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Harnessing Climate Finance for Solid Waste Management in Nairobi:

The Circular Economy, Carbon Credits and Emissions Reduction Approach

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Abstract

This paper explores harnessing climate finance, particularly carbon credits, to address Nairobi's solid waste management challenges. The city generates approximately 3,500 tonnes of waste daily, with over 60% organic, yet only 45% is recycled or reused, leading to pollution and health risks from unmanaged dumps. The study examines waste-to-energy, composting, and recycling as means to generate carbon credits for funding sustainable infrastructure. Key projects, such as the proposed 45 MW Nairobi Waste-to-Energy Plant (projected to reduce 1.8 million tonnes of CO^2 over 20 years) and the Circular Economy Composting Project (diverting waste, creating 12,000 jobs, and benefiting 50,000 farmers), demonstrate emission reductions and economic gains. Challenges include insufficient funding (cited by 30% of respondents), regulatory gaps, and institutional fragmentation. Recommendations involve strengthening public-private partnerships, enhancing regulatory frameworks, and integrating carbon finance strategies to promote sustainability, resilience, and alignment with global climate goals.

Keywords: Climate change resilience, ambient environment, circular economy, green/ climate finance, climate smart solutions, carbon credits, waste management, sustainability, emission reductions

INTRODUCTION

The generation of municipal solid waste is escalating globally, presenting substantial challenges to sustainability and urban planning. According to the United Nations Environment Programme's Global Waste Management Outlook 2024, municipal waste reached nearly 2.3 billion tonnes in 2023 and is projected to rise to 3.8 billion tonnes by 2050 (UNEP, 2024). Without measures to decouple economic growth from waste production, management costs could reach USD 640 billion by 2050 (UNEP, 2024). This underscores the imperative for environmental protection, economic stability, and sustainable urban development.

In Africa, inadequate infrastructure exacerbates these issues, with the continent producing 125 million tonnes of waste annually, yet recycling less than 10% (E4Impact, 2025). Poor management leads to pollution, health hazards, and methane emissions, a potent greenhouse gas (Amugsi et al., 2022). Kenya mirrors this, generating 22,000 tonnes daily, with Nairobi contributing 2,400 tonnes, over half organic (C40, 2023; ESI Africa, 2023). Recycling rates stand at 45%, with plastics comprising 20% of the waste stream (World Bank, 2025). The Sustainable Waste Management Act (SWMA) of 2022 promotes recycling, private sector involvement, and penalties for non-compliance (Airflo Sciences, 2023).

Kenya is emerging as a leader in African carbon markets, with the Climate Change (Amendment) Act 2023 and proposed Carbon Trading Bill facilitating carbon credit transactions aligned with national goals (IFC Review, 2024). Nairobi hosted the world's largest voluntary carbon auction in June 2023, where Saudi firms purchased 2.2 million tonnes, 70% from African projects including Kenyan renewable energy initiatives (Reuters, 2023). This burgeoning carbon market presents a novel opportunity to address one of

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Kenya's most persistent urban challenges: solid waste management.

As Kaza et al. (2018) note, integrating waste management with emission reductions is essential. Waste-to-energy, composting, and recycling can generate carbon credits to fund infrastructure, fostering a circular economy in urban Africa.

Research Objectives

The primary objective is to evaluate Nairobi's current waste management financing infrastructure and identify associated challenges, highlighting inefficiencies and proposing improved models. A secondary aim is to analyze global sustainable waste financing options and derive applicable lessons for Kenya. Finally, the study proposes policy enhancements to facilitate sustainable waste infrastructure financing in Nairobi and similar contexts.

Justification

Nairobi's rapid growth strains waste management systems, with infrastructure shortages and limited resources (Kasuku, 2024). Daily waste generation reaches 2,400 tonnes, predominantly organic, overwhelming existing facilities and leading to environmental and health risks in informal settlements (C40, 2023). Poor organic waste handling produces methane, exacerbating climate change, while hindering circular economy adoption, which could create jobs and recover resources.

Funding shortages persist despite priorities, as municipalities rely on external aid or loans, an unsustainable approach. Climate finance, including carbon credits, offers innovative potential, alongside public-private partnerships (PPPs). However, adoption requires addressing regulatory and institutional gaps, which are fragmented and inconsistently enforced (NEMA, 2023). This study aims to strengthen frameworks, propose improvements, and enhance resilience, improving environmental, health, and economic outcomes in dynamic African cities like Nairobi.

THEORY

Global and Regional Waste Management Challenges

Municipal solid waste production is rising due to population growth, urbanization, and consumption patterns. Global waste is projected to increase 65% by 2050, with direct costs at USD 252 billion in 2020, excluding externalities like pollution and health impacts (UNEP, 2024). In Africa, rapid urbanization strains systems, generating 125 million tonnes annually, with recycling below 10% (E4Impact, 2025). Organic waste, over 50% in cities like Nairobi, contributes to methane emissions and health risks (C40, 2023).

Nairobi's waste includes 20% plastics, with low recycling rates exacerbating issues (World Bank, 2025). Circular economy principles emphasize recycling and reuse to minimize environmental costs and create opportunities (Ouro-Salim & Guarnieri, 2021). Food waste management is key in developing countries (Duarte et al., 2021). Challenges include infrastructure deficits and funding, but strengths lie in raw materials and job potential; opportunities include global demand for green practices and climate finance (Wikurendra et al., 2022).

Climate Finance and Carbon Markets: Opportunities for Waste Management

Climate finance, via carbon credits (certified reductions of one tonne CO_2 equivalent), supports emission-reducing projects (IFC Review, 2024). Kenya's reforms, including a national registry, enhance attractiveness (IFC Review, 2024). Producing 20% of African credits, Kenya hosted a major auction (DevelopmentAid, 2025). Projects in renewable energy, cookstoves, and forestry dominate, with BURN Manufacturing reducing over 50.9 million tonnes CO_2 (DevelopmentAid, 2025). Nairobi can leverage waste-to-energy, composting, and recycling for credits, funding infrastructure and aligning with mitigation goals.

Addressing the Gap: Policy, Regulatory, and Institutional Issues

Kenya's policies are fragmented, hindering enforcement (NEMA, 2023). The SWMA 2022 defines roles and introduces EPR (Airflo Sciences, 2023). Greater circular economy integration is needed (Banda & Mufuka, 2023). Capacity limitations in local governments impede sustainability. Nairobi can enhance systems through climate finance, policy harmonization, and circular principles, mitigating environmental and health issues while exploiting economic opportunities.

Theoretical Framework

This paper employs Systems Theory, Coordination Theory, and Endogenous Growth Theory. Systems Theory views waste management as an interconnected system involving stakeholders like community-based organizations (CBOs), emphasizing integration for sustainability (Conlon, 2021). Coordination Theory focuses on aligning activities among public, private, and informal actors in Kenya's devolved system (Malone & Crowston, 1994). Endogenous Growth Theory highlights investments in human capital and technology for economic growth via waste infrastructure (Rangongo & Ngwakwe, 2019). These theories directly link to the research problem: Systems Theory identifies synergies in financing; Coordination Theory addresses institutional fragmentation; Endogenous Growth Theory underscores economic benefits from sustainable models.

Conceptual Framework

The framework analyzes funding sources, challenges, and solutions for sustainable waste management. It emphasizes stakeholder coordination (government, private sector, CBOs) and innovative models, integrating circular economy principles for resource optimization, partnerships, and infrastructure. This framework guides the research by illustrating interactions: independent variables (e.g., funding mechanisms, regulatory frameworks) influence dependent variables (e.g., infrastructure sustainability, emission reductions). It structures analysis of challenges and opportunities, informing policy recommendations **Figure 1**.

RESEARCH METHODS

This study adopts a mixed-methods qualitative case study design to examine Nairobi's waste management dynamics. It combines qualitative (interviews, focus group discussions [FGDs], questionnaires) and quantitative data for comprehensive insights.

Qualitative data capture stakeholder perceptions via structured/semi-structured interviews and FGDs. Questionnaires reach broader respondents. Key informants, purposively selected for expertise, include: 3 from NEMA (policy regulators), 5 from Nairobi City County Government (NCCG; operational leads), 15 from private waste service providers (WSPs; logistics experts), and representatives from Kenya Alliance of Waste Recyclers (KAWR) and Kenya Plastic Pact (KPP; industry insights). CBOs and residents provide community perspectives, with 1,100 households reached via CBOs for representation in low-income areas. Sample sizes ensure depth (e.g., NEMA's small number for targeted expertise) and breadth (e.g., households for diverse views),

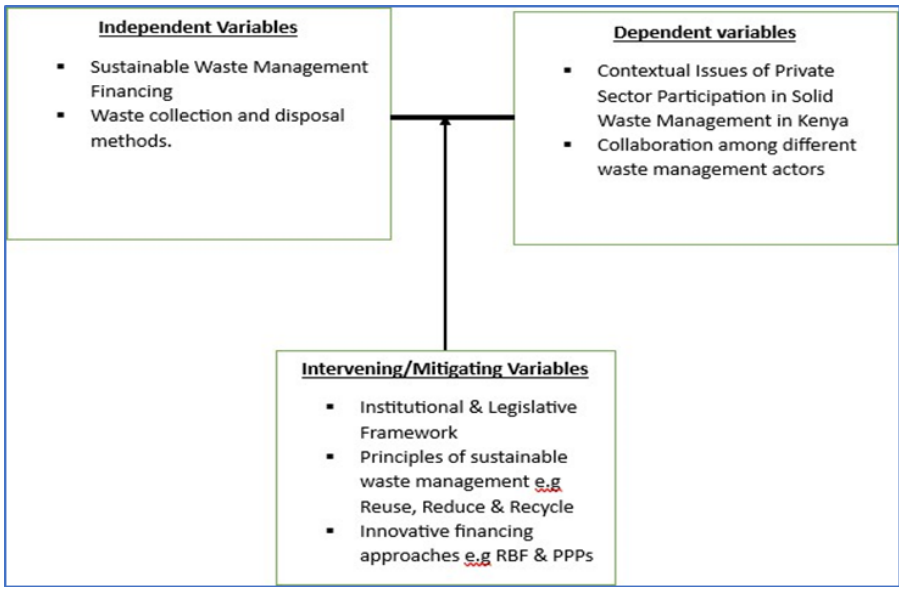

FIGURE 1
Conceptual framework for sustainable waste management financing
Source: Authors'Analysis (2025), adapted from Systems, Coordination, and Endogenous Growth Theory

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balancing feasibility with inclusivity. Secondary data was gotten from peer-reviewed journals and reports contextualize findings. Purposive sampling was used targeting knowledgeable participants; random sampling within communities ensures representation. Quantitative data was analysed using descriptive statistics; qualitative analysis employed NVivo for thematic coding. Ethical protocols included informed consent, withdrawal rights, and anonymity.

The number of residents in the total sample or target groups is 48, which refers to the major stakeholders, participants in the waste management system **Table 1**. The larger group of 1,134 households represented by the community-based institutions is useful in ensuring that a wide range and representative member of the local population is reached out to, as they are the ones interacting directly with the waste management system. The sample size is big enough to provide an overview of the functioning of the waste management system on all its levels starting with the implementation of the policy and going down to the personal waste disposal practices.

RESULTS

Waste Generation and Management in Nairobi

The waste management system in Nairobi is also affected by various issues, aggravated by a fast urbanization, population increment, and inadequateness of waste management facilities in the city **Table 2**. Nairobi also produces about 3, 500 tonnes of waste leading to a disposal of more than 60% of the weight which is organic (Nairobi City County, 2024). In spite of this large waste generation, only 45 percent of the waste is being recycled or reused and the rest of such waste ends up in open dumpsites, which has added to pollution and health hazards of the people (World Bank, 2025). The current waste infrastructure in Nairobi could do little to manage the increasing amount of garbage due to some liquidity problems and scattered regulatory guidelines. Such difficulties have contributed to poor waste management approaches, which affect the environment and the health of the people.

Waste Composition and Recycling Rates

An in-depth analysis of Nairobi's waste composition reveals that organic waste—such as food scraps, yard trimmings, and other biodegradable materials—constitutes more than 60% of the total waste stream. Plastic waste accounts for approximately 20%, while other materials like paper, metal, and glass make up the remainder. Despite the high proportion of organic waste, Nairobi's recycling rates remain low, with only 45% of the waste being recycled or reused (World Bank, 2025). This figure highlights the underutilization of recyclable materials, particularly in sectors where resource recovery could significantly reduce waste volumes, such as in organic waste management through composting **Table 3**.

TABLE 1
Sample size distribution

Target Group	Total Population	Population Sample
NEMA (National Environment Management Authority)	3	3
NCCG (Nairobi City County Government)	2	2
Kenya Alliance of Resident Associations (KARA)	5	25
Community-Based Organizations (CBOs)	34	1,100 households
Kenya Association of Waste Recyclers (KAWR)	1	1
Kenya Plastic Pact (KPP)	1	1
Kenya Association of Manufacturers (KAM)	1	1
Area Chief (Dandora)	1	1
TOTAL	**48**	**1,134**

Source: Author's field survey (2025)

TABLE 2
Waste generation and management statistics

Context	Statistic/Value	Source
Global municipal solid waste generation (2023)	2.3 billion tonnes	UNEP Global Waste Management Outlook 2024 (UNEP, 2024)
Projected global waste generation by 2050	3.8 billion tonnes	UNEP Global Waste Management Outlook 2024 (UNEP, 2024)
African waste generation per year	125 million tonnes	DevelopmentAid (2025)
Africa recycling rate	< 10 % recycled; > 90 % dumped or burned	DevelopmentAid (2025)
Kenya daily waste generation	22,000 tonnes per day	ESI Africa (2023)
Nairobi daily waste generation	3,500 tonnes per day	World Bank (2025), C40 (2023)
Nairobi plastic proportion	20 % of waste is plastic Recyclable	World Bank (2025)
Nairobi organic proportion	> 60 % organic waste Can be used for compost	C40 Umoja Estate Case Study (2023)
Nairobi waste recycling/reuse rate	~45 % recycled or reused	World Bank (2025)

Source: Compiled from UNEP (2024), DevelopmentAid (2025), ESI Africa (2023), World Bank (2025), C40 (2023)

TABLE 3
Waste generation and composition in Nairobi

	Proportion of Total Waste (%)
Organic Waste	60
Plastic Waste	20
Paper Waste	10
Metal Waste	5
Glass Waste	2
Other Waste	3

Source: Nairobi City County (2024); World Bank (2025)

The large share of organic wastes gives a special possibility to use a composting and anaerobic digestion system that would lead to diversion of wastes material and the fermentation of organic products into fertilizers **Figure 2.** Most of the waste generated in Nairobi is organic, but this has not been utilized mostly to create compost.

Challenges in Waste Separation

Although there is a ton of recyclable materials, the poor source separation system is one of the chief inhibitors of the enhanced rate of recycling. The most mentioned barriers to the effective segregation of waste were by key informants such as government officials, who cited poor infrastructure and low levels of public awareness (Nairobi City County, 2024). The construction of landfills increases the problem because the majority of waste goes to landfills due to a lack of organization, and even the sorting that occurs is disposed of inappropriately: Some of it is burned, polluting the air, and some landfills are not made correctly, releasing, again, into the air.

Informal waste sector is also important in recycling where informal waste pickers ensure that a substantial part of the city has been recycled. Nevertheless, their initiatives are not always

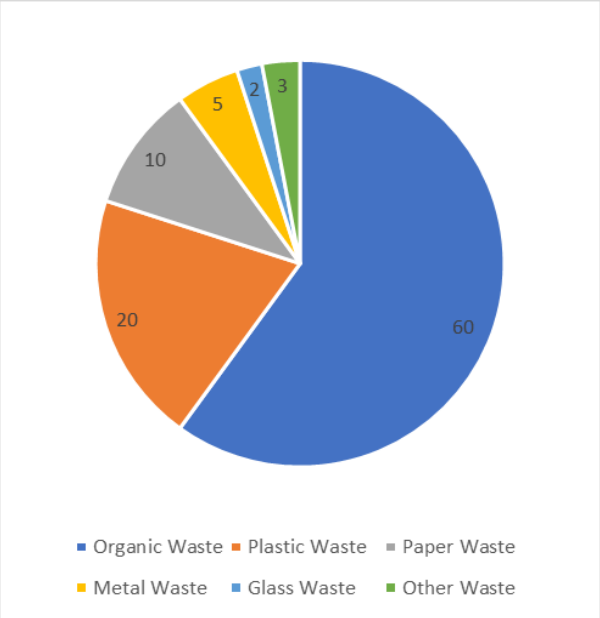

FIGURE 2
Percentage of type of waste produced in Nairobi County
Source: Nairobi City County Waste Report (2025)

well organized, safe and/or they do not add any significant value to the entire recycling level. The presence of Private waste service providers (WSPs) is more common in middle- and high-income communities although their activities cannot cover the needs in lower-income communities forcing the informal sector to provide the services which are lacking there **Table 4**.

Public Perception and Satisfaction

The perception of Nairobi's waste management infrastructure varies significantly among residents, with about 32% of respondents expressing satisfaction with the available infrastructure, while 60% considered it inadequate. This mixed response reflects the unequal distribution of waste management services and the gap in service quality between different areas of the city. Inefficiencies in waste segregation, collection, and disposal are especially evident in low-income neighborhoods, where waste management services are often inadequate or entirely absent. These areas rely heavily on the informal waste sector, which contributes to both positive and

TABLE 4
The average disposal costs to Dandora dumpsite per ton of waste collected in Nairobi County

Zone	Rate per Tonne (Kshs)
CBD	1,144
Kamukunji	943
Starehe	990
Embakasi	852
Dagoretti	1,210
Makadara	849
Westlands	1,155
Kasarani	891
Langata	1,144

Source: Nairobi City County (2025)

negative outcomes in terms of waste management effectiveness **Figure 3**.

These findings suggest that while some areas in Nairobi may be well-served by waste management systems, others, particularly informal settlements, are underserved. Addressing this disparity will require targeted investments in waste management infrastructure, particularly in underserved neighborhoods.

Waste Management Infrastructure Utilization

Landfills are the most commonly used waste management infrastructure in Nairobi, with approximately 70% of the city's waste being sent to these facilities. Landfills, however, contribute significantly to methane emissions, which have a much higher global warming potential than CO_2 **Figure 4**. The city's reliance on landfills, combined with limited recycling efforts (only 9-15% of waste is recycled), indicates a clear need for improved waste diversion strategies, such as composting and waste-to-energy projects.

The low percentage of recycling highlights the inefficiencies in the current system, where waste is not being recovered in the most sustainable way. Further investments in waste diversion infrastructure, such as material recovery facilities and recycling stations, could significantly improve recycling rates and reduce landfill use.

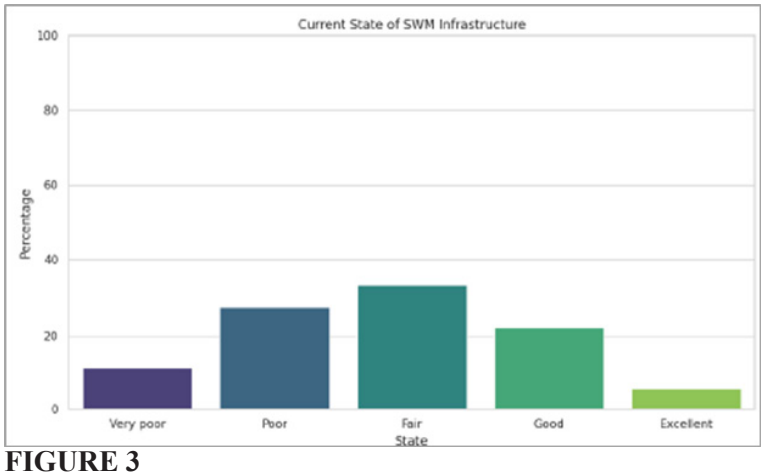

FIGURE 3
Most of the respondents revealed that current SWM infrastructures are in a fair state
Source: Author's field survey (2025)

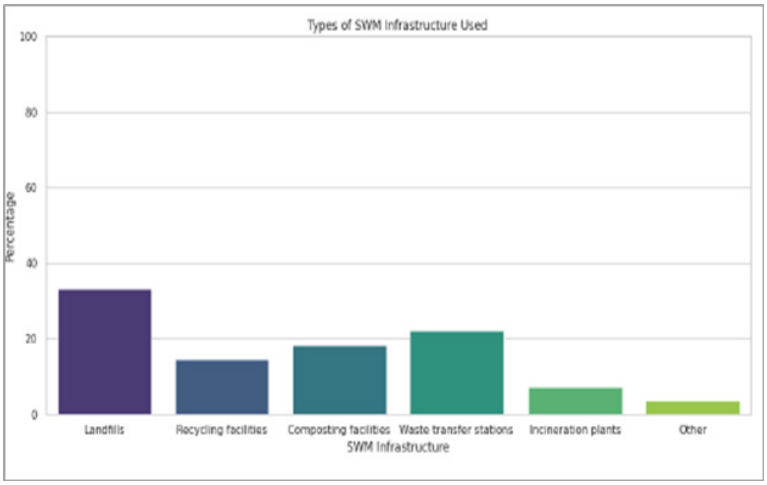

FIGURE 4
Landfills are the most readily available forms of SWM infrastructure in Nairobi County
Source: Author's field survey (2025)

The major problem with waste management infrastructure in Nairobi is perceived to be a lack of adequate funding, and 30 percent study participants echoed the same **Figure 5**. This is worsened by inadequate regulatory guidelines, planning and technical knowhow of waste management. The findings can imply that financial constraints are the main obstacle to the enhancement of the model of waste management in Nairobi. This is compounded by institutional disintegration, and a regulatory gap that makes coordination of the city to adopt a comprehensive policy of waste management difficult **Figure 6.**

Carbon Credit Projects and Emission Reduction Potential

The potential for carbon credit projects to fund waste management infrastructure in Nairobi is

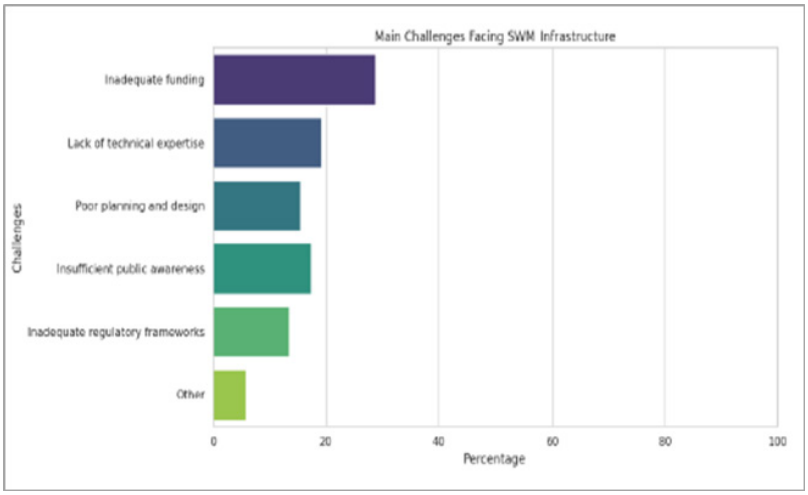

FIGURE 5
30% of the study respondents believe that inadequate funding is the main challenge SWM infrastructure provision in Nairobi
Source: Author's field survey (2025)

FIGURE 6
Dandora dumpsite
Source: ANairobi City County Photographic Archive (2025

significant. Projects like the proposed 45 MW Nairobi Waste-to-Energy Plant, which is projected to reduce 1.8 million tonnes of CO_2 over 20 years (CCAC, 2023), could contribute to the city's efforts to meet its zero-waste goals. Similarly, the Circular Economy Composting Project in Kenya has diverted large quantities of waste from landfills, created over 12,000 jobs, and benefited 50,000 farmers (Climate Impact Partners, 2024). These initiatives illustrate how waste management projects can generate carbon credits and financial revenue, which can then be reinvested into further waste infrastructure improvements **Table 5.**

The potential to generate carbon credits through waste-to-energy and composting projects in Nairobi is substantial. The sale of these credits can help finance future waste management infrastructure projects, providing a self-sustaining cycle of investment and emission reduction.

Waste Management Infrastructure and Financing Mechanisms

In Nairobi, waste management infrastructure is largely financed by the National Government and Nairobi City County, with limited participation from the private sector (Nairobi City County, 2024). **Table 6** outlines the primary sources of financing for waste management infrastructure. Public-private partnerships (PPPs) and donor funding remain underutilized, though they present significant opportunities for increasing financial resources.

In Nairobi, most waste management infrastructure is funded by the national government and the Nairobi City County with little financial contribution by the private sector (Nairobi City County, 2024). **Table 6** provides an overview of the more significant financing tools that exist, indicating that PPPs and donor funds continue to have a minor role to play in overall financing. Nevertheless, there is indeed a chance of the private sector assuming a higher financial burden since the Sustainable Waste Management Act (2022) offers Extended Producer Responsibility (EPR) framework (Mugendi, Mireri, & Enevoldsen, 2024) **Figure 7**. There is still a low level of investment by the private sector hindering the expansions of waste management infrastructure. With the introduction of the Extended Producer Responsibility (EPR) concept in the Sustainable Waste Management Act (2022), there is a great potential to shift the focus to the involvement of the private sector in waste management, thus reducing some pressure on the state budget

TABLE 5
Carbon credit projects and emission reduction metrics

Project/Context	Key Metrics	Source
Urfa Yenice Landfill Gas to Energy (Turkey)	114,253 tCO_2 emission reductions; prevents 8,000 tonnes of methane annually (~230,000 tCO_2e); 32,400 MWh of renewable electricity	Anthesis Group (2025)
Johannesburg Landfill Gas Project (South Africa)	19 MW capacity; generates over 250,000 carbon credits annually	C40 (2023)
Oneida Herkimer Landfill Gas Project (USA)	Eliminated ~500,000 t CO_2e; generated more than 500,000 carbon offsets; provides energy for 3,300+ households	Google Sustainability (2018)
Circular Economy Composting Project (Kenya)	Diverts waste to compost and products; created >12,000 jobs; improved yields for 50,000 farmers; 35% of Nairobi's waste reaches managed landfills	Climate Impact Partners (2024)
Kenya Carbon Credit Auction (2023)	2.2 million tonnes of carbon credits sold; 70% from African projects; average price USD 6.27 per tonne	Reuters (2023)

Source: Anthesis Group (2025); C40 (2023); Google Sustainability (2018); Climate Impact Partners (2024); Reuters (2023)

TABLE 6
Main financing mechanisms for waste management infrastructure in Nairobi

Financing Source	Proportion of Total Financing (%)
National Government	40
Nairobi City County	30
Private Sector Investment	10
Donor Funding	10
Public-Private Partnerships (PPP)	10

Source: Nairobi City County (2025)

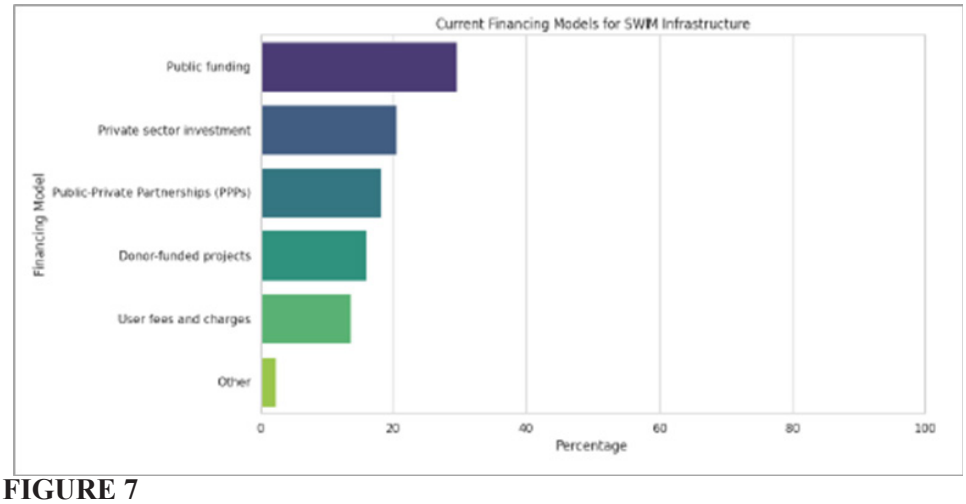

FIGURE 7
The National & County governments are the main financier of SMW infrastructure in Nairobi County
Source: Mugendi, Mireri & Enevoldsen (2025)

(Mugendi, Mireri, & Enevoldsen, 2024).

The financial environment of the waste management infrastructure is still dependent largely on how much is raised publicly. As government budgets continue to be overwhelmed, raising funds to fund waste management projects through innovative sources such as the issuance of green bonds, RBF, and PPPs, could do the trick of mitigating the financing shortfalls.

Key Challenges and Opportunities
The paper has outlined some important issues that the Nairobi waste management network is dealing with such as a lack of fiscal space, institutionalized segmentation and poor and incoherent regulatory frameworks. Based on the information, 30 percent of the respondents indicated that ineffective funding was the largest hindrance whereas 35 percent claimed their limitation was on regulatory gap and institutional fragmentation. These difficulties are coupled by the fact that there is no technical expertise in the area of waste management thus providing a constraint on developing large-scale, high-quality waste management projects. A number of opportunities can be used to counter these obstacles. Green bonds and results-based financing (RBF) are examples of potential additional sources of financing, as are increased public-private collaboration and increased private sector participation. Through the carbon credits, Nairobi can also tap into new sources of revenue to be used in the city waste management infrastructure development.

These solutions indicate that Nairobi can address its current situation by diversifying sources of finance and enhancing regulatory regimes to bring up an efficient waste management process that is environmentally friendly **Figure 8**. The results of this paper reveal the extent of problems that the Nairobi waste management system has

FIGURE 8
Proposed solutions to improve waste management infrastructure financing
Source: Authors' Analysis (2025)

to deal with. The city has low recycling rates amid the excessive dependence on landfills as a waste disposal facility, although it produces 3,500 tonnes of waste per day. The large amount of organic waste poses a great potential source of composting and anaerobic digestion. However, carbon credit schemes seen in this study prove that Nairobi has the potential to benefit itself by using waste-to-energy and composting projects to earn carbon credits and receive finances to fund waste management facilities. Nairobi can transform its way of management of waste into a more environmentally friendly, sustainable, and efficient through diversification in terms of financing, public-private partnerships, and regulatory framework.

Through carbon credit financing, development of a mix of public-private partnership, varying regulation, Nairobi can become a city that can effectively deal with waste streams. The EPR approach is a potential avenue towards achieving financial sustainability and the private sector hold the key to investing in facilities and infrastructure needed to manage the waste. That results of this study highlight the significance of innovative forms of financing, including green bonds and Results-Based Financing (RBF), to help spur the investments in waste infrastructure that are so urgently needed.

DISCUSSION

Aligning Waste Management with Climate Finance Opportunities

Nairobi is producing roughly 3,500 tonnes of waste per day with more than 60 percent of the waste being organic (World Bank, 2025). That organization of waste in a global environment where global warming and climate change are the burning issues is indispensable. When organic waste is placed in landfills, it decomposes anaerobically, and this produces a greenhouse gas with global warming potential that is 25 times higher than that of CO 2 (UNEP, 2024). Composting and anaerobic digestions will enable Nairobi to curtail methane using the products of these processes as organic fertilizers to agricultural fields. This will create carbon credits that can be sold in carbon markets providing a source of funds to help pursue other waste management related activities.

The Circular Economy Composting Project in Nairobi demonstrates how such projects will lead to employment, enhance soil fertility, and foster environmental conservation through lowered greenhouse emission. According to Climate Impact Partners (2024), the project has diverted in excess of 12,000 jobs and benefited 50,000 farmers by diverting large quantities of waste to the landfill. This is an indication of the fact that composting projects may be useful not only in pursuance of waste management agenda but help in contributing economically tangible values to communities. This aspect of integrating climate action and employment goals can be used to develop solutions to the waste problems affecting Nairobi by exploiting the potential of these projects to deliver crucial solutions to the waste problems facing Nairobi in addition to social development.

Waste-to-energy (WtE) projects also offer another bright prospect in regard to climate finance. This could allow the push to build a 45 MW waste-to-energy plant in Nairobi to reach its proposed goal of eliminating 1.8 million tonnes of CO2 in the next 20 years, as an example (Climate & Clean Air Coalition, 2023). The plant could have two functions in converting the waste to electricity so that it manages the waste disposal challenges facing the city and harnessing renewable energy. These projects have the potential to create huge emission cuts and hence carbon credits which can then be sold in the voluntary carbon markets. An example of such successful waste-to-energy projects is the Johannesburg Landfill Gas Project that makes more than 250,000 carbon credits a year (C40, 2023). Moreover, the Oneida Herkimer Landfill Gas Project, in the United States, demonstrates how the carbon credit investment in the first stages of the project compensation can be beneficial, as it gives the opportunity to introduce the project faster and guarantee it incomes (Google Sustainability, 2018).

Policy and Regulatory Considerations

The regulatory framework governing the waste management and climate finance in Kenya has developed over the years and yet there is still a lot yet to be done in terms of policy deficit when it comes to integrating finance related to climate in the management of waste in Nairobi. The Sustainable Waste Management Act (2022) is a positive stepping stone, since it defined the roles of the national and county governments, introduced extended producer responsibility (EPR), and identified the punitive measures of not following the regulations (Airflo Sciences, 2023). Such are an ambition to encourage the improvement of the waste management practices, recycling and engage the private sector into participating in waste management processes.

Nevertheless, concerns remain with regard to governance of carbon credit revenues (evident in the interviews with policymakers). The details of revenue distribution among the project developers, the local communities and the government agencies are not clear. Additional clarity is needed on the process of revenue distribution so that any carbon credit income is directly beneficial to the local communities, and leads to equitable development. This concurs with the DevelopmentAid (2025), which reveal that clear benefit-sharing arrangements are required in the carbon market-based projects.

Besides, policymakers need to solve the issue of the absence of comprehensive principles to supervise and guarantee carbon credit projects and to make sure the reduction of emissions is really additional and corresponds to international standards. To enjoy the full potential of the carbon credit markets, there is a need to strengthen these regulatory tools to clarify key issues such as how projects will be monitored, what additionality means and how the projects will be permanent to ensure that the projects result in real and lasting environmental gains.

Effective community engagement is also a critical concern that can be determined to be a key constituent in the application of carbon credit projects. In the context of DevelopmentAid (2025) along with other sources one must stress the significance of having 100 percent community approval, high additionality and straightforward provision of benefit sharing. In the case of Nairobi, generating carbon finance through waste-to-energy or composting projects must be preceded by an active policy process of engaging local residents or informal waste pickers and civil society organizations in the design and implementation of the project. Clear communication needs to be established about the dangers and harms of these projects as well as a proper grievance redress system will be needed to maintain social legitimacy and assure that the

poor and vulnerable are not displaced or wasted.

Financial and Institutional Challenges

Although carbon credits could offer new revenues to Nairobi waste management industry, they are not likely to cover all capital and operating costs of most waste infrastructure. As revealed by the experience of the Urfa Yenice Landfill Gas to Energy Project that oved benefits of international partnerships and is certified under Gold Standard (Anthesis Group, 2025), waste to energy projects demand substantial investment due to the initial capital outlay. Likewise, Oneida Herkimer project had planned on long-run purchase commitments with Google to offer financial stability (Google Sustainability, 2018). Nairobi might be required to arrange blended finance arrangements through a combination mix of carbon credits income alongside public-money, private investments, and concessional loans. Such structures are capable of sharing financial risks of waste management infrastructure projects.

Low level of carbon credits under voluntary markets is another setback to the funding situation. Such state of carbon credits price as averagely obtained in the Nairobi carbon auction of 6.27 USD per tonne (Reuters, 2023) is an indicator that they must be regarded as add on, as opposed to basic, sources of funding. Although carbon credits will present a small fortune as financing of emission reduction projects, it is highly unlikely that the funds required to construct and to ensure the maintenance of waste infrastructure will be met. Therefore, Nairobi has to consider other financing mechanisms, including green bonds or results-based financing (RBF), to make the waste management infrastructure sustainably long-term.

Another serious limitation is the institutional capacity The interviews with NEMA officials and the waste operators in the sector indicated absence of technical expertise in the development of carbon credit projects, such as determining the baseline, monitoring, reporting and verification. Such programs of capacity-building are important to enable Nairobi to acquire the skills and knowledge that can assist it to design and execute high-quality carbon credit projects. The establishment of partnerships with international organizations, like in the case of the Oneida Herkimer project (Google Sustainability, 2018), could potentially add value to the development of Nairobi carbon credit projects, both in terms of offering technical assistance and expertise that will speed up the process.

CONCLUSION

This paper has evaluated the opportunities of using climate finance -carbon credits and carbon reductions incentives in dealing with Nairobi waste management. Although the city experiences high volumes of daily waste generation and has minimal recycling facilities (World Bank, 2025), the volumes of predominant organic wastes present an opportunity in terms of composting and anaerobic digestion projects that have the capacity to earn the city carbon credits. Such projects, as the example of the Circular Economy Composting Project and the planned 45 MW waste-to-energy plant, can reduce greenhouse gas emissions, as well as generate employment and increase agricultural productivity (Climate Impact Partners, 2024; Climate & Clean Air Coalition, 2023).

To make full use of these opportunities, there are a number of conditions, which must be satisfied in Nairobi. Effective regulatory systems, transparent measures on carbon trade must be in place, and the voices of the local communities and informal waste workers must be incorporated in the governance structure to increase opportunities to benefit out of such projects. Corresponding with huge infrastructure projects will require significant volumes of capital, and public-private partnerships, blended finance structures and innovative financing mechanisms like green bonds and results-based financing will be necessary to mobilize the capital needed to achieve infrastructure at this scale. By engaging climate finance in its waste management plan, Nairobi can turn its waste emergency into a win-win situation regarding both environmental and social development, benefitting the environment and its citizens.

RECOMMENDATIONS

Policy Recommendations

i. Establish a holistic approach to carbon finance in the waste sectored: Nairobi City County is supposed to schedule a series of meetings with the national government agencies, NEMA and the Ministry of Environment to develop

a detailed plan in which they integrate carbon credits into waste management planning. This plan must be top-prioritized in composting, anaerobic digestion, and capturing landfill gases, describe the funding options and include public-private partnerships and blended finance, and establish the emission reduction and revenue collection targets.

ii. Enhance regulatory framework and institutional capacity: Kenya Primary is to complete the Carbon Trading Bill, implement the national carbon registry and issue clear guidelines on carbon credit projects, addosity, monitoring and benefits sharing. Training initiatives to the county authorities, waste management business entities, and community groups, among others, will be undertaken to maximize an appreciation of carbon credit systems and market dynamics.

iii. Facilitate effective pro-poor benefit-sharing systems: This is to ensure that carbon credit revenues are shared fairly between project developers, local populations and government agencies. Projects are to receive free, prior, and informed consent of the communities that will be affected by the project and are to maintain transparency in terms of benefits they bring and their risks (DevelopmentAid, 2025). The benefit sharing agreements should ensure that part of the revenues is invested in community development projects, that include health care, water supply and education.

iv. Encourage investment in waste-to-energy, composting and recycling projects: The government must stimulate interest in waste-to-energy and recycling projects by granting tax concessions, incentives, or reducing the rate of interest on a concessional loan scheme. Extended producer responsibility programs have the potential to encourage manufacturers to invest in recycling facilities and affiliations with technology providers have prospects to be more operationally efficient and lower costs of operation.

v. Induce Public awareness and source separation: Source separation can only vastly be achieved through public awareness programmes. Nairobi as an authority must invest in programs to influence households to separate house hold waste and avail separated collection services. Inclusion of community-based organizations and informal waste pickers will become a bonus since it will enhance social inclusion and increase participation rates.

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