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Roseline Joseph
Department of Environmental Sciences, Sharda School of Basic Sciences and Research Sharda University, Greater Noida, Uttar Pradesh, India

Josiah V Sando
Department of Environmental Sciences, Sharda School of Basic Sciences and Research Sharda University, Greater Noida, Uttar Pradesh, India

Robert G Nyemah
Department of Environmental Sciences, Sharda School of Basic Sciences and Research Sharda University, Greater Noida, Uttar Pradesh, India

Garima Nagpal
Department of Environmental Sciences, Sharda School of Basic Sciences and Research Sharda University, Greater Noida, Uttar Pradesh, India

Corresponding Author:
Garima Nagpal
Department of Environmental Sciences, Sharda School of Basic Sciences and Research Sharda University, Greater Noida, Uttar Pradesh, India

Survey on solid waste management and recycling practices in Girdharpur village, Greater Noida, U.P., India

Roseline Joseph, Josiah V Sando, Robert G Nyemah and Garima Nagpal

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Abstract
This study offers a detailed empirical assessment of solid waste management practices in Girdharpur Village, located in Gautam Buddha Nagar district, Uttar Pradesh, India. Grounded in the principles of the waste hierarchy and circular economy, it explores household-level behaviors particularly segregation, composting, and recycling within a rural context marked by infrastructural limitations and institutional gaps.

The research focused on three objectives: (i) examining prevailing waste segregation practices, (ii) assessing the environmental impact of current disposal methods, and (iii) identifying systemic, socio-cultural, and behavioral barriers to sustainable waste governance. A mixed-methods design ensured analytical depth and data triangulation. Quantitative data were collected from 75 randomly selected households through structured surveys. This was supplemented by semi-structured interviews with five key informants, field observations, and secondary data reviews.

Findings show that organic waste constitutes 76% of household waste, yet its management remains largely informal. Although 62.7% of households engage in composting, efforts are hampered by limited technical knowledge, seasonal challenges, and inadequate infrastructure. Regular waste segregation is practiced by only 9.3% of households, and participation in recycling initiatives is minimal. Additionally, 65.3% of households lack formal waste collection services, leading to open dumping and burning practices harmful to both the environment and public health.

Despite these challenges, the study found promising community engagement: 92% of respondents recognized the environmental harm of improper disposal, and 94.7% expressed willingness to join structured community waste programs. Key informants echoed these findings and stressed the urgency of decentralized systems supported by environmental education, infrastructure, and institutional backing. The study concludes that advancing sustainable rural waste management in India requires a multidimensional strategy involving behavior change, technical training, community participation, and policy integration tailored to local socio-economic realities.

Keywords: Waste management, segregation, composting, recycling, environmental impact, public health, organic waste, community participation, circular economy, Rural, Girdharpur Village

1. Introduction
Solid waste management constitutes a critical environmental and public health concern globally, particularly in developing countries where infrastructural limitations, institutional inefficiencies, and low levels of environmental awareness undermine effective waste handling. Rapid urbanization, population growth, and changing consumption patterns have led to a marked increase in the volume and complexity of waste generated. However, rural areas often remain marginalized in waste management discourse and policy implementation, resulting in severe ecological degradation and heightened health risks (Sharma & Patel, 2023) [4, 14, 25].

While urban centers benefit from formalized systems for waste collection, segregation, treatment, and disposal, rural communities typically rely on informal, unsustainable, and often hazardous practices. These include open dumping, unregulated burning, and rudimentary composting, all of which contribute to soil contamination, groundwater pollution, and deteriorating air quality. Although composting holds potential for organic waste management, it is commonly practiced without technical guidance or standardized procedures, thereby limiting its efficacy (Roy & Mehta, 2023; Kumar *et al*., 2022) [3, 13, 25, 2, 9, 21].

Furthermore, rural waste management challenges are deeply intertwined with socio-economic and gender disparities. Women, who often assume responsibility for household waste disposal, face structural barriers such as lower literacy levels, limited access to information, and minimal

involvement in community-level environmental decision-making processes. These constraints hinder the adoption of sustainable waste practices and exacerbate existing inequalities (Sharma *et al*., 2021) [5, 15].

In this context, the present study focuses on Girdharpur, a rural village situated in the Gautam BuddhaNagar district of Uttar Pradesh, India. The village lies approximately 8 kilometers from Greater Noida and encompasses a geographical area of 82.03 hectares. Despite its proximity to an urban hub, Girdharpur continues to exhibit characteristics typical of rural settlements, including an agrarian economy, modest infrastructure, and limited access to organized waste management services. According to the 2011 Census of India, the village hosts a population of 1,887 individuals, with significant gender disparities in literacy and participation in environmental initiatives (Census of India, 2011; VillageInfo, 2023) [1, 7, 6, 16].

Waste generation in Girdharpur fluctuates seasonally, largely driven by agricultural activities. During harvest periods, organic waste production increases, adding to the already unstructured nature of waste disposal. In the absence of formal waste collection services, households resort to self-managed disposal methods. Open dumping remains the most prevalent practice, with waste accumulating in vacant plots, along roadsides, and near water bodies, leading to environmental contamination and the proliferation of vector-borne diseases (Gupta & Verma, 2020) [8]. Burning of waste is another widely used method, contributing to air pollution and exacerbating respiratory conditions among vulnerable groups, particularly children and the elderly (Rai *et al*., 2019) [12]. While some households practice composting, the lack of technical guidance limits its efficiency, preventing it from serving as a viable long-term waste management solution.

Efforts have been made by local governing bodies and community organizations to improve waste management in the village. Awareness campaigns have been conducted to encourage waste segregation, composting has been promoted as an alternative to burning and dumping, and occasional cleanliness drives have been organized (Kumar & Singh, 2022) [2, 9, 21]. However, the impact of these initiatives has been limited due to several persistent challenges. Many residents remain unaware of the environmental and health consequences of improper waste disposal, and financial constraints hinder the establishment of a structured waste management system. Additionally, weak enforcement of regulations has prevented the implementation of consistent waste collection and recycling programs (Mishra & Sharma, 2023) [11].

Despite persistent challenges, there are substantial opportunities for transformative change in rural waste management systems. Advancing sustainable practices necessitates an integrated framework that aligns with the socio-economic conditions, behavioral tendencies, and cultural norms of the local population. Effective interventions must therefore be grounded in a thorough understanding of existing practices and community dynamics. This study seeks to investigate the current waste disposal practices in Girdharpur village, assess their environmental implications, and uncover the systemic and socio-cultural barriers that hinder sustainable waste management. The study further aims to generate insights that inform practical recommendations for policymakers, addressing the unique challenges encountered by rural communities in managing solid waste effectively. By producing empirically grounded findings, the research aspires to contribute meaningfully to the broader discourse on rural development and environmental sustainability, emphasizing inclusive and locally adaptive approaches.

1.1 Problem Statement

Despite growing awareness of environmental sustainability, waste management in rural areas remains an overlooked issue. The increasing use of non-biodegradable materials, especially plastics, has exacerbated the problem, as many rural areas lack adequate recycling facilities (Patel & Singh, 2024) [24]. The lack of segregation at the source further complicates the recycling process, leading to higher landfill dependency and environmental hazards. Studies indicate that ineffective waste management in rural settings is directly linked to rising cases of waterborne diseases, respiratory problems due to burning waste, and soil infertility caused by hazardous waste accumulation (Ellen MacArthur Foundation, 2023) [19].

In Girdharpur, waste management practices are largely informal, with households disposing of waste in open areas, water bodies, or through burning. While some community-led initiatives have attempted to introduce segregation and composting, the lack of government support, financial constraints, and limited community participation have hindered progress. This research seeks to explore the current waste management practices in Girdharpur, assess their environmental impact, and propose sustainable waste management solutions that align with local socioeconomic conditions.

1.2 Significance of the Study

This research is significant as it contributes to the growing body of knowledge on rural waste management, which is often underrepresented in environmental studies. The findings will provide valuable insights for policymakers, local authorities, and non-governmental organizations (NGOs) working to improve waste management in rural India. By highlighting the challenges and opportunities in Girdharpur, the study aims to influence the development of more inclusive and sustainable waste management policies at the local and national levels. Additionally, this research will serve as a reference for future studies on rural waste management and environmental sustainability.

1.3 Scope and Limitations

This study examines waste management practices in Girdharpur village, with a specific focus on waste segregation, composting, and recycling. Employing a mixed-methods approach**,** the research integrates both qualitative and quantitative data collection techniques to provide a comprehensive analysis.

Qualitative data were obtained through interviews, field observations, and focus group discussions**,** offering valuable insights into community perceptions, attitudes, and behavioral patterns related to waste management. Meanwhile, quantitative data were gathered through structured surveys**,** enabling an assessment of waste generation trends and household participation in waste management practices.

The study primarily evaluates the environmental impact of current waste disposal methods and identifies potential sustainable solutions. However, while policy recommendations are proposed, the research does not extend to a detailed financial assessment of large-scale waste management system implementation in rural settings. Additionally, the study is limited to Girdharpur village and may not fully represent waste management dynamics in other

rural communities with differing socio-economic and infrastructural conditions.

2. Literature Review

2.1 Overview of Waste Management Practices in Rural Settings

Waste management in rural areas varies significantly due to differences in infrastructure, awareness, and policy implementation. Unlike urban centers, where formal waste collection systems are more prevalent, rural areas often rely on informal or traditional methods of waste disposal, including open dumping, burning, and basic composting. Studies suggest that despite lower waste generation per capita in rural areas, improper disposal methods contribute to severe environmental issues. (Sharma & Patel, 2023) [4, 14, 26].

Community participation plays a crucial role in rural waste management. Recent research indicates that waste segregation and composting initiatives have gained traction in some villages, reducing landfill dependency and promoting circular waste practices. However, inconsistent policies and lack of financial incentives hinder widespread adoption. (Kumar *et al*., 2022) [2, 9,21].

Plastic waste accumulation is a growing concern in rural areas due to increased consumerism and inadequate disposal mechanisms. A study by Roy and Mehta (2023) [3, 13, 25] highlights that while awareness campaigns have improved waste segregation behaviors, infrastructural limitations prevent effective recycling, leading to continued plastic pollution in rural settings.

2.2 Theoretical Framework: Sustainable Waste Management Principles

This study is guided by the waste hierarchy framework: reduce, reuse, and recycle. This model emphasizes minimizing waste generation at the source, repurposing materials, and improving recycling infrastructure to limit landfill dependence. (Wilson, 2022) [28].

The Circular Economy Model has also gained prominence, promoting closed-loop waste cycles through sustainable product design and producer responsibility. Research suggests that adopting circular economy principles in rural waste management could optimize resource efficiency and reduce environmental impact. (Ellen MacArthur Foundation, 2023) [19].

Patel and Singh (2024) [24] argue that a transition to circular economy-based waste management in Indian villages requires policy support, financial incentives, and behavioral change among local communities to ensure long-term sustainability.

Case Studies on Effective Waste Management in Villages

Several recent case studies illustrate the effectiveness of innovative waste management strategies in rural settings:

- **Bihar, India**: A community-driven waste segregation project in a Bihar village led to a 40% reduction in landfill waste within two years. The initiative's success was attributed to extensive local engagement and government-supported financial incentives. (Das & Verma, 2023) [18].
- **Maharashtra, India**: In Maharashtra, an NGO-led composting initiative reduced organic waste accumulation and provided farmers with nutrient-rich compost, boosting agricultural productivity while mitigating waste-related environmental issues. (Joshi & Nair, 2022) [20].
- **Indonesia's Rural Waste Program**: A waste segregation initiative in rural Indonesia successfully improved plastic recycling rates by introducing village-operated waste collection centers. This model has been recommended for adaptation in Indian villages. (Suyoto *et al*., 2023) [27].

These case studies demonstrate that sustainable rural waste management relies on localized solutions, financial support, and strong community engagement.

2.3 Policies and Government Initiatives on Waste Management in India

The Indian government has recently introduced policies to strengthen waste management, particularly in rural areas:

- **Swachh Bharat Mission (SBM) - Phase II**: Launched in 2022, this initiative focuses on waste treatment infrastructure development in rural India. Early assessments indicate progress in village-level composting units but highlight challenges in plastic waste management. (Ministry of Housing and Urban Affairs, 2023) [23].
- **Solid Waste Management Rules (Amended, 2023)**: These updated regulations emphasize decentralized waste processing, promoting composting, and village-based recycling units. However, enforcement remains inconsistent across different states. (Central Pollution Control Board, 2023) [17].
- **Plastic Waste Management Rules (2024 Update)**: The latest amendments emphasize stricter regulations on single-use plastics and increased accountability for manufacturers under the extended producer responsibility (EPR) policy. While urban areas have seen improvements, rural adoption of plastic waste recycling remains limited. (MoEFCC, 2024) [23].

Despite these policy advancements, studies indicate that the effectiveness of waste management policies in villages depends on proper implementation, public awareness, and financial support. Girdharpur village, like many rural communities, faces challenges related to limited infrastructure, insufficient funding, and gaps in policy execution.

2.4 Gaps in Existing Literature

Existing research on rural waste management primarily addresses policies, community initiatives, and challenges but lacks depth in key areas. Policy implementation gaps, particularly enforcement inconsistencies, remain underexplored. While financial and infrastructural constraints are acknowledged, sustainable funding models and localized solutions receive little attention. Case studies often highlight short-term successes, yet long-term sustainability strategies are insufficiently examined. The practical integration of the circular economy model into rural waste systems requires further investigation. Additionally, research on cost-effective technological innovations for waste processing is limited. Behavioral and social factors influencing waste management practices remain underexplored, and a lack of cross-regional comparative studies restricts broader applicability.

2.5 Research Contribution

This study will contribute to address these gaps by analyzing waste segregation practices in Girdharpur village, assessing the environmental impact of waste disposal, and identifying barriers to sustainable waste management. It will provide insights into policy implementation challenges, propose cost-effective financial and infrastructural solutions, and explore

long-term sustainability strategies. Furthermore, the research will examine circular economy opportunities, the role of technology, and social factors influencing waste behavior. As a scalable case study, this research will contribute to improving rural waste management policies and practices in India, offering evidence-based recommendations for sustainable and adaptable solutions.

3. Research Objectives: Effective waste management is crucial for environmental sustainability, particularly in rural areas where infrastructure and policy enforcement may be limited. This study aims to contribute to the understanding of rural waste management by examining current practices, assessing environmental impacts, and identifying challenges to sustainability. Through a case study of Girdharpur village, this research seeks to generate insights that can inform policy interventions and practical solutions for waste management in similar rural contexts.

The specific objectives of this study are:

- To analyze waste segregation practices in Girdharpur village
- To examine the impact of waste management on the local environment
- To identify challenges and propose sustainable waste management improvements

3.1 Methodology

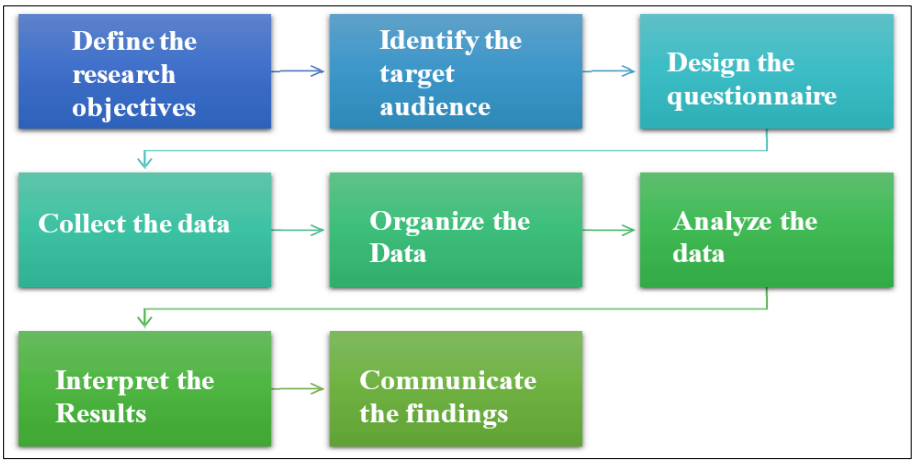


Fig 1: Structure

3.2 Research Design

This study employed a mixed-methods research approach, integrating both qualitative and quantitative methods to provide a comprehensive analysis of waste management practices in Girdharpur village. The research successfully captured both measurable trends and the lived experiences of residents, offering a holistic assessment of household waste behaviors, environmental impacts, and systemic challenges. The integration of quantitative and qualitative techniques facilitated data triangulation, enhancing both the validity and depth of the findings. While the quantitative component enabled the identification of statistical trends and behavioral patterns, the qualitative component allowed for the exploration of context-specific dynamics and perceptions that shape waste management practices in the village.

3.3 Study Population and Sampling Strategy

The study engaged 75 participants, including local households and key stakeholders involved in waste management. A hybrid sampling strategy, combining both purposive and random techniques, was used to ensure a balance of representativeness and contextual insight.

- Household Survey Sampling: A random sampling method was employed to select 75 households across diverse demographic and socio-economic backgrounds. These households constituted the primary units of analysis for the collection of quantitative data.
- Key Informant Selection: In addition to household surveys, five key informants were purposively selected based on their active involvement in community-level waste management initiatives. These informants included local leaders and stakeholders with relevant experiential knowledge. Their insights were critical in contextualizing household behaviors within broader socio-political and institutional frameworks.

Special emphasis was placed on capturing residents' subjective experiences to explore behavioral, cultural, and economic determinants of waste-related practices, thereby enriching the qualitative dimension of the study.

3.4 Data Collection Methods

Data were collected through a multi-method approach incorporating structured surveys, semi-structured interviews, field observations, and secondary data review. This combination enhanced the reliability and comprehensiveness of the data.

- Structured Household Surveys: A structured questionnaire was administered to the 75 randomly selected households. It included closed-ended questions to collect quantifiable data on practices such as waste segregation, composting, and recycling, and open-ended questions to elicit detailed insights on perceptions, challenges, and motivations.
- Key Informant Interviews: Semi-structured interviews were conducted with five purposively chosen informants. These interviews explored community-level waste governance, local cultural norms, and infrastructural challenges. The qualitative data were analyzed using thematic analysis, revealing recurring patterns and unique contextual challenges.
- Field Observations: Researchers conducted systematic observations at household and community levels. This involved documenting disposal methods, informal dumping sites, and visible environmental conditions (e.g., contamination, localized pollution). These observations served to validate and triangulate self-reported data.

- Secondary Data Review: Relevant secondary sources such as government policy documents, academic literature, and case studies on rural waste management in India were analyzed. These sources provided a comparative and policy-oriented context for interpreting primary data.

The multi-source data collection approach enabled a robust exploration of both observable practices and underlying community dynamics.

3.4.1 Data Analysis

Data analysis followed the study's mixed-methods framework, utilizing both statistical and thematic analytical techniques.

- **Quantitative Analysis:** Data from structured surveys were analyzed using descriptive and inferential statistics, enabling the identification of trends, correlations, and demographic patterns related to household waste practices.
- **Qualitative Analysis:** Open-ended survey responses, interview transcripts, and field notes were analyzed using thematic analysis. Emergent themes included barriers to effective waste management, community perceptions of sustainability, and drivers of behavioral change.

The combination of these analytical strategies ensured a multifaceted understanding of the waste management ecosystem in Girdharpur village, generating insights to inform context-appropriate and sustainable interventions.

The methodological framework adopted in this study was instrumental in generating a comprehensive and contextually grounded understanding of waste management practices in Girdharpur village. By leveraging a mixed-methods approach and triangulating data from diverse sources, the research was able to capture both the measurable and intangible dimensions of household and community-level waste behaviors. This rigorous methodology not only strengthens the credibility of the findings but also lays a strong foundation for evidence-based recommendations tailored to the specific needs and challenges of the study area.

3.5 Description of Study Area

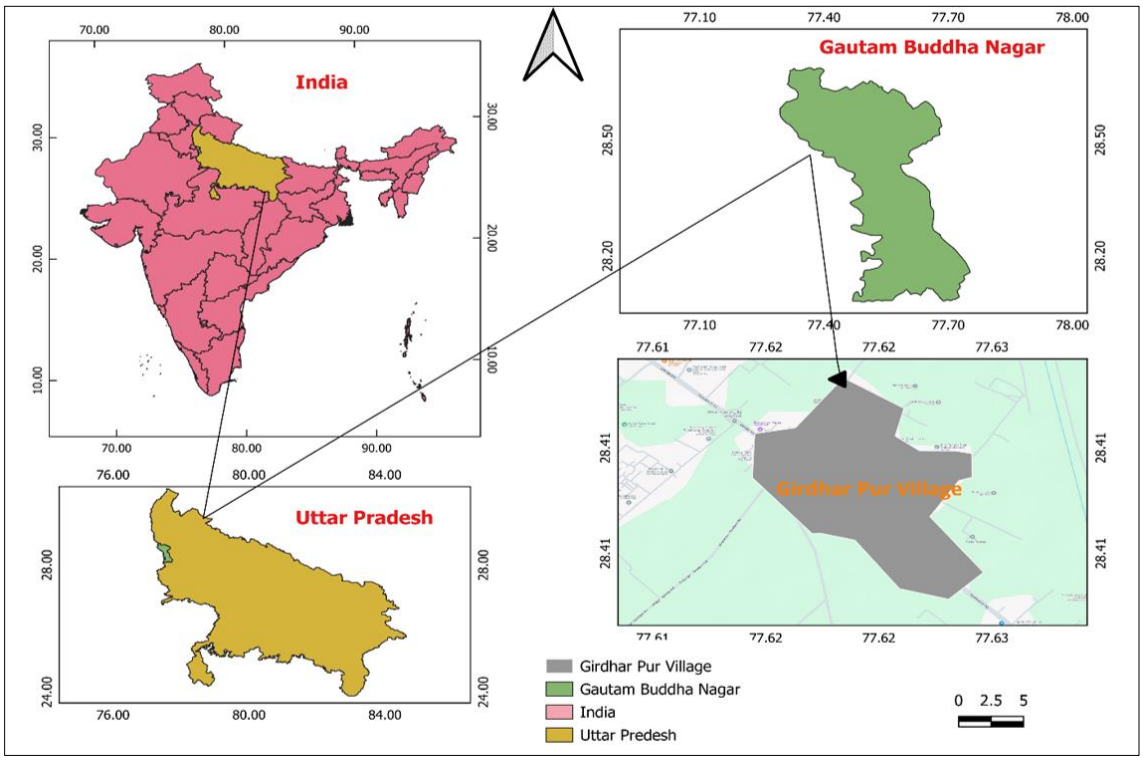


Fig 2: Country, State, District and Girdharpur Village map

The study was conducted in Girdharpur village, located in the Gautam Buddha Nagar district of Uttar Pradesh, approximately 8 kilometers from Greater Noida. As per the 2021 local administrative records, the village had a population of approximately 1,800 residents living in around 300 households, spread across an area of about 2.5 square kilometers. The local economy was primarily agrarian, with most residents engaged in farming, daily-wage labor, and small-scale trade.

Fieldwork was carried out on March 03, 2025. Girdharpur was purposively selected as the research site due to its lack of formal waste management infrastructure, continued reliance on traditional disposal methods such as open dumping and burning, and rising environmental and public health concerns. The absence of structured waste services, coupled with limited awareness and institutional support, made it a relevant case for exploring the challenges of rural waste management.

The village's proximity to urban Greater Noida further highlighted its transitional character and the potential spillover effects of urbanization on rural environmental practices. Overall, Girdharpur provided a representative context for assessing waste management behaviors, identifying system-level gaps, and exploring sustainable, community-based solutions applicable to similar rural settings across India.

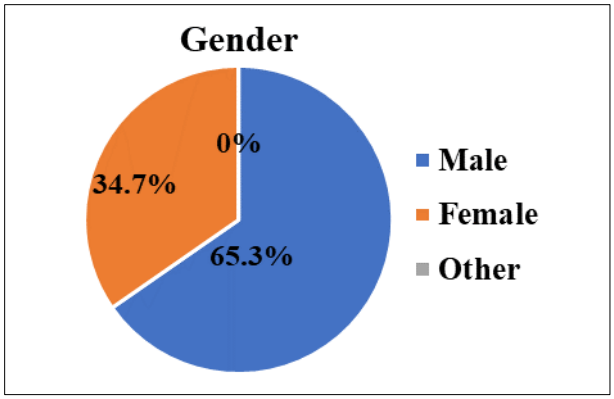
4. Data analysis and findings

4.1 Introduction

This section presents a comprehensive analysis of primary data collected from 75 households in Girdharpur Village, with the objective of addressing the study's key research

aims. It begins by examining the demographic structure, household composition, and socio-economic conditions of the respondents to establish the contextual framework within which waste management behaviors occur. The subsequent analysis explores household-level waste segregation practices, evaluates the perceived and observed environmental impacts of existing waste management systems, and identifies key challenges faced by the community. The findings are intended to inform the formulation of context-sensitive, sustainable waste management strategies grounded in local realities and community engagement.

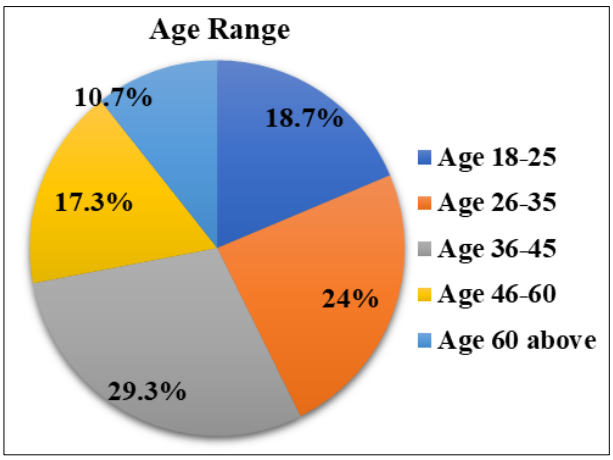
4.2 Data Analysis



Source: Field Survey Data, 2025

Fig 3: Distribution of Respondents by Gender

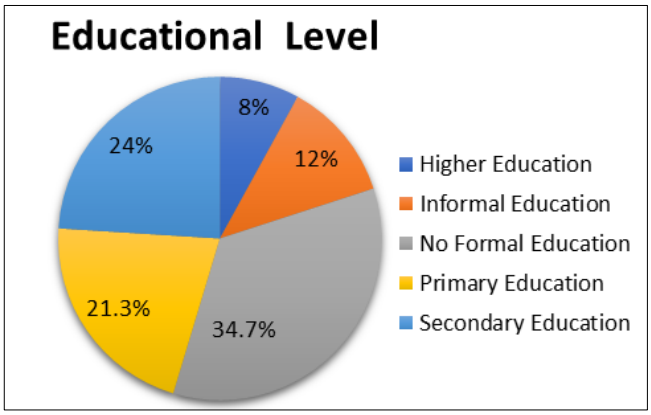
As illustrated in Figure 3, the gender distribution of survey respondents reveals a notable imbalance, with 65.3% identifying as male and 34.7% as female. No individuals identified as non-binary or other genders. This male-dominated response rate may reflect traditional gender roles in the village, where men are often the ones participating in formal surveys or public discussions. However, this presents a limitation when assessing waste management practices, as women typically manage household waste and may have valuable insights into daily segregation, composting, and disposal routines. Their limited representation could result in a partial understanding of the actual on-ground practices, and future programs should ensure more inclusive female participation to accurately address community waste management needs.



Source: Field Survey Data, 2025

Fig 4: Distribution of Respondents by Age Range

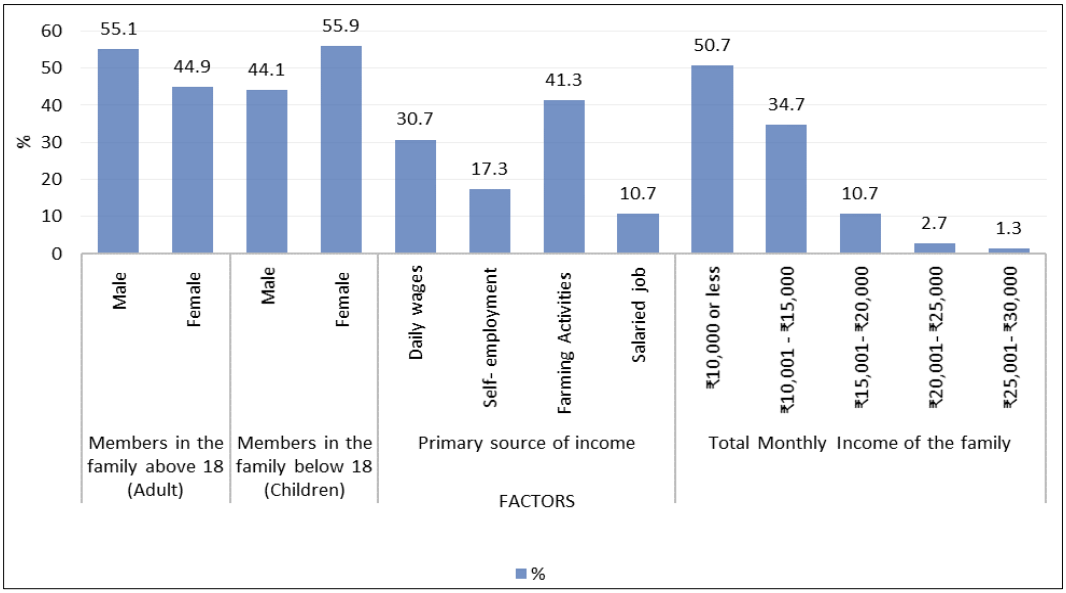
According to Figure 4, the survey respondents span a diverse age range, with the majority falling within the productive and working-age population (18-45 years). Specifically, 29.3% of respondents are aged 36-45 years, followed by 24% aged 26-35, and 18.7% aged 18-25. This youthful demographic is crucial for adopting and sustaining environmentally responsible practices such as waste segregation at source, composting of organic waste, and community-led recycling efforts. The remaining respondents included 17.3% between 46-60 years and 10.7% above 60 years, whose involvement provides a balance of maturity and traditional knowledge. This generational diversity is a strength, offering a mix of experience and adaptability that can drive behavioral change if engaged effectively through training and awareness drives tailored to different age groups.



***Source*:** Field Survey Data, 2025

Fig 5: Distribution of Respondents by Educational Level

As shown in Figure 5, the educational profile of respondents indicates significant gaps that could influence how waste management practices are understood and implemented. A substantial 34.7% of the population reported having no formal education, which may hinder comprehension of proper segregation techniques or the environmental benefits of composting and recycling. Nevertheless, 21.3% had primary education, and 24% had secondary education, suggesting a foundation on which practical, visual-based educational campaigns can be built. A smaller segment had informal education (12%) and higher education (8%), possibly making them suitable candidates for peer-led training or community facilitator roles. Given these figures, it becomes clear that simplified, hands-on awareness strategies are necessary for promoting sustainable waste management behaviors across educational levels in Girdharpur.



Source: Field Survey Primary Data, 2025

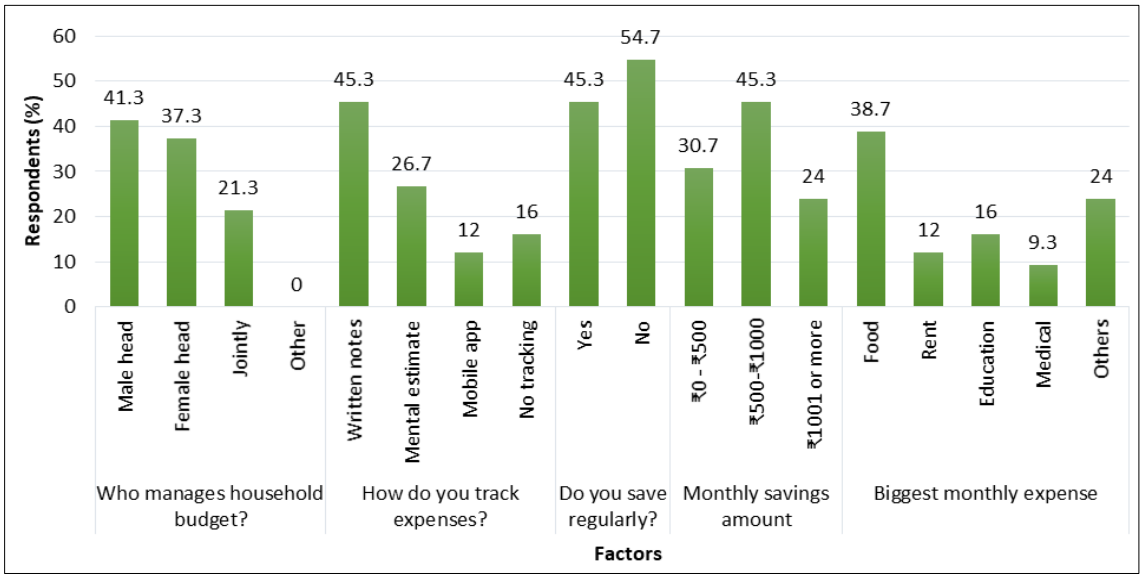
Fig 6: Socio-Economic and Household Profile of Respondents

Figure 6 outlines the socio-economic and demographic characteristics of 75 households surveyed in Girdharpur Village, providing a foundational understanding of the structural factors influencing household waste management behaviors, including segregation, composting, and recycling. Across these 75 households, a total of 488 individuals were identified, comprising 225 adults and 263 children under the age of 18. Among the adult population, 55.1% were male and 44.9% female. In contrast, the child population exhibited a reverse trend, with 44.1% male and 55.9% female. This balanced demographic composition underscores the importance of integrating environmental education within local schools, fostering early and lasting behavioral change among the youth.

In terms of livelihoods, agriculture emerged as the principal income source for 41.3% of households, followed by daily wage labor (30.7%), self-employment (17.3%), and salaried employment (10.7%). The heavy reliance on agriculture and informal work highlights a degree of economic vulnerability, which may pose challenges to the adoption of capital-intensive waste management technologies. However, this also creates a strategic opportunity for promoting low-cost, decentralized solutions such as composting, which are well-suited to the agrarian lifestyle and existing resource base.

Household income levels further reflect these economic limitations. Over half (50.7%) of the households earn ₹10,000 or less per month, while 34.7% fall within the ₹10,001-₹15,000 range. Only a small minority report monthly incomes exceeding ₹15,000. With more than 85% of households living below a modest income threshold, there is a critical need for affordable and locally adapted waste management solutions.

Overall, the findings reveal that Girdharpur Village is predominantly composed of low-income, agrarian households with a demographically balanced population. These conditions call for a bottom-up, community-based approach to waste management one that emphasizes environmental awareness, inclusive participation, and economic empowerment. Particular focus should be placed on engaging women, youth, and children, while promoting sustainable, cost-effective practices that align with local livelihoods and foster long-term environmental resilience.

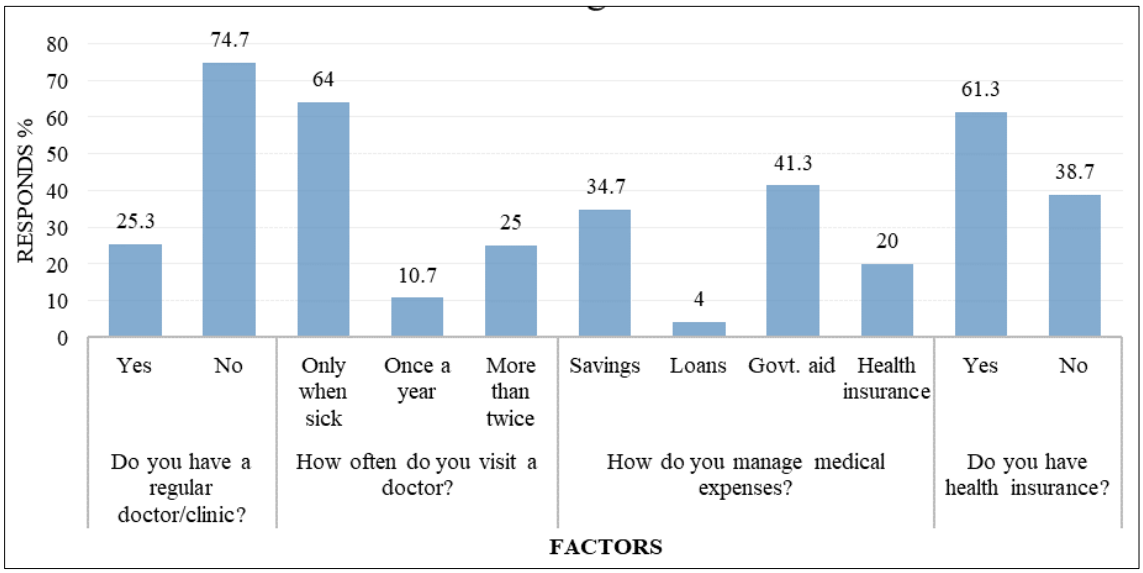


Source: Field Survey Primary Data, 2025

Fig 7: Household Financial Management and Expenditure Practices in Girdharpur Village

Figure 7 outlines household-level financial management practices in Girdharpur Village, focusing on budget control, savings behavior, and expenditure tracking. Financial decision-making is primarily undertaken by male heads (41.3%), though female-led (37.3%) and jointly managed (21.3%) households reflect moderate gender inclusivity.

Regarding expense tracking, 45.3% of households use written records, 26.7% rely on mental estimates, and only 12% utilize digital tools. Notably, 16% lack any tracking mechanism, pointing to gaps in financial literacy. Regular saving is uncommon, with 54.7% not following a consistent savings plan. Among those who save, 45.3% set aside ₹500-1000 monthly, 30.7% less than ₹500, and 24% over ₹1000, indicating limited financial buffers. Food constitutes the largest monthly expense (38.7%), followed by education (16%), rent (12%), and healthcare (9.3%), with 24% citing miscellaneous costs. The findings reveal that while some households in Girdharpur Village demonstrate structured financial management practices, a considerable proportion lack systematic tracking and savings mechanisms. These findings point to the need for targeted financial inclusion programs that promote budgeting skills, digital financial tools, and savings awareness to enhance long-term economic resilience.



***Source*:** Field Survey Data, 2025

Fig 8: Household Healthcare Practices in Girdharpur Village

The medical and healthcare profile of Girdharpur Village, as delineated in Figure 8, reveals critical disparities in access, utilization patterns, and healthcare financing mechanisms. Among the 75 households surveyed, only 25.3% reported regular access to a doctor or clinic, while 74.7% lacked consistent medical support. This limited access underscores infrastructural deficiencies and potential barriers such as economic constraints, geographical inaccessibility, and limited health literacy factors frequently associated with rural and peri-urban settings.

Health-seeking behavior within the community is predominantly reactive rather than preventive. A substantial proportion (64%) reported seeking medical care only during episodes of illness, whereas a mere 10.7% engaged in routine annual check-ups, and 25% reported more frequent visits. This trend reflects a low uptake of preventive healthcare services, which may contribute to delayed diagnoses and adverse health outcomes. Healthcare financing in Girdharpur exhibits a heavy reliance on public support, with 41.3% of households depending on government assistance. Additionally, 34.7% reported utilizing personal savings, while only 20% had access to health insurance. A marginal 4% resorted to loans, highlighting financial vulnerability and the absence of comprehensive risk-pooling mechanisms. Although 61.3% of households reported some form of health insurance coverage, 38.7% remained uninsured, thereby increasing their exposure to catastrophic health expenditures. These findings underscore the imperative to strengthen the rural healthcare delivery framework through the expansion of accessible and affordable primary healthcare services, the promotion of preventive health behaviors, and the enhancement of health insurance coverage. Targeted policy interventions in these domains are essential to improving health resilience and advancing equitable health outcomes in underserved communities such as Girdharpur Village.

Table 1: Educational Access and Prioritization among Households in Girdharpur

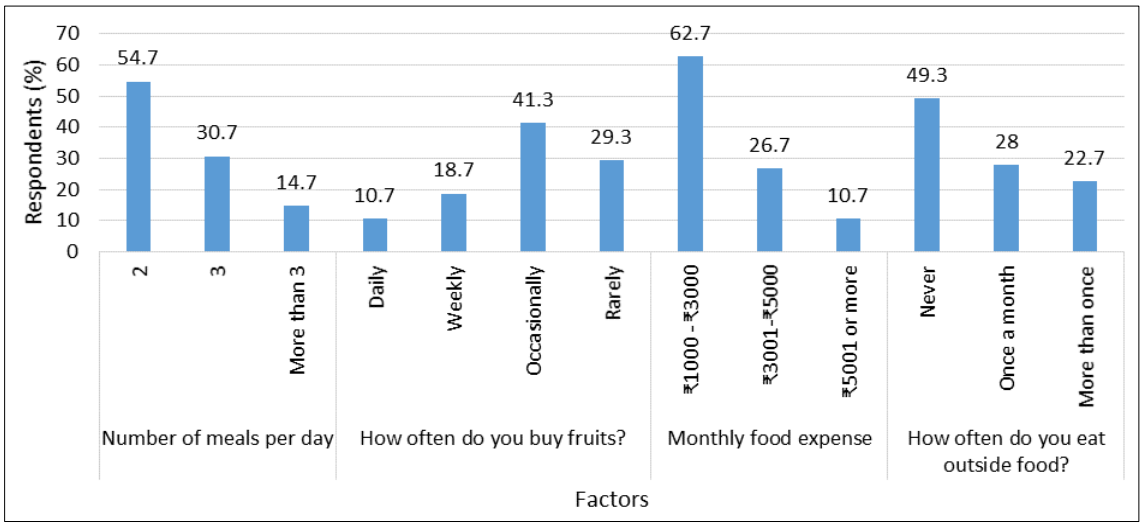
Factors	Description	Frequency	%
How many children go to school?	Male	48	18.3%
	Female	22	8.4%
	None	193	73.4%
Type of school attending?	Govt. school	54	20.5%
	Private school	16	6.1%
	Not attending	193	73.4%
Do you pay for tuition/coaching?	Yes	9	12%
	No	14	18.7%
Monthly cost of education per child	₹0 - ₹500	33	44%
	₹501 -₹1000	24	32%

	₹1001 or more	18	24%
Is there any school in your area	Government School	31	41.3%
	Private School	23	30.7%
	ICDS School	11	14.7%
	Not Sure	10	13.3%
Are all you family members can read and write	Yes	18	24%
	No	57	76%
Is education prioritized over other expenses?	Yes	7	9.3%
	No	68	90.7%

***Source*:** Field Survey Data, 2025

Table 1 highlights significant educational gaps in Girdharpur Village, particularly in school attendance, literacy, and educational investment. Only 26.7% of children attend school 18.3% male and 8.4% female while 73.4% are not enrolled, with the gender disparity pointing to additional barriers for girls. Of the school-going children, 20.5% attend government schools and 6.1% private schools, indicating heavy reliance on public institutions, likely due to financial constraints. Educational spending is low: 44% of households spend ₹0-₹500 per child monthly, 32% spend ₹501-₹1,000, and only 24% exceed ₹1,000. Just 12% reported tuition or coaching expenses. In terms of access, 41.3% reported a nearby government school, 30.7% a private one, and 14.7% an ICDS center, though 13.3% were unaware of any local options signaling gaps in infrastructure or awareness. Literacy remains a challenge, with 76% of households lacking full literacy and only 9.3% prioritizing education over other expenses.

These findings reflect systemic underinvestment in education, shaped by socio-economic limitations. Policy measures that expand access, raise awareness, subsidize costs, and promote inclusive education are crucial to bridging these gaps.



***Source*:** Field Survey Data, 2025

Fig 9: Dietary Patterns, Nutritional Intake, and Food Expenditure among Households in Girdharpur Village

Figure 9 offers a comprehensive overview of the dietary practices and associated food expenditure patterns of households in Girdharpur Village. The data reveal that a majority of respondents (54.7%) consume two meals per day, with 30.7% consuming three meals and only 14.7% reporting more than three meals daily. This distribution suggests varying degrees of food security and may indicate underlying socioeconomic disparities influencing meal frequency. Fruit consumption patterns further underscore nutritional challenges within the community. Only 10.7% of households reported purchasing fruits daily, whereas 41.3% do so occasionally and 29.3% rarely. These figures may point to limited affordability, accessibility, or awareness of the nutritional importance of fruit intake, potentially affecting overall dietary quality and health outcomes.

In terms of monthly food expenditure, a significant proportion (62.7%) of households reported spending between ₹1000 and ₹3000. Approximately 26.7% indicated spending between ₹3001 and ₹5000, and only 10.7% exceeded ₹5000. These data suggest a constrained food budget for most households, possibly linked to income levels and household size, which may impact dietary diversity and nutritional adequacy. The frequency of outside food consumption appears relatively low, with 49.3% of respondents stating they never eat food prepared outside the home. An additional 28% reported doing so once a month, and 22.7% more frequently. This limited reliance on external food sources may be attributed to financial prudence, cultural food practices, or concerns over hygiene and food safety.

Collectively, these findings highlight critical areas for nutritional interventions and policy support, particularly concerning meal sufficiency, fruit and vegetable access, and overall food security.

Table 2: Household Sanitation and Hygiene Practices Girdharpur Village

Factors	Description	Frequency	%
Frequency of buying hygiene products	Weekly	8	10.7
	Monthly	15	20
	Only when needed	52	69.3

Access to clean drinking water?	Yes	48	64
	No	27	36
Functional toilet at home?	Yes	33	44
	No	42	56
Regular use of cleaning products?	Yes	28	37.3
	No	47	62.7
Hygiene-related health issues?	Yes	51	68
	No	24	32

***Source*:** Field Survey Data, 2025

Table 2 highlights hygiene and sanitation challenges in Girdharpur Village, with 69.3% purchasing hygiene products only as needed, reflecting irregular practices due to economic or awareness constraints. Only 10.7% buy them weekly. Sanitation access remains limited 36% lack clean drinking water, and 56% have no functional toilet, increasing health risks. Only 37.3% use cleaning products regularly, while 68% report hygiene-related health issues, reinforcing the link between poor sanitation and health concerns.

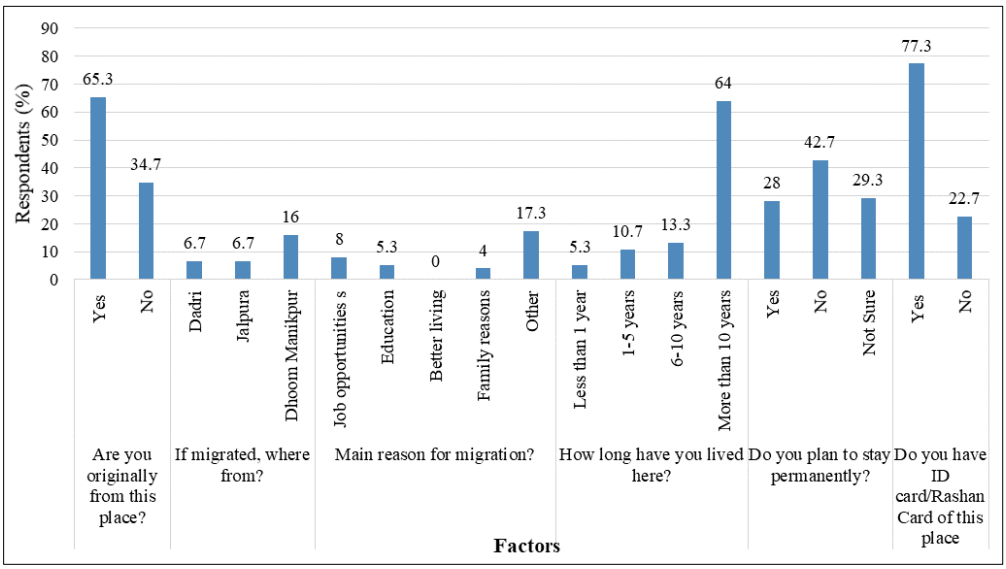
These findings underscore the need for community-driven hygiene programs, improved sanitation infrastructure, and behavioral interventions to promote sustainable hygiene practices.

Table 3: Household Insurance, Savings, and Financial Security in Girdharpur Village

Factors	Description	Frequency	%
Do you have life insurance?	Yes	37	49.3
	No	38	51.4
Do you participate in any government savings/insurance	Yes	43	57.3
	No	32	42.7
Type of Government schemes	Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY)	23	30.7
	Pradhan Mantri Suraksha Bima Yojana (PMSBY)	20	26.7
How would you manage an unexpected expense?	Savings	22	29.3
	Loan	9	12
	Help from family	38	50.7
	Other	6	8
Do you feel financially secure?	Yes	28	37.3
	No	47	62.7
Interested in financial literacy training?	Yes	56	74.7
	No	19	25.3

***Source*:** Field Survey Data, 2025

Table 3 presents key insights into the financial preparedness of households in Girdharpur Village. Nearly half (49.3%) of respondents reported having life insurance, while 51.4% lacked any coverage, indicating significant gaps in financial protection. Encouragingly, 57.3% were enrolled in government-sponsored schemes, with 30.7% under the PMJJBY and 26.7% in PMSBY, reflecting moderate engagement with financial inclusion programs. In response to financial emergencies, 50.7% rely on family support, 29.3% on savings, and 12% on loans highlighting a reliance on informal systems and limited financial resilience. Only 37.3% of households reported feeling financially secure, whereas 62.7% expressed economic vulnerability. However, 74.7% showed interest in financial literacy training, suggesting strong potential for capacity-building initiatives. These findings underscore the need for targeted interventions that enhance financial literacy, expand micro-insurance access, and promote structured savings to support long-term financial stability in rural areas.



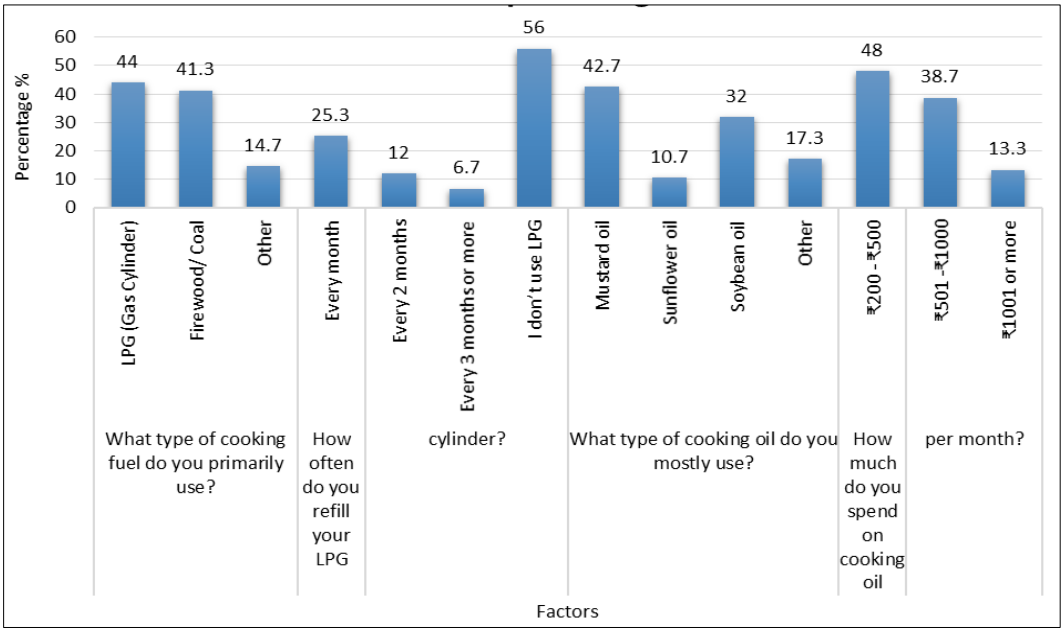
***Source*:** Field Survey Data, 2025

Fig 10: Household Migration, Origin and Access to Legal Documentation

Figure 10 analyzes migration patterns, settlement duration, and administrative inclusion in Girdharpur Village. It shows that 34.7% of residents are migrants, mainly from nearby villages like Dhoom Manikpur (16%), Jalpura (6.7%), and Dadri (6.7%). Migration drivers include employment (8%) and education (5.3%), while 17.3% cited other socio-economic reasons.

Regarding settlement, 64% of households have lived in the village for over a decade, yet only 28% plan to stay permanently, while 42.7% do not and 29.3% remain uncertain. This transience impacts community development and planning.

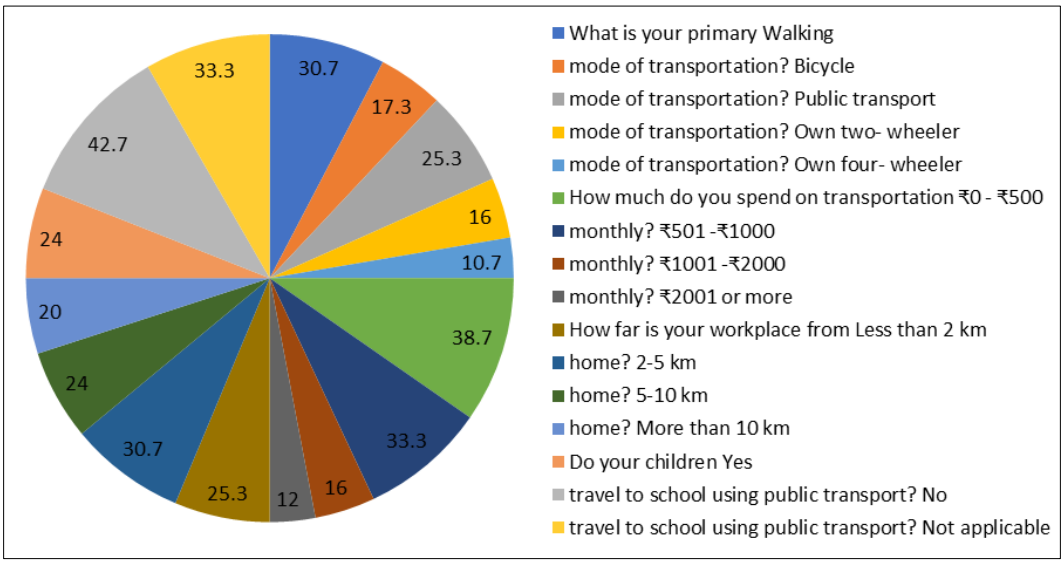
Institutional inclusion is notable, with 77.3% holding local identification essential for public services, but 22.7% lack documentation, posing access challenges. These findings highlight the need for policy efforts to improve bureaucratic inclusion and social protection.



***Source*:** Field Survey Data, 2025

Fig 11: Patterns of Cooking Fuel Usage and Edible Oil Consumption and Their Implications for Waste Management in Girdharpur Village

Figure 11 shows cooking fuel and edible oil usage in Girdharpur Village, revealing environmental challenges. While 44% of households use LPG, 41.3% still depend on biomass fuels like firewood and coal, contributing to indoor air pollution and ash waste. Although LPG is available, 56% don't use it regularly, and only 25.3% refill monthly, pointing to economic and infrastructure barriers. The lack of electric or kerosene stove usage further limits clean cooking options. Mustard oil is most commonly used (42.7%), followed by soybean (32%) and sunflower (10.7%), typically packaged in plastic. With 86.7% of households spending ₹200-₹1000 monthly on oil, plastic waste is increasing. These patterns highlight the need for better waste segregation, composting, and recycling systems. Initiatives like repurposing ash for agriculture and collecting used oil containers can help reduce environmental impact and support sustainable rural development.



***Source*:** Field Survey Data, 2025

Fig 12: Transportation and Mobility Patterns in Girdharpur Village

Figure 12 shows that walking (30.7%) and bicycling (17.3%) are the main transport modes in Girdharpur Village, reflecting affordability issues and a compact layout. Public transport serves 25.3%, while private vehicle ownership is low 16% own two-wheelers and 10.7% own four-wheelers. Most households (72%) spend under ₹1,000 monthly on transport, and 56% work within 5 km, though 20% travel over 10 km, indicating unequal job access.

Only 24% of children use public transport for school, 42.7% don't, and 33.3% marked "not applicable," pointing to concerns around affordability, safety, or distance. These trends call for better non-motorized infrastructure, affordable transit options, and stronger links between transport, education, and employment to support rural development.

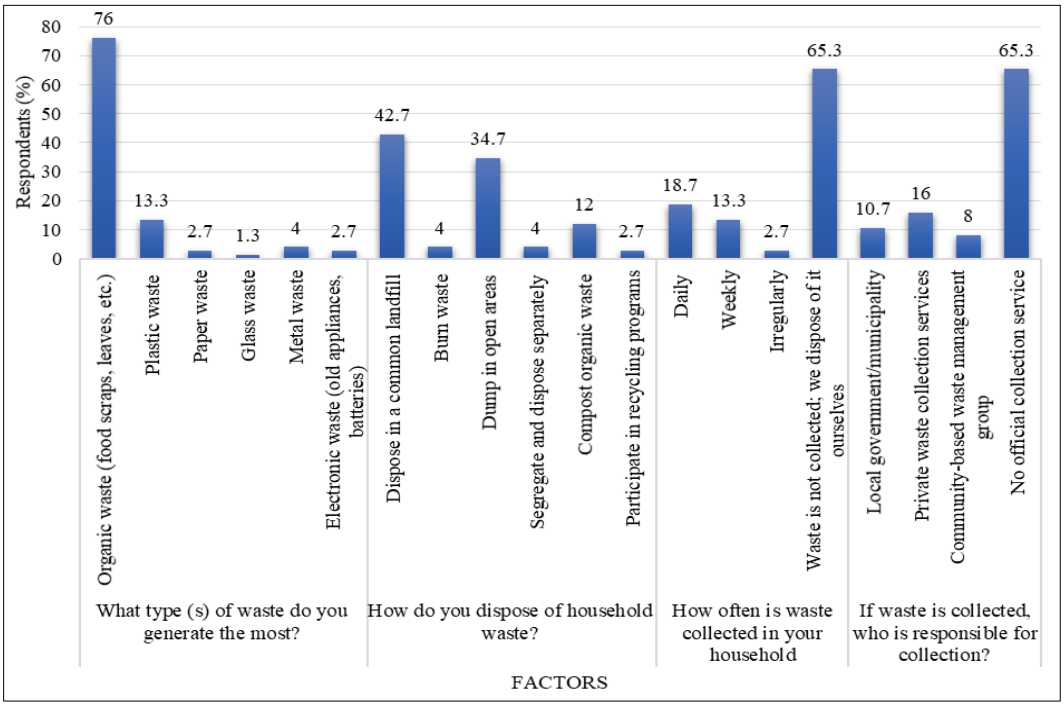
Table 4: Public Awareness, Access, and Utilization of Government Welfare Schemes in Girdharpur Village

Factors	Description	Frequency	%
Have you heard about any government schemes Such as:	Pradhan Mantri Awas Yojana (Housing)	52	69.3
	Ayushman Bharat (Healthcare)	64	85.3
	PM Garib Kalyan Anna Yojana (Free food grains)	39	52
	MGNREGA (Employment)	51	68
	National Social Assistance Programme (Pension) Other (Please specify)	47	62.7
How did you learn about these schemes?	TV/Radio/ Newspaper	13	17.3
	Social media	15	20
	Word of mouth	17	22.7
	Government offices	14	18.7
	NGO/Community group	16	21.3
Have you or anyone in your family benefited from any government scheme?	Yes	48	64
	No	27	36
Did you find the application process easy or difficult?	Very easy	13	17.3
	Manageable	16	21.3
	Difficult	25	33.3
	Gave up hallway	21	28
What are the main challenges you faced?	Lack of information	13	17.3
	Complicated process	27	36
	No proper guidance	24	32
	Corruption or middlemen involved	11	14.7

***Source*:** Field Survey Data, 2025

Table 4 shows that awareness of government welfare schemes in Girdharpur Village is fairly high 85.3% know of Ayushman Bharat, 69.3% of PM Awas Yojana, and 68% of MGNREGA reflecting effective outreach. Awareness sources include word of mouth (22.7%), NGOs (21.3%), traditional media (17.3%), and digital platforms (20%), emphasizing the value of multi-channel communication. While 64% of households benefited from at least one scheme, only 38.6% found the application process easy; most faced difficulties or gave up.

Barriers included complex procedures (36%), lack of guidance (32%), limited information (17.3%), and reports of corruption or intermediaries (14.7%). These gaps highlight the need for simpler processes, better information access, and stronger local support to improve program reach and effectiveness.

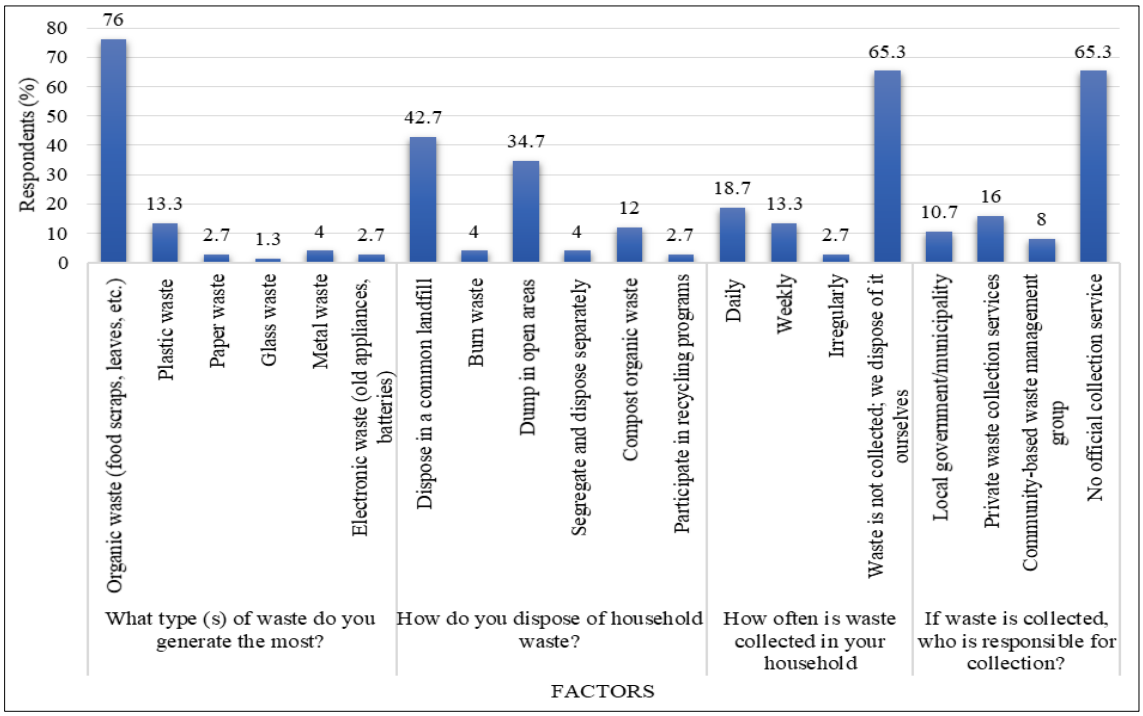


***Source*:** Field Survey Data, 2025

Fig 13: Household Waste Generation, Disposal Practices, and Waste Collection Systems in Girdharpur Village

Figure 13 shows that most households in Girdharpur Village generate mainly organic waste (76%), followed by plastic (13.3%), with minimal paper, metal, glass, and e-waste. Hazardous waste was not reported, likely due to underreporting or low awareness. Disposal is mostly informal common landfill use (42.7%) and open dumping (34.7%) dominate, while composting (12%), segregation (4%), and recycling (2.7%) remain rare. Waste burning (4%) persists despite its environmental harm.

Waste collection is largely absent, with 65.3% lacking formal services. Limited daily (18.7%) and weekly (13.3%) pickups, plus irregular collection (2.7%), point to service gaps. Responsibility is fragmented across private agencies (16%), municipal bodies (10.7%), and community groups (8%). These trends highlight the need for better governance, education on waste segregation, and decentralized waste systems to improve sustainability and health outcomes.



***Source*:** Field Survey Data, 2025

Fig 14: Waste Segregation and Recycling Practices in Girdharpur Village

Figure 14 reveals low household engagement in waste segregation and recycling in Girdharpur Village. Only 9.3% consistently segregate waste, while 26.7% do so occasionally; 64% do not segregate at all. Among those who do, focus is mainly on organic waste (29.3%), with little attention to recyclables (4%), hazardous (1.3%), or e-waste (1.3%). Key barriers include lack of awareness (49.3%), no separate bins (26.7%), and poor waste collection (16%), along with time constraints and other minor factors.

Recycling awareness and participation are also limited only 18.7% were aware of recycling, and just 9.3% actively participated. Most non-participants (70.7%) cited lack of knowledge, followed by inadequate facilities (12%) and no incentives (8%). Few households recycle plastic (4%), paper/cardboard (2.7%), or metal (2.7%), with no reported glass or e-waste recycling. These findings highlight major gaps driven by informational and infrastructural issues, calling for targeted education, better tools, local recycling systems, and policy support.

Table 5: Household Composting Practices in Girdharpur Village

Factors	Description	Frequency	%
Do you practice composting at home?	Yes	47	62.7
	No	28	37.3
If no, what are the reasons for not composting?	Lack of knowledge	13	17.3
	Lack of space	0	0
	Not interested	8	10.7
	No perceived benefits	2	2.7
	Other	5	0
If you compost, what materials do you include?	Food scraps	21	28
	Garden waste (leaves, grass, etc.)	14	18.7
	Paper waste	0	0
	Other	12	16
How do you use the compost?	For home gardening	19	25.3
	Sell or donate it	17	22.7
	Other	11	14.7

***Source*:** Field Survey Data, 2025

Table 5 presents data on composting behaviors among households in Girdharpur village, highlighting the extent of engagement and key influencing factors. A majority of the respondents (62.7%) reported practicing composting at home, indicating a moderate level of awareness and participation in sustainable waste management initiatives. However, 37.3% of the surveyed population did not compost, citing reasons such as lack of knowledge (17.3%), disinterest (10.7%), and a perceived lack of benefits (2.7%).

Among households that do compost, the most commonly utilized materials included food scraps (28%) and garden waste such as leaves and grass (18.7%). Notably, no respondents reported composting paper waste, although 16% included other biodegradable materials. Regarding the application of compost, respondents reported using it primarily for home gardening (25.3%) or selling/donating it (22.7%), while 14.7% indicated other forms of usage.

These findings suggest a promising foundation for advancing community-level composting programs, while also identifying clear gaps in knowledge and engagement that could be addressed through targeted education, resource support, and extension services.

Table 6: Perceived Environmental Impact and Community Awareness in Girdharpur Village

Factors	Description	Frequency	%
Do you believe that improper waste disposal affects the local environment?	Yes	69	92.0
	No	7	9.3
If yes, what are the most common environmental problems caused by poor waste management in your village?	Water pollution (contaminated rivers and streams)	2	2.7
	Air pollution (burning waste)	38	50.7
	Soil contamination	0	0
	Increased spread of diseases and pests	0	0
	Unpleasant odor and aesthetic issues	23	30.7
	Other	6	8
How do you think waste management practices can be improved in your village?	More frequent waste collection services	13	17.3
	Awareness campaigns on waste segregation and recycling	29	38.7
	Government or community-led composting programs	18	24
	Incentives for recycling participation	3	4
	Construction of proper waste disposal facilities	12	16
	Other	0	0
Are you willing to participate in a community waste management program?	Yes	71	94.7
	No	4	5.3
If yes, how would you like to contribute?	Volunteering for waste collection efforts	26	34.7
	Spreading awareness and educating others	31	41.3
	Participating in recycling initiatives	14	18.7
	Other	0	0

***Source*:** Field Survey Data, 2025

Table 6 presents respondents' perceptions of the environmental impacts of improper waste management and their willingness to engage in local interventions. A significant majority (92.0%) recognized that poor waste disposal harms the environment, indicating strong environmental awareness. Air pollution from open waste burning was the most cited issue (50.7%), followed by unpleasant odours and visual degradation (30.7%). Fewer respondents mentioned water pollution (2.7%), and none identified soil contamination or disease transmission, suggesting limited awareness of these indirect effects.

When asked about improving waste practices, the most suggested measure was awareness campaigns on segregation and recycling (38.7%), followed by composting programs (24.0%), more frequent waste collection (17.3%), and better disposal infrastructure (16.0%). Only 4.0% highlighted incentives for recycling. Encouragingly, 94.7% expressed willingness to engage in community initiatives, primarily through awareness efforts (41.3%), waste collection volunteering (34.7%), and recycling activities (18.7%). These findings underscore the potential for fostering participatory environmental stewardship through targeted community mobilization strategies.

4.3 Thematic Analysis

To develop a comprehensive understanding of household-level solid waste management practices in Girdharpur Village, a thematic analysis was conducted based on qualitative data obtained from open-ended survey responses. To enhance the depth and validity of the finding's, semi-structured interviews were also carried out with five key informants possessing relevant knowledge and lived experience within the community. This triangulated qualitative approach enabled the identification of salient themes and recurring patterns related to waste generation, disposal methods, segregation practices, composting behaviors, and environmental awareness. Table 7 presents a consolidated thematic representation of the principal findings derived from this analysis.

Table 7: Thematic Analysis of Solid Waste Management in Girdharpur Village

Theme	Key Insights	Challenges Identified	Respondents Quotes
Waste Generation and Disposal	Households primarily generate organic waste (food scraps, agricultural residues) with some inorganic waste (plastics, glass, metals). Organic waste is reused or composted, while plastic waste is often burned or dumped.	Absence of structured collection services, environmental hazards from open burning, and lack of designated disposal sites.	"We compost vegetable peels, but plastic is hard to manage without collection services."
Waste Segregation and Recycling	Limited practice of segregation; some efforts made to separate biodegradable and non-biodegradable items. Recycling is minimal due to lack of facilities.	Lack of awareness, infrastructure, and economic incentives for segregation and recycling.	"We just throw everything in one pile… no one taught us how to recycle."
Composting Practices	Many respondents compost organic waste for use in fields and gardens. Composting is seen as beneficial	Space limitations, pest issues, seasonal challenges (e.g., rain),	"We have a compost pit, but during the rainy season,

	for farming.	and lack of proper composting equipment.	it floods and becomes unusable."
Environmental Impact and Community Awareness	Residents express concern about pollution from burning and dumping waste. There is awareness of negative effects on air, soil, and water quality.	Insufficient infrastructure, poor community coordination, and harmful disposal habits.	"Plastic waste is affecting our crops and water… we need better ways to manage it."
Recommendations and Participation	Strong willingness to engage in better practices if resources, training, and systems are provided. Calls for government intervention, youth involvement, and public education.	Lack of external support, tools (e.g., bins, bags), and community-led programs.	"If we had bins and a recycling system, people would stop dumping everywhere."

***Source*:** Field Survey Data, 2025

Table 7 presents a thematic analysis of household waste management practices in Girdharpur Village. Five key themes emerged: waste generation and disposal, waste segregation and recycling, composting practices, environmental impact and community awareness, and recommendations for improvement.

The analysis reveals that while organic waste is largely reused through composting or livestock feeding, the lack of a formal waste collection system leads to environmentally harmful practices such as burning plastic. Waste segregation is limited due to low awareness and absence of infrastructure, reflecting a critical barrier to recycling efforts. Composting is relatively common, but challenges such as space constraints, pests, and seasonal disruptions limit its efficiency. Environmental concerns, particularly pollution and health risks, are widely recognized, showing a growing awareness among residents. Importantly, participants demonstrated a willingness to adopt better practices if provided with appropriate support, including bins, collection services, and education campaigns. These analysis underscores the need for integrated, community-led waste management strategies that are supported by local authorities and environmental education.

4.4 Field Observations: To strengthen the validity and contextual depth of the study, systematic field observations were conducted alongside household surveys and key informant interviews. These observations served to triangulate self-reported data and offered empirical insight into prevailing waste management practices, infrastructural deficiencies, and their environmental implications within Girdharpur Village. Through structured on-site assessments, the research team documented routine household and community-level waste disposal behaviors, identified informal waste accumulation zones, and evaluated observable environmental impacts, including soil degradation, water contamination, and substandard sanitary conditions.

A critical observation emerged regarding the inadequacy of the existing landfill site, which lacks engineered containment infrastructure such as impermeable liners or leachate collection systems. The absence of such safeguards facilitates the percolation of leachate generated from the decomposition of mixed waste into the surrounding soil and groundwater. This uncontrolled leachate migration poses considerable ecological and public health risks by introducing potentially hazardous contaminants that compromise soil quality, reduce agricultural viability, and pollute potable water sources.

***Source*:** Field Survey Data, 2025

Fig 15: Landfill in Girdharpur Village

5. Discussion, Conclusions and Recommendations

5.1 Discussion

5.1.1 Key Findings

The analysis of data collected from 75 households in Girdharpur Village reveals a complex interplay of socio-economic factors and waste management practices that shape the community's environmental behaviors. The demographic profile shows a male-dominated respondent pool (65.3%),

with limited female participation, which reflects traditional gender roles in rural India. This gender imbalance presents a limitation, as women typically manage household waste, and their underrepresentation may affect the accuracy of understanding actual waste practices. The population is predominantly young, with a majority in the productive working age group (18-45 years), presenting an opportunity to engage this demographic in sustainable waste initiatives.

The educational profile is mixed but offers promise. While 34.7% of respondents reported having no formal education, 57.3% had attained primary, secondary, or informal education, providing a foundational base upon which practical, hands-on educational campaigns can be effectively implemented. Only 8% had higher education, which suggests a need for simplified, visual approaches to community training. Economically, Girdharpur is largely agrarian, with most households reliant on farming (41.3%) or daily wage labor (30.7%). Financially, the majority are income-constrained, with over half earning ₹10,000 or less per month and 85.4% earning below ₹15,000. This economic vulnerability highlights the importance of low-cost, community-based waste solutions such as composting.

Organic waste dominates household waste streams (76%), which is consistent with agricultural lifestyles. However, waste disposal methods remain largely informal, with 42.7% using a communal landfill and 34.7% dumping waste in open areas. Only 12% of households compost, and formal waste segregation and recycling are virtually absent. Waste collection services are inadequate, with 65.3% of households managing waste independently. These infrastructural gaps contribute to environmentally harmful practices such as waste burning an issue cited by 50.7% of respondents as a major environmental concern.

Despite these challenges, environmental awareness is relatively high. A significant 92% of respondents acknowledged that improper waste disposal negatively affects the environment. Encouragingly, 94.7% expressed willingness to engage in community-based waste management efforts through volunteering, awareness-raising, or recycling. This indicates strong potential for participatory and locally driven interventions. Composting practices, adopted by 62.7% of households, primarily involve food scraps and garden waste and are often linked to home gardening or local sale. However, composting faces constraints such as limited space, pest infestations, and seasonal disruptions, particularly during the monsoon.

Recycling remains a minimal practice. Only 9.3% of households reported any involvement in recycling, and 81.3% were unaware of recycling initiatives. The primary barriers include lack of knowledge (70.7%), infrastructure (12%), and absence of incentives. These gaps highlight the need for targeted awareness campaigns and improved access to recycling facilities.

Qualitative thematic analysis and field observations reinforce these quantitative findings. Respondents expressed concern over the environmental impacts of open dumping and burning but pointed to the absence of segregation infrastructure and collection services as core barriers. Field assessments revealed that the local landfill lacks essential containment systems, including leachate management, posing risks to soil and water quality.

5.1.2 Linking Findings to Theoretical and Conceptual Framework

The study's findings reflect key principles of the waste hierarchy and circular economy frameworks, which promote reducing, reusing, and recycling to limit landfill use. In Girdharpur Village, 76% of household waste is organic, and 62.7% of households compost, showing some alignment with these models. However, composting is mostly informal and faces challenges like poor infrastructure and seasonal flooding, revealing gaps in technical and institutional support. Recycling efforts are even weaker only 9.3% of households participate, with over 70% citing lack of knowledge, showing limited application of circular economy practices.

These gaps underscore the need for integrated solutions that combine infrastructure, education, and supportive policies, as emphasized by Patel and Singh (2024) [24]. Although most residents (92%) recognize the dangers of poor waste management, regular segregation remains low at 9.3%, constrained by factors like limited education (34.7%) and low income (85.4% earn under ₹15,000/month). Still, the strong willingness (94.7%) to join community-led initiatives signals potential for culturally adapted, locally driven solutions if backed by sustained policy efforts and investment.

5.2 Conclusion

In conclusion, this study provides a comprehensive assessment of household-level waste management practices in Girdharpur Village, with an emphasis on segregation, composting, and recycling, and evaluates their broader implications for environmental sustainability in rural settings. The findings reveal that while environmental awareness among residents is relatively high, this has not been effectively translated into sustainable waste practices due to several interrelated constraints namely, limited infrastructure, low levels of technical and institutional support, and insufficient public knowledge regarding waste segregation and recycling. Composting emerges as the most commonly practiced form of waste management, particularly for organic waste, indicating a viable point of intervention for promoting circular economy strategies. However, its efficacy remains limited by seasonal and technical challenges, including poor compost pit design and a lack of extension services. In contrast, recycling and segregation practices are significantly underdeveloped, hindered by a lack of awareness, absence of appropriate facilities, and fragmented waste collection systems.

Importantly, the study highlights a strong willingness within the community to participate in structured waste management programs, and 57.3% of the population possesses at least basic formal education two critical factors that can be leveraged to foster locally grounded, participatory solutions. These findings underscore the need for decentralized, community-based models of waste governance that are not only technically sound but also socially inclusive and economically feasible. Ultimately, the study concludes that sustainable rural waste management must be embedded within the socio-economic and cultural context of the community. Technical solutions alone are insufficient; they must be accompanied by behavioral interventions, capacity building, inclusive policy design, and active community engagement. Despite the existing limitations, Girdharpur Village is well-positioned to benefit from targeted, integrated, and participatory interventions that support the transition toward a more sustainable and resilient waste management system.

5.3 Recommendations

Based on the study's findings, the following recommendations are proposed to improve waste management in Girdharpur and similar rural areas:

5.3.1 Local Governance and Panchayati Raj Institutions:
1. Establish effective waste collection systems with trained community members
2. Develop micro-scale infrastructure for composting, such as compost pits and bins, and initiate community-based composting units to foster local waste processing.
3. Monitor informal dumping sites and environmental risks regularly.

5.3.2 State and National Policymakers
1. Expand the Swachh Bharat Mission (Phase II) to include decentralized waste processing and recycling in rural areas.
2. Provide financial incentives for households adopting composting and waste segregation.
3. Strengthen regulations on open dumping and burning, focusing on supportive enforcement

5.3.3 Non-Governmental Organizations (NGOs) and Educational Institutions
1. Launch community-specific awareness programs using visual and peer-led methods.
2. Integrate environmental education into local schools to foster sustainable practices.
3. Empower women and youth to lead local waste management efforts.

5.3.4 Private Sector and Corporate Social Responsibility (CSR) Stakeholders
1. Support mobile recycling units or material recovery facilities in partnership with local communities.
2. Distribute waste segregation kits to low-income households to support segregation and composting practices

5.4 Limitations of the Study
Despite offering valuable insights, this study is subject to certain limitations that must be acknowledged:

1. **Geographic Scope:** The research is geographically confined to Girdharpur Village and may not be fully representative of other rural areas, which may exhibit different economic, cultural, and infrastructural characteristics.
2. **Temporal Constraints:** The study was conducted over a limited period, which may not account for seasonal variations in waste generation and behavior, potentially limiting the comprehensiveness of the findings.
3. **Gender Representation:** The study's sample had a higher proportion of male respondents, which may not adequately reflect the perspectives and roles of women in waste management activities. This imbalance could lead to an underrepresentation of women's experiences and contributions in this context.

Suggestions for Future Research
Building on the findings of this study, future research could explore the following directions:

1. **Comparative Studies:** Conduct comparative research across multiple rural sites to identify broader patterns and variations in waste management practices, considering the diversity of economic and cultural contexts.
2. **Cost-Benefit Analysis:** Develop a comprehensive cost-benefit analysis of decentralized waste management systems, which could serve as a valuable tool for policymakers in designing efficient and sustainable fiscal plans for waste management.
3. **Gendered Dimensions:** Explore the gendered aspects of rural waste management more explicitly, examining women's participation, indigenous knowledge systems, and the specific constraints they face in engaging with waste management practices.
4. **Digital Platforms and Technology:** Investigate the role of digital platforms and mobile technologies in enabling community-level waste tracking, reporting, and awareness. Such technologies could offer innovative solutions for enhancing waste management practices and community engagement.

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