The Socio-Economic and Environmental Impacts of Untreated Domestic Wastewater in Tirupattur urban limits of Tirupattur District in Tamil Nadu.

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ABSTRACT

The rapid urbanization and population growth in Tirupattur urban centers, a developing urban center in India, have led to significant increases in domestic wastewater generation. This study explores the economic impacts of domestic wastewater on local environmental management systems, highlighting the challenges and financial burdens associated with inadequate wastewater treatment infrastructure. The environmental remediation expenses, as well as indirect costs related to public health, groundwater contamination and ecosystem degradation. Through a combination of field surveys, stakeholder interviews, the research identifies critical inefficiencies in wastewater handling and examines how these inefficiencies strain the financial resources of urban local bodies. Furthermore, the study evaluates the long-term economic consequences of neglecting sustainable wastewater management, including increased healthcare expenditures and reduced economic productivity due to environmental deterioration. This study aligns with multiple United Nations Sustainable Development Goals (SDGs), particularly SDG 6 (Clean Water and Sanitation) and sustainable urban planning, the research offers policy-level recommendations to reduce economic strain while promoting environmental resilience and sustainable development in Tirupattur.

Keywords: *Economic impact, domestic waste water, environmental degradation*

Introduction

Domestic wastewater refers to the used water, 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, when properly treated and managed, offers several benefits that can contribute to both environmental sustainability and economic efficiency. One of the primary advantages is the potential for water reuse. Treated wastewater can be recycled for non-potable purposes such as agricultural irrigation, industrial processes and landscaping, which helps to reduce the strain on freshwater resources. In water-scarce regions like Tirupattur District, reusing wastewater can alleviate pressure on local water bodies and support agricultural productivity, especially during periods of drought.

The economic impact of domestic wastewater is significant, particularly in urban areas where growing populations generate large volumes of waste. When wastewater is not properly treated, it leads to increased public health costs due to waterborne diseases, contamination of drinking water sources, and environmental degradation. This not only puts financial pressure on healthcare systems but also affects the productivity of the workforce, as illnesses become more prevalent. Additionally, polluted water sources can harm agriculture by reducing the quality and availability of irrigation water, leading to lower crop yields and higher production costs.

Worldwide, approximately the 359.4 billion cubic meters of wastewater are produced annually. While a significant portion, around 63%, is collected, only about 52% receives treatment. A considerable amount, around 48%, is discharged directly without any treatment, urban areas growing populations exacerbate the issue, with inadequate sanitation systems contributing to waterborne diseases and environmental degradation (United Nation, Water (UN-Water, 2022).

Domestic wastewater management remains a critical environmental and public health challenge. The country generates approximately 72,368 million liters per day (MLD) of sewage but the existing treatment capacity stands at only 31,841 MLD, leaving over 50% of wastewater untreated and discharged into natural water bodies (CPCB, 2021).

Tirupattur District's urban municipalities Tirupattur, Jolarpettai, Vaniyambadi and Ambur collectively generated the 30 million liters per day (MLDs) of sewage. However, their combined sewage treatment capacity at only 18 MLDs, leaving a deficit at 12 MLDs,

or 40%, were untreated sewage. Tirupattur municipality produces at 8 MLDs but has a treatment capacity of just at 3 MLD, resulting at 5 MLD of untreated sewage. Jolarpettai and Vaniyambadi were each generate at 6 MLD; Jolarpettai has an under-construction at 3 MLD plant, while Vaniyambadi at 4 MLD plant is also under construction. Ambur, the highest generator at 10 MLD, has an operational at 8 MLD plant but still lacks capacity for at 2 MLD. This infrastructure gap poses significant environmental and public health risks, underscoring the urgent need for investment in sewage treatment facilities to address the shortfall and ensure sustainable urban development.

Objectives

- To understand the socio- economic conditions of the households.
- To assess the environmental consequences of untreated domestic wastewater.

Methodology

The study descriptive and analytical design to assess the impact of poor domestic wastewater management in Tirupattur District, Tamil Nadu, utilizing a mixed-methods approach. Data were collected over three months using 530 stratified random samples, encompassing primary data from structured interviews, questionnaires, and focus group discussions, as well as secondary data from official reports and publications. Quantitative data were analyzed using statistical tools such as percentages, means, and regression analysis, while qualitative data were analyzed using thematic analysis, providing a comprehensive understanding of wastewater generation and treatment practices in the municipalities

Review of Literature.

Hemamalini. J et al. (2017) examined the negative impact of untreated wastewater from dyeing industries and sewage discharge on water quality in Pandravedu village, resulting in the deterioration of tank water and groundwater quality. Comparison of irrigation indices revealed that water from tank, bore wells, open wells, and wastewater fall within the "hard" to "very hard" categories. Wastewater, in particular, has high salinity and medium sodium hazard, making it unsuitable for sodium-sensitive crops and livestock, with paddy yield reduced by about 40%. The study found that the water's high salinity and

sodium content contributed to this yield decline. Additionally, the water's poor quality led to fish mortality, as many parameters exceeded the tolerance limits. The wastewater analysis showed dangerously high levels of free ammonia, BOD and COD. The study stressed the need for proper disposal measures for sewage and dye industry effluents, to protect groundwater, human health, livestock and biodiversity, ensuring sustainable development.

G U Fayomi, et al. (2019) found that, human activities contribute immensely to the production of wastewater, which comes from residences, industries and agricultural practices that pollutes the environment and water bodies. The 80-90% of the wastewater produced in developing countries is disposed of into surface and groundwater, which is a major cause of environmental pollution that threatens human health. According to UN report, over 80% of the wastewater produced in the world and over 95% in some least developed countries, is released, without being treated, into the environment. The untreated direct of sewage disposal, report impact on the environment, aquatic contaminant and the human health. Emphasis is placed on the impact of disposal of various contaminants in water bodies, which could make water unsafe for drinking and for other domestic and recreational activities.

Dushyanth V Babu R, et al. (2019) consider waste water treatment to be very important because if the wastewaters are not treated, then the human and environment health may be negatively impacted. Experiment was carried on the wastewater sample in Tehran.

Olufunmilayo et al. (2020), examined the environmental impact of domestic waste management in Zaria, Kaduna State, Nigeria, focusing on waste generation, disposal practices and contamination levels. Using a mixed-methods approach, the research revealed that improper waste disposal, including open dumping and burning, led to significant environmental and health risks, such as water pollution, soil degradation and increased waterborne diseases. Soil and water samples showed elevated levels of contaminants like heavy metals. The study identified inadequate infrastructure, lack of public awareness, and poor enforcement of regulations as major challenges. Integrated strategies, including waste recycling, public education, and stricter policy enforcement are necessary to tackle these issues.

Saurabh S. Joshi et al. (2020) observed that pollution of channels, with contaminated substances and excessive nutrients, as well as destructive land use practices in areas surrounding freshwater ecosystems, led to deterioration of water quality. There is also need for 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 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.

Bello Aduke Olufunmilayo et al. (2020) assessed the impact of home waste management, on the environment in Zaria, Kaduna State, Nigeria, through observation and a questionnaire survey of 200 randomly selected respondents from. It highlights the environmental consequences of waste management, including air, land, and water pollution, which pose significant health risks. Descriptive statistics, using the ANOVA method. Applied to analyze the data, the study revealed the need for more effective waste management practices to mitigate pollution and health risks. The study identified economic challenges, such as the high costs of proper waste disposal, the lack of professional sanitation managers, and insufficient public awareness regarding waste-related hazards.

Kavindra Kumar Kesariet et al. (2021) demonstrated that 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 serious environmental and public health concerns. Instead of using untreated wastewater, treated wastewater has been found to be an ecofriendly option. The study proposed a model showing the efficient methods for wastewater treatment and the utilization of solid wastes in fertilizers.

Nikore, M. & Mittal, M. (2021) in the study on report Arresting India's Water Crisis. The Economic Case for Wastewater Use highlights the economic and environmental benefits of wastewater reuse in addressing India's water scarcity. Focusing on 20 wastewater treatment plants across various states, the study found that treated wastewater could meet 40% of industrial and 30% of urban non-potable water demands. However, only 20% of wastewater is currently treated. Key barriers include inadequate infrastructure, regulatory gaps and low public awareness. The study recommends scaling up treatment

investments and decentralizing wastewater systems, aligning with initiatives like the Jal Shakti Abhiyan and National Water Mission's 2023 report.

Analysis and interpretation

Table: 1. Water quality and improper disposal of domestic wastewater

Water quality	Disposal of domestic wastewater				Total
	Lack of Awareness	Lack of Proper Infrastructure	Rapid Urbanization	Lack of Financial Resources	
Highly Satisfied	24	2	24	8	**58**
	(41.4%)	(3.4%)	(41.4%)	(13.8%)	(100.0%)
	[11.3%]	[3.9%]	[11.9%]	[12.1%]	[10.9%]
Satisfied	28	5	22	11	**66**
	(42.4%)	(7.6%)	(33.3%)	(16.7%)	(100.0%)
	[13.2%]	[9.8%]	[10.9%]	[16.7%]	[12.5%]
Average	30	1	16	26	**73**
	(41.1%)	(1.4%)	(21.9%)	(35.6%)	(100.0%)
	[14.2%]	[2.0%]	[8.0%]	[39.4%]	[13.8%]
Dissatisfied	52	25	46	0	**123**
	(42.3%)	(20.3%)	(37.4%)	(0.0%)	(100.0%)
	[24.5%]	[49.0%]	[22.9%]	[0.0%]	[23.2%]
Highly Dissatisfied	78	18	93	21	**210**
	(37.1%)	(8.6%)	(44.3%)	(10.0%)	(100.0%)
	[36.8%]	[35.3%]	[46.3%]	[31.8%]	[39.6%]
Total	**212**	**51**	**201**	**66**	**530**
	(40.0%)	(9.6%)	(37.9%)	(12.5%)	(100.0%)
	[100.0%]	[100.0%]	[100.0%]	[100.0%]	[100.0%]

Source: Computed from Primary Data

Note: Figures in ( ) rows in percentages and those in [ ] are column percentages.

The Table:1 displays the relationship between satisfaction with domestic water quality and the factors contributing to improper disposal methods of domestic wastewater. A significant proportion represented by 210 respondents, at 39.6 percent were highly dissatisfied with the water quality lack of proper and cited infrastructure as the main factor leading to improper wastewater disposal, followed by rapid urbanization by 93 respondents, at 46.3 percent and lack of financial resources by 21 respondents, at 31.8

percent. In other words, poor infrastructure and urbanization were the key contributors to wastewater disposal issues. Conversely, highly satisfied individuals represented by 58 respondents, at 10.9 percent, were relatively less in number and 24 respondents reported lack of awareness as primary factor contributing to improper disposal domestic waste water. In other words education play a vital role in preventing water quality concerns. A similar trend was observed among those satisfied with the water quality. Lack of awareness to the most significant factor 28 respondents, at 42.4 percent, but lack of proper infrastructure was reported by 25 respondents who were dissatisfied with the water quality. Respondents with average satisfaction level, represented by 26 respondents cited lack of financial resources being to the most significant factor in wastewater disposal. In short, lack of infrastructure and financial resources were strongly linked to dissatisfaction with water quality and improper wastewater disposal, while awareness and urbanization were also reported to be influential factors in this study.

Table: 2. Proper domestic wastewater treatment and public health

Public health	Name of the municipalities				Total
	Tirupattur	**Jolarpettai**	**Vaniyambadi**	**Ambur**	
Yes	90	43	129	106	**368**
	(24.5%)	(11.7%)	(35.1%)	(28.8%)	(100.0%)
	[64.3%]	[71.7%]	[71.7%]	[70.7%]	[69.4%]
No	50	17	51	44	**162**
	(30.9%)	(11.7%)	(31.5%)	(27.2%)	(100.0%)
	[35.7%]	[28.3%]	[28.3%]	[29.3%]	[30.6%]
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

Note: Figures in ( ) rows in percentages and those in [ ] are column percentages

The Table: 2 demonstrates the importance of proper domestic wastewater treatment, for safeguarding public health, among four municipalities in the study area.

Among the sample respondents, was 368 respondents, at 69.4 percent, affirmed that proper wastewater treatment was vital for public health. Among them, Vaniyambadi with 129 respondents, at 35.1 percent had reported the highest number of positive responses, followed by Ambur with 106 respondents, at 28.8 percent, Tirupattur with 90 respondents, at 24.5 percent, and Jolarpettai with 43 respondents, at 11.7 percent. The percentages of individuals, who agreed that wastewater treatment was essential for public health were notably high in all municipalities, with Tirupattur, showing the lowest proportion of 90 respondents, at 64.3 percent and Vaniyambadi with the highest of 43 respondents, at 71.7 percent. On the other hand, 162 respondents, at 30.6 percent disagreed. The distribution of these negative responses was relatively consistent across all areas, ranging from 44 respondents, at 27.2 percent in Ambur to 50 respondents, at 35.7 percent in Tirupattur. While a significant majority, across all municipalities, recognized the importance of wastewater treatment, a small portion of the population were unconvinced. Vaniyambadi stood out for its particularly strong endorsement of wastewater treatment's role in public health while Jolarpettai reported the lowest overall support, indicating potential gaps in awareness or differing priorities in this area.

Table: 3. Protection of groundwater quality is a priority for environmental conservation

Environmental protection	**Name of Municipalities**				**Total**
	Tirupattur	**Jolarpettai**	**Vaniyambadi**	**Ambur**	
Strongly Agree	34	12	44	35	**125**
	(27.2%)	(9.6%)	(35.2%)	(28.0%)	(100.0%)
	[24.3%]	[20.0%]	[24.4%]	[23.3%]	[23.6%]
Agree	58	20	65	56	**199**
	(29.1%)	(10.1%)	(32.7%)	(28.1%)	(100.0%)
	[41.4%]	[33.3%]	[36.1%]	[37.3%]	[37.5%]
Neutral	27	13	42	38	**120**
	(22.5%)	(10.8%)	(35.0%)	(31.7%)	(100.0%)
	[19.3%]	[21.7%]	[23.3%]	[25.3%]	[22.6%]
Disagree	15	14	11	6	**46**
	(32.6%)	(30.4%)	(23.9%)	(13.0%)	(100.0%)
	[10.7%]	[23.3%]	[6.1%]	[4.0%]	[8.7%]
Strongly Disagree	6	1	18	15	**40**

	(15.0%)	(2.5%)	(45.0%)	(37.5%)	(100.0%)
	[4.3%]	[1.7%]	[10.0%]	[10.0%]	[7.5%]
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

Note: Figures in ( ) rows in percentages and those in [ ] are column percentages

The Table: 3 presents the data, to find out how respondents from four municipalities perceived the importance of protecting groundwater quality as a priority for environmental conservation. The majority of respondents agreed that groundwater protection was essential, with Vaniyambadi by 65 respondents, at 36.1 percent and Ambur by 56 respondents, at 37.3 percent. From Tirupattur 34 respondents, at 24.3 percent, strongly agreed on environmental consciousness in this area. But, Jolarpettai recorded the lowest levels of support, with only 12 respondents at 9.6 percent, strongly agreeing and 20 respondents, at 33.3 percent agreeing, showing a comparatively lower priority for groundwater protection in this municipality. Neutral responses were reported the highest in Vaniyambadi by 42 respondents, at 35.0 percent and Ambur by 38 respondents, at 31.7 percent, suggesting that while many respondents understood the importance of groundwater protection, they may feel uncertain about the effectiveness of current measures. 15 respondents from Tirupattur and 14 respondents, from Jolarpettai at 23.3 percent, disagreed indicating less awareness or concern for groundwater conservation. Strongly disagreed responses were the highest in Vaniyambadi by 18 respondents, at 10.0 percent and in Ambur by 15 respondents, at 10.0 percent, but data indicated that most respondents viewed groundwater protection as a priority.

Table: 4. Man day loss

Man day loss	**Name of the municipalities**				**Total**
	Tirupattur	**Jolarpettai**	**Vaniyambadi**	**Ambur**	
Yes	85	36	109	88	**318**
	(26.7%)	(11.3%)	(34.3%)	(27.7%)	(100.0%)
	[60.7%]	[60.0%]	[60.6%]	[58.7%]	[60.0%]
No	55	24	71	62	**212**

	(25.9%)	(11.3%)	(33.5%)	(29.2%)	(100.0%)
	[39.3%]	[40.0%]	[39.4%]	[41.3%]	[40.0%]
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

Note: Figures in ( ) rows in percentages and those in [ ] are column percentages.

The Table: 4 illustrates distribution of man-day losses over the sample municipalities, 318 respondents, at 60 percent reported experiencing man-day loss due to health issues, with varying levels across municipalities. Vaniyambadi recorded the highest proportion of respondents with 109 respondents, at 60.6 percent, experiencing man-day loss, followed by Tirupattur at 85 respondents, at 60.7 percent and Ambur with 88 at 58.7 percent. Jolarpettai reported the lowest proportion, with 36 respondents, at 60 percent, reporting man-day loss. Ambur reported the highest proportion of 62 respondents who did not experience man-day loss at 41.3 percent. Tirupattur and Vaniyambadi followed with 55 respondents at 39.3 percent and with 71 at 39.4 percent, respectively. Jolarpettai reported man-day loss by 24 respondents at 40 percent. These trends revealed the broad impact of health issues on workdays, across all areas, with Vaniyambadi and Tirupattur seeing the highest loss of man-days.

Table: 5. Satisfaction level of the respondents in municipality drainage system and challenges of domestic waste water management

Satisfied	**Challenges in the domestic waste water management**					**Total**
	Lack of proper infrastructure	**Population growth**	**Lack of Cost**	**Lack of Awareness**	**Lack of enforcement**	
Highly Satisfied	30	17	8	33	7	**95**
	(31.6%)	(17.9%)	(8.4%)	(34.7%)	(7.4%)	(100.0%)
	[15.9%]	[14.2%]	[25.8%]	[20.4%]	[25.0%]	[17.9%]
Satisfied	16	15	6	25	5	**67**
	(23.9%)	(22.4%)	(9.0%)	(37.3%)	(7.5%)	(100.0%)
	[8.5%]	[12.5%]	[19.4%]	[15.4%]	[17.9%]	[12.6%]
Average	30	7	3	12	2	**54**
	(55.6%)	(13.0%)	(5.6%)	(22.2%)	(3.7%)	(100.0%)

	[15.9%]	[5.8%]	[9.7%]	[7.4%]	[7.1%]	[10.2%]
Dissatisfied	41	20	4	27	2	**94**
	(43.6%)	(21.3%)	(4.3%)	(28.7%)	(2.1%)	(100.0%)
	[21.7%]	[16.7%]	[12.9%]	[16.7%]	[7.1%]	[17.7%]
Highly Dissatisfied	72	61	10	65	12	**220**
	(32.7%)	(27.7%)	(4.5%)	(29.5%)	(5.5%)	(100.0%)
	[38.1%]	[50.8%]	[32.3%]	[40.1%]	[42.9%]	[41.5%]
Total	**189**	**120**	**31**	**162**	**28**	**530**
	(35.7%)	(22.6%)	(5.8%)	(30.6%)	(5.3%)	(100.0%)
	[100.0%]	]100.0%]	[100.0%]	[100.0%]	[100.0%]	[100.0%]

Source: Computed from Primary Data

Note: Figures in ( ) rows in percentages and those in [ ] are column percentages

The Table: 5 presents the challenges, faced by poor domestic wastewater management and the corresponding levels of satisfaction with municipal drainage systems across respondents. The most significant challenge for wastewater management was lack of proper infrastructure, reported 72 respondents, at 38.1 percent, to be highly dissatisfied and 41 respondents, at 21.7 percent, to be dissatisfied. Population growth was also a major issue, as reported by 61 respondents, at 27.7 percent, to be highly dissatisfied. Lack of awareness about wastewater management contributed to high degree of dissatisfaction, with 65 respondents, at 40.1 percent. Seven respondents were highly satisfied with enforcement and five were satisfied with enforcement of regulations. Similarly, 30 respondents were highly satisfied with the infrastructure and 16 were satisfied with the infrastructure. In shorts, there was a clear gap between infrastructure quality and satisfaction, with the majority of respondents, expressing dissatisfaction with infrastructure deficiencies, population growth and lack of enforcement.

Table: 6. Economic benefits of proper wastewater treatment

Economic benefits	Improvement in healthier economy and environment		Total
	Yes	No	
Increased Property Values	90	77	**167**
	(53.9%)	(46.1%)	(100.0%)
	[30.6%]	[32.6%]	[31.5%]
Cost Savings	69	29	**98**
	(70.4%)	(29.6%)	(100.0%)
	[23.5%]	[12.3%]	[18.5%]
Job Creation	47	48	**95**
	(49.5%)	(50.5%)	(100.0%)
	[16.0%]	[20.3%]	[17.9%]
Enhanced Agricultural Productivity	28	26	**54**
	(51.9%)	(48.1%)	(100.0%)
	[9.5%]	[11.0%]	[10.2%]
Protection of Natural Resources	30	31	**61**
	(49.2%)	(50.8%)	(100.0%)
	[10.2%]	[13.1%]	[11.5%]
Economic development	30	25	**55**
	(54.5%)	(45.5%)	(100.0%)
	[10.2%]	[10.6%]	[10.4%]
Total	**294**	**236**	**530**
	(55.5%)	(44.5%)	(100.0%)
	[100.0%]	[100.0%]	[100.0%]

Source: Computed from Primary Data

Note: Figures in ( ) rows in percentages and those in [ ] are column percentages

The Table: 6 shows the economic benefits of investing in proper domestic wastewater management systems and how it correlates with respondents' belief in its positive impact on a healthier economy and environment. 90 respondents, at 53.9 percent, reported that increased property values would be a key economic benefit. In other words, that investment in wastewater infrastructure was perceived as a driver of real estate desirability and price growth. Cost savings, identified by 69 respondents, at 70.4 percent of was reported as the second-highest economic benefit, because proper wastewater management would lead to healthier economies and environment, reducing long-term costs

associated with pollution and public health. Job creation followed with 47 respondents, at 49.5 percent, seeing it as an economic benefit, suggesting that wastewater management projects can generate employment opportunities in construction, maintenance, and technical services. Enhanced agricultural productivity was reported by 28 respondents and protection of natural resources was reported by 30 respondents. Lastly, economic development was also seen as a potential benefit by 30 respondents, at 54.5 percent of respondents, linking proper wastewater treatment to broader economic growth. In short, these responses revealed the significant positive impacts, that investment in wastewater systems can have, on both the economy and the environment.

Table No. 7: One Way ANOVA test between impacts of poor domestic wastewater management

Factors		Sum of Squares	df	Mean Square	F	Sig.
Poor ground water quality directly affects public health	Between Groups	23.299	2	11.649	11.136	.000
	Within Groups	551.313	527	1.046		
	Total	574.611	529			
Effect of untreated domestic waste water effect on groundwater quality	Between Groups	21.225	2	10.613	10.386	.000
	Within Groups	538.527	527	1.022		
	Total	559.753	529			
Impact of groundwater contamination on local economy	Between Groups	67.197	2	33.599	23.859	.000
	Within Groups	742.131	527	1.408		
	Total	809.328	529			

Effects on income, livestock	**Between Groups**	28.313	2	14.157	181.964	.000
	Within Groups	41.000	527	.078		
	Total	69.313	529			

Source: Computed from Primary Data

The Table: 7, presents the results of One-Way ANOVA, to analyze the impact of poor domestic wastewater management, across different factors. For each factor, the analysis included Between Groups and Within Groups variations, along with statistical values. The first factor, Poor groundwater quality directly affects public health, revealed significant differences between groups with an F-value of 11.136 and a p-value of .000, indicating strong evidence that groundwater quality did affect the public health. Similarly, the second factor, untreated domestic wastewater effect on groundwater quality, also revealed significant results ,with an F-value of 10.386 and a p-value of .000, suggesting untreated wastewater did impact the groundwater quality. The third factor, Groundwater contamination's impact on the local economy, reported a higher F-value of 23.859, again with a p-value of .000, confirming significant economic effects due to groundwater contamination. The fourth factor, effects on income and livestock, reported an extraordinarily high F-value of 181.964, indicating a very strong and statistically significant relationship between wastewater management and economic impact on income and livestock. For all factors, the p-values were less them the threshold of 0.05, signifying that poor wastewater management significantly affected public health, groundwater quality, local economy and livestock.

Conclusion

The findings from the study underscore the urgent need to address the multifaceted challenges of domestic wastewater management in India, particularly in urban areas. A significant 39.6% of respondents expressed high dissatisfaction with water quality, primarily due to inadequate infrastructure and rapid urbanization. This dissatisfaction is compounded by the alarming statistic that over 60% of urban sewage in India remains untreated, entering water

bodies and exacerbating pollution. Health impacts are evident, with approximately 60% of respondents reporting man-day losses due to health issues, highlighting the direct link between poor wastewater management and economic productivity. Despite recognizing the importance of proper wastewater treatment for public health, support varies across municipalities, indicating potential gaps in awareness or differing priorities. Economic benefits, such as increased property values and cost savings, are perceived by respondents, emphasizing the potential positive impact of investing in wastewater management systems. Statistical analyses confirm significant impacts of poor wastewater management on public health, groundwater quality, local economy, and livestock, with p-values less than 0.05 across all factors.

These findings align with the United Nations' Sustainable Development Goal 6 (SDG 6) for Clean Water and Sanitation, underscoring the need for universal access to safe and affordable drinking water, adequate sanitation and improved hygiene. Addressing infrastructure deficiencies, enhancing public awareness, and investing in wastewater management are pivotal steps towards achieving SDG-6. The study highlights the interconnectedness of health, environment and economy, underscoring the necessity for integrated approaches to wastewater management. In the context of India, where 50% of urban sewage remains untreated, the study's insights are particularly pertinent. Efforts such as the Swachh Bharat Mission and AMRUT-2.0 aim to address these challenges, but sustained investment and policy enforcement are crucial for meaningful progress for the development.

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