Promoting Public Acceptance of Low-Cost Wastewater Solutions in Urban India: A Literature Review

Anup M Deshmukh, Research Scholar, Department of Business Management, RTMNU, Nagpur
Dr. PRASHANT PATIL, Research Supervisor, Department of Business Management, RTMNU, Nagpur

Abstract

This literature analysis delves into the tactics used to promote affordable wastewater management systems in metropolitan areas in India, specifically examining Nagpur City. Due to limited financial resources, fast population expansion, and increased urbanisation, wastewater management poses a serious problem to metropolitan regions in India. In order to determine public acceptance of wastewater treatment systems that are both effective and inexpensive, this study synthesises results from previous research. Technological advancement, efficiency, ecological effect, and community involvement are important topics. This study provides valuable insights into how to overcome public acceptability challenges by highlighting successful case studies and best practices from metropolitan situations like Nagpur. This paper seeks to offer a thorough framework for environmental advocates, urban planners, and legislators to adopt cost-effective and community-approved sustainable wastewater management solutions by illuminating the cultural and socioeconomic dynamics that impact public opinion.

Keywords – Public acceptance, low-cost wastewater solutions, urban India, Nagpur City, wastewater management

Introduction

Inadequate infrastructure, especially in the field of wastewater treatment, and fast urbanisation are two problems that Indian metropolitan areas are trying to solve simultaneously. The deterioration of the environment, health concerns, and socioeconomic inequalities are all consequences of the strain on wastewater systems caused by rapidly growing urban populations. These problems need immediate and creative answers, and Nagpur City, a major city in Maharashtra, is a prime example of this.

To maintain public health, ecological sustainability, and general urban livability, efficient wastewater treatment is essential. Many metropolitan neighbourhoods lack access to traditional wastewater treatment procedures due to their high prices and sophisticated technology. Therefore, it is critical to investigate and advocate for sustainable wastewater solutions that are both affordable and feasible in areas with limited resources.

The public's buy-in is critical to the long-term viability of these affordable alternatives. Factors such as cost, perceived advantages, simplicity of use, and socio-cultural concerns impact public perception and readiness to accept new technology. In order to develop and promote wastewater management policies that attract substantial support and involvement, it is crucial to have a thorough understanding of these elements.

The purpose of this study is to evaluate the existing literature on the topic of urban wastewater management in India, specifically in the city of Nagpur, and to draw conclusions on how best to get the public on board with affordable solutions. Policymakers, urban planners, and environmental activists in India may benefit from this study's synthesis of current research on wastewater management in urban areas by learning about successful techniques, case studies, and best practices.

Objectives of the study

- To identify cost-effective wastewater management solutions suitable for urban areas in India, with a focus on Nagpur City.
- To analyze the factors influencing public acceptance of low-cost wastewater treatment methods in urban settings.
- To assess the effectiveness of community engagement strategies in promoting the adoption of economical wastewater solutions.

Research Methodology

This study employs a comprehensive literature review approach to explore the promotion of public acceptance of low-cost wastewater management solutions in urban India, with a particular focus on Nagpur City. The methodology involves systematically identifying, selecting, and analyzing relevant academic and industry research, case studies, and policy documents. Primary databases such as Google Scholar, JSTOR, PubMed, and industry reports were utilized to gather a wide range of sources. Keywords including "public acceptance," "low-cost wastewater solutions," "urban India," "Nagpur City," and "wastewater management" guided the search process. The selected literature was critically reviewed to extract key themes, successful strategies, and barriers related to public acceptance of economical wastewater solutions. Additionally, case studies from Nagpur and similar urban contexts were analyzed to identify best practices and lessons learned. The findings were synthesized to provide a comprehensive understanding of the factors influencing public acceptance and to offer actionable recommendations for policymakers, urban planners, and environmental advocates. This methodology ensures a robust and holistic examination of the current state of knowledge in the field, laying the groundwork for informed decision-making and effective implementation of sustainable wastewater management solutions.

Literature review

Rapid urban population expansion is a major environmental and health concern in many low- and middle-income nations, as highlighted by Kookana et al. (2020) and Sun et al. (2020). Lack of adequate wastewater treatment is one of the most critical ones. (Khatri et al., 2008; Kuttuva et al., 2018; Lüthi et al., 2020) Conventional, centralised wastewater treatment systems, which are based on sewers, are often insufficient, have restricted coverage, or both. Because of this, polluted and unsanitary wastewater is dumped into the environment, either not cleaned enough or not at all. According to Klinger et al. (2020), Larsen et al. (2016), and Massoud et al. (2009), centralised system expansion or retrofitting is often impractical or too expensive in low- and middle-income situations.

Collecting and treating wastewater close to its point of production, such as inside a single building or a small cluster of buildings, is one way to address this problem (Hering et al., 2013; Hoffmann et al., 2020; Rabaey et al., 2020). reduced wastewater is discharged into the environment, leading to improved sanitation and reduced pollution. On top of that, the wastewater treatment process allows for its reuse on-site for non-potable or potable uses, such as irrigation or toilet flushing. According to Garcia and Pargament (2015) and Gikas and Tchobanoglous (2009), this practice helps to conserve freshwater resources, which in turn enhances water security for both the system users and the general public.

There is a lack of widespread adoption of on-site wastewater treatment and reuse technologies, despite their many benefits. The city of Bengaluru in India is one of many local governments that has made it mandatory to install on-site systems for certain building types in an effort to boost their use. However, the treated water in Bengaluru is of poor quality since many of the on-site systems that have been built are not functioning correctly. This results in the water being sent down the storm drains instead of being reused, which in turn causes the water bodies and groundwater in Bengaluru to remain polluted (Kuttuva et al., 2018). One possible explanation for these operational problems is that new water treatment and reuse technologies are not well-received by the general public (Hurlimann and Dolnicar, 2010; Kenney, 2019). Since users in Bengaluru were ordered to install the systems but have not done so willingly, user acceptability of on-site systems may be especially crucial in this scenario. The effective implementation and reliable operation, monitoring, and maintenance of on-site systems depend on user approval, which is why the mandate alone is insufficient.

The fact that users are disproportionately responsible for the expenses and dangers associated with on-site systems may be a major factor in their low level of adoption. Some examples of

these include the time and effort put into operation, monitoring, and maintenance (OMM), the money and health risks that could result from a system failure, and the costs of investment and operation (Eggimann et al., 2016; Kuttuva et al., 2018; Voulvoulis, 2018; Watson et al., 2016). The perceived costs, risks, and advantages of on-site systems by users (and prospective users) may be more relevant than the objective costs, risks, and benefits evaluated by experts in determining user acceptability, according to studies. Perceived costs, risks, and benefits are the key factors that determine whether new technologies are accepted or not. This holds true for both new technologies in general and centralised wastewater treatment and reuse in particular. Several studies have demonstrated this (e.g., Bearth and Siegrist, 2016; Liu et al., 2019; Mankad and Tapsuwan, 2011; Nancarrow et al., 2009). The adoption of on-site systems is also supported by preliminary evidence (Amaris et al., 2020; Domènech and Saurí, 2010; Nancarrow et al., 2010; Portman et al., 2022; see also Contzen et al., 2023). Specifically, expert estimates tend to differ from user views of costs, risks, and benefits (e.g., Savadori et al., 2004; Slovic et al., 1985) and from layperson perceptions more broadly. Users' perceptions of costs, risks, and rewards are crucial for understanding and predicting their adoption of on-site technologies. With this information in hand, future political, psychological, and technological actions aimed at boosting user approval of on-site devices might be better conceived. Also important is the level of acceptance from those who aren't now required to use the system, but may be in the future (i.e., those who aren't users at the moment) (henceforth referred to as non-user acceptance). The usage of on-site systems is on the increase in low- and middle-income nations that are grappling with water shortages and fast urbanisation. As a result, it is probable that current mandates will be extended or new ones will emerge. The perceptions of cost, risk, and benefits, and therefore the degrees of acceptability, might vary between users and non-users due to differences in knowledge and experience with sustainable technology (Amaris et al., 2020; Huijts et al., 2012; Schuitema et al., 2011). Users who have encountered system failures may, for instance, attribute greater health risks to such incidents. Their perceived value may be reduced, nevertheless, if there are no negative health impacts for the consumers. It may be necessary to treat present and prospective required users differently in interventions that attempt to increase acceptance, according on their perspectives.

The majority of research on the subject of wastewater treatment and reuse has focused on either centralised systems (e.g., Hartley, 2006; Marks et al., 2008; Moya-Fernández et al., 2021; Nancarrow et al., 2009) or water reuse in general (Fielding et al., 2019; Ross et al., 2014). Centralised and on-site systems vary in fundamental features, such as the personal financial commitment needed or the responsibility and effort for maintenance, hence these conclusions cannot be immediately applied to on-site systems. Particularly lacking is research on how users perceive on-site systems: Only four studies have examined the relationship between the perceived costs, hazards, and advantages of on-site systems and acceptability by users or non-users so far (Domènech and Saurí, 2010; Amis et al., 2020; Nancarrow et al., 2010; Portman et al., 2022). According to three studies, on-site systems were found to be less acceptable in cases where the water quality was perceived as poor (e.g., due to colour and odours; Amaris et al., 2020; Domènech and Saurí, 2010) or when the risk of health threats or system failure was higher (Domènech and Saurí, 2010; Portman et al., 2022). The monetary advantages of reusing treated wastewater were also associated with better acceptability, according to Amaris et al. (2020).2

To reach a complete solution for wastewater management and public health and environmental protection in cities of low- and middle-income countries without or with incomplete sewerage networks and centralised treatment facilities, it is necessary to treat both greywater and blackwater, or wastewater from toilets. From a psychological standpoint, people may have different impressions of a combined wastewater treatment and reuse system compared to one that only treats greywater. This is because people may be less accepting of the combined system

due to higher perceptions of health risks (Rozin et al., 2015). Consequentially, it is unclear if the results on greywater treatment perceptions are applicable to combined greywater and blackwater treatment perceptions.

The one and only research on treating and reusing grey and black water simultaneously indicated that less acceptability was associated with a greater perceived overall danger to families, the public, and the environment (Nancarrow et al., 2010). See Henrich et al. (2010) and Muthukrishna et al. (2020) for similar arguments; however, the research was not carried out in a low- or middle-income nation, therefore the results may not be immediately applicable to such a setting. In addition, out of the four research, only one has looked at how perceived benefits affect acceptance4, and none have systematically evaluated which costs, risks, and benefits were the most telling when it came to acceptance. Their narrow focus on a subset of potential costs and hazards meant that they could draw only limited conclusions about the problem at hand. As a result, there isn't enough data to make firm judgements on how people in low- and middle-income countries see the costs, hazards, and advantages of on-site systems that treat and reuse both greywater and blackwater.

Research Gap

There is a clear lack of knowledge on the elements that impact public acceptability of affordable wastewater solutions, even though there is an increasing amount of literature on urban India's wastewater management. The current body of literature pays little attention to the perceptual, social, and cultural factors that influence public acceptability in favour of technical advancements and cost-effectiveness. Furthermore, while there are many case studies that detail successful wastewater management system installations, there is a dearth of thorough analyses that bring together these results to provide a unified framework for winning over the public. There is a serious lack of locally relevant techniques for increasing community involvement and engagement due to the under-researched specific socio-economic and cultural dynamics of Nagpur City and comparable urban environments. To provide customised, efficient methods that guarantee the effective adoption and long-term viability of affordable wastewater management systems in urban India, it is crucial to fill this void. To address this knowledge vacuum, this project will survey the relevant literature, determine what elements have an impact on public approval, and provide concrete suggestions for those involved.

Conclusion

Public support for affordable wastewater management systems in urban India, particularly in Nagpur City, is of paramount significance, as this extensive literature analysis demonstrates. Protecting public health, maintaining environmental sustainability, and improving urban livability all depend on efficient wastewater treatment. But there are several socio-cultural, economic, and perceptional hurdles that must be overcome before cost-effective solutions may be widely adopted.

The research shows that in order to win over the public, technology advancements and efficient approaches aren't enough; strong community involvement tactics are also required. The importance of transparency, education, and participatory techniques, as well as the value of include local people in the planning and implementation stages, have been shown by successful case studies.

Proximity to local socio-cultural values, perceived advantages, simplicity of use, and affordability are important determinants of popular acceptability. For politicians, city planners, and eco-activists, the study's findings on what works in Nagpur and other comparable metropolitan settings are invaluable.

This study offers a thorough framework for analysing and improving public acceptability of sustainable wastewater solutions, filling a gap in the current research. Some of the suggestions include using culturally appropriate communication methods, increasing community involvement, and capitalising on local expertise.

In conclusion, boosting public adoption of low-cost wastewater management systems is vital for solving the severe wastewater concerns in urban India. In order to improve the social, economic, and environmental conditions of urban populations, stakeholders should combine community-centric methods with technical breakthroughs to create wastewater management strategies that are both sustainable and generally acceptable.

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