



Existing Governance Structures for Sustainable Solid Waste Management in Kisii Town, Kenya

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Abstract – This study aims to determine the effect of water content on free fatty acid levels in nyamplung (*Calophyllum inophyllum L.*) seed oil. Nyamplung fruit seeds have a relatively high oil content ranging from 40%-73%, which can be used as a biodiesel raw material. Nyamplung seed oil has a high FFA content that ranges from 15%-30%. The process of extracting nyamplung seed oil is done by the soxhletation method because it is considered the most efficient and uses nhexane solvent, which has non-polar properties and can increase oil yield (more than 50%). This study will use the factorial design level 2 method to determine the most influential process variables to produce optimum operating conditions in making nyamplung seed oil with the lowest FFA content. The variables used in this study are moisture content (8% and 12%), particle size (15 mesh and 25 mesh), and the ratio of materials and solvents (1:1 and 1:3). The analysis results showed that water content had the most significant influence on free fatty acid content with a value of 0.25 and the lowest free fat content of 13.30%.

Keywords – Optimization, raw material

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1. Introduction

Solid waste management (SWM) has been and is a main hindrance to sustainable urban development in many cities/towns worldwide (Adebayo and Bin Ismail, 2016; Andole, 2016; Aryampa et al., 2019; Awasthi et al., 2019; Gupta and Goel, 2021; Un-Habitat, 2020). The governance structures in place in a number of cities/towns especially in developing countries are limited in handling the burden of unsustainable solid waste management (Adeleke et al., 2021) The SWM problem in this new era challenged with COVID- 19; which inputs new solid wastes of face masks and related waste materials will overburden the existing management structures of solid wastes(Gupta and Goel, 2021) though the problem will not be as alarming as it is in the developing countries whose systems are already incapacitated (Un-Habitat, 2020).

The burden of governance and managing of solid wastes particularly in developing countries is made worse by the ever-increasing population, the urbanization process and economic development which consequently increase solid waste generation in urban areas (Kanda and Cheron, 2020). The ever-increasing urbanization rate in the world have had negative impacts and not in tandem with sustainable SWM practices in place (Oluoko and Mutisya, 2019). The burden of ensuring effective and sustainable

SWM systems is crucial to the attainment of SDGs, especially Goal 11 which aims to make cities sustainable cities which is a problem to developing countries. Thus, adversely impacting the environment, polluting water sources and posing serious health hazard to human beings as depicted by African countries a situation similar in other developing countries (Ogutu et al., 2020).

The governance of developing countries has failed to adapt sustainable and economically viable technologies to manage solid wastes and spur economic growth in their urban areas (Un-Habitat, 2020). On paper, most developing countries have succeeded in drafting policies that will ensure a clean and green environment. However, there is often lack of will power to enforce those laws and policies; often compromise the system by collecting bribes from defaulters (Ighravwea and Edemb, 2020). Several developing countries often collect unsorted wastes from households; this governance practice compounds the burden of SWM agencies to effectively separate recyclable and unrecyclable waste, compostable among other wastes.

The African continent's urbanization process continue to surge becoming a worrying trend that majority of the urban areas in Africa are and will be overwhelmed by the ever rising pace and intensity of urbanization process (Manteaw and Boachie, 2019). Further, they allude that

waste management and sanitation have become an ever-enduring problem across African cities, which lack pre-requisite infrastructure and governance to address the problem. (Adebayo and Bin Ismail, 2016) studied the types of wastes generated, trends in management over years, collection and transportation of wastes across East African nations (Uganda, Kenya and Tanzania) in comparison to Abuja town in Nigeria and they identified; lack of transparency, poor governance and preference to corruption in majority of African countries.

According to (Ogutu et al., 2020), dumpsites are sprouting everywhere exposing the ineffectiveness in the policy implementation in SWM. The challenge of urban waste on the other hand can present great opportunities to youth and entrepreneurs to rescue the economy battered with COVID-19 pandemic (Oluoko and Mutisya, 2019). Accordingly, management of solid waste is at a rudimentary stage where efforts to address the increasing solid waste quantities, diminishing natural resources, inadequate finances and increasing urbanization are yet fully addressed in the country. Governing SW efficiently in Kenya is extremely important to achieving the right to a clean and healthy environment for all as enshrined in the constitution, improve the economy to create employment opportunities and wealth thus realizing the country's SDGs (Andole, 2016).

Additionally, Kenya's sustainable waste governance is key to delivery of the government's "big four" national priorities and for Kenya's blue economy with its aim on spurring economic development, enhancing health water and building safe environment (Asefi et al., 2020). SWM is a visible urban areas service that is practically evidenced in a sustainable manner in which its governed will provide an indicator for good local governance and this is related to performance of urban governance. Large generation volumes accompanied with low collection capacity, low recovery, uncoordinated disposal and inadequate laws and incentives are the major challenges in governance of SWM (Mulatya, 2011). Other studies indicate that minimal public awareness, participation, source point sorting of wastes and lack of accurate data where estimates are used are a major challenge in the governance of solid wastes in Kenya (Andole, 2016; Sarry, 2010; Sibanda et al., 2017). County government fail to prioritize the implementation of SWM disposal guidelines, also poor coordination in this practice as (Muiruri et al., 2020) asserts.

Weak governance, several policies on SWM, weak implementation and unsound waste disposal are the major challenges of SWM governance in Kenya as illustrated by (Haregu et al., 2017) study in Nairobi and Mombasa. Challenges of low separation, low levels re-use and recycling, improper disposal such as at quarries and lack of collection and, disposal points exist in Kenya as studied by (Ochieng, 2016). According to (Ochoro, 2016), SWM in Kenya faces a myriad of challenges including: minimal waste reduction, lack of a policy to ensure wastes are reused or recycled and lack of legislative frameworks in promoting safe industrial wastes disposal.

The residents in cities are not empowered to enforce policies and regulations of SWM as (Ogutu et al., 2020), observed. He further noted that institutions such as NEMA and county governments mandated to implement formulated waste management policies are the weak links and do not involve all stakeholders. Also, limited public awareness is a major derailment in governance of SWM in Kenya (Ogutu et al., 2019). Collaboration among institutions is limited in waste management, equity, public participation, transparency, accountability, corruption and non-conformity to the rule of law are among the major setbacks of SWM in Kenya as (Ogutu et al., 2020) critiques. The current policies, laws and regulations are unable to make an impact since they are on the national sphere and have not been adapted and enacted by the county assemblies for reinforcement to enable sustainable sound environment. Either the laws are not well understood or the inability to implement them successfully (Oluoko & Mutisya, 2019) is also a challenge in the town. The NEMA laws are on paper with little knowledge about them by the waste generators and there is need for strictness and corruption intolerance in the application of the laws to see a change in future.

Also, poor linkage and use of regulations, poor formulation of plans, non- implementations of plans, inadequate budgetary allotment to SWM at local levels, poor cooperation of waste management services and the inability to value waste as a resource to exploit its usefulness are the major problems counties are grappling with in waste management (Kanda & Cheron, 2020).

The current policies, laws and regulations in Kenya are unable to make an impact since they are on the national sphere and have not been adapted and enacted by the Kisii county assembly for reinforcement to enable sustainable sound environment. The laws are not well understood nor they are implemented successfully (Oluoko & Mutisya, 2019) is also a challenge in the town. The NEMA laws are on paper with little knowledge about them by the waste generators and there is need for strictness and corruption intolerance in the application of the laws to see a change in future.

The current state of linear fashion in Kisii of SWM from: waste generation, to collection, transportation and disposal at sites poses serious environmental challenges (Wakhungu and Sunkuli, 2016). The challenge of diminishing disposal sites is common in Kisii where dumpsite land has experienced grabbing, quarrying and emergence of commercial storey buildings (Moreka, 2017). From these literatures it's evident that there exist governance gaps in policies, legal and institutional frameworks which will foster sustainable solid waste management in the country. This study therefore sought to assess the governance structures for sustainable solid waste management and urban development in Kisii town- Kenya and other developing countries.

2. Materials and Methods

2.1. Location

Kisii town geographically is sited on Latitude: 0° 41' 0 S and Longitude: 34° 46' 0 E. Kisii is 309 km from Nairobi to the east-southeast. The town is situated at a height of 1,700 m (5,577 ft) asl the gentle slopes of the highlands of Kisii. The town currently serves as the county headquarters of Kisii County in the larger Nyanza region. It covers 8 km² and it has recently sprawled to extend its boundaries by 29 km², a total of 37 km². The town's siting on highlands enhances growth of varied vegetation cover enabling the hinterland to produce a lot of food crops and vegetation G.O.K (2021).

The area majorly receives orographic/ relief rainfall all year round, caused by its location on the Kisii highlands and its proximity to Lake Victoria. The rainfall is reliable with

two maxima's on April and October. Kisii town mainly consists of volcanic soils which favour the cultivation of cash and food crops.

As of 2019, the town had a population of 112,417 (KNBS, 2019) making it the second most populous town in Nyanza region after Kisumu city. The town is the eighth most populous town in Kenya. Among Kenya's urban areas, Kisii town has a relatively high population density of 2,862 persons per km² (KNBS,2019). Kisii town is among the most densely populated areas in Kenya after the two cities of Nairobi and Mombasa. The economy of the town currently is obtained from bustling business activities and agriculture. The town is characterised by tall commercial flats with ever abound activities. Currently the town is the fastest growing in Western Kenya.

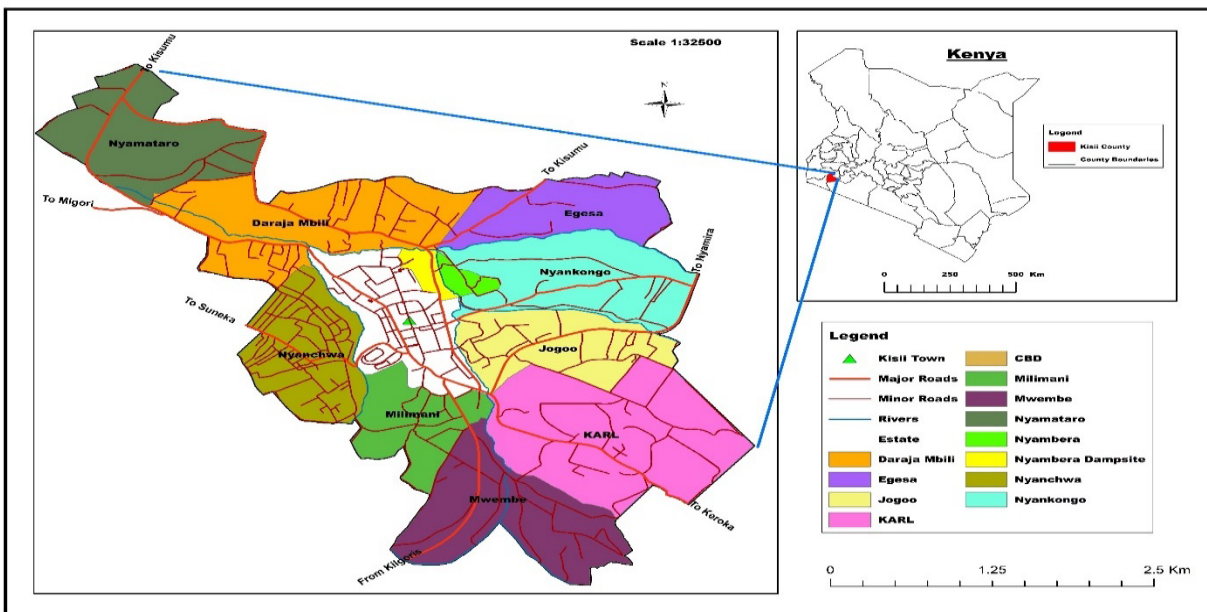


Figure 1. Map of Kisii Town
Source: Modified Kisii Topographical Sheet 130/2 G.O.K (2021)

2.2. Research design

This research adopted a cross-sectional research design. Variables were observed and analyzed how the existing governance structures solid wastes hinders sustainable SWM that will spur sustainable waste management and urban development. Both qualitative and quantitative methods were used.

2.3. Sampling and Sample size

This research employed purposive and random sampling. Purposive sampling guided the selection of nth governance focus groups dealing with management and disposal of solid wastes. Random sampling was used to select the staff working on the various sectors of SWM in Kisii town. The study targeted governance of SW in Kisii town. Focus groups dealing with management of solid wastes formed the sample size. This focus groups include the NEMA officials at Kisii county, directorate environment

department, directorate public health department waste management, directorate municipality, SWM staff (collectors, transporters and disposal site workers), NGOs, CBOs and CSOs dealing with waste management, and private sector engaged in SWM. Using Yamane's formula: $n = \frac{N}{1+N(e)^2}$, the following sample size was determined.

Target Population/Department	Number of Staff	Sample Size
NEMA Kisii office	4	2
CEC and CO Environment	2	2
Directorate Environment	4	2
Directorate public Health (WM)	8	3
Directorate Municipality	10	4
SWM Staff	175	64

Target Population/Department	Number of Staff	Sample Size
Private Organizations Collection	8	3
Private Organizations Recovery	2	2
Total	201	82

2.4. Data Collection

Data were collected using primary data collection tools; questionnaires, use of Key Informant Interviews and observation (Creswell, 2014). Using KOBO collect data was collected from the sample size. Questionnaires and focus group interviews were the preferred data collection tool for the three objectives. Questionnaires were useful in collecting data from waste management officers and SWM staff. Interview schedules were used for the SWM and governance officials. Questionnaires were used to collect data concerning existing governance structures. Interview schedules were also used to assess the existing governance structures for sustainable SWM

2.5. Data Analysis

Data from interviews were analyzed descriptively where percentages, and charts were used to present the results. Data obtained from questionnaires was coded using softwares; Statistical Package for Social Science (SPSS), KOBO and excel spreadsheets. These results are presented using bar graphs, tables, pie charts and proportional circles.

3. Result

3.1. Knowledge of the existence of solid waste governance structures in Kisii County

The purpose of the study was to determine whether the respondents were aware of the solid waste governing systems in Kisii County. These governance structures include; households (waste segregation), county municipality (waste collection), county municipality (waste transportation), environment/agriculture department (waste composting and recycling), environment department (waste disposal), public health (waste hygiene) and public works (waste equipment). It was determined that more than 50% of the respondents were aware about the solid waste management governance frameworks in Kisii County (Figure 2).

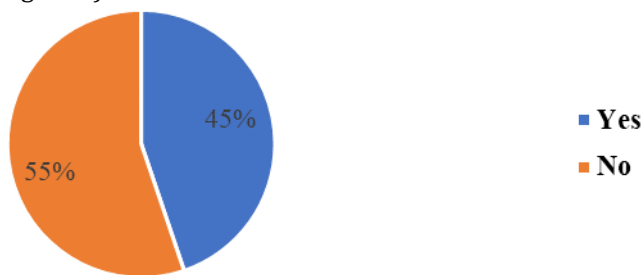


Figure 2. Awareness of the governance structures in SWM in Kisii County

This knowledge also, helps residents and county management to understand and know which office/department to call/report to concerning any mishap such as collection, transportation and hygiene.

3.2.1 Knowledge of residents on existing departments that manage solid waste in Kisii town

The residents from the results indicate that they are not aware of the departments managing solid wastes in Kisii town. This is evidenced by the residents listing departments that do not manage solid wastes such as: Kenya Urban Roads Authority (KURA), Kisumu Water Sanitation Company (KIWASCO), National Environment Management (NEMA). Other sectors listed are non-existent such as burning and segregation and county waste collections as shown in Figure 3.

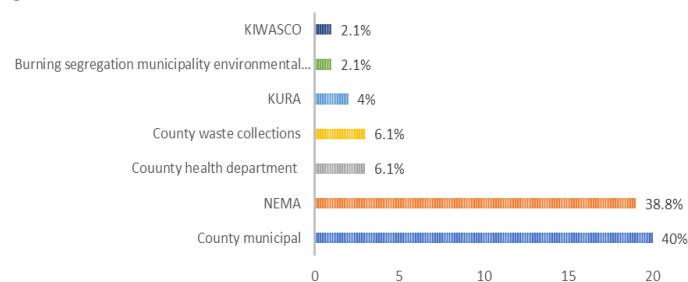


Figure 3. The knowledge of residents on the departments that manage solid waste in Kisii town.

3.2.2. Knowledge of SW workers on departments that manage solid waste in Kisii town.

In determining the awareness of departments managing solid waste among the workers engaged in SWM in Kisii town;6 the study established that different departments are in charge of managing solid waste in Kisii County. Solid waste management is a responsibility shared by the County municipality department, the County Department of Environment and Natural Resources, the municipality department, the public health department, and the private sector in Kisii Town. The several departments in charge of effective management in Kisii town are listed in Table 4. below.

Table 4. Awareness of SW workers on departments managing solid waste in Kisii town

Department	Frequency	Percentage
1 National environmental management authority (NEMA)	41	17.1
2 County Department of Environment and Natural Resources	36	15.0
3 Municipality department of the county government	119	49.6
4 Department of public health of county government	25	10.4
5 Private sector	19	7.9
Total	247	100

These results indicate that majority of the workers know the departments concerned with solid waste management though the municipality is common. The data implies that solid waste is inter-departmental in Kisii town therefore lacking a particular department in charge. Further, this result indicates that there is collaboration among departments managing solid wastes.

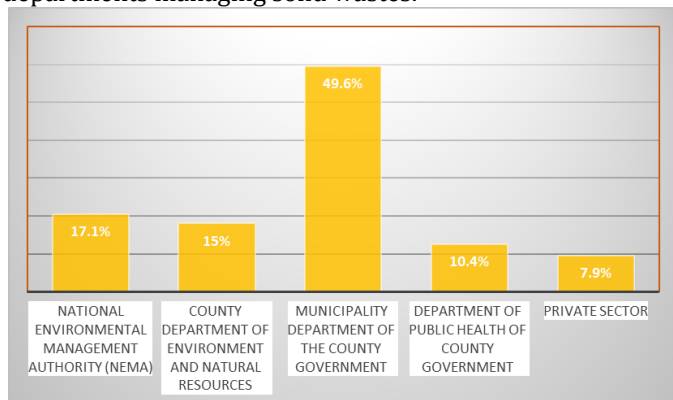


Figure 4. Knowledge of SW workers on departments that manage solid waste in Kisii town.

3.3. Knowledge of Existing solid waste policies in Kisii town.

It was of interest to this study to establish the awareness of the study respondents of the policies that govern SW in Kisii County. These policies included: On-source Waste Separation strategy is the most known of them all. The results of Figure 4 shows that the majority of study respondents are unaware of plastic recycling policies. However, the study respondents are also aware of other rules, although to a lesser degree.

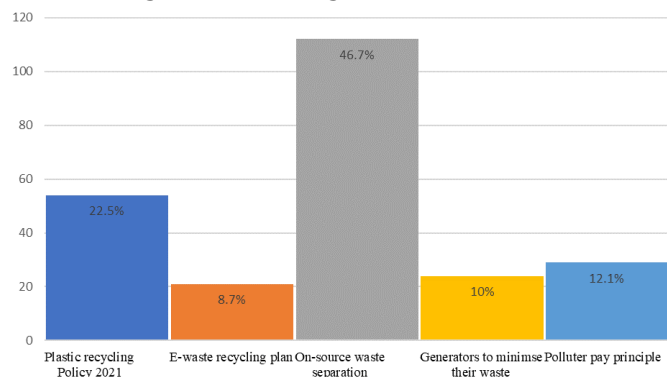


Figure 5. Participants' awareness of waste policies in Kisii Town.

From the results in figure 5 its evident that study respondents have limited awareness on the SW policies. The study established that only 46.7% of the respondents are aware of On-source separation, whereas 22.5% are conversant with plastic recycling policy 2021, 12.1% are aware of the polluter pay principle, 10% about waste minimization by generators and 8.7% on the E-waste recycling plan of Kisii County. These results indicates that public participation which is a preliquisite for the formulation of policies is not incorporated. This makes

enforcement and compliance of these policies difficult to the residents.

3.4. Perceptions of various groups of people concerning the existing laws

It was of great interest for the study to sample perceptions of some groups of people regarding the existing laws in Kisii town and its environs. As follows, the researcher sampled the groups in terms of youths, women, and adult men to gather their views. From the data obtained, it was established that the involvement of NEMA in waste management in Kisii town is a belief of adult men as compared to the youths and women (45.5% > 34.1% > 20.5%). Table 4.3 below is a summary of these outcomes.

More youths (58.9%) accept as true that there are laws that guide waste recovery in Kisii town. The percentage of the youths affirming this perception is higher than the one recorded for NEMA(58.9% > 34.1%). Notably, more adult men than women believe that there exist waste recovery laws and policies in Kisii town(32.6% > 8.5%) (Table 4.1).

About half of the sampled youths (45.5%) trust that the segregation of solid wastes happens in Kisii town. Notably, the portion recorded in this segment is lower than that obtained for youths regarding waste segregation, although higher than that obtained for NEMA (45.5% < 58.9% > 34.1%). Also, more women than adult men(32.9% > 21.7%) believe that waste separation occurs in Kisii town (Table 4.3).

Still, most youths trust the involvement of multi-stakeholders in Kisii town has enhanced effective waste management (66.4%). Compared to earlier sections, the current response for the youths surpasses all those obtained for County laws, waste segregation, and NEMA (66.4% > 58.9% > 45.5% > 34.1%). Remarkably men with a similar belief, double the portion of the women participants(Men 23.1% > Women10.5%)(Table 4.1).

More youths than adult men and women believe that Kisii County has decent mechanisms for sustainably managing SW(78.3% > 17.5% > 4.2%)(Table 4.1). On the other hand, most of the youths feel that the County Ministry of Environment and Natural Resources has succeeded in managing solid waste in Kisii town (51.0% > Men 35.0% > Women 14%)(Table 4.1).

Table 4.1. The perception of various groups of people regarding SWM

	Perception	Youths %	Women%	Men %
1	NEMA has played a critical role in managing solid waste in Kisii town.	34.1 ± 2.1 ^a	20.5 ± 1.1 ^b	45.5 ± 2.3 ^c
2	There exist laws and policies guiding waste recovery in Kisii town.	58.9 ± 0.1 ^a	8.5 ± 1.8 ^b	32.6 ± 1.3 ^c
3	The involvement of multi-stakeholders in Kisii town has enhanced the effective management of waste	66.4 ± 1.2 ^a	10.5 ± 1.2 ^b	23.1 ± 0.9 ^c
4	The county government has good	78.3 ± 3.1 ^a	4.2 ± 3.2 ^b	17.5 ± 2.2 ^c

mechanisms for sustainably managing solid wastes in Kisii town.				
5	Segregation/separation of solid waste takes place in Kisii town.	45.5 ± 2 ^a	32.9 ± 5.8 ^b	21.7 ± 1.2 ^c
Pearson Chi-Square value (84.02 ^a), <i>Asymp. Sig. (2 – sided)</i> = 0.00, letters ^{abc} in the same row differ statistically by Chi-square				

3.5. Existing Governance Practices on laws, policies and regulations for sustainable SWM.

3.5.1. Environmental Management Coordination Act (EMCA 1999)

EMCA1999 establishes appropriate legal and institutional structures for environmental management. Some of the EMCA 1999 laws include; on-source waste segregation, Generator minimises waste, Polluter pays principle, and the colour code separation of waste.

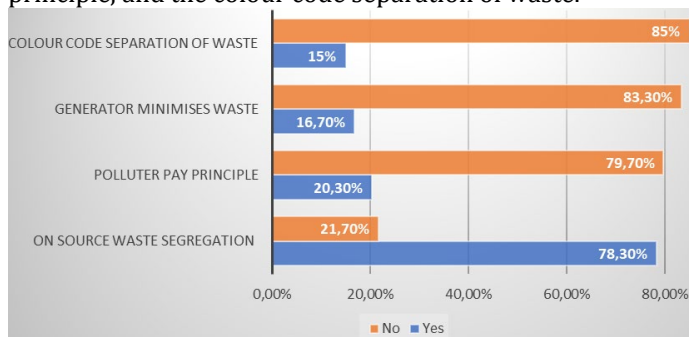


Figure 6. Application of EMCA 1999 Laws in Kisii Town

An Analysis of the responses shows minimal application of laws on waste separation by colour (15%) (Figure 6). Nevertheless, Kisii town has structures that guide on-source waste separation as provided by the EMCA 1999 (78.3%) (Figure 6). The existence of the other two laws is not well known to the respondents. The findings of Figure 5 indicate 20.30% and 16.70% affirmation of the law requiring the generator to minimise waste and the ‘Polluter pays principle’ respectively.

3.5.2. National Environment Management Authority (NEMA) laws (2006,2012, 2017, 2022)

NEMA laws applicable in Kisii town are waste minimisation, polluter pays principle, waste treatment, waste valorisation, sustainable waste management, reuse/recycle, and extended producer responsibility. Waste minimisation and polluter pays principle were covered in section 4.2.1, Figure 6.

NEMA’s Extended Producer Responsibility (EPR) is the most known law applicable in Kisii town (67.1%). Similarly, the sustainable waste policy is applicable although moderately 50.3% (Figure 7). Reuse and recycling are other laws that have also been implemented in Kisii although not extensively (30%) (Figure 7). Waste treatment (25.5%) and waste valorisation (21.4%) are also other NEMA laws that are used by Kisii county administration to ensure solid waste management practices in Kisii town (Figure 7).

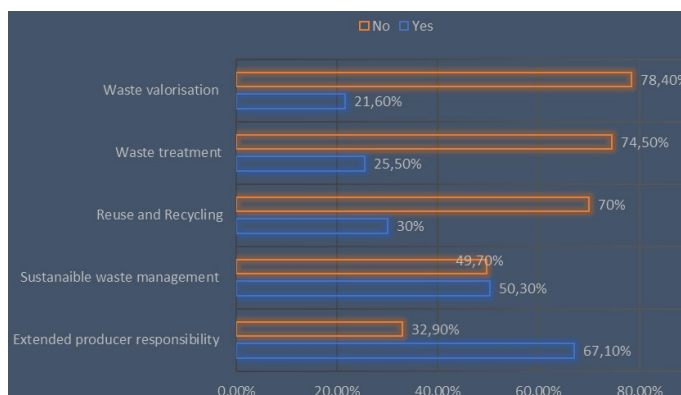


Figure 7. Application of NEMA laws in Kisii town

3.5.3. Kisii County by-laws

The study established that the Kisii county administration has enacted laws to guide solid waste management in Kisii town and its environs. These laws are the E-waste recycling plan, the plastic waste recycling plan 2019, and the Organic waste separation 2022 as shown in figure 7 below.

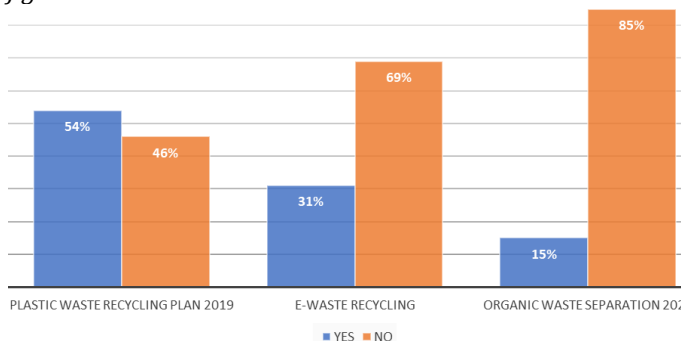


Figure 8. Kisii County laws on Waste Management.

The plastic recycling plan of 2019 is the most successfully implemented law (54%) (Figure 6). E-waste recycling has also been implemented but not to standards of the plastic recycling (31%) (Figure 8). Lastly, organic waste separation is the least implemented law in Kisii town (15%).

The findings of figure 8 indicate more than half of the respondents affirmed the enforcement of Plastic recycling of 2019 this law in Kisii town, though the practice has only been achieved partially. The outcomes of figure 8 outline the experiences of Kisii residents and county employees who have sort help in getting rid of e-waste from their residences or though they lack proper structures for e-waste recycling and disposal.

3.5.4. Roles of Departments in Kisii County Managing Solid Wastes

Kisii County attracts various entities in SW management. The outcomes of the responses show six entities taking part in SWM in Kisii town and its surroundings (Figure 8).

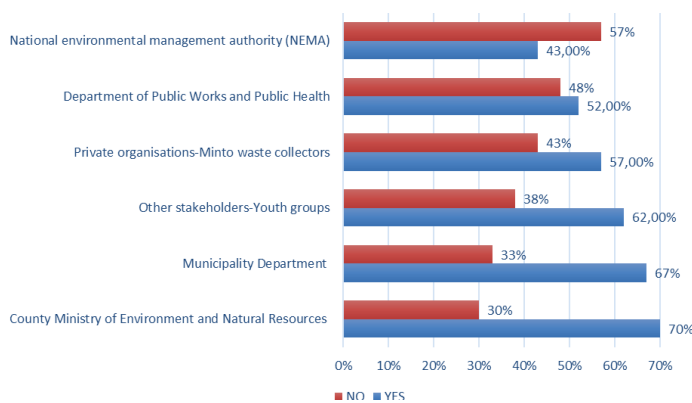


Figure 9. Departments managing solid waste in Kisii

The County Ministry of Environment and Natural Resources manages most of the SW in Kisii town and the surrounding areas (70%). The Municipality department also manages a wide section of SW within Kisii town (67%) (Figure 9). Remarkably informal youth groups do a major part in managing solid wastes within and outside Kisii town (62%) (Figure 8). Private organizations particularly Minto Waste Collectors are also involved widely in SW management activities in Kisii town. Lastly, the Public Works and the Public Health departments also participate in the SW management (52%) with NEMA trailing the departments (43%) Figure 9.

Public works design and maintain the routes followed by county vehicles in the collection and transportation of waste. Furthermore, this department offers repair services to county vehicles and tractors to ensure their daily operations. On the other hand, the Public Health Department plays a supervisory role that ensures overall sanitation, and adherence to the guidelines that promote public hygiene. Although the operations may be minimal, the functions of these departments are vital in ensuring sanity in Kisii town. NEMA provide general supervision, and coordination of environmental matters. Furthermore, NEMA oversees the implementation of policies that safeguard against environmental degradation in Kisii town and its environs.

3.6. The Operations of the Existing Governance Structures for Sustainable Solid Waste Management

This study sought to establish if various activities of the existing governance structures occur in Kisii town. The results obtained are presented in Table 4.2 with a detailed discussion thereafter.

Table 1.2. The operations of governance structures regarding SWM

Policy	Yes %	No %
1 Segregation/separation of solid waste takes place in Kisii town.	90.9 ± 0.1 ^a	9.1 ± 0.4 ^b
2 There exist laws and policies guiding waste recovery in Kisii town.	84.1 ± 0.5 ^a	15.9 ± 1.5 ^b

Policy	Yes %	No %
3 The county government has good mechanisms for sustainably managing solid wastes in Kisii town.	93.1 ± 0.4 ^a	6.9 ± 1.1 ^b
4 NEMA has played a critical role in managing solid waste in Kisii town.	89.0 ± 0.1 ^a	11.0 ± 0.2 ^b
5 The municipality department has succeeded in managing solid waste in Kisii town.	90.9 ± 0.1 ^a	9.1 ± 0.4 ^b
6 The involvement of multi-stakeholders in Kisii town has enhanced the effective management of waste	88.4 ± 0.1 ^a	11.6 ± 0.4 ^a

Pearson Chi-Square value (4.591^a), *Asymp. Sig. (2 – sided)* = 0.047, letters ^{ab} in the same row differ statistically by Chi-square

Only 9.1 percent of respondents stated that solid waste segregation/separation did not take place at their home, compared to a fairly substantial majority (90.0%) who statistically significantly affirmed that it occurs at household level. According to the study, SWM services are not generally provided to low-income urban neighbourhoods. Nevertheless, the findings of this study support a variety of waste separation techniques in Kisii town, including on-source separation of garbage, debris, and e-waste.

4. Discussion

Concerning awareness of governance structures, the results indicate that only 45% of the respondents who were mainly workers in SWM are aware of the existing governance structures in SWM. This implies that the residents are not aware of these structures and how they operate. The results also implies that respondents are barely informed concerning the departments managing SW in the town. This is supported by the research findings that rank NEMA second as a department managing solid wastes.

On knowledge of existing waste policies, these results indicates that public participation which is a prerequisite for the formulation of policies is not incorporated. This makes enforcement and compliance of these policies difficult to the residents. There still is confusion and misunderstanding on the residents concerning who should play the core role of SWM. According to table 4.1; men, women and youths do not agree on who manages solid wastes, whether the policies in place are sufficient for sustainability, the involvement of multi-stakeholders yields much, the mechanism in place by the county government are adequate and whether separation takes place. These divergent perceptions of men, women and youths clearly indicate inadequate public participation and the whole process is not streamlined.

EMCA 1999 regulations according to the finding are on paper, rarely practised neither implemented especially colour code separation law, waste minimisation by the generator, polluter pay principle. Though the results indicate that there are strides made in on-source separation which is an initiative of the current county government to separate organic waste for composting, its yet to realise full

implementation. Further, NEMA regulations according to the findings minimally enforced except EPR that seemed to be on course of full implementation following the emphasis by the current county government regime to separate solid wastes, much emphasis laid on organic wastes.

The findings on Kisii county by-laws indicate more than half of the respondents affirmed the enforcement of Plastic recycling of 2019 this law in Kisii town, though the practice has only been achieved partially. The outcomes of figure 7 outline the experiences of Kisii residents and county employees who have sort help in getting rid of e-waste from their residences or though they lack proper structures for e-waste recycling and disposal. The research found out that the county government was in the process of sensitising the public to separate their wastes especially organic wastes for composting. The county government also closed the open dumpsite at Nyambara; this leaves out other forms of solid wastes. The results indicate that there are multi-stakeholders handling solid wastes. These stakeholders and departments are not well known to the respondents. The respondents have no clear understanding of the mandate of each department.

The results indicate that, the municipality department is now in charge of managing solid waste in Kisii town. Further, according to the evidence that is currently available, the county government's municipality department collects 70% of the domestic solid garbage in Kisii town (Mecheo, Omondi, and Abdirizak, 2019). The municipality department is responsible for collecting solid garbage daily from selected official spots and transports it to a designated dumping site within the county using tractors and vans. Also, the Ministry of Environment and Natural Resources is one of the National agencies in charge of waste management, responsible for disposing of solid wastes, contributing (15.38%) of waste management in Kisii town (Mogaka, 2022). The public health department has been working with other groups to guarantee proper management of solid waste in Kisii town. Lastly, the management of solid wastes in Kisii town has also incorporated the private sector. According to a study by Mogaka (2022), the Kisii county administration has collaborated with youth organizations to collect solid garbage in several Kisii town-zoned estates.

Nevertheless, the findings of this study support a variety of waste separation techniques in Kisii town, including on-source separation of garbage, debris, and e-waste. To facilitate sorting and easy identification at the dump site, these wastes are divided and kept in various waste bins (Kanda and Cheron, 2020). The results of this study seem to support the assertion made by Wakhungu and Sunkuli in (2016) that on-source waste segregation takes place in Kisii County and is carried out by the private sector with the assistance of informal groups. From the solid garbage that is gathered and sent to several specified locations throughout the town, these groups salvage commercially valuable materials.

The investigation also proved that Kisii County has laws and regulations that govern the management of solid wastes

in Kisii town. The majority of respondents (74.1%) said that the county does indeed have rules that assist in managing solid waste in the municipality. Guidelines for the generator's accountability, waste separation, and transportation, among other aspects, are explicitly established in the 2006 Act (NEMA, 2023). Additionally, the Sustainable Waste Management Act of 2021 offers rules and laws that direct waste management throughout the Nation (Kenya Gazette Supplement, 2021). This Act's goals include, among others, promoting sustainable waste management, improving Kenyans' health by maintaining a clean and healthy environment and assuring efficient solid waste delivery services. According to the results of the current study, 89% of the participants said NEMA was actively leading Kisii's solid waste management activities. This result is accurate since the 1999 EMCA required NEMA to oversee the execution of environmental impact assessments on projects before their deployment to prevent potential environmental harm (Mogaka, 2022). This is why NEMA works in conjunction with all county governments on issues of environmental preservation, including solid waste management. NEMA strives to ensure that counties and sub-counties enact regulations and legislation that safeguard against environmental deterioration.

According to earlier research, the town of Kisii has systems in place for solid wastes storage, collection, transportation, and disposal (Mecheo, Omondi, and Abdirizak 2019). When it comes to storage, generated solid waste is kept for a short period before being moved to a shared location on the property and finally transported to the dumping site, (Mecheo, Omondi, and Abdirizak, 2019). However, private organizations are in charge of collecting solid wastes from some locations in the municipality. The county has established solid waste collection routes within the town, which makes it possible for collectors to reach predetermined places for the collection of waste.

Finally, the study found that Kisii town's multi-stakeholder participation had improved the efficient management of waste. The waste management in Kisii town is reportedly ensured by collaboration between the Kisii county administration and local non-formal groups as well as government ministries, international investors, and agencies. According to a study by Mogaka (2022), for instance, the Kisii county government has partnered with Malaysian investors since the year 2019, a move that led to the establishment of an e-waste recycling program though not a with the current county government. Collaboration with other parties enables people to act collectively and exchange information, according to social capitalism. As a result, there are empowerment and communication strategies that work well for attaining some particular objectives (Akhavan, and Mahdi Hosseini, 2015). If properly applied, this ideology can improve waste management. To ensure that solid waste is managed effectively in Kisii County, multi-stakeholder participation is essential.

5. Conclusion

There exist governance structures in the management of solid wastes in Kisii town. These structures are guided by the national EMCA 1999 laws, NEMA policies and regulations and Kisii county by-laws and policies. The resident's knowledge concerning the existing laws and policies is limited implying that public participation is minimal. Various groups of respondents in Kisii town's information of stakeholders in SWM is conflicting between youths, women and men. The laws, policies and regulations in both the national and county levels in place are rarely implemented and enforced in Kisii town. Further, the county government should streamline the departments handling solid waste for efficiency and fast track the implementation and enforcement of the existing laws, policies and regulations. Finally, the operations of waste management by the various governance sectors are still at low percentages, this calls for the need to upgrade SWM governance operations to enhance sustainable waste management resulting to circular economy.

6. Recommendations

This study outlines the following recommendations:

- i) Public participation should be incorporated in all decisions, laws, policy and regulation formulation as a constitutional requirement and to enable residents understand their role, resulting to cooperation when they are implemented. This will help realize full implementation to enable sustainable SWM.
- ii) The structure of solid waste management should be streamlined to enable the public to understand the departments responsible for SWM and where to report to in case there is an issue. Also, multi-stakeholders' involvement should be handled decisively such that each stakeholder has a streamlined and clear-cut mandate to avoid duplicating of roles and functions
- iii) Public education through the media (radio, television, newspapers), banners, posters, public baraza and other methods be carried out to educate the general public SWM governance structures, laws, policies and regulations and how they work. This will help the residents to cooperate in implementing them.

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