



3. Solid Waste Value Addition and Sustainable Development in Kisumu County, Kenya

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ABSTRACT

Kisumu County is a flourishing and dynamic region of Kenya, particularly when it comes to economic growth. Recently, Kisumu City has taken vital steps in implementing sustainable waste management practices. These actions are aimed at reducing the negative impact of waste disposal on the environment, enhancing the health of residents, and drawing investors to the city. Interestingly, Kisumu County government management and stakeholders have discovered innovative ways to convert garbage into a valuable commodity by creating value from waste. This study explores the role of waste value addition in supporting sustainable development in the county. Using a cross-sectional, correlational survey design, the research aimed to validate the proposed hypotheses. Results indicated that recycling, composting, and waste-to-energy initiatives are key strategies implemented by the county to manage solid waste. These efforts have also contributed significantly to youth employment in the county through the establishment of waste recycling plants, which, in turn, has driven investor interest. The study recommends that strict regulations and guidelines be enforced to preserve and sustain these environmentally-friendly waste management practices.

KEYWORDS

Economic Growth, Waste Management, Value Addition, Sustainable Development.

1. Introduction:

Managing waste is a significant challenge facing most countries around the world. Whether it is the inadequate infrastructure or the lack of proper disposal mechanisms, the challenges are vast and require innovative solutions. The growth of populations, increased urbanization, and changing lifestyles are contributing factors to the increasing volumes of waste generated each year. Developing countries are particularly vulnerable to the negative effects of waste management, with insufficient resources and infrastructure to cope with the various challenges. However, all countries must work together to find sustainable solutions (World Bank 2018)

According to the European Environmental Agency (EEA) (2018), one of the greatest challenges in managing waste is reducing the generation of waste. It is imperative to create awareness about the significance of waste reduction, and how every individual can play a role in minimizing waste generation. At the household level, the waste reduction strategies can include reusing household products, recycling, and composting. The adoption of these methods can improve the quality of life while reducing waste volumes. For businesses, the waste reduction strategies can include the implementation of recycling programs, reducing the use of plastics and paper, and embracing lean manufacturing processes.

Another challenge in waste management is the inadequate infrastructure to manage the waste generated. Waste management infrastructure encompasses waste collection systems, landfills, treatment facilities, recycling plants, and hazardous waste disposal facilities. The construction of appropriate infrastructure is a significant undertaking that requires investment in both capital and labor resources. Governments must work with the private sector to establish the infrastructure necessary to manage waste efficiently, improve environmental standards, and enhance public health.

United Nations environmental Programme (UNEP) (2020) observe that the lack of proper waste disposal mechanisms is a significant factor contributing to the environmental pollution associated with waste. Open dumping and open burning are some of the hazardous disposal practices that contaminate the environment and affect human health. Shifting to sustainable disposal mechanisms such as energy recovery from waste, material recovery, and composting can mitigate some of the negative impacts of traditional waste disposal mechanisms.

Waste management entails the adoption of sustainable waste practices that promote the circular economy. Sustainable waste management involves converting waste into a resource, recycling waste to create new goods, and reducing the environmental impact of waste. The adoption of sustainable waste practices can create jobs and contribute significantly to the sustainable development of communities (UNEP, 2020)

The global challenge of waste management requires innovative and sustainable solutions. The adoption of sustainable waste management practices, recycling, reduction of waste generation, and the establishment of infrastructure is critical in improving the living conditions of communities worldwide. The potential benefits of improved waste management are numerous, including the reduction of environmental pollution, improving public health and creating jobs. It is, therefore, a responsibility for everyone to play an active role in waste management initiatives for the benefit of all.

1.1 The garbage crisis in Kisumu city:

Kisumu City, located in Western Kenya, has been grappling with a garbage crisis for years. The city generates approximately 300 tonnes of waste every day, but the waste management infrastructure is inadequate to handle this amount of waste. As a result, most of the waste is dumped in open spaces or along roads, leading to environmental degradation, health hazards, and unpleasant living conditions for residents. (County government of Kisumu (CGK), 2021) The stench emanating from the heaps of garbage is unbearable and attracts rodents and other disease-causing organisms.

The situation has been worsened by a growing population and increased urbanization, leading to a surge in waste generation. The local government has been struggling to find sustainable solutions to the garbage crisis, and this has prompted innovative approaches to tackle the problem. The city has come up with innovative ways of managing waste and turning it into a valuable resource. By recycling, reusing, and upcycling waste, Kisumu City is not only improving the environment but creating jobs and generating income for the community. The waste-to-wealth initiative is one such approach that has been adopted to address the garbage crisis in Kisumu City (CGK, 2021)

1.2 The current state of waste disposal in Kisumu City:

The current state of waste disposal in Kisumu City is a cause for concern. The city generates an estimated 500 tons of waste daily, but only about 40% of it is collected and disposed of properly, leaving the rest to accumulate in open areas or water bodies. This is not only unsightly but also poses significant health and environmental risks to the city's residents and the ecosystem.

Improper waste disposal practices in Kisumu City have also contributed to the pollution of Lake Victoria, which is a vital source of livelihood for many residents. The lake is a key attraction for tourists, and its pollution has a significant impact on the city's economy, as it discourages investment and tourism.

Furthermore, the current waste disposal practices in Kisumu City are not sustainable, as they rely heavily on landfilling, which is not only expensive but also has negative environmental impacts. There is a need for a shift towards more sustainable waste disposal practices that are both economically and environmentally viable.

Addressing the current state of waste disposal in Kisumu City is crucial in attracting investors and promoting sustainable development. By implementing sustainable waste management practices, the city can improve its image, attract more investors, and create a healthier and more sustainable environment for its residents.

1.3 The challenges facing Kisumu City in waste disposal practices:

Kisumu City, like many other urban centers in developing countries, is facing numerous challenges when it comes to waste disposal practices. With a growing population, the amount of waste being generated in the city has increased drastically over the years. Unfortunately, the city's infrastructure and resources have not been able to keep up with this growth, leading to a backlog of waste that has not been properly disposed of.

One of the major challenges facing Kisumu City is the lack of proper waste disposal facilities. Most of the waste generated in the city is dumped in open spaces or burned, which leads to pollution and health hazards for the residents. The city also lacks proper waste collection systems, which has made it difficult to manage the waste generated. Another challenge facing Kisumu City is the lack of awareness among residents regarding proper waste disposal practices. Most people still dispose of their waste in open spaces, which exacerbates the problem.

The city government has recognized these challenges and has been working to address them. However, there is still a long way to go. It is essential to invest in proper waste disposal facilities, as well as educate residents on proper waste disposal practices. Only then can Kisumu City be transformed into a clean and sustainable environment, attracting investors and promoting economic growth.

1.4 Sustainable waste disposal practices and their impact on city development

Sustainable waste disposal practices play a vital role in city development. A city that has a good waste management system in place is not only appealing to investors but also to residents and visitors. It gives a sense of cleanliness and organization, which is a key factor in attracting investors to the city. Waste disposal practices can have a positive or negative impact on the environment, public health, and the economy. Therefore, it's essential to adopt sustainable waste disposal practices that are environmentally friendly and socially responsible.

One of the strategies that can be employed is waste reduction through recycling. Recycling is the process of converting used materials into new products, thereby reducing the need for virgin materials and minimizing the environmental impact of resource extraction. By recycling products like paper, plastics, glass, and metal, natural resources can be conserved, reduce emissions of greenhouse gases and other pollutants, and reduce the amount of waste sent to landfills. Furthermore, recycling has economic benefits as well, creating job opportunities and saving money on raw materials.

One of the key benefits of recycling is its ability to conserve natural resources. When we recycle materials like paper and metals, we reduce the need for virgin materials, which require energy and resources to extract, process, and transport. This reduced demand for virgin materials can help to preserve natural habitats, reduce deforestation, and conserve water resources. Additionally, recycling can help to reduce emissions of greenhouse gases and other pollutants, as it requires less energy than manufacturing products from scratch.

Another key benefit of recycling is its ability to reduce the amount of waste sent to landfills. Landfills are major sources of pollution, as they release toxic gases and leachate - a toxic liquid that can contaminate groundwater and soil. By recycling materials instead of sending them to landfills, we can reduce the burden on these facilities and help to protect the environment from the negative impacts of waste.

Recycling also has economic benefits. By reducing the demand for virgin materials, recycling can help to drive down the cost of raw materials, making it less expensive for companies to produce goods. Additionally, recycling creates jobs in industries such as waste management, processing, and manufacturing, bolstering local economies and contributing to overall economic growth. (Troschinetz,& Mihelcic,(2009)

Another strategy is composting. Composting is a revolutionary strategy that has become quite popular in recent times. It is an aerobic process that involves the decomposition of complex organic materials into a nutrient-rich soil amendment. This process is a great way to manage waste and to improve the quality of the soil by returning valuable nutrients to the earth. (Toledo, Siles, Gutiérrez,& Martín, 2018).

According to Abdel-Shafy, & Mansour, (2018), The process of composting begins when organic materials such as leaves, food wastes, yard waste, and wood chips are allowed to decompose. These materials are combined in a compost bin and are kept moist and aerated until they break down. The process of breaking down the organic matter is facilitated by microorganisms such as bacteria, fungi, and worms.

Composting has a lot of benefits, both environmental and economic. For one, it reduces the amount of waste that ends up in landfills. This reduces the costs associated with solid waste management and also reduces emissions from the landfills. Secondly, composting is a sustainable way of improving soil health. The nutrient-rich compost can be used to improve the quality of the soil rather than relying on expensive fertilizers. This results in improved crop yields and reduced water consumption.

Another advantage of composting is that it reduces greenhouse gas emissions. When organic waste breaks down in a landfill, it releases large amounts of methane gas, which is a potent greenhouse gas. Composting can help reduce greenhouse gas emissions by diverting organic waste from landfills and thus reducing the need for methane-producing anaerobic conditions found in landfills (Taiwo,2011).

1.5 The Waste to wealth Initiative (Value addition)

The waste-to-wealth initiative in Kisumu City was born out of the need to address the growing problem of waste management in the city. The city's landfill sites were overflowing with waste, and the environmental impact was becoming increasingly worrying. This led to the idea of turning waste into a resource that could generate income and create job opportunities for the local community (CGK,2021). The initiative was launched in 2018, with a focus on collecting and sorting waste materials such as plastic, glass, and metal. The waste is then processed and transformed into valuable products such as building materials, furniture, and fashion accessories, to name a few.

The project has not only provided a solution to the waste management problem but has also created a sustainable source of income for the local community. The initiative has also helped to raise awareness about the importance of proper waste management and the impact of waste on the environment. Today, the waste-to-wealth initiative in Kisumu City continues to thrive, with more and more people embracing the concept of turning waste into a resource. The initiative has become a model for other cities around the world, and it is proof that with the right mindset and resources, waste can truly be turned into wealth. (CGK,2021)

2. Literature Review:

2.1 Theoretical Perspectives

A theory is a systematic way of understanding behavior, events, and/or situations. Theories use plausible principles, concepts, and propositions to predict or explain events, situations, or phenomena. The study is anchored on participation theory. According to Sukhor, Mohammed, Sani, & Awang (2011), the participation theory highlights the importance of

empowering stakeholders in development initiatives to be active participants rather than passive recipients. This theory asserts that while change agents may catalyze progress, the ultimate success of any intervention relies on the meaningful participation of the beneficiaries themselves (Reed *et al.*, 2018).

The ecological perspective of the participation theory takes this idea further, encouraging participation from stakeholders in environmental management for the betterment of both health and the environment (Hotta & Aoki-Suzuki, 2014). This perspective argues that individual and collective efforts to confront environmental sanitation challenges can lead to sustainable solutions that benefit entire communities.

2.2 Empirical literature Review:

Radwan, Khan & Elmanfaloty, (2021) looked at optimization of solid waste collection using RSM approach, and strategies delivering sustainable development goals (SDG's) in Jeddah, Saudi Arabia. Expert software was involved in the optimization of process parameters during the collection of municipal solid waste (MSW) from Jeddah city. The study concluded that municipal solid waste generated in Saudi Arabia is having great potential to be converted into wealth which contributes to development.

Samiha, (2013) analysed the importance of the 3R principle of municipal solid waste management for achieving sustainable development. This paper analyzed how the 3R principle (reduce, reuse and recycle) can help to achieve sustainable development. And in order to evaluate and analyze people's behavior and willingness to participate in the 3R principle, this study used survey in a university environment in China. And the results showed that if everyone participates in the 3R principle, then factories will be established to use the waste as raw materials thereby contributing to development of towns.

Baud, Grafakos, Hordijk, & Post, (2001) examined quality of life and alliances in solid waste management and contributions to urban sustainable development. The study was based on case studies of three multi-million cities in developing countries: Chennai, India; Manila, Philippines; and Lima, Peru. The results showed that informal trade and recycling enterprises contribute more heavily to financial viability, employment, and cleaner urban neighbourhoods, as well as greater re-use and recycling of waste fractions.

Muigua (2019) conducted a study on Integrated Natural Resources and Environmental Management for Sustainable Development in Kenya. The primary goal of the study was to gain a comprehensive understanding of the natural resource base in Kenya, and identify sustainable management strategies to meet both current and future needs. To accomplish this, a mixed-methods approach was used to collect data from primary and secondary sources. Qualitative and quantitative methods were employed to analyze the data, resulting in a holistic understanding of issues regarding natural resource management and sustainable development in Kenya.

The study revealed that human activities including deforestation, overgrazing, and pollution pose a threat to Kenya's natural resource base, impacting the environment and leading to its destruction. Consequently, the study recommended interventions to address these issues and ensure the sustainable management of natural resources.

The authors Henry, Yongsheng, and Jun(2006) conducted a study in which they explored the challenges faced in managing municipal solid waste (MSW) in developing countries, using Kenya as a case study. The study examined potential solutions that could be implemented to improve the quality of MSW services. It was discovered that environmental impact is rarely taken into consideration by local authorities when selecting sites for MSW disposal, resulting in a high risk of pollution in surface and groundwater. Illegal dumping of MSW on river banks and roadside not only poses threats to nearby properties but also to the environment and economy. The lack of appropriate funding, poor servicing of MSW collection vehicles, and the inadequate state of infrastructure impedes optimization of MSW disposal services.

Oluoko-Odingo, Alice and Emmanuel Mutisya (2019) conducted a study on The Enterprise of Waste Management Among Urban Youth for Sustainable Development. The study aimed to examine how young people in urban areas are tackling waste management challenges and implementing innovative waste management solutions. The researchers started by discussing the current state of waste management in urban areas, characterizing it as a scenario with limited resources, weak governance, and lack of infrastructure. They emphasized the need for urban youth to create sustainable waste management practices. Additionally, the research stressed the significance of collaborations between local governments and youth-led waste management enterprises. The study highlights the role of municipalities in providing support to these enterprises, including technical assistance, access to resources, and other support mechanisms. In conclusion, youth-led enterprises can be instrumental in assisting local governments in meeting their waste management mandates and reducing environmental pollution.

Gakungu, Gitau, Njoroge, and Kimani (2012) conducted a comprehensive study on solid waste management in Kenya, with specific attention given to public technical training institutions. The study analysed the dynamics that affect the efficient management of solid waste. The study found that there is an urgent need to design and implement effective waste management policies that address critical issues, such as solid waste disposal and recycling. The authors suggest the adoption of innovative waste management techniques, such as composting, which can aid in organic waste decomposition. Additionally, they suggest the use of public-private partnerships that can help mitigate some of the challenges faced in waste management.

The study conducted by Mascarenhas, Ness, Oloko & Awuor (2021) aimed to assess the appropriateness of six municipal solid waste treatment technologies in Kisumu, namely landfilling, incineration, composting, anaerobic digestion, waste-to-energy, and mechanical biological treatment, for addressing the waste management issue in urban areas. Through a multi-criteria analysis, the researchers examined the technologies' feasibility, environmental impact, economic viability, and public acceptance based on 13 different criteria. The study findings revealed that the selection of a suitable waste treatment technology depends on the specific context of the location, with waste-to-energy technologies, composting, or anaerobic digestion being more appropriate for some situations than others.

Awuor, Nyakinya, Oloo, Oloko & Agong'(2019) conducted a study on the Kachok dumpsite in Kisumu City to analyze waste management practices and their effects on public health and the environment.

The findings revealed that poorly managed waste disposal systems could have severe consequences. Recommendations for sustainable waste management included sourcing more appropriate landfill sites, constructing better waste disposal facilities, and implementing strict waste management policies. Additionally, the study proposed involving the local community in managing waste and raising awareness on the importance of environmental conservation, as this would create a long-term sustainable solution to the waste management problem.

The studies that have been conducted in Kenya regarding waste management have not been able to establish a clear link between waste value addition and sustainable development. Instead, they have primarily focused on elucidating the challenges associated with managing solid waste. Some notable works in this area include Muigua's (2019) study on integrated natural resources and environmental management for Sustainable Development in Kenya, Henry *et al's* (2006) research on waste management challenges, Gakungu *et al's* (2012) exploration of waste management challenges, and Oluoko-Oding *et al's* (2019) analysis of obstacles in waste management practice. Moreover, Mascarenhas *et al's* (2021) work on the appropriateness of waste management strategies in Kisumu, and Awuor *et al's* (2019) investigation of the consequences of waste management practices on public health and the environment, have not considered waste value addition in the context of sustainable development.

This indicates that no research has been conducted to establish the connection between waste value addition and sustainable development in Kenya. This study sought to bridge this gap.

3. Methodology:

3.1 Research Design:

The research utilized a cross-sectional correlational survey design that aimed to test hypotheses and achieve study objectives. As per Nachmias and Nachmias (2008), using survey design is ideal when researching a problem and measuring its scope. Ethnographers increasingly combine their work with survey research due to the benefits of using a survey design.

3.2 Study Area:

The study was conducted in Kisumu county, Kenya and specifically Kisumu Central, East and west constituencies that have suffered the brunt of solid waste disposal for decades. These three constituencies are the most urbanized areas within the Kisumu County, with Kisumu central being the commercial hub, Kisumu east being the home to the largest informal settlement (Nyalenda) and Kisumu west being the most populous constituency.

Kisumu West on the other hand, has been the site of innovative waste management solutions such as the conversion of waste to energy. The Kisumu waste management project, jointly implemented by the county government and the Kisumu water and sanitation company, that has seen the construction of waste to energy plant that generates electricity from the methane gas produced by decomposing waste at the dump site.

Overall, the growth and development of waste value addition is a programme that is coordinated by the Kisumu County government with the aim not only to address waste management challenge but also to create employment opportunities and spur economic growth.

3.3 Target Population, Sample Size and data collection instrument

The participants in this study were 40 employees from departments that are directly involved in the county’s waste management. These include the [1] Department of land, physical planning, housing and physical development, [2] Department of medical services, public health and sanitation,[3] Department of trade, tourism, industry and marketing and [4] Department of water, environment, natural resources and climate change. 10 respondents from each department was surveyed in this study. The study used structured questionnaire to gather information from participants.

4. Results and Discussion:

The main objective of the study was to examine the role of waste value addition on sustainable development in Kisumu County. The study looked at recycling, composting and waste to energy initiatives as independent variables and sustainable development as the dependent variable. The regression analysis gave the following results as shown in the table below:

Table 1: Effect of waste value addition on sustainable development

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.704	.054		23.432	.000
	Recycling	.236	.054	.340	8.537	.000
	Composting	.218	.055	.339	8.486	.000
	Waste to energy initiative	.359	.055	.283	7.363	.000
	R square	.146				
	Adjusted R square	.136				

Source: Survey data, (2023)

R^2 is 0.146 and is significant. Similarly, the adjusted R^2 is 0.136 and also significant. The shrinkage in this case is 0.01 (0.684-0.674) which is below the level of 0.5 recommended by Field (2013). This indicates that the model is valid, has good predictability, and predicts variance of performance at 14.6 percent, insinuating that green manufacturing recycling wastes, Composting wastes and waste to energy initiative all together explain 14.6 percent of sustainable development of Kisumu County.

Similarly, waste to energy initiative is the greatest contributor to Kisumu county development with a coefficient of 0.359 followed by recycling(0.236) and finally composting(0.218).The analytic model that may be developed from this cause-and-effect situation is as follows:

Kisumu county sustainable development = 0.704+ 0.236 *Recycling* + 0.218 *Composting* +0.359 *waste to energy initiative*.

These results show that value management of solid waste in Kisumu County is indeed a contributor to Kisumu urban development. This is in concurrence with the study of Omosanya,(2019) who analysed prospects of waste management principles to enhance sustainable development in Nigeria and found that waste management and sustainability development are strongly related.Similar results were found by Radwan, Khan & Elmanfaloty,(2021), Samiha, (2013) and Baud, *et al*, (2001).

5. Conclusion:

The study concludes that Kisumu City can transform its waste management practices to attract investors and promote sustainable development. The city has enormous potential to attract investors, but this is only possible if it can assure them of a clean and healthy environment. Sustainable waste management practices play a critical role in achieving this objective. It ensures that people put efforts towards a cleaner and healthier environment. Effective waste management not only leads to the reduction of pollution but also contributes to the conservation of natural resources. Moreover, proper waste management also has economic benefits. It creates job opportunities for people involved in waste collection, sorting, and recycling. It also results in the production of raw materials that can be used in different industries. When waste is not managed properly, it can cause a range of problems such as air and water pollution, soil contamination, and the emission of greenhouse gases. This has a negative impact on the health of people and the environment. In Kisumu City, the waste management approach has been transformed into an opportunity for sustainable development. By turning garbage into gold, the city has been able to create employment opportunities, improve hygiene, and reduce pollution. Finally, effective waste management requires the cooperation of different stakeholders including the government, industry, and the public. It is an essential component of sustainable development and a responsibility that must be taken seriously for the benefit of present and future generations.

6. Recommendations:

Based on the findings, the study recommends the following:

- [i].The city should enforce strict regulations and guidelines to ensure that waste management practices are sustainable and environmentally friendly. This will require the involvement of all stakeholders, including the government, waste management companies, and the public.
- [ii]. The city should invest in public education and awareness campaigns to sensitize the public on the importance of sustainable waste management practices. Residents of the city need to be aware of the benefits of proper waste disposal, and how they can play their part in ensuring a cleaner environment. These campaigns can highlight the

importance of reducing, reusing and recycling waste, and how waste can be managed safely and sustainably.

- [iii]. Another important aspect of sustainable waste management in Kisumu city is the development of partnerships with the private sector, non-governmental organizations (NGOs), and other stakeholders. Such partnerships can help to identify innovative waste management practices and technologies that are appropriate for the city and maintain the environment's cleanliness.
- [iv]. A key step in planning for sustainable waste management is to identify the different types of waste produced in the city, and their composition. This information can help to determine the most appropriate ways to handle each type of waste, including ways to reuse, recycle or dispose of them responsibly.
- [v]. Effective waste management requires the use of appropriate resources, including human and capital resources. A dedicated team of professionals is essential for the efficient operation of the waste management system, and the use of appropriate technology can reduce the environmental impact of waste disposal. Alternative energy sources, such as solar power for heating or cooling systems, can help to reduce the carbon footprint of waste management operations.

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