Turning Waste into Wealth: Exploring Sustainable Plastic Management Pathways in Karisimbi Commune, Goma City, DRC

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ABSTRACT

This study examined the potential and challenges for sustainable plastic waste management in Karisimbi Commune, Goma City, North Kivu Province in DRC. It aimed to identify infrastructural and institutional gaps, assessed community attitudes and practices, explored local recycling initiatives, and proposed improvement strategies. Using a mixed-method approach involving surveys, interviews and observations, the study founded major infrastructural shortcomings, notably poor waste collection systems, limited sorting and recycling facilities, and difficult access in densely populated areas. Findings showed that most respondents agreed there were a lack of designated plastic waste collection points (Mean = 3.33; SD = 1.40), indicating a strong perception of inadequate infrastructure, further exacerbated by weak policy enforcement and limited institutional capacity. Although awareness of plastic waste hazards is high, unsustainable behaviors persist. Nonetheless, local initiatives such as NGOs partnerships, youth-led cleanup campaigns, and informal recycling efforts demonstrated growing community engagement. The study recommended decentralized waste governance, strengthened public-private partnerships and environmental education to enhance sustainable plastic waste management and urban environmental resilience in Karisimbi commune and beyond.

Keywords: Plastic waste, sustainable development, infrastructure gaps, community solutions, waste management.

INTRODUCTION

Plastic waste pollution has become one of the most significant environmental threats of the 21st century, particularly in rapidly urbanizing areas of developing countries. The increasing pace of urban population growth, coupled with insufficient waste management infrastructure and weak enforcement of environmental policies, has intensified the accumulation of plastic waste in African cities (Kamana et al., 2024). As a result, urban environments are facing severe ecological degradation, clogged drainage systems and heightened public health risks, posing serious challenges to sustainable urban development.

In the Democratic Republic of Congo (DRC), this problem is especially evident in major cities such as Goma, where the commune of Karisimbi experiences growing pressure due to ineffective plastic waste management systems. Although environmental regulations exist, limited institutional capacity and poor policy enforcement have hindered their implementation, allowing plastic waste to accumulate in open areas and waterways (Pandey et al., 2023). This growing crisis not only threatens environmental balance but also jeopardizes human health and urban resilience, as communities are increasingly exposed to pollution and sanitation-related diseases (Mapanzi et al., 2022).

Specifically, the research focuses on the role of infrastructure and community participation in improving waste management practices. It seeks to identify the main barriers hindering efficient waste collection and recycling systems, evaluate the awareness and behavioral patterns of the local population toward plastic waste and examine community initiatives that promote recycling, reuse and environmental stewardship (Kwemoi, 2025).

By integrating these dimensions, the seeks to highlight how community engagement, local innovation and improved infrastructure can work together to reduce plastic waste and promote environmental sustainability. It further underscores the need for decentralized waste governance, public-private partnerships, and locally tailored environmental education programs that empower citizens to take an active role in managing waste responsibly. Ultimately, the study contributes to the ongoing discourse on urban environmental governance in sub-Saharan Africa, providing insights that may inform sustainable waste management strategies in Goma and similar urban contexts across the region (Pandey et al., 2023).

This research intended to achieve the following specific objectives:

1. Identify the main gaps that hinder the effective management of plastic waste in Karisimbi Commune.

2. Assess the attitudes, practices, and level of awareness of the local population regarding plastic waste management and its impact on sustainable development.

3. Examine existing community initiatives aimed at reducing plastic waste and promoting recycling or reuse in Karisimbi Commune.

4. Propose policy and infrastructure recommendations for sustainable plastic waste management in Karisimbi Commune based on the findings.

Although no prior research has examined plastic waste management specifically in Goma, existing studies conducted in the DRC and globally have offered useful insights into the assessment of challenges and opportunities for sustainable plastic waste management (Kwemoi, 2025; Pandey et al., 2023; Ferronato et al., 2024). These studies highlight the importance of infrastructure, policy frameworks, community participation, and innovative recycling approaches in addressing plastic pollution. This study bridges that gap by providing a localized assessment of Karisimbi Commune, analyzing infrastructure deficiencies, evaluating community awareness and engagement, and identifying practical, context-specific strategies to enhance sustainable waste management practices.

LITERATURE REVIEW

This section reviews key theoretical frameworks underpinning the assessment of challenges and opportunities for sustainable plastic waste management systems in Karisimbi Commune, Goma City. It draws on several foundational theories that provide insight into the social, institutional, and behavioral dimensions of waste management. Among these, systems theory, Theory of Planned Behavior (TPB), and stakeholder theory are particularly central to this study.

According to Karmagatri et al. (2024), Systems Theory views society as a network of interdependent parts in which the performance of one element affects the entire system. In the context of plastic waste management, this means that inefficiencies in infrastructure, weak regulation, or low public participation can disrupt the whole waste management chain. The theory underscores the need for a holistic and coordinated approach that integrates social, institutional, and technological components to ensure system sustainability.

The Theory of Planned Behavior (TPB), as discussed by Si et al. (2019), provides a behavioral framework for understanding how individuals' attitudes, social norms, and perceived control influence their environmental actions. It explains why awareness of plastic pollution does not always translate into responsible behavior unless individuals feel supported by community expectations and have access to adequate waste management resources.

Similarly, Stakeholder Theory emphasizes inclusiveness and shared responsibility among all actors involved in waste management governments, NGOs, private sectors, and community groups (Koech, 2023a). The theory highlights that sustainable solutions depend on collaboration and participatory decision-making where each stakeholder's contribution is valued.

Together, these theories form an integrated framework for understanding the multifaceted nature of plastic waste management in Karisimbi, linking systemic coordination, human behavior, and stakeholder collaboration as key factors in achieving environmental sustainability.

Perception on waste management

Public perception critically shapes the success of waste management initiatives (Utami et al., 2024). In many societies, waste is still viewed as a governmental issue rather than an individual responsibility, reducing participation in segregation and recycling (Mugobo et al., 2022; Gebrekidan et al., 2024). However, growing environmental awareness has fostered the perception of waste as a resource that supports a circular economy (Sesay & Fang, 2025). Accessibility and convenience of services influence engagement, as user-friendly systems encourage participation. Trust is also pivotal, citizens must believe that their efforts in waste separation are meaningful (Nema et al., 2021). Communities near disposal sites often hold negative views due to pollution and health risks (Mapanzi et al., 2022). Ultimately, education and awareness campaigns are essential to build positive perceptions, promote responsible behavior and frame waste management as a shared responsibility for sustainable living (Nema at al.,2021).

Waste management practices

Waste management involves the systematic handling of waste through collection, transportation, processing, recycling and disposal to minimize its environmental and health impacts (Gebrekidan et al., 2024). Core practices include source reduction, which focuses on minimizing waste generation through product design and sustainable consumption (Amasuomo, 2021), and reuse, which extends the life of materials through repeated use or repurposing. Recycling remains central, converting waste into new products to conserve resources and reduce pollution (Darko et al., 2023a). For non-recyclable waste, treatment and disposal methods such as composting, incineration, and landfilling are applied. Composting transforms organic waste into useful soil nutrients (Pandey et al., 2023), while incineration generates energy but raises emission concerns (Gebrekidan et al., 2024). Landfilling, though still common, poses environmental risks, greenhouse gas emissions as such and groundwater contamination (Bukasa et al., 2020). These practices are structured within the waste hierarchy, prioritizing prevention, reuse, recycling, recovery, and disposal (Sesay & Fang, 2025).

Policy and governance mechanisms

To create sustainable waste management systems, the institutional and regulatory environment is essential. According to the World Bank, many African cities, particularly those in the Democratic Republic of Congo, lack comprehensive plastic waste management policies and enforcement mechanisms. (Kaza et al., 2018).

Regulations are often outdated or ill-suited to the plastic economy, and waste governance is dispersed across multiple agencies. According toBank Group, 2024), it was found that the lack of legislative incentives for private sector investment and recycling innovations left a vacuum that discouraged government participation. As a result, plastic waste management is often entrusted to inadequately trained local government agencies or unorganized and unprotected actors (Sesay & Fang, 2025). Finally, the DRC has promulgated the law banning the production, importation, marketing and use of plastic bags, sachets, films and other non-biodegradable plastic packaging (Bruno Tsibala Nzenzhe, 2018).

Gaps in waste management

Despite technological progress, waste management faces major gaps related to infrastructure, awareness, financing and governance (Brown & Ikiriko,2025). Developing countries often lack adequate collection systems, modern recycling facilities, and engineered landfills, leading to open dumping and burning (Sihaloho & Rusliadi, 2025). Public participation remains low due to limited education and awareness about waste segregation and recycling (Meelan et al., 2024). Financial constraints also hinder progress, as many municipalities lack sufficient budgets or sustainable funding mechanisms (Uche, 2023). Policy weaknesses including outdated regulations and poorly enforced laws further exacerbate inefficiencies, especially where extended producer responsibility schemes are absent (Kwemoi, 2025). Specialized waste streams such as e-waste and medical waste remain poorly

managed, often handled informally at significant environmental and health costs (Brown & Ikiriko,2025). Finally, inadequate data collection and monitoring systems restrict effective planning and evaluation of waste management programs (Nema et al.,2021).

Theoretical review

The Theory of Planned Behavior (TPB) explains that human behavior is influenced by attitudes, social norms, and perceived behavioral control, which together determine an individual's intention to act. In the context of environmental practices, TPB helps to understand why individuals may or may not engage in proper waste management, recycling, or plastic disposal(Roche Cerasi et al., 2021). For instance, in Karisimbi Commune, a resident may be aware of the health and environmental risks caused by plastic pollution, but awareness alone does not guarantee responsible behavior. Behavior change becomes more likely when individuals not only recognize the benefits of proper waste management but also feel social encouragement and believe they have the necessary means, such as access to bins or collection services, to act effectively (Si et al., 2019).

This theory is particularly relevant to the study on Challenges and Opportunities for Sustainable Plastic Waste Management in the DRC. It provides a framework for identifying the psychological and social barriers that hinder sustainable practices and highlights the need for supportive social norms and adequate infrastructure. TPB emphasizes that effective interventions should go beyond awareness creation by fostering a sense of empowerment and collective responsibility. Through community-based awareness campaigns and improved waste management systems, individuals can develop both the motivation and the perceived control necessary for sustainable behavior change in Karisimbi (Si et al., 2019).

Stakeholder Theory, as described by Koech (2023a), it asserts that organizations and systems should address the needs and concerns of all groups affected by their actions, not just shareholders. In plastic waste management, stakeholders include community members, NGOs, private waste firms, government agencies, and informal recyclers. The theory underscores that sustainable waste management can only be achieved through the engagement and collaboration of these diverse actors. It promotes shared responsibility, teamwork and participatory decision-making to ensure that every stakeholder contributes to effective environmental outcomes (Koech, 2023a).

This theory directly is much linked to the study in the direction of where limited government capacity and weak institutional frameworks make stakeholder collaboration essential. Informal groups such as youth associations, women's cooperatives, and local recyclers play a crucial role in managing waste and filling institutional gaps. Stakeholder Theory thus provides a lens for understanding how inclusive partnerships between formal and informal actors can enhance sustainability. By fostering cooperation and empowering local participants, the theory highlights both the challenges of weak institutional support and the opportunities for building resilient, community-driven waste management systems in Karisimbi (Koech, 2023a).

METHODOLOGY

Research Design

The research design provides a comprehensive explanation of the research design, population and sampling methods, data collection techniques, tools used and the approaches adopted for data analysis. The research employed a descriptive cross-sectional survey design to assess the challenges and opportunities for sustainable plastic waste management in Karisimbi Commune. This design was chosen because it allows for the collection and analysis of data from a population at a single point in time, providing a comprehensive snapshot of the existing waste management practices, community perceptions, and infrastructural gaps.

Population and sample

The target population for this research included household heads and local waste management stakeholders residing in Karisimbi Commune. The population was estimated at 96874 households, which formed the sampling

frame for the study. The average household size of six people was considered along with the demographic data for 2024 to determine the total number of households (INS North-Kivu, 2024) .

The sample size was calculated at a 90% confidence level using the formula provided by the Sample Size Calculator tools available on Sample Size Calculator by Raosoft, Inc.

$$.Sampling\ size = \frac{\frac{z^2*p(1-p)}{e^e}}{1+(\frac{z^2*p(1-p)}{e^2\ N})}$$; In short words, n= n_0=$\frac{z^2*p(1-p)}{e^e}$

And n=$\frac{n_0}{\frac{1+n_0}{N}}$, where Z=1.96 for 90% confidence level is 1.645,

$z^2 = (1.645)^2$=2. 2706025; $p(1-p)$=0.25 and $e^2 = (0.05)^2 = 0.0025$

n_0=$\frac{2.2706025x0.25}{0.0025}$=270.6025$\approx 270\ households$,

z = 1.96; e (error) = 0.05; p= 0.5 and N = 96874 household

The average household size of six people was considered along with the demographic data for 2024 to determine the total number of households. Thus, data were collected from 286 households, considered representative of the entire study population. The average household size in the province is slightly higher (5.5) than that of the country as a whole (5.3) in the DRC (PNUD, 2024).

Data collection instruments

The study employed a mixed-methods primary data collection approach, combining both quantitative and qualitative techniques to ensure comprehensive and credible findings (Taherdoost, 2021; Creswell, 2009). The main quantitative instrument was a structured questionnaire administered to 286 respondents, containing both closed and open-ended questions that explored household plastic waste practices, awareness, infrastructure gaps and community engagement. The questionnaire was divided into sections based on the study objectives and utilized a 5-point Likert scale ranging from Strongly Agree (5) to Strongly Disagree (1) to quantify attitudes and perceptions for statistical analysis (Joshi et al., 2015). Additionally, semi-structured interviews were conducted with key informants such as local government officials, waste collectors, and community-based organization leaders to gather qualitative insights. This triangulated approach enhanced the richness, validity, and reliability of the study's findings (Creswell, 2009).

Validity and Reliability

The validity and reliability of the research instruments were carefully assessed to ensure accuracy and consistency in data collection. Validity, which measures how well an instrument captures what it intends to measure (Borsboom et al., 2004), was ensured by aligning all questionnaire items with the study objectives and ensuring clarity for respondents. The Content Validity Index (CVI) was calculated using the formula CVI = n/N, resulting in a value of 0.70, which exceeds the acceptable threshold of 0.5, indicating that the questionnaire was valid. Both face validity and construct validity were also considered to ensure the instrument effectively measured community perceptions, awareness and practices related to plastic waste management. Reliability, defined as the stability and consistency of measurement results (Bonzio et al., 2021), was tested using Cronbach's alpha in SPSS, yielding a value of 0.82**,** which signifies a high level of internal consistency. This confirms that the Likert-scale items were reliable and effectively measured the intended constructs.

Data analysis

The data analysis in this study was conducted systematically using SPSS version 25**,** ensuring both statistical rigor and alignment with the study objectives on sustainable plastic waste management in Karisimbi Commune. Descriptive statistics such as frequencies and percentages were used to summarize demographic data and

respondents' knowledge, attitudes, and practices while cross-tabulations examined relationships between socio-economic factors and waste management behaviors. The reliability of the questionnaire was confirmed with a Cronbach's alpha score of 0.82, indicating strong internal consistency. Quantitative findings were complemented by thematic analysis of open-ended responses and results were presented for clarity. This mixed-method analytical approach provided comprehensive and evidence-based insights into the challenges and opportunities for sustainable plastic waste management within the community.

Ethical considerations

Participants were clearly provided with detailed information about the study objectives, procedures, risks and benefits before obtaining their consent to participate.

Findings related to the research objectives

This section deals with the findings of the study and their equivalent discussions, which derive from data gathered from Karisimbi commune respondents. The analysis of this data aligns closely with the predefined-specific objectives of the study, providing valuable insights into various aspects of the assessment of challenges and opportunities for sustainable plastic waste management.

To identify and analyze key infrastructure gaps.

The first objective of this study was to assess infrastructural and institutional gaps. To achieve this objective, the respondents were asked to rate the items that describe the infrastructure and administration influence by using five-point Likert scales namely Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D) and Strongly Disagree (SD).

Table 1. Identification and analysis of key infrastructure gaps that hinder effective plastic waste management.

No	Statement	SA	A	N	D	SD	Mean	S Dev
1	There is a lack of designated plastic waste collection points in my area.	71	82	46	43	44	3.33	1.40
2	The roads and access roads in my area are a hindrance to waste collection trucks.	201	79	0	6	0	4.66	0.59
3	The local authority provides adequate waste collection services.	0	0	16	90	180	1.43	0.60
4	There are insufficient bins or plastic waste storage facilities in my community.	184	76	3	22	1	4.47	0.88
5	The current plastic waste management system is effective in my neighborhood.	17	11	8	97	153	1.75	1.09

Source: Field data, 2025

The findings of Table 1 revealed that infrastructure gaps significantly hinder effective plastic waste management in Karisimbi Commune. Most respondents agreed that their areas lack designated plastic waste collection points (Mean = 3.33; SD = 1.40) and that poor road conditions severely obstruct waste collection efforts (Mean = 4.66; SD = 0.59). Similarly, a large majority strongly agreed that there are insufficient bins or storage facilities for

plastic waste (Mean = 4.47; SD = 0.88). Conversely, respondents overwhelmingly disagreed that local authorities provide adequate waste management services (Mean = 1.43; SD = 0.60) and rated the current plastic waste management system as ineffective (Mean = 1.75; SD = 1.09). These results highlight consistent dissatisfaction with municipal performance and widespread acknowledgment of critical infrastructure deficiencies.

Overall, the mean score of 3.13 indicates moderate but predominantly negative perceptions across the study area, with road access and availability of bins identified as the most pressing challenges. The mean standard deviation of 0.91 reflects moderate variation in responses, suggesting that while a few neighborhoods may have slightly better conditions, the overall infrastructure and institutional support remain inadequate. These findings align with national trends in the DRC, where cities like Kinshasa face similar challenges, limited collection coverage, insufficient storage facilities, and deteriorating roads that hinder waste collection (Utami et al., 2024). Collectively, the results underscore the urgent need for infrastructure development, improved municipal capacity and community-driven solutions to promote sustainable plastic waste management in Karisimbi.

To Assess community awareness, attitudes and practices.

The second objective of the study was to evaluate community awareness, level of attitude and practices. Respondents were asked to rate the statements labelling the assessment of community awareness and attitudes regarding plastic waste in Karisimbi by using five-point Likert scales like Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree to capture their insights.

Table 2. Assessment of community awareness and attitudes regarding plastic waste.

S/N	Statement	SA	A	N	D	SD	Mean	S Dev
1	I am aware of the negative environmental impacts of plastic waste.	122	32	0	98	34	3.38	1.58
2	I am aware of the health risks associated with burning or spilling plastic.	123	53	14	74	9	3.76	1.35
3	I actively try to reduce the use of plastic in my household.	0	5	0	130	151	1.51	0.60
4	Plastic waste is one of the main environmental problems in this community.	162	111	7	6	0	4.50	0.65
5	My household separates plastic waste from other types of waste.	6	21	1	115	143	1.71	0.95
6	Community members are sufficiently informed about plastic waste management.	83	53	3	60	87	2.95	1.67

Source: Field data, 2025

Based on the survey results in table 2, the data analysis reveals that while awareness of plastic waste issues is relatively high among residents of Karisimbi, actual behavioral practices remain significantly low. Most respondents (mean = 3.38 and 3.76) acknowledged understanding the environmental and health impacts of plastic waste, indicating a generally informed community. However, the large standard deviations (1.58 and

1.35) suggest uneven awareness levels across different groups. Likewise, almost all respondents (mean = 4.50) strongly agreed that plastic waste is a serious environmental problem in their community, reflecting a strong collective perception of its importance.

Despite this high awareness, the results show a sharp decline in action-oriented behaviors. Respondents reported very low engagement in reducing plastic use (mean = 1.51) or separating plastic waste at the household level (mean = 1.71), demonstrating a major gap between knowledge and practice. The high variability in perceived information adequacy (mean = 2.95, SD = 1.67) further suggests disparities in access to environmental education and awareness campaigns. Overall, these findings indicate that while residents recognize the problem and its risks, behavioral change remains constrained by limited information outreach, weak infrastructure, and insufficient community engagement mechanisms.

Community initiative for sustainable plastic waste management.

In recent years, various grassroots and NGOs-led initiatives in Goma have attempted to mitigate plastic pollution through recycling, reuse campaigns, and community clean-ups. Evaluating the effectiveness and scalability of such efforts is vital for shaping inclusive waste management strategies (UNEP, 2021). Therefore, Community initiatives for sustainable plastic waste management were assessed using five-point Likert scales like Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree.

Table 3. Community initiatives for sustainable plastic waste management.

S/N	Statement	SA	A	N	D	SD	Mean	S Dev
1	There are community clean-up campaigns organized in my neighborhood.	87	56	24	109	10	3.35	1.35
2	I participated in a community initiative related to waste management.	56	83	4	32	111	2.79	1.64
3	Community groups are active in recycling plastic waste.	67	54	1	84	80	2.80	1.58
4	Informal recycling or reuse of plastic is common in this community.	76	53	10	87	60	2.99	1.55
5	There is collaboration between households and local groups on issues related to plastic waste.	0	56	7	80	143	1.92	1.14

Source: Field data, 2025

The analysis of Table 3 reveals that community initiatives for sustainable plastic waste management in Karisimbi remain weak and inconsistent. With an overall mean of 2.77 and a standard deviation of 1.45, respondents generally expressed neutrality or slight disagreement regarding the presence and effectiveness of such initiatives. Although community clean-up campaigns (mean = 3.35) appear to be the most visible activity, their uneven implementation across neighborhoods suggests limited frequency and inconsistent participation. Similarly, participation in community waste management activities (mean = 2.79) and the presence of active recycling groups (mean = 2.80) indicate that while some level of engagement exists, it remains low and fragmented, with many residents not directly involved in organized environmental actions.

Furthermore, informal recycling or reuse of plastics (mean = 2.99) appears sporadic, often limited to a few households, while collaboration between households and local groups (mean = 1.92) is notably weak. This lack

of coordination undermines collective community efforts toward sustainable waste management. The high variability in responses suggests uneven access to or awareness of ongoing initiatives, likely reflecting disparities in mobilization and leadership among neighborhoods. Overall, these findings demonstrate that while isolated community and youth-led actions exist, as seen in initiatives such as Resilience for Development and Young Water and Sanitation Professionals (YWSP) clean-ups, widespread and structured community participation remains limited, underscoring the need for inclusive, coordinated and well-supported community engagement strategies.

Policies and Partnerships: (Governance Assessment and Potential Solutions)

Sustainable plastic waste management requires an integrated approach combining policy enforcement, infrastructure development, and community involvement. Recommendations must reflect the socio-economic realities of the commune and prioritize affordable, decentralized solutions (Bank Group, 2024; Nduwimana et al., 2025). It is I this regards Policies and Partnerships were assessed using five-point Likert scales such as Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree.

Table 4. Policies and Partnerships Assessment

S/N	Statement	SA	A	N	D	SD	Mean	S Dev
1	The local government has effective policies on plastic waste management.	51	45	11	102	77	2.62	1.47
2	There is a need for stricter regulations on the use and disposal of plastic.	156	130	0	0	0	4.55	0.50
3	Local leaders and institutions support efforts to reduce plastic waste.	88	67	16	97	18	3.38	1.38
4	Public-private partnerships could improve plastic recycling in Karisimbi.	203	83	0	0	0	4.71	0.45
5	There is a need for greater investment in infrastructure to effectively manage plastic waste.	255	30	1	0	0	4.89	0.33

Source: Field data, 2025

The analysis of Table 4 indicates that while respondents in Karisimbi commune recognize the urgent need for stronger governance and partnerships in plastic waste management, they remain dissatisfied with current policy effectiveness. The low mean score for the effectiveness of local government policies (2.62) shows widespread perception of weak policy implementation and inadequate enforcement at the local level. In contrast, the high mean scores for stricter regulation (4.55) and investment in infrastructure (4.89) reflect near-unanimous agreement on the need for stronger legal frameworks and enhanced financial commitment to address plastic waste challenges. The moderate score for institutional support (3.38) suggests that while some leadership efforts are visible, they are inconsistent and insufficiently coordinated across the community.

Furthermore, respondents strongly supported the potential of public-private partnerships (mean = 4.71) as a promising strategy for improving recycling systems and sustainable waste management. The overall mean of 4.03 confirms a generally positive attitude toward policy reform, institutional collaboration, and infrastructure investment, while the overall standard deviation (1.30) indicates some variation in perceptions based on personal or neighborhood experiences. These findings highlight that residents are both aware of and ready to support meaningful policy actions, provided they are inclusive and well-enforced. The strong alignment with national trends such as weak enforcement of plastic bans but growing support for PPPs and infrastructure reforms

demonstrates a shared national call for effective governance, accountability and strategic partnerships to advance sustainable plastic waste management.

Thematic analysis

Respondents emphasized the inadequacy of infrastructure for plastic waste management, describing recycling facilities as "almost non-existent" and noting the shortage of trucks and collection bins. A local authority stated, *"we have only two functional trucks to cover the whole commune, and this makes timely collection nearly impossible."* This gap was seen as a barrier not only to effective waste management but also to community trust in governance, as residents felt abandoned in their struggle against plastic pollution.

Interviewees reported mixed practices in handling plastic waste, with some communities burning plastics while others dump them in drainage systems or empty lots, worsening flooding. Awareness was described as "growing but still shallow," with an NGO representative noting, *"Most people know plastic is dirty, but they don't fully understand its long-term impact on health and the environment."* Limited follow-up and irregular education were cited as reasons for low behavior change despite growing recognition of plastic hazards.

Grassroots efforts led by youth groups, women's associations, and NGOs were highlighted, including clean-ups and small-scale recycling projects. A community leader explained, *"Our youth group organize Saturday cleaning campaigns, but without financial or logistical support, it is difficult to sustain these efforts."* While successes were noted in public mobilization, challenges such as lack of funding, recycling facilities, and weak coordination with local leaders limit broader impact.

Overall, most of the respondents consistently described local government action as weak, with one waste collector stating: *"The rules exist only on paper; on the ground, we work without protective equipment and without support."* Nevertheless, there was optimism for stricter bans on single-use plastics, enforcement of disposal rules and greater investment in public-private partnerships. NGO representatives suggested linking recycling cooperatives with private companies to create jobs while reducing waste.

CONCLUSION AND RECOMMENDATIONS

Conclusion

As the study draws to a close, it is evident that plastic waste management in Karisimbi is hindered by inadequate infrastructure, limited community awareness, and weak government enforcement. While grassroots initiatives and youth-led clean-ups show promise, their impact is constrained by lack of funding, coordination and logistical support. Despite these challenges, there is strong optimism among residents and stakeholders for stricter regulations, improved enforcement and greater investment in public-private partnerships, highlighting the potential for collaborative, sustainable solutions if structural gaps and community engagement are effectively addressed.

Recommendations

To strengthen sustainable plastic waste management in Karisimbi, it is recommended to implement a community-centered approach that combines awareness, infrastructure and economic empowerment. This includes mobilizing and training neighborhood committees, conducting continuous public education campaigns, establishing local collection points and recycling centers, and providing skills training for youth and women to create green jobs. Complementary measures should involve local authorities, NGOs, schools, and the private sector in supporting clean-up activities, promoting recycling cooperatives, enforcing severer regulations and developing participatory monitoring systems, ensuring that plastic waste management becomes both effective and sustainable through coordinated community engagement and evidence-based policy interventions.

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