
A Study On Waste Water Management Practices In Textile Units Of Agraharam, Erode City
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Abstract

The textile industry is a significant contribution to industrial development in Tamil Nadu, particularly in Erode district, which is renowned for its textile processing. Textile dyeing and finishing procedures generate significant amounts of effluent containing colours, salts, chemicals, and organic contaminants. Numerous small-scale and medium-sized textile companies operate next to residential areas in Agraharam, one of Erode City's densely populated neighbor-hood, creating major environmental and public health issues. Considering these facts, this study evaluated the state of the textile units' current waste water management procedures in Agraharam and evaluated the reasons why inappropriate waste water disposal has negative effects on the environment and human health. As a result, primary data were obtained using structured questionnaires from textile unit owners, workers, and neighbor-hood residents, while secondary data were gathered from government reports and published studies. The findings show that a lack of effluent treatment facilities, inconsistent functioning of Effluent Treatment plants, and wastewater discharge into open drains are frequent in the research area. In fact, they have led to water pollution, groundwater contamination, and inhabitants' health problems. To protect the environment and public health, the report underlines the need for further improvements in waste treatment facilities, stringent regulatory enforcement, and the use of sustainable management practices.

Keywords: Textile wastewater management, Agraharam, Erode City, effluent treatment plant, and water pollution.

Introduction

Textile industry is an important diversifying force in Indian industrial development, and Tamil Nadu has established itself as one of the most cloth-producing states in India. Erode District, also known as "The Textile City," is home to numerous dyeing, bleaching, and finishing mills that cater to its power-looms and garments industries. Though textile industries are essential for economic development, they are also known to be water-intensive industries and chief contributors for industrial wastewater pollution.

The processing of textiles involves the use of a large amount of water and chemicals, hence the production of waste water that contains dyes, salts, acids, alkalis, surfactants, organic materials, and heavy metals. The release of industrial wastewater lacks proper treatment and thus affects the environment as it contaminates water and the soil. High levels of color, BOD, COD, and TDS contribute greatly towards the adverse impact on the aquatic ecosystem due to the reduction of clean water.

Agraharam is a thickly populated locality in Erode City. The distinguishing feature of Agraharam is that it has several SME units engaged in textile processing. Since it is a congested area with space and financial constraints and lacks facilities for treating sewage water, most of the textile units in this region dispose of untreated or partially treated sewage waters into open drains or storm water canals. As a result, environmental pollution has increased in this region.

In this scenario, this research aims at investigating the wastewater management practice adopted by textile units in Agraharam, Erode City. To assess the existing treatments for waste water management in this region and examine the challenges associated with this management. In addition, this research will evaluate the risks associated with improper disposal of effluents from these textile units and contribute towards improving knowledge and adopting appropriate wastewater management practices in urban textile hubs.

Characteristics of Textile Waste water

Textile effluent is one of the most complicated and highly polluted industrial effluent due to the complex nature of chemicals used during the textile manufacturing process. Textile effluent can be characterized based on the type of fabric being processed, dyes used, and technological processes being followed during processes such as desiring, scouring, bleaching, dyeing, washing, and finishing that make the resulting effluent very heterogeneous in nature, thereby requiring complex and expensive methods for its treatments.

One of the major traits of the waste water generated in the textile industry is the presence of intense colors that cannot be broken down by biodegradation. It has been observed that the presence of even a minute quantity of dyes causes the water to appear colored. It has been noticed that the presence of dyes retards light in water and affects photosynthesis in water. Textile industries generate wastewater with high Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) because of the large amount of organic matter, surfactants, and chemical additives used during various processing stages.

Another major factor that was identified as important is the presence of high total dissolved salts and salinity, which mainly originates from the large use of salts such as sodium chloride and sodium sulphate during the dyeing stage. A high total dissolved salts value prevents water from being used for drinking purposes or industrial purposes. Another important factor is that textile wastewater could be very alkaline or acidic depending on the chemicals that were used. Furthermore, textile waste water contains toxic heavy metals like chromium, copper, nickel, and zinc from the use of dyes and fixing agents. These heavy metals are non- biodegradable and usually have tendencies to accumulate in soil and ground waters. Suspended solids, oils, grease, and residual chemicals are some of the factors that contribute to the pollution of textile waste water. In conclusion, the intricate chemical make-up and level of pollutants in the water as well as the non-biodegradable characteristics of the contaminating factors have made textile mill water a severe concern in the environment. In view of this fact, appropriate water management techniques need to be employed in heavily populated textile zones like Agraharam and Erode City to avoid any severe environmental alterations.

Water Waste water Management Practices in Agraharam, Erode

The existing wastewater management in Agraharam, Erode City, majorly depends upon the scale, financial strengths, and capability of the textile firms operating at this location. The major occupation of Agraharam is with small and medium-scale textile dyeing and processing units operating in a congested residential environment. Because of space and financial constraints, wastewater management in this region is done inadequately. A few units in Agraharam have Effluent Treatment Plants (ETPs) installed. These units follow a normal treatment process that includes screening, chemical coagulation, sedimentation, and partial bio-treatment. However, as experienced in Agraharam, it has been found that many units are not functioning properly. The main reasons may be high operational costs and lack of skilled manpower. Some units function during visits of concerned authorities because of which units continue to channel out untreated and partially treated effluents.

In the case of majority of the small-scale textile processing units in Agraharam, there are no treatment units; hence, the untreated water is directly drained into open water-draining systems. The water flows through residential roads before joining any sewage water in natural water bodies. This increases environmental pollution in terms of colored water discharge, stench associated with the water bodies, water stagnation, and choked drainage. Furthermore, seepage of polluted water into groundwater can result due to lack of lining in the drainage systems.

Availability of Common Effluent Treatment Plants (CETPs) is remote for the textile units of Agraharam. Most of the textile units are therefore

not fully compliant with the norms of wastewater treatment. Though it is mandatory on the part of the effluent authorities for the treatment of effluents, it is difficult for them to monitor the units.

Besides the infrastructural problems, the lack of awareness among the unit owners as well as the staff about the environment also affects waste water treatment. Most of the respondents stated that their lack of awareness about the approved discharge levels as well as the negative effects of the improper disposal of wastewater was one of the causes. Overall, the practices associated with waste management in Agraharam include partial treatment, irregular functioning of ETPs, direct discharging methods, and poor regulation compliance. The above practices signal the importance of associating the region with better treatment facilities, strict regulation methods, better access to CETPs, as well as education on sustainable waste management.

Environmental and Health Effects

Inappropriate treatment and disposal of wastewater from the textile industry in Agraharam, Erode City, have led to severe environmental degradation and health concerns for people living in this region. The incessant release of untreated and semi-treated wastewater into open drains and storm water canals has had detrimental effects on surface water, groundwater, soil, and the habit of this region.

Environmental Impact

One of the important environmental hazards that could be seen in Agraharam is the pollution of surface water. The textile wastewater with dyes, salts, and chemicals changes the physical and chemical characteristics of water, resulting in the formation of excess- colored substances, bad smell, and less dissolved oxygen content. All these are harmful to aquatic life and reduce the natural self-purification capacity of water sources. The still water in open drains contributes to water pollution by accumulating chemicals and forming sludge.

Groundwater pollution is also an environmental concern in the study area. Textile waste water pollutants seep into the soil through unlined drains and open discharge channels, causing the gradual pollution of the groundwater aquifers. Higher levels of Total Dissolved Solids (TDS), water hardness, and chemicals make the groundwater undrinkable for use through bore-wells by the locals. Those that use the water from bore-wells complain of poor water quality, with poor tastes and smell.

The discharge of textile wastewater is also responsible for soil degradation. Chemical- rich wastewater changes soil properties and elevates the soil salts' concentration. These soil conditions hinder vegetation growth and soil fertility in the region around the disposal site. The buildup of salt and toxic materials further diminishes the land's potential for use.

Health Impacts

The pollution of the environment by textile waste water has both direct and indirect impacts on the health of the people. The people living around the polluted drains are often in contact with the polluted water, vapors of the chemicals, as well as unhygienic environments. Some of the health problems often recorded include skin irritation, rashes, burning of the eye, respiratory ailments, headaches, and digestive disorders.

Stagnant water containing waste water acts as a breeding ground for mosquitoes, apart from other disease-causing carriers, thus leading to an increased number of cases related to vector- borne diseases like dengue, malaria, and soon. Also, improper draining of water with consequent stagnation of wastewater hampers sanitation. Workers in textile coloration plants face occupational health hazards because of direct exposure to dyes and chemicals without proper safety measures. The lowered danger of chemical burns, irritation, and occupational health difficulties exacerbates the situation. In summary, the environmental and health implications in Agraharam highlight the urgent need for improved wastewater management procedures. There is a need to enhance the management of wastewater in textile-dominant cities in a bid to promote environmental awareness and protect the environment as well as public health

Results and Discussion

This article will highlight and analyze the results derived from the questionnaire survey conducted among 150 participants, which includes textile unit owners, workers, and residents in and around Agraharam, Erode City. The result has been presented using percentage analysis in the form of a table, pie chart, and bar graph.

Percentage/Descriptive Analysis

1. Awareness Level about Textile Waste water Pollution

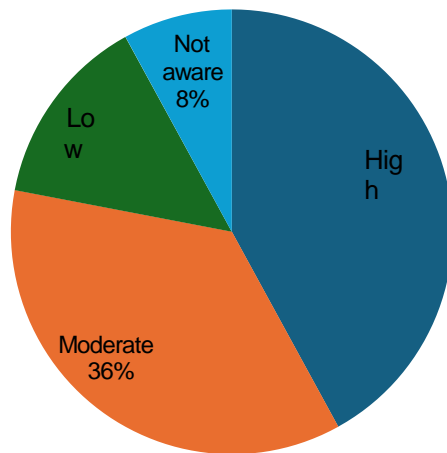
Table 1: Awareness Level of Respondents (n = 150)

Awareness Level	No. of Respondents	Percentage (%)
High	63	42
Moderate	54	36
Low	21	14
Not aware	12	8
Total	150	100

Pie Chart

Distribution of respondents based on awareness level regarding textile wastewater pollution

Awareness Level about Textile Wastewater Pollution



Discussion:

The outcome shows that most people (78%) have high to moderately high awareness regarding textile wastewater pollution. However, 22% of the population is still lacking low to no awareness, leading to improper disposal practices as well as inadequate community effort in combating the pollution. There is a gap in creating awareness in Agraharam as per the outcome.

2. Waste water Treatment Plants Status

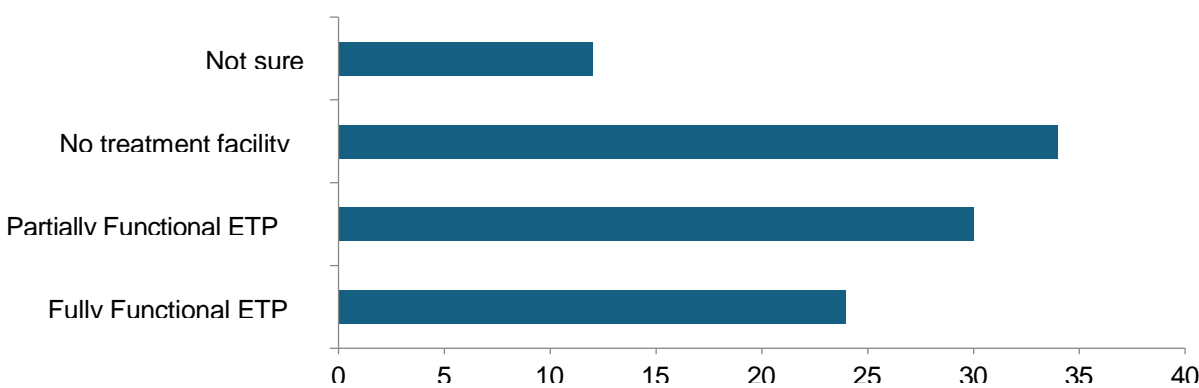
Table2: Availability and Status of Wastewater Treatment Plants

Treatment Facility Status	No. of Respondents	Percentage (%)
Fully functional ETP	36	24
Partially functional ETP	45	30
No treatment facility	51	34
Not sure	18	12
Total	150	100

Bar Chart

Condition of the waste water treatment plants in textile businesses

Availability and Status of Waste water Treatment Plants



Discussion:

A mere 24% of respondents had access to fully functional Effluent Treatment Plants, and the majority (64%) had partial or no treatment facilities. The inadequacy of wastewater treatment infrastructure in Agraharam is apparent in this scenario, with the effluents being directly discharged into the environment without treatment.

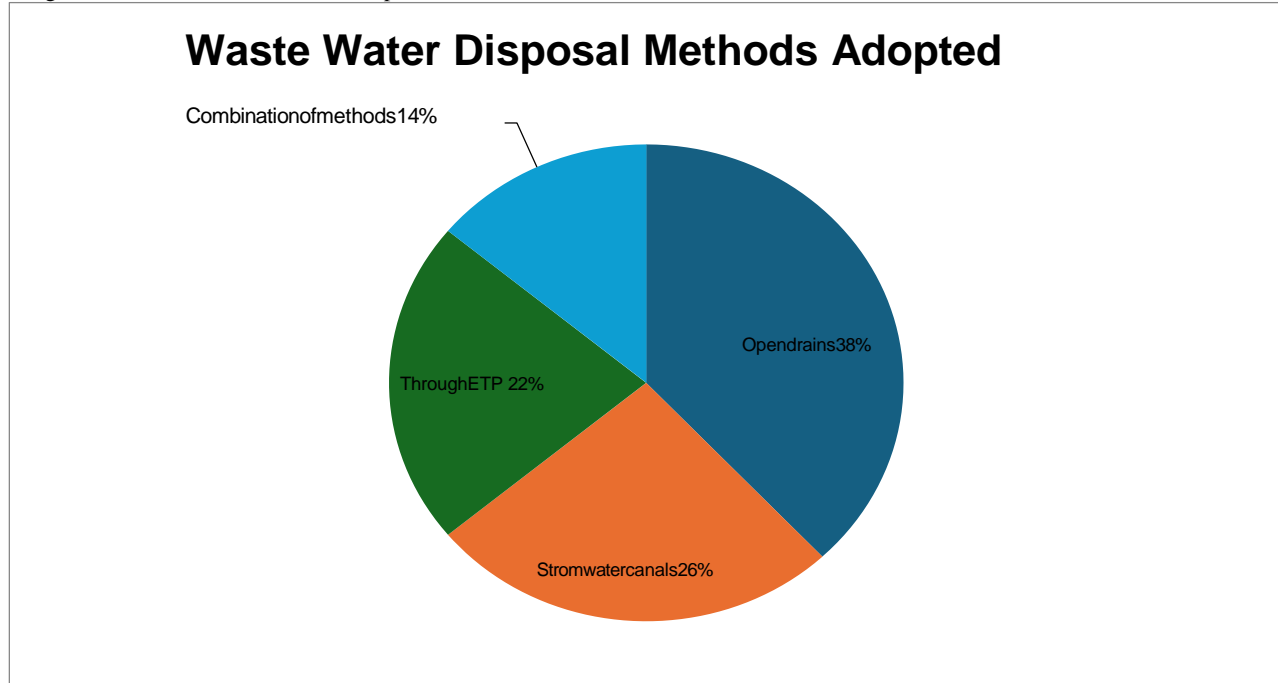
3. Methods of Waste water Disposal

Table3: Waste water Disposal Methods Adopted

Disposal Method	No. of Respondents	Percentage (%)
Open drains	57	38
Storm water canals	39	26
Through ETP	33	22
Combination of methods	21	14
Total	150	100

Pie Chart

Agraharam Practices Waste water Disposal Methods



Discussion:

The study reported that open drains, 38%, remain the most common method of getting rid of wastewater, followed by storm water canals at 26%. Only 22% of respondents reported using suitable waste treatment systems. This practice poses significant environmental and health dangers, especially in residential areas.

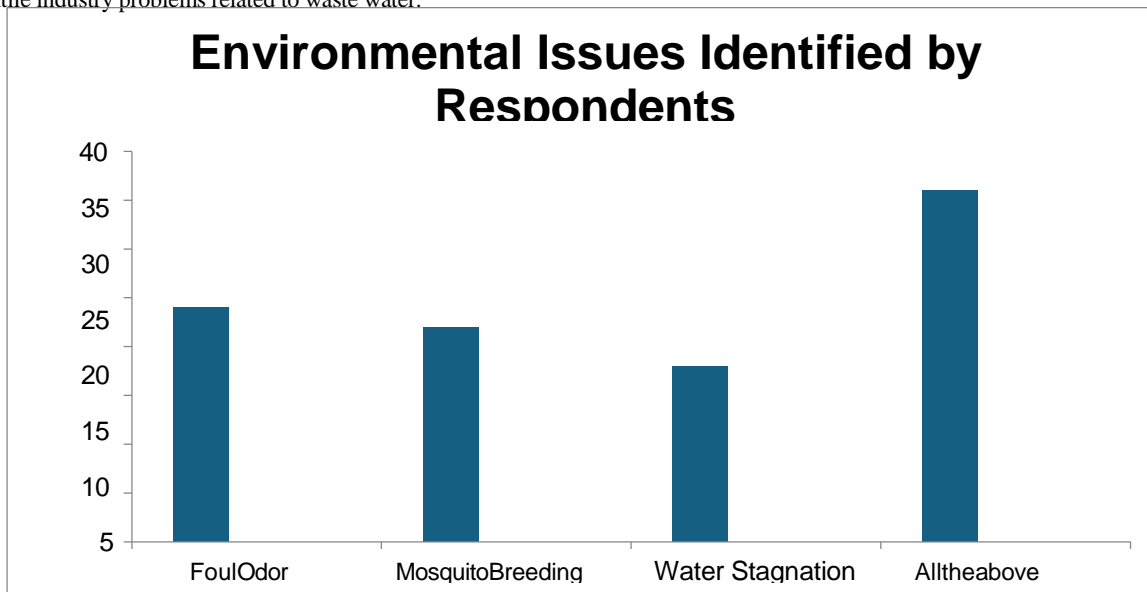
4 Environmental Problems Exposed due to Wastewater

Table 4: Environmental Issues Identified by Respondents

Environmental Issue	No. of Respondents	Percentage (%)
Foul odor	36	24
Mosquito breeding	33	22
Water stagnation	27	18
All the above	54	36
Total	150	100

Bar Chart

Textile industry problems related to waste water.



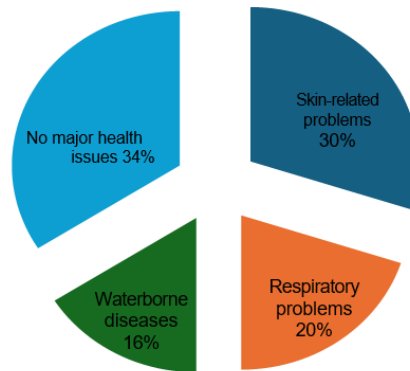
Discussion

A substantial portion of the respondents (36%) faced more than one environmental problem at the same time, showing the extent of environmental degradation. Ground-level foul smell, mosquito breeding sites, and stagnant water filled with wastewater affect the standard of living in Agraharam

Pie Chart-

Effects of health that result from pollution caused by waste water

Reported Health Issues Among Respondents



Discussion:

Health problems relating to the skin (30%) were the most dominant, followed by health problems related to the respiratory system (20%) and waterborne diseases (16%). While 34% of the population did not experience serious health problems, there is a significant link between wastewater pollution and health impacts on the residents.

Overall Discussion:

Overall Results from 150 respondents clearly established that there is a problem with waste water management in Agraharam. To a moderate to quite a high level of awareness, there is improper treatment and disposal of wastewater in this region, resulting in pollution and associated health risks. Open drains and partial treatment are the main methods of wastewater disposal in this region, highlighting the need for better management and operations

Statistical Analysis

Correlation Analysis:

Purpose: This study is to look at the relationship between wastewater treatment awareness and adoption

Table 6: Correlation Between Awareness and Wastewater Treatment Practice

Variables	Awareness Level	Waste water Treatment Practice
Waste water Treatment Practice	0.341*	1
Variables	Awareness Level	Waste water Treatment Practice
Awareness Level	1	0.341*

The correlation is significant at the 0.05 level.

Interpretation:

A positive connection ($r=0.341$, $p<0.05$) suggests that increased awareness leads to more effective wastewater treatment adoption.

Chi-Square Test

Purpose: This study is to evaluate the relationship between disposal methods and health issues.

Table 7: Cross-tabulation (Disposal Method vs Health Issues)

Disposal Method	Health Problems Observed	No Health Problems	Total
Open drains	48	9	57
Storm water canals	27	12	39
Through ETP	12	21	33
Combination	15	6	21
Total	102	48	150

Chi-Square Test Results:

Chi-Square Value	Degrees of Freedom (Df)	p-value
32.45	3	<0.001

Interpretation:The study found a significant association between disposal method and health concerns ($p < 0.05$). Open drains and storm water canals pose increased health dangers

Discussion of Findings

The statistical studies provide valuable insights into wastewater management strategies and their effects in the research area. The correlation study shows a positive association between environmental consciousness and the adoption of wastewater treatment measures, implying that enhanced awareness helps to encourage sustainable behaviours. The Chi-square analysis also reveals a strong relationship between wastewater disposal methods and perceived environmental and health impacts, emphasizing that incorrect disposal adds to environmental degradation and health hazards. The third analytical tool backs up these findings by demonstrating the consistency of responses across various factors connected to wastewater management and its repercussions. Overall, the statistical findings are consistent with the study's aims and demonstrate that inadequate treatment facilities and weak regulatory enforcement continue to pose significant issues, necessitating improved wastewater management solutions.

Regulatory Challenges: Although there are well-defined environmental regulations in India, effective enforcement of waste water management requirements among textile facilities remains a significant concern, particularly in small and densely populated clusters such as Agraharam and Erode City. Regulatory authorities such as the Central Pollution Control Board (CPCB) and the Tamil Nadu Pollution Control Board (TNPCB) have set effluent discharge standards and mandated the development and operation of Effluent Treatment Plants (ETPs). However, compliance with these regulations is variable on the ground.

One of the most significant regulatory difficulties is the enormous number of small and medium-sized textile units operating in a limited geographical area. Due to a lack of people and resources, pollution control officials cannot visit all of them on a regular basis. Inspections are frequently periodic rather than continuous, allowing some plants to run ETPs just during inspections while discharging untreated wastewater during normal operations.

Another issue is small-scale units' low technical and financial capacity to fully comply with regulatory requirements. The high expenses of installing, operating, and maintaining wastewater treatment systems discourage compliance. Though rules require modern treatment systems, many units are unable to implement the owing to cost constraints, resulting in partial or non-compliance.

Inadequate monitoring infrastructure further undermines regulatory enforcement. The reliance on self-reported industrial data, combined with a lack of real-time effluent monitoring, jeopardizes regulatory control. Furthermore, delayed penalties and limited legal action against violators reduce the deterrent effect to legislation. Regulatory issues are exacerbated by a lack of environmental awareness among unit owners and workers about legal responsibilities and the long-term implications of pollution. Furthermore, ineffective cooperation among regulatory organizations, local governments, and industrial associations impedes the success of enforcement activities. Overall, regulatory issues in Agraharam highlight the importance of strengthening monitoring methods, increasing inspection frequency, providing financial and technical help to small units, and raising environmental compliance knowledge. Taking on these difficulties appears to be critical for improving wastewater management methods and achieving sustainable textile manufacturing in urban industrial clusters.

Need for Sustainable Waste-water Management

Sustainable waste water management practices promote a multidisciplinary approach to environmental preservation, public health, and the long-term survival of companies, particularly in textile-dominated areas like Agraharam, Erode City. The textile sector consumes a lot of water and chemicals, thus the wastewater produced has a significant pollutant burden. Conventional disposal procedures with incomplete or no adequate treatment systems, which are already under stress owing to rising environmental challenges, will no longer meet legal standards; hence, adopting sustainable wastewater management strategies becomes vital. One of the most important aspects of sustainable wastewater management is the protection of water resources. The continuous release of untreated or partially treated textile effluents contaminates surface and groundwater, limiting the availability of clean water for household, agricultural, and industrial uses. Sustainable measures such as effective wastewater treatment, recycling, and reuse help to conserve freshwater resources and reduce reliance on the limited natural water supply. This advocates for sustainable wastewater management to reduce environmental degradation. Advanced treatment technologies for colour, organic pollutants, salts, and hazardous wastes would reduce soil deterioration, damage to aquatic habitats, and biodiversity loss. By lowering pollutant loads at the source, sustainable methods help to restore environmental balance at damaged areas. Another critical need is the safeguarding of the public's health. Poor wastewater management exposes communities to chemical toxins, infections, and unsanitary conditions, causing skin illnesses, respiratory problems, and waterborne diseases. In this context, sustainable treatment and disposal significantly minimize health hazards while enhancing sanitation and the quality of life for residents living near textile clusters. Sustainable waste water management promotes regulatory compliance and provides long-term economic benefits. Adoption of effective treatment solutions, such as water recycling and Zero Liquid Discharge, may help enterprises satisfy pollution control standards, avoid penalties, and improve operational efficiencies. While such projects come at a high initial cost, sustainable practices result in lower long-term expenditures related with water procurement, regulatory infractions, and environmental harm. Finally, effective waste water management promotes responsible industrial expansion and social responsibility. Adopting environmentally friendly textile units can help achieve sustainable development goals, improve public image, and gain the trust of local communities and regulatory agencies. In a nutshell, sustainable wastewater management has the potential to help conserve natural water resources for future generations while also minimizing environmental and public health hazards without any regulatory barriers, paving the way for sustainability in the textile industry in Agraharam, Erode City.

Conclusion

The current study focuses on textile treatment procedures used in Agraharam, Erode City, including disposal practices, environmental implications, health problems, and regulatory challenges. The findings indicate that wastewater management procedures in the research area are often insufficient and inconsistent. Despite respondents' high levels of awareness of environmental degradation caused by textile wastewater, this understanding has not translated into effective waste water treatment or safe disposal methods.

This study demonstrates that a considerable number of textile units either do not have functional ETPs or only use them occasionally due to budgetary constraints, entrepreneurs' lack of technical skill, and regulatory bodies' laxity in enforcing them. As a result, untreated or inadequately treated wastewater is released into open drains and storm water canals, causing pollution in surface water bodies, contamination of groundwater, deterioration of soil quality, and health problems among surrounding residents. The environmental and health consequences of bad Odor, mosquito breeding, skin disorders, and respiratory concerns highlight the critical need for improved waste water treatment in Agraharam. In addition, regulatory difficulties such as insufficient monitoring capacity and ineffective enforcement mechanisms contribute to ongoing contamination. As a result, the study recommends effective and sustainable wastewater management to protect water resources, public health, and environmental quality in textile-dominated metropolitan areas. Adoption of sustainable treatment technologies, stronger legislation, greater access to treatment infrastructure, and enhanced environmental awareness among stakeholders are critical for ecologically responsible and sustainable textile production in Agraharam, Erode City.

References

- Banerjee, S. (2018). Textile wastewater treatment: A review. *Journal of Environmental Research and Development*, 12(3), 543–552.
- Central Pollution Control Board (CPCB). (2019). *Comprehensive industry document on textile sector (dyeing and processing)*. Ministry of Environment, Forest and Climate Change, Government of India, New Delhi.
- Gita Devi, R. (2021). Effectiveness of effluent treatment plants in textile industries. *International Journal of Environmental Engineering Research*, 10(2), 45–53.
- Karthikeyan, K. (2019). *Assessment of pollution load from textile dyeing industries in South India*. *International Journal of Environmental Sciences*, 9(1), 67–75.
- Rajkumar, R., Natarajan, S., & Selvam, P. (2020). Groundwater quality assessment in textile industrial regions of Tamil Nadu. *Environmental Monitoring and Assessment*, 192(6), 1–15.
- Sadiq, M. (2016). Environmental awareness and wastewater management practices in small-scale textile industries. *Asian Journal of Environmental Management*, 5(2), 112–119.
- Sharma, R., & Nair, R. (2020). *Heavy metal contamination in textile wastewater and its environmental impact*. *Environmental Monitoring and Assessment*, 192(6), 1–15.
- Tamil Nadu Agricultural University (TNAU). (2018). *Impact of industrial wastewater on soil and crop productivity*. Coimbatore, In N. & Scarfone, K. (2019). *Blockchain technology overview*. Preprint arXiv:1906.11078.
- Tamil Nadu Pollution Control Board (TNPCB). (2020). *Guidelines for effluent treatment plants in textile industries*. Chennai, India.
- World Health Organization (WHO). (2017). *Guidelines for drinking-water quality* (4th ed.). Geneva, Switzerland.