

Original Article

Recycling of Waste Water in Our Society

Dr. Sujata Modhave¹, Tanish Shriram Pathare², Rohit Pramod Patil³, Tvisha Nakul Sharma⁴

^{1,2,3,4} AISSMS, College of Engineering, Pune

Manuscript ID:
BN-2026-030401

ISSN: 3065-7865

Volume 3

Issue 4

April 2026

Pp. 1-5

Submitted: 05 Mar. 2026

Revised: 20 Mar. 2026

Accepted: 09 Apr. 2026

Published: 30 Apr. 2026

DOI:

10.5281/zenodo.21187376

DOI link:

<https://doi.org/10.5281/zenodo.21187376>



Quick Response Code:



Website: <https://bnir.us>



Abstract

Increasing pressure on freshwater resources due to urban expansion, population growth, and changing climate patterns has intensified the need for sustainable water management strategies. Wastewater recycling presents a viable approach to mitigate water scarcity while reducing environmental degradation. This study examines the potential of wastewater reuse in urban societies by analysing treatment technologies, application areas, and associated challenges. Wastewater generated from domestic and industrial activities can be effectively treated through integrated physical, chemical, and biological processes to meet reuse standards. Advanced treatment techniques, including membrane-based filtration and disinfection systems, further enhance water quality, enabling its use in non-potable and, in some cases, portable applications. The adoption of wastewater recycling contributes to reduced dependency on freshwater sources, improved ecological balance, and enhanced resilience of urban water systems. Despite its advantages, the implementation of wastewater recycling systems is constrained by economic, technical, and social factors, including high capital investment, operational complexity, and limited public acceptance. This paper emphasizes the importance of policy support, technological innovation, and stakeholder engagement in overcoming these barriers. The findings suggest that wastewater recycling can serve as a cornerstone of sustainable urban development if supported by effective governance and increased public awareness.

Keywords: technologies, wastewater, recycling, awareness

Introduction

Water is an essential resource that supports all forms of life and is used extensively in everyday human activities such as drinking, cooking, bathing, washing, and cleaning. However, a large portion of the water used in households is discharged as wastewater and is often not reused. In urban areas, where large populations live together, this leads to significant water wastage and increased pressure on limited freshwater resources. In many countries, especially India, water scarcity is becoming a serious and growing concern. Factors such as rapid population growth, urban development, falling groundwater levels, and changing climate conditions have made water availability uncertain. During summer seasons, many regions experience water shortages, making it difficult to meet daily needs. In such conditions, recycling wastewater becomes an important and practical solution rather than just an optional practice. This case study focuses on wastewater recycling in residential societies, where multiple families share common infrastructure and water supply systems. The study aims to understand how wastewater is generated, how it can be treated effectively, and how it can be reused for different purposes within the society. It also highlights the impact of wastewater recycling on water conservation and environmental protection.

1. What is Wastewater?

Wastewater is water that has already been used and has become contaminated with various impurities.

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Address for correspondence:

Sujata Modhave, AISSMS, College of Engineering, Pune

Email: ssmodhave@aiissmscoe.com

How to cite this article:

Modhave, S., Pathare, T. S., Patil, R. P., & Sharma, T. N. (2026). Recycling of Waste Water in Our Society. *Bulletin of Nexus Journal*, 3(4), 1–5. <https://doi.org/10.5281/zenodo.21187376>

In residential areas, wastewater is mainly generated from daily household activities. It can be broadly divided into the following categories:

- **Grey Water:**

This type of wastewater comes from sources such as sinks, bathrooms, bathtubs, and washing machines. It contains soap, detergents, grease, and small particles of dirt. Although it is not highly polluted, it still requires basic treatment before reuse.

- **Black Water:**

Black water is generated from toilets and contains human waste and harmful microorganisms. It is highly contaminated and needs proper and advanced treatment before it can be reused or safely disposed of.

- **Storm Water:**

Storm water refers to rainwater that flows over surfaces like roads, rooftops, and open areas. As it flows, it collects dust, dirt, and waste materials, which makes it unsuitable for direct use without treatment.

A residential society can generate a large amount of wastewater every day. If this water is not treated and reused, it is simply wasted and can also lead to environmental pollution.

2. Importance of Wastewater Recycling

Recycling wastewater is becoming increasingly important, especially in urban residential areas, for several reasons:

- Freshwater sources such as rivers and lakes are gradually getting polluted
- Groundwater levels are decreasing rapidly in many cities
- Water shortages and supply cuts are common, particularly during summer
- The cost of water is increasing, making conservation necessary
- Treated wastewater can be reused for purposes like gardening, toilet flushing, cleaning, and washing vehicles
- It reduces environmental pollution and lowers the burden on public water supply systems

So, wastewater recycling is a sustainable and efficient approach to managing water resources. It helps conserve freshwater, reduces pollution, and ensures better water availability for future needs.

Methods of Wastewater Recycling

Wastewater can be treated and reused through a variety of methods, depending on the level of contamination and the intended reuse of the treated water. In residential societies, the choice of method is influenced by factors such as space availability, cost, and required treatment efficiency. The following are some commonly used wastewater recycling methods:

1. Sewage Treatment Plant (STP)

A Sewage Treatment Plant (STP) is one of the most widely used systems in residential complexes. In this method, wastewater from all buildings is collected and directed to a centralized treatment unit within the society premises. The treatment process typically involves multiple stages, including the removal of large solids, filtration of finer particles, and biological or chemical treatment to eliminate harmful microorganisms.

The final treated water, often referred to as recycled water, can be safely used for non-potable purposes such as gardening, cleaning, and toilet flushing.

2. Constructed Wetlands

Constructed wetlands are an environmentally friendly method of wastewater treatment that mimics natural purification processes. In this system, wastewater flows through a specially designed bed of plants, sand, and gravel. The combined action of plant roots, microorganisms, and filtration media helps in removing contaminants.

Although this method is cost-effective and sustainable, it requires a relatively larger land area, making it more suitable for societies with sufficient open space.

3. Rainwater Harvesting Integrated with Recycling

Rainwater harvesting involves collecting rainwater from rooftops and other surfaces and storing it in underground or surface tanks. This water is then filtered and reused for non-drinking purposes. When integrated with wastewater recycling systems, it significantly reduces dependency on external water sources and improves overall water management within the society.

4. Biofilter Systems

Biofilter systems use naturally occurring microorganisms to decompose organic matter present in wastewater. These systems are compact, efficient, and suitable for residential complexes with limited space.

Due to their effectiveness and relatively low maintenance requirements, biofilter-based treatment units are increasingly being adopted in modern housing societies in India.

5. Case Study: Residential Society Implementation

Society Name: Green Valley Cooperative Housing Society

Location: Pune, Maharashtra

Number of Flats: 240

Population: Approximately 900 residents

System Installed: Sewage Treatment Plant (STP) integrated with a biofilter system

Green Valley Cooperative Housing Society is a large residential complex located in Pune. Prior to

implementing wastewater recycling, the society relied heavily on municipal water supply and private water tankers, particularly during the summer months. This resulted in high water expenses and frequent shortages between March and June.

Due to their effectiveness and relatively low maintenance requirements, biofilter-based treatment units are increasingly being adopted in modern housing societies in India.

System Installed: Sewage Treatment Plant (STP) integrated with a biofilter system. Green Valley Cooperative Housing Society is a large residential complex located in Pune. Prior to implementing wastewater recycling, the society relied heavily on municipal water supply and private water tankers, particularly during the summer months. This resulted in high water expenses and frequent shortages between March and June.

In 2021, the society management initiated the installation of an in-house STP in collaboration with a local water treatment service provider. The system was designed to treat approximately 75,000 litres of wastewater per day within the available basement space.

Within six months of operation, the society observed significant improvements in water management. The treated water was utilized for landscaping, cleaning common areas, and toilet flushing. As a result, the demand for freshwater decreased by nearly 40%, leading to both economic and environmental benefits.



6. Treatment Process in the STP

The wastewater treatment process followed in the STP consists of several sequential steps:

Collection:

Wastewater from kitchens, bathrooms, and toilets is collected through a network of pipelines into a central collection tank.

1. Screening:

Large solid materials such as food particles, plastics, and cloth pieces are removed using screens or mesh filters.

2. Sedimentation (Settling Tank):

The water is allowed to remain undisturbed so that heavier suspended particles settle at the bottom, reducing the overall solid content.

3. Aeration (Biological Treatment):

Air is introduced into the water to promote the growth of beneficial bacteria that break down organic waste.

4. Clarification:

The partially treated water is passed through a clarifier where remaining suspended particles are separated.

5. Disinfection:

Chemicals such as chlorine or other disinfectants are added to eliminate harmful pathogens and ensure the water is safe for reuse.

6. Storage and Reuse:

The treated water is stored in a separate tank and distributed for non-potable applications such as gardening, cleaning, and flushing.



Results and Discussion

1. Water Quality Data Table

Parameter	Before Treatment	After Treatment	Standard Limit	Status
pH Value	8.9	7.2	6.5 – 8.5	✓ Pass
BOD (mg/L)	280	18	< 30	✓ Pass
COD (mg/L)	520	65	< 250	✓ Pass
TSS (mg/L)	310	22	< 100	✓ Pass
Total Coliform (MPN/100mL)	1600	8	< 10	✓ Pass
Turbidity (NTU)	45	3	< 5	✓ Pass
Dissolved Oxygen (mg/L)	0.8	6.4	> 5	✓ Pass

2. Benefit Observed:

Benefit	Details
Water Savings	40% reduction in fresh water consumption per month
Cost Savings	Society saved approx. 1.8 lakhs per year on water tanker bills
Environmental Benefit	Less waste water going into drains, reducing local water pollution
Green Gardens	Garden area stayed green even in dry summer months
Awareness	Residents became more careful about water usage at home

3. Challenges Faced

Although wastewater recycling offers multiple advantages, its implementation is associated with certain challenges. During the installation and operation of the treatment system, the residential society experienced the following difficulties:

- **High Setup Cost:**

The installation of the Sewage Treatment Plant (STP) required an investment of approximately ₹12 lakhs. Managing this expense was challenging and required additional financial contributions from residents.

- **Limited Space Availability:**

The system required a fixed area for installation. Due to space limitations within the society, part of the basement parking area had to be utilized for setting up the plant.

- **Ongoing Maintenance Needs:**

The treatment system requires regular supervision to function efficiently. Routine cleaning, timely repairs, and continuous monitoring are necessary, which also demands the presence of a trained operator.

4. Suggestions and Recommendations

Based on the experience of the case study and observations from similar residential societies, the following recommendations can help in the successful implementation of wastewater recycling systems:

- **Evaluate Water Consumption:**

Conduct a proper assessment of daily water usage to estimate the quantity of wastewater generated. This helps in planning the system effectively.

- **Select a Suitable System:**

Choose a treatment system that is appropriate for the size and needs of the society to ensure cost-effectiveness and efficiency.

- **Promote Awareness Among Residents:**

Inform and involve residents in the process by explaining the environmental and economic benefits of wastewater recycling.

- **Take Advantage of Government Schemes:**

Many government bodies provide financial support or subsidies for eco-friendly projects. Societies should explore these opportunities to reduce costs.

- **Install Separate Pipelines:**

Ensure that recycled water and drinking water are supplied through different pipelines to avoid contamination.

- **Provide Proper Training:**

Assign trained personnel to operate and maintain the system to ensure smooth and safe functioning.

- **Monitor Water Quality Regularly:**

Regular testing of treated water is necessary to ensure that it is safe for its intended uses.

- **Combine with Rainwater Harvesting:**

Integrating wastewater recycling with rainwater harvesting can further improve water conservation and reduce dependency on external sources.

Conclusion

Water is a vital resource that is often undervalued in daily life, despite its increasing scarcity. With growing population demands and declining availability of clean freshwater, the need for efficient water management has become more critical than ever. A significant amount of water used in households is discharged as wastewater,

much of which can be treated and reused effectively.

The case study of Green Valley Cooperative Housing Society in Pune demonstrates that wastewater recycling is both feasible and beneficial for residential communities. By implementing a Sewage Treatment Plant (STP) and reusing treated water for non-potable purposes, the society was able to reduce its dependence on freshwater sources by approximately 40%. This not only improved water availability but also reduced overall costs in the long term.

From a scientific perspective, wastewater treatment involves a combination of physical, biological, and chemical processes such as filtration, microbial degradation, and disinfection. These processes highlight the practical application of scientific principles in addressing real-world environmental challenges.

The findings of this study suggest that wider adoption of wastewater recycling systems in residential societies can significantly contribute to water conservation and environmental sustainability. Although initial investment and maintenance are required, the long-term advantages outweigh the challenges.

In conclusion, effective wastewater management is a practical solution to the growing water crisis. With increased awareness, proper planning, and collective effort, communities can play a key role in conserving water resources and ensuring a sustainable future.

Acknowledgment

We express our sincere gratitude to our guide, Dr. Sujata Modhave, AISSMS College of Engineering, Pune, for her valuable guidance, encouragement, and continuous support throughout the preparation of this case study on "Recycling of Waste Water in Our Society."

Financial support and sponsorship

Nil.

Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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