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SWOT ANALYSIS OF ECO-SANITATION PRACTICES AND LONG-TERM SUSTAINABILITY IN SUBURBAN AREAS: A FOCUS ON DAULATPUR THANA

Suvro Sarker Suvo[1] and Mohammad Ismail Hossain[2]

[1,2]Institute of Disaster Management, Khulna University of Engineering and Technology (KUET), Khulna, 9203, Bangladesh

ABSTRACT

Reliable and affordable ecological sanitation is a major challenge in rural and suburban areas of developing countries. This study explores Daulatpur Thana, a suburb in Khulna district, as a potential site for implementing Ecological Sanitation (EcoSan) systems. A mixed methods approach was used including household surveys, key informant interviews, focus group discussions, field observations and secondary data analysis. GIS identified areas with high sanitation needs and suitable sites for EcoSan in Daulatpur Thana. Many households still rely on unsanitary latrines or open defecation, causing waterborne diseases and contamination. While environmental awareness is growing, knowledge of EcoSan remains limited. Most households are willing to adopt EcoSan systems with financial support, technical assistance, and awareness programs. A SWOT analysis identifies challenges like cultural barriers, lack of expertise, and inadequate infrastructure. This research investigates Daulatpur Thana in the Khulna district as a possible location for Ecological Sanitation (EcoSan) systems, which provide a sustainable substitute for conventional techniques by turning human waste into useful materials like fertilizer and compost.

***Key words**: Wastewater, Decentralized management, Applicability, Developing countries*

INTRODUCTION

Rapid population growth and urbanization in peri-urban areas pose a number of challenges to the provision of sustainable waste management systems and adequate sanitation. Globally, approximately 2.4 billion people lack access to sanitation; 70% of these people live in rural areas (World Health Statistics, 2015). Globally, ecological sanitation (EcoSan) has emerged as a viable alternative to traditional systems as it combines human waste disposal with nutrient recycling and minimal environmental impact (Langergraber & Muellegger, 2005). The natural content of nitrogen, potassium and phosphorus in human urine is high. Vegetables and crops fed with human urine were found to be 10% larger than those grown with regular fertilizer (Effebi et al., 2019).

In addition to addressing these broad needs, it is also important to ensure the sustainability of sanitation systems – both in terms of their long-term function and use, as well as their interaction with other social, environmental, institutional and financial needs (Andersson & Minoia, 2017). It is in line with the United Nations' Sustainable Development Goals (SDGs), particularly Goal 6, which aims to ensure access to water and sanitation for all by promoting sustainability and resource efficiency (United Nation, 2015). EcoSan has been introduced in several countries, including Sweden, China, and South Africa, demonstrating its potential to address sanitation challenges while promoting agricultural productivity through nutrient recovery (Simha & Ganesapillai, 2017).

The majority of these people live in poor countries and many of them do not even have sanitary toilets (Abraham et al., 2011). It is extremely difficult to provide affordable, durable, practical, elegant and effective environmental sanitation systems and services to these people (Hu et al., 2016). Bangladesh's national sanitation report states that open defecation rates in the country have fallen from 33% in 1990 to 1% in 2015 (MGD: Bangaldesh Progress Report, 2016). Furthermore, 75% of people have access to better sanitation, compared to 2.7% who defecate outdoors and 22.3% who use alternative toilets (BBS, 2017). Ecological sanitation is an umbrella term for a variety of sanitation systems that involve the containment, treatment, and safe reuse of human waste. Ecological hygiene is often associated with a double hopper dry toilet (UDDT), known locally as an “Ecosan toilet” (Dagerskog et al., 2015). By utilizing the organic components and nutrients in wastewater, Eco-San systems aim to recover resources, increase agricultural production, improve soil fertility and structure, and reduce water and energy requirements (Hu et al., 2016). Previous studies on EcoSan in

Bangladesh have largely focused on urban or rural areas, with limited attention to suburban areas, which often face particular challenges due to their transitional nature and hybrid infrastructure (Zhou et al., 2010). The research gap lies in the lack of comprehensive assessments of the strengths, weaknesses, opportunities and threats (SWOT) of EcoSan in suburban contexts like Daulatpur Thana. This study fills this gap by conducting a SWOT analysis of EcoSan in Daulatpur Thana and examining its viability and sustainability in suburban Bangladesh. The main objectives of this study are to assess the potential of ecological sanitation in Daulatpur Thana using a SWOT framework, identify the key barriers and facilitators to its adoption and suggest strategies for integrating EcoSan into sustainable suburban development plans. By focusing on Daulatpur Thana as a case study, this research aims to contribute to the broader discourse on sustainable sanitation in transitional settings and provide insights that can inform policy and practice in Bangladesh and similar contexts worldwide.

METHODOLOGY

Study area

Khulna is the third largest metropolis in the country and is located in southwest Bangladesh. Over 1.5 million people live in this city with a population density of 67,994 people per km². Daulatpur Thana (Khulna Metropolitan) is a 13.62 square kilometer region located between latitudes 22°50' and 22°54' N and longitudes 89°28'. and 89°32' East. Dighalia Upazila and Bhairab River border it on the east, while Khan Jahan Ali Thana and Dumuria Upazila border it on the west. Khan Jahan Ali Thana borders on the north and Khalishpur Thana on the south (KCC, 2024). A total of 118,380 people, 63,066 men and 55,314 women. Water sources for drinking: tap 2.07%, pond 0.13%, tube well 96.82% and others 0.98%. Sanitation: 2.58% of houses do not have toilets, while 66.56% of households in Thana shelters use sanitary latrines and 30.86% use non-hygienic latrines (BBS, 2022).

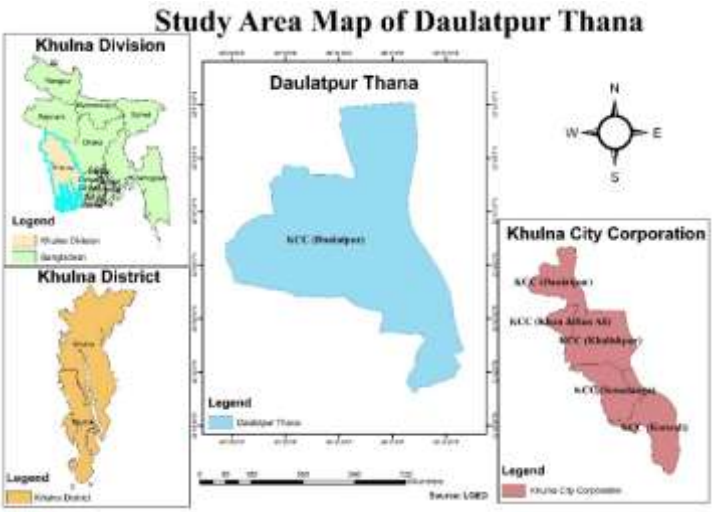

Figure 1 Study area map of Daulatpur

The choice of this suburban location was based on its proximity to rural and urban areas as well as the general hygiene issues faced by the growing population. Given socio-economic diversity, environmental fragility, waste management problems and water pollution, research in ecological sanitation is essential and can provide long-term answers.

Sampling Technique

The study focuses on maintaining sustainability and ecological sanitation in suburban areas. Using stratified random sampling techniques, data will be collected from households to determine the use of traditional toilets, type of safety tank, water usage for sanitation, knowledge of sanitation and sustainable development, drainage systems and other sanitation systems in the area. This ensures wide representation in the region across all areas of socio-economic culture, sanitation practices, sanitation system and geographical sectors (Chipatiso, 2023). Based on population size, additional in-depth interviews were conducted with residents, sanitation service providers and relevant authorities in 58 households. Finally, based on the collected data, simple statistical tables and tables for SWOT were created and analyzed. In addition to primary data, extensive secondary literature, information and data from several published and unpublished sourceswere used.

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Data Collection Methods

Data were collected by professional enumerators using paper surveys. To conduct the survey, a standardized questionnaire was given to the home manager or the nearest available representative. A mixed methods approach was used, using household surveys, key informant interviews, focus group discussions, field observations and secondary data analysis for both qualitative and quantitative data collection techniques (Syrjä et al., 2019). NGOs, local authorities and sanitation experts took part in the interviews, while house cleaners and community leaders were the focus of the surveys. Observations made during the trips assessed the preservation of the environment and sanitation infrastructure. The study evaluated the functionality, usability and structure of the system, highlighting issues such as cultural barriers and waste management. Secondary data from published literature, policy documents and government publications provided background information and facilitated comparison of local practices with regional or national patterns. Findings derived from primary data were confirmed by census records, previous surveys and technical evaluations.

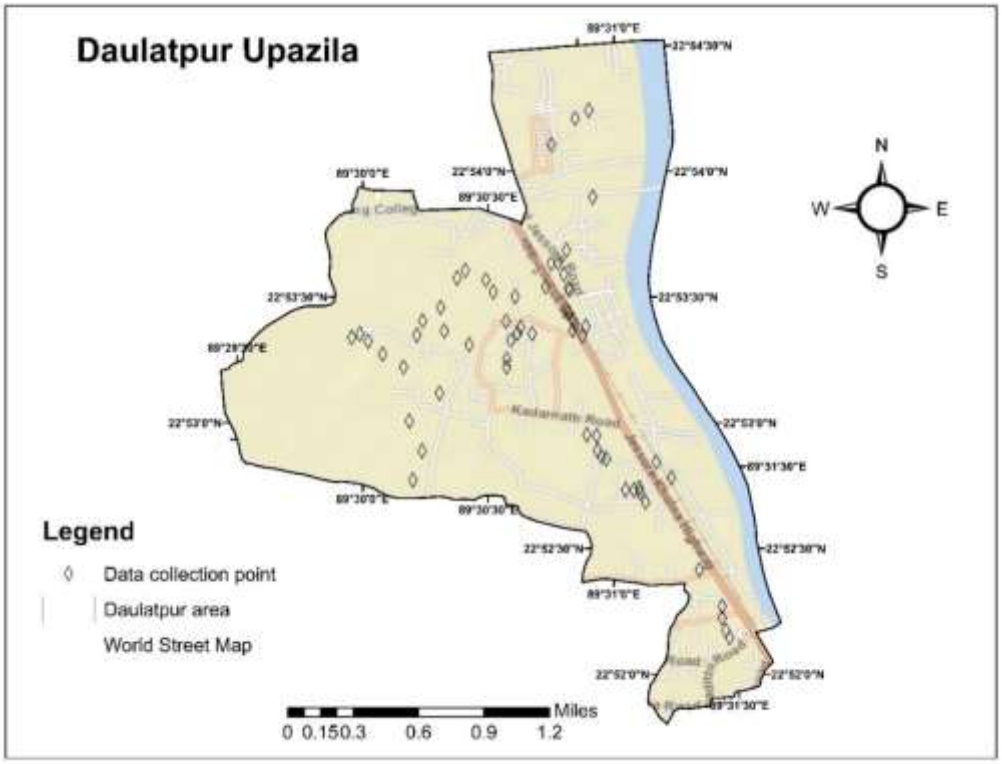

Figure 2 Data collection from study area

Data Entry and Analysis

Once all household information was collected, Standard Package for Social Science (SPSS) software was used to enter and process the data. In preparation for data entry, the variables were selected and determined. After data entry was completed, the data was converted into a Microsoft Excel spreadsheet for further analysis. Geographic information systems (GIS) were also used to locate regions with high needs for improved sanitation and possible EcoSan deployment sites.

Results and discussion

The demographic profile of the respondents provides important background information for assessing community dynamics and attitudes towards sustainability and ecological sanitation in Daulatpur Thana. In order to tailor sanitation programs to the unique needs and difficulties of the community, the data shows enormous differences in gender, age, marital status, educational background and occupation.

Table 1 Demographic table of the study population

Characteristic	Variable	Frequency	Frequency percentage
Gender	Male	20	35.7
	Female	36	64.3
Age	<=18	7	12.5
	<=18-45	27	48.2
	>=45	22	39.3
Marital status	Yes	29	51.8
	No	27	48.2
Educational Status	Illiterate	1	1.8
	PSC	9	16.1
	SSC	17	30.4
	HSC	20	35.7
	HONORS	9	16.1
	upper	0	0
Occupation	housewife	18	32.1
	business	4	7.1
	job	11	19.6
	student	23	41.1
Duration of residents	<5	6	10.7
	5 year	7	12.5
	>5	43	76.8

The gender distribution shows that women are more represented (64.3%) than men (35.7%). The gender gap could impact how ecological sanitation practices are perceived and applied, as women are often responsible for household cleanliness and water management (Tilley et al., 2013). Women's viewpoints need to be included in inclusive and effective sanitation strategies (Devkota et al., 2020).

Strengths of ecological sanitation

There is increasing focus on ensuring that sanitation systems are sustainable, as long-term use after deployment has proven difficult in many situations (Dickin et al., 2018). Water resources and the ecosystem become less polluted when adequate sanitation and downstream treatment are provided (Kherbache & Oukaci, 2020). Almost half of respondents (41.1%) considered the EcoSan awareness-raising activities to be extremely effective, while 42.9% considered them to be somewhat successful and 16.1% considered them to be ineffective. The findings highlight the need for a more inclusive approach to promote sustainable hygiene practices in Daulatpur Thana.

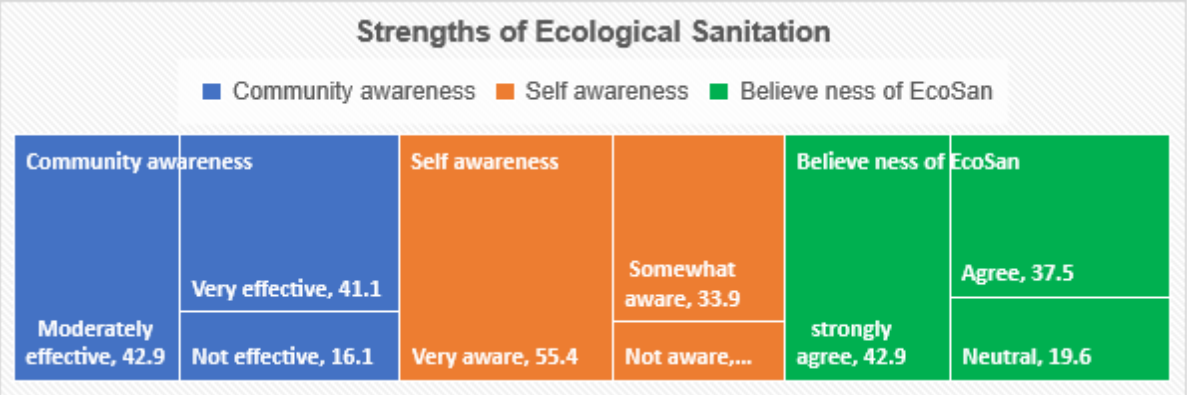

Figure 3 Strengths of Ecological Sanitation of the study area

These results demonstrate the need to continue and strengthen EcoSan's education and awareness activities. The effective adoption and sustainability of ecological sanitation techniques will depend on closing the knowledge gap in the remaining population, even if the majority of residents have a high level of awareness. The benefits of EcoSan, including better waste management, reduced waterborne diseases and better environmental outcomes, are thereby clearly supported and

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recognized (Ryals et al., 2019). This data shows the community's overall positive opinion of EcoSan systems and is encouraging for their adoption and sustainability. Improving educational initiatives and promoting effective EcoSan implementations can help transform passive viewpoints into active support, thereby increasing regional sanitation and sanitation standards (Thorn et al., 2020).

Weaknesses of ecological sanitation

The main concerns of respondents were taboos and cultural difficulties reflecting societal and cultural resistance to certain EcoSan methods. Taboos and cultural resistance were key concerns, while 28.6% of respondents cited a lack of knowledge or training, emphasizing the need for targeted education and capacity-building programs for EcoSan systems. Although ecological sanitary toilets are more complicated to maintain and maintain than pit toilets or flush toilets, they impose a greater burden on the user (Musingafi et al., 2015). High spending was cited by 21.4% of respondents as a cause of economic constraints, while 17.9% cited maintenance concerns as a sustainability issue. The majority of participants were dissatisfied with EcoSan. They reported that they did not like the Eco-san toilet as they found it unhygienic, smelly, unhealthy and too technical (Devkota et al., 2020). The results indicate that while most users find the designs effective, a significant portion remains dissatisfied or considers them unsuitable. User-centered improvements and community feedback can address these issues, enhancing usability and adoption.

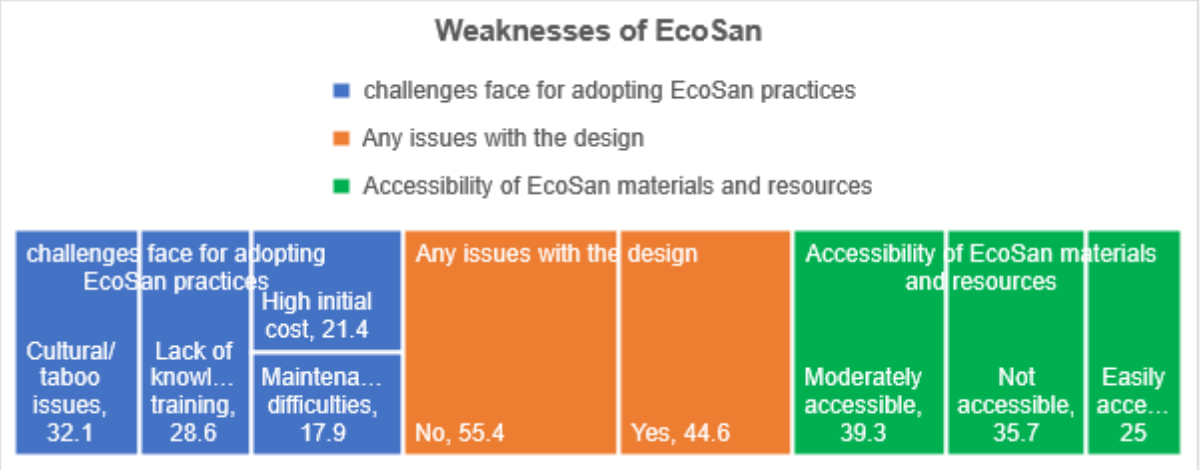

Figure 4 Weaknesses of EcoSan in this area

The findings are consistent with a study conducted in Uganda which found that a significant incidence of misunderstanding in community schools was due to a lack of awareness and commitment to Eco-san (Trimmer et al., 2016). This draws attention to supply chain and logistics issues that may make it more difficult for the community to successfully implement and operate EcoSan systems. Municipalities could serve more people with the same financial investment as traditional methods (Musingafi et al., 2015). The way the Eco-san toilet is handled and operated is shaped by cultural ideas. The customs and traditions of Nepali culture require that handling human urine is unacceptable (Devkota et al., 2020).

Opportunities for ecological sanitation

Sustainable agriculture and reduced reliance on conventional sanitation systems are the two main benefits cited by respondents, as indicated by 33.9% of participants. These results show how EcoSan can both improve agricultural production through recycling nutrients and overcome the disadvantages of traditional sanitation methods (Ryals et al., 2021). Although only 1.8% recognize EcoSan's job creation potential, EcoSan systems promote health by reducing waterborne infections, suggesting that the prospects are under-utilized. The use of urine as fertilizer was more common among those who were aware of its benefits. They also did not consider it unhygienic to consume food fertilized with human urine (Karak & Bhattacharyya, 2011). Community participation is critical to the effectiveness of EcoSan. Onboarding incentives are highlighted by 44.9% of respondents, while training and awareness campaigns are highlighted by others. The need for greater community involvement is highlighted by the fact that only 7.1% of respondents reported working with neighborhood organizations. The only problem highlighted with Eco-san toilets and their use is the processing of human urine (Devkota et al., 2020). 30.4% prioritized advocacy, education and awareness campaigns to influence policy and decision-making, while 39.3% highlighted the importance of financial support and emphasized the need for subsidies.

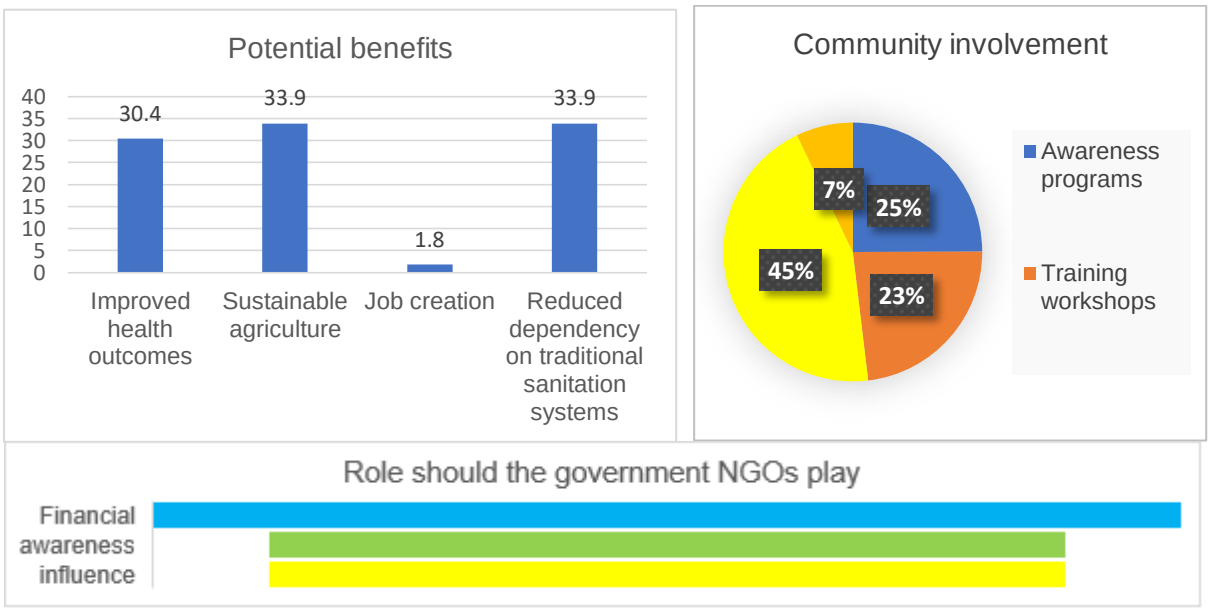

Figure 5 Opportunities for ecological sanitation in the study area

Adoption rates can be increased through increased community engagement through training, incentives and awareness campaigns. In addition, strong financial, educational and advocacy from governments and non-governmental organizations can solve current problems and create an atmosphere that supports long-term sanitation solutions. Although experiences from Zimbabwe showed that rural women preferred the Eco-san toilet, they built it closer to their homes (Kaur et al., 2018). These revelations underscore the need for an inclusive and collaborative strategy to fully utilize EcoSan systems that ensures both the long-term viability of the community and its immediate benefits.

Threats to Ecological Sanitation

The sustainability of EcoSan is affected by a complex interplay of social, economic, technological and environmental issues, as demonstrated by the listed threats (Ejigu & Yeshitela, 2023). While economic uncertainty and funding constraints highlight the need for financial support and strategic investments, community resistance highlights the need for cultural adaptation and awareness initiatives (Gwara et al., 2022). The need for strong infrastructure and flexible solutions for the proper management of EcoSan systems is further highlighted by the lack of technical support and the impact of environmental factors. Although experiences from Zimbabwe have shown that rural women prefer the Eco-san toilet, they have built it closer to their homes (Takahashi et al., 2016).

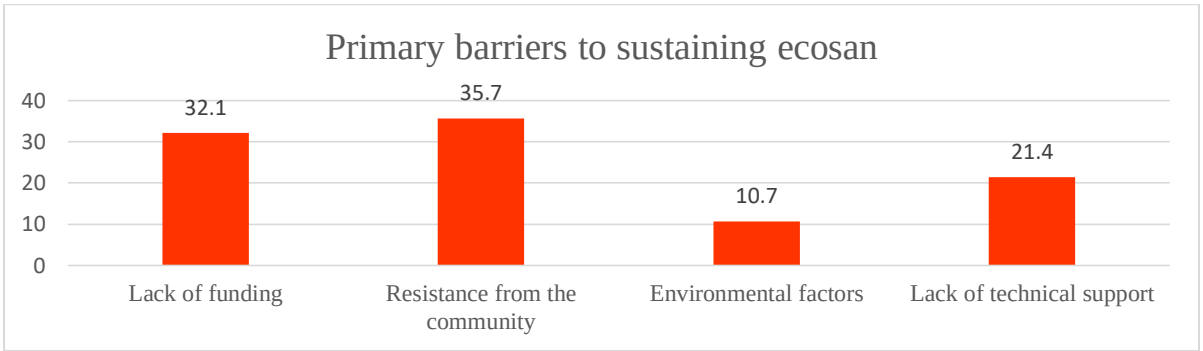

Figure 6: Threats to ecological sanitation in the study area

Addressing these challenges requires a comprehensive strategy that includes community participation, reliable sources of funding, technical assistance and policy advocacy. To reduce these threats and ensure the survival of EcoSan practices in Daulatpur Thana, governments, non-governmental organizations and local people should work together and strengthen institutional support. Through agricultural techniques, knowledge of Eco-san toilets, and the fertilizer value of waste, researchers demonstrated how the introduction and acceptance of Eco-san toilets in the community helped solve current and emerging sanitation problems (Werkneh & Gebru, 2023).

CONCLUSION

In summary, there are both opportunities and barriers to applying EcoSan techniques in suburban environments. Major challenges include lack of funds, community opposition and environmental issues; Potential benefits include better health, sustainable agriculture and reduced reliance on traditional plumbing. External variables that have significant impacts on sustainability include political changes and economic instability. Addressing these obstacles requires a multi-pronged strategy involving community participation, technical assistance and stricter regulations. Collaboration between the public and private sectors can close gaps and ensure that EcoSan systems are successfully implemented in Daulatpur Thana and other comparable regions to promote sustainable development and better public health.

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