table-2:Water usage for domestic purpose

Water usage in Lt	Municipality name				Total
	Tirupattur	Jolarpettai	Vaniyambadi	Ambur	
UP to 200 Lt	3	3	6	0	**12**
	25.0%	25.0%	50.0%	0.0%	**100.0%**
	2.1%	5.0%	3.3%	0.0%	**2.3%**
201 to 400 Lt	11	4	11	15	**41**
	26.8%	9.8%	26.8%	36.6%	**100.0%**
	7.9%	6.7%	6.1%	10.0%	**7.7%**
401 to 600 Lt	71	27	92	72	**262**
	27.1%	10.3%	35.1%	27.5%	**100.0%**
	50.7%	45.0%	51.1%	48.0%	**49.4%**
601 to 800 Lt	52	25	67	59	**203**
	25.6%	12.3%	33.0%	29.1%	**100.0%**
	37.1%	41.7%	37.2%	39.3%	**38.3%**
Above 801 Lt	3	1	4	4	**12**
	25.0%	8.3%	33.3%	33.3%	**100.0%**
	2.1%	1.7%	2.2%	2.7%	**2.3%**
Total	140	60	180	150	**530**
	26.4%	11.3%	34.0%	28.3%	**100.0%**
	100.0%	100.0%	100.0%	100.0%	**100.0%**

Source: Computed from Primary Data

The above Table-2,reveals the distribution of water usage for domestic purposes across four municipalities of Tirupattur district such as Tirupattur, Jolarpettai, Vaniyambadi, and Ambur. The largest group of respondents 49.4% use between 401 to 600 liters of water per month, with Vaniyambadi showing the highest proportion (51.1%) in this category, followed closely by Ambur (48.0%). The second-largest group 38.3% uses 601 to 800 liters, with similar distribution across municipalities, led by Ambur (39.3%) and Jolarpettai (41.7%). A smaller percentage of respondents 7.7% use between 201 to 400 liters, with Ambur again reporting the highest usage (36.6%). Only 2.3% of respondents use more than 800 liters, with a notable proportion in Vaniyambadi (33.3%) and Ambur (33.3%) for this category. A small fraction (2.3%) use up to 200 liters, with Vaniyambadi showing the highest (50.0%) and Ambur none in this category. This data indicates that most households across the municipalities tend to use moderate to high quantities of water (401-800 liters), and those with lower usage are fewer in number.

Without proper wastewater treatment, contaminants can seep into local water sources, affecting public health.

Table-3:Domestic Wastewater discharge

Wastewater Discharge	Municipality name				Total
	Tirupattur	Jolarpettai	Vaniyambadi	Ambur	
Open area	19	7	18	16	**60**
	31.7%	11.7%	30.0%	26.7%	**100.0%**
	13.6%	11.7%	10.0%	10.7%	**11.3%**
Public drainage	79	36	111	86	**312**
	25.3%	11.5%	35.6%	27.6%	**100.0%**
	56.4%	60.0%	61.7%	57.3%	**58.9%**
Water bodies	32	12	43	36	**123**
	26.0%	9.8%	35.0%	29.3%	**100.0%**
	22.9%	20.0%	23.9%	24.0%	**23.2%**
Dumping in own pit	10	5	8	12	**35**
	28.6%	14.3%	22.9%	34.3%	**100.0%**
	7.1%	8.3%	4.4%	8.0%	**6.6%**
Total	**140**	**60**	**180**	**150**	**530**
	26.4%	**11.3%**	**34.0%**	**28.3%**	**100.0%**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Computed from Primary Data

In Table-3,the domestic wastewater discharge methods shows that public drainage is the most common disposal method across all municipalities, with 58.9% of respondents using it. Vaniyambadi leads with 61.7% of respondents using public drainage, followed by Ambur (57.3%), Tirupattur (56.4%), and Jolarpettai (60%). The second most common method is discharging wastewater into water bodies, which accounts for 23.2% of all respondents. Vaniyambadi has the highest percentage of this method (23.9%), while Ambur (24%) and Tirupattur (22.9%) follow closely. Jolarpettai reports the lowest percentage at 20%. The third most common method is the discharge of wastewater into open areas, with 11.3% of respondents overall. Tirupattur has the highest proportion of open-area discharge (13.6%), while Vaniyambadi (10%) and Ambur (10.7%) have slightly lower figures. The least common method is dumping wastewater into private pits, with only 6.6% of respondents choosing this option. Ambur (8%) and Jolarpettai (8.3%) have the highest percentages of pit dumping, while Tirupattur (7.1%) and Vaniyambadi (4.4%) are lower. Overall, public drainage is the dominant method, with water bodies and open areas also playing significant roles in wastewater disposal.

Table-4:Family members affecting diseases

Affecting Diseases	Municipality name				Total
	Tirupattur	Jolarpettai	Vaniyambadi	Ambur	
Typhoid Fever	38	17	45	33	**133**
	28.6%	12.8%	33.8%	24.8%	**100.0%**
	27.1%	28.3%	25.0%	22.0%	**25.1%**
Diarrhea	8	3	7	11	**29**
	27.6%	10.3%	24.1%	37.9%	**100.0%**
	5.7%	5.0%	3.9%	7.3%	**5.5%**
Cholera	53	22	54	34	**163**
	32.5%	13.5%	33.1%	20.9%	**100.0%**
	37.9%	36.7%	30.0%	22.7%	**30.8%**
Skin allergy	32	11	47	40	**130**
	24.6%	8.5%	36.2%	30.8%	**100.0%**
	22.9%	18.3%	26.1%	26.7%	**24.5%**
Viral fever	9	7	27	32	**75**
	12.0%	9.3%	36.0%	42.7%	**100.0%**
	6.4%	11.7%	15.0%	21.3%	**14.2%**
Total	**140**	**60**	**180**	**150**	**530**
	26.4%	**11.3%**	**34.0%**	**28.3%**	**100.0%**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Computed from Primary Data

Table-4, infers the overview of disease prevalence in all the four municipalitiessuch as Tirupattur, Jolarpettai, Vaniyambadi, and Amburand how they contribute to total disease cases. Cholera stands out as the most widespread disease, accounting for 30.8% of total cases, with Vaniyambadi (33.1%) and Tirupattur (32.5%) showing the highest percentages. Typhoid fever follows closely, with Vaniyambadi (33.8%) and Tirupattur (28.6%) having notable rates, contributing 25.1% of total cases. Skin allergies are more common in Vaniyambadi (36.2%) and Ambur (30.8%), representing 24.5% of all cases. Viral fever has the highest concentration in Ambur (42.7%), and Vaniyambadi (36%) shows a significant share, but it accounts for only 14.2% of the total cases. Lastly, Diarrhea is most prevalent in Ambur (37.9%) but makes up just 5.5% of the overall cases. Overall, the data shows that inadequate wastewater management, combined with contaminated water sources, plays a significant role in the

spread of waterborne and vector-related diseases, especially in municipalities with poor sanitation infrastructure.

Table-5:Barriers for proper wastewater management

Barriers	Municipality name				Total
	Tirupattur	Jolarpettai	Vaniyambadi	Ambur	
Lack of awareness	37	15	47	42	**141**
	26.2%	10.6%	33.3%	29.8%	**100.0%**
	26.4%	25.0%	26.1%	28.0%	**26.6%**
Lack of infrastructure	55	22	69	59	**205**
	26.8%	10.7%	33.7%	28.8%	**100.0%**
	39.3%	36.7%	38.3%	39.3%	**38.7%**
Cost of treatment	39	19	53	44	**155**
	25.2%	12.3%	34.2%	28.4%	**100.0%**
	27.9%	31.7%	29.4%	29.3%	**29.2%**
Lack of enforcement	9	4	11	5	**29**
	31.0%	13.8%	37.9%	17.2%	**100.0%**
	6.4%	6.7%	6.1%	3.3%	**5.5%**
Total	**140**	**60**	**180**	**150**	**530**
	26.4%	**11.3%**	**34.0%**	**28.3%**	**100.0%**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Computed from Primary Data

In Table-5, infers the barriers to proper wastewater management in the municipalities of Tirupattur, Jolarpettai, Vaniyambadi, and Ambur are multifaceted, with the lack of infrastructure being the most significant obstacle. In all four municipalities, the lack of infrastructure, cited by 38.7% of respondents, poses a severe challenge to effective wastewater management, contributing to the contamination of local water sources. This inadequacy in wastewater disposal systems directly impacts public health, leading to the spread of waterborne diseases. Moreover, the high costs associated with wastewater treatment, reported by 29.2% of respondents, exacerbate economic hardship, particularly in low-income households, as they face the dual burden of healthcare costs and treatment for illness caused by untreated or poorly managed wastewater. The lack of awareness, reported by 26.6% of respondents, further compounds these issues, as many may not understand the importance of proper wastewater disposal or the health risks of contamination. Additionally, weak enforcement of regulations, cited by only 5.5% of respondents. Collectively, these barriers not only diminish the quality of life but also strain local economies by increasing healthcare expenditures, productivity losses due to illness, and the financial burden of inadequate sanitation infrastructure.

Table-6.1:results of Multiple Regression Analysis

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.969[a]	.940	.939	.122
a. Predictors: (Constant), Man day loss due health impact, contamination of water, Family size, domestic water usage in Lt				

Source: Computed from Primary Data

The above Table-6.1, highlights the regression analysis indicates a robust model with an R-value of 0.969, showing a very strong correlation between the predictors and the dependent variable. The R-square value of 0.940 means that 94% of the variability in the outcome can be explained by the included factors: man-day loss due to health impacts, water contamination, family size, and domestic water usage. The Adjusted R-square value of 0.939 confirms the model's reliability after adjusting for the number of predictors. The relatively low standard error of 0.122 suggests the model provides accurate predictions, highlighting the significant influence of these variables, particularly improper sewage systems, on public health outcomes.

Table-6.2:Multiple Regression Analysis

Coefficients [a]						
Model		**Un standardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	**(Constant)**	.056	.028		2.039	.042
	Family size	-.003	.005	-.007	-.576	.565
	Contamination of water source	-.012	.012	-.011	-.965	.335
	Domestic water usage in Lt	6.246E-005	.000	.018	1.145	.253
	Man day loss due health impact	.967	.013	.962	73.341	.000
a. Dependent Variable: Proper sewage systems in your house						

Source: Computed from Primary Data

In Table-6.2, shows the relationship between various predictors and the dependent variable, "proper sewage systems in your house." The constant value of 0.056 indicates a baseline effect when all predictors are held at zero. The predictor "man day loss due to health impact" has a very strong positive effect with a coefficient of 0.967 and a highly significant p-

value of 0.000, meaning that for every unit increase in man-day loss due to health impacts, the likelihood of having proper sewage systems increases significantly. This suggests that communities with greater health impacts due to poor sanitation are more likely to implement better sewage systems.

In contrast, family size (B = -0.003, p = 0.565) and water contamination (B = -0.012, p = 0.335) have negative coefficients, but their p-values are greater than 0.05, indicating these variables are not statistically significant predictors. This suggests that, in this particular model, family size and water contamination do not have a meaningful impact on the presence of proper sewage systems. Similarly, domestic water usage (B = 0.00006246, p = 0.253) has a small positive coefficient, but its p-value exceeds 0.05, showing no significant effect. Overall, the most influential predictor of proper sewage systems is the health impact, highlighting the importance of addressing health consequences in driving sanitation improvements.

FINDINGS

- The majority of respondents 71.9% reported contamination in their water sources. The contamination levels indicate that the local water supply may be insufficiently regulated or that poor wastewater management practices, are contaminating the water supply.
- The largest group of respondents 49.4% use between 401 to 600 liters of water per month,without proper wastewater treatment, contaminants can seep into local water sources, affecting public health.
- The public drainage is the most common disposal method across all municipalities, with 58.9% of respondents using it. Public drainage is the dominant method, with water bodies and open areas also playing significant roles in wastewater disposal.
- The data shows that inadequate wastewater management, combined with contaminated water sources, plays a significant role in the spread of waterborne and vector-related diseases, especially in municipalities with poor sanitation infrastructure.
- The lack of infrastructure, cited by 38.7% of respondents, poses a severe challenge to effective wastewater management, contributing to the contamination of local water sources. This inadequacy in wastewater disposal systems directly impacts public health, leading to the spread of waterborne diseases.

CONCLUSION

The findings underscore a critical link between inadequate domestic wastewater management and the deteriorating health of communities. The alarming 71.9% of respondents reporting contamination in their water sources highlights insufficient regulation and poor wastewater management practices, which exacerbate public health risks. The predominant use of public drainage systems by 58.9% of respondents, coupled with the lack of infrastructure (38.7%), exacerbates wastewater disposal challenges and contributes to contamination. The data also shows the direct economic burden of poor sanitation, with 60% of individuals reporting man-day loss due to illness, emphasizing the strain on the workforce, particularly in low-income communities. These findings highlight the need for improved wastewater infrastructure, stricter water quality regulations, and comprehensive ailment prevention strategies to safeguard public health.

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