

RO Wastewater Management and Reuse in Gurgaon

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Introduction

- Reverse osmosis (RO) uses a semi-permeable membrane to purify water by separating water molecules from dissolved substances.
- 33% of households in Sharadha Nagar, Lucknow, use RO systems, generating approximately 270 liters of wastewater per person per month(Kumar & Loknath, 2023).
- A study from the Netherlands shows that industrial RO plants there reuse wastewater, but it's used solely for industrial activities.
- Gurugram contributes 0.6% to India's GDP while housing only 0.1% of the population (GMDA, 2021; Government of Haryana, n.d.).
- Freshwater sources in Gurugram include groundwater, the Yamuna River, and rainwater for recharging groundwater (Siwatch, 2015; TERI, 2021).
- Elevated TDS levels are prevalent, especially in the southwestern parts of Gurugram, due to the saline Yamuna River (Team Urban Update, 2022).
- TDS levels in some areas increased from 3,011 mg/L to 5,140 mg/L between 2016-17 and 2017-18 (Arora, 2018).

The Problem with Reverse Osmosis

- Various water filtration systems exist, including ultrafiltration, ultraviolet purification, candle filters, activated carbon filters, and reverse osmosis (RO).
- RO filtration is the most efficient and popular, as it reduces TDS levels significantly, has additional filtration stages compared to alternatives, improves taste and safety of water and is more adaptable.
- However, RO systems waste 3-4 litres of water for every 1 litre of potable water produced, resulting in 75% water wastage (World Economic Forum, n.d.).
- Higher TDS levels in water can lead to health issues such as kidney stones, heart diseases, diabetes, and gastrointestinal problems.
- In Gurugram, the Municipal Water Line supplies water with a TDS of 250-300 ppm, near the WHO's "excellent" and "good" classifications (Dhankar, 2022).
- Despite being considered "good," this level of TDS has reportedly caused 205 residents of Westend Heights to fall ill, indicating the need for RO systems.
- No technological solutions currently address this issue effectively.
- Makeshift solutions include placing a bucket under the RO wastewater pipe to reuse water for flushing and washing dishes, but this practice is inefficient and requires significant effort.

Research Objective

This study analyzes the number of people consuming water in a household, water usage per person, general water usage, and wastage of RO wastewater. No studies on RO wastewater have been conducted in Gurugram. However, such studies are becoming increasingly necessary as the area is riddled with a water shortage. This research aims to help this area and community recover from the shortage of fundamental human rights. Currently, there are no studies about the management and reuse of RO wastewater in Gurugram. This study aims to assess RO wastewater management practices in Gurugram City and explore the reuse potential of this wastewater as a step toward fighting the shortage of potable water.

Specifically, the aim of this study is to:

- Gauging awareness levels of RO wastewater generation
- Understanding the number people who re-used RO wastewater currently,
- Understanding why people do not re-use their RO wastewater
- Exploring methods of managing RO reject water

Methodology

Selection of Study Area: The study focuses on Gurugram, part of the National Capital Region of Delhi, covering approximately 1,258 sq. km (Government of Haryana, n.d.-b). This area was selected due to the lack of research on water usage and RO water wastage, identifying a knowledge gap. Data from various households across Gurugram, including The World Spa Sector 30, Nirvana Country Sector 50, and Orchid Island Area, were used to generalize water wastage in the city.

Sampling Strategy: A descriptive research approach was used, with a survey questionnaire designed to assess water usage, RO wastewater generation, and usage in Gurugram. Random sampling was employed to minimize bias, particularly in a culturally diverse city (Lal, 2018).

Methodology

Survey: A Google form was sent to 500 individuals, with 143 responses (28.6% response rate). Of these, 40% were female, and 60% male. Most respondents (55%) were aged 36-50, with 35% over 50. The highest education level for 72.8% was a Master's Degree. Household incomes varied, with 35% earning over 100 lakh INR, 28% between 50-100 lakh, 14.7% between 25-50 lakh, and 22.3% earning less than 25 lakh INR.

Questionnaire: A total of 22 questions were asked, which fall under the following domains.

1. **Demographic Data:** Age, gender, Location, Type of House
2. **Academic Data:** Level of Education
3. **Occupational Status:** Profession
4. **Socioeconomic Status:** Range of Income
5. **Overall Water Consumption and Wastage:** 4 questions were asked regarding a) the number of family members, b) the number of permanent house helpers, and c) awareness of water consumption, and respondents were then asked to give d) their estimate of water used per person per day.
6. **Different sources of water consumption and wastage:** 3 questions were asked about a) activities that require the most water usage, b) sources of water for the household, and respondents were asked whether they had a Reverse Osmosis system or not.
7. **The RO System:** 8 questions were asked regarding how much the RO system was used in their house, their estimate of how much water is wasted by an RO system, whether they reuse their RO wastewater, and their awareness of how they could reuse RO wastewater.

Results

Fig 1: Major source of Water supply to the locations under study - 85.3% Municipal Water Line, 14.0% Borewells/Groundwater

Fig 2: Predicted awareness of RO wastewater generation based on the educational qualification of the participants - 51%

Fig 3: Actual awareness of RO wastewater generation based on the educational qualification of the participants - approximately 25.2%

Fig 4: The areas where water is used most V/S the areas where RO wastewater can be used

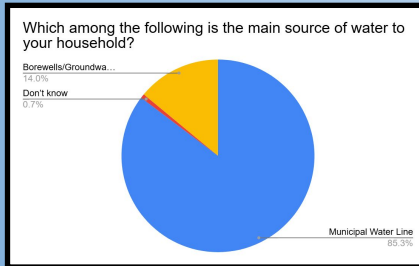


Fig 1

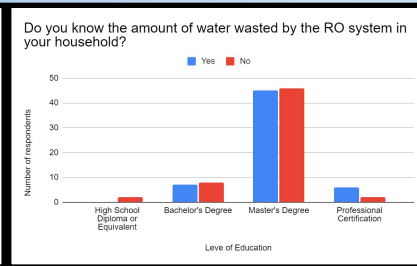


Fig 2

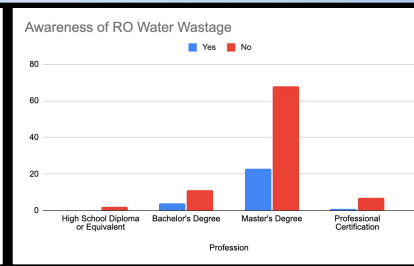


Fig 3

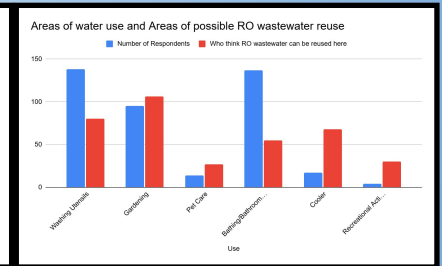


Fig 4

Discussion

- RO systems waste water at a 1:3 or 1:4 ratio, but only 25.2% of respondents were correctly aware of this, highlighting a misconception, despite 51% claiming to know.
- No link between education level and awareness of RO wastage, showing education does not improve water conservation knowledge.
- Main water uses: cooking, washing, bathroom (90%). Only 39.8% reuse RO wastewater, despite interest in buckets (60%), storage tanks (35%), and plumbing (29%) as reuse solutions.
- 14% would adopt reuse if better technology existed, signaling a demand for innovation.
- Similarities with Sharadha Nagar (reuse rates of 33% vs. 39.8%) show consistent low reuse across regions, highlighting the need for better awareness and infrastructure.

Conclusion

- 86% of respondents had an RO system, with 45% aware of reuse practices and 39.8% reusing wastewater.
- 25.2% accurately knew the amount of RO wastewater produced, while 51% believed they knew, indicating misconception.
- 14% expressed willingness to implement reuse systems if better technology were available.
- There is a significant knowledge gap about RO wastewater reuse in Gurugram, highlighting the need for education programs and public awareness campaigns.
- Promoting reuse could reduce water waste and improve resource management in the face of Gurgaon's water shortages.
- The study's limitations include focusing only on Gurugram, reliance on self-reported data, and lack of detail in some responses.
- Future research should focus on other cities (e.g., Mumbai, Chennai) to understand national trends and could also explore health impacts related to TDS levels and household illnesses.
- More technological solutions must be researched and created to promote reuse of RO wastewater.

Proposed Solutions

The effectiveness of awareness campaigns or education programs in improving residents' understanding of RO wastewater wastage and reuse practices must be studied, especially as this study calls out the need for more awareness on this issue. The government could also implement certain policies, such as making environmental studies compulsory throughout K-12 education, though there must be certain nuances that the concerned authorities must work out. A greater number of awareness campaigns and education drives could also be launched by the government, based on the results of the research study suggested above. Lastly, future work in this field should go beyond theory and data, and there could be a development of new technologies or systems that can store and repurpose RO wastewater effectively, addressing the concerns of respondents who expressed interest in better reuse systems.

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