

Forside

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Assessment of Factors Affecting Household Solid Waste Management in Kibugu, Kenya

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I. Abstract

This study introduces and discusses the factors affecting household solid waste management in Kibugu, Kenya. In Kenya, there is ample legislation working towards sustainable solid waste management, in particular the National Solid Waste Management Strategy written by the National Environment Management Agency. However, this legislation is often not implemented effectively and thus Kibugu faces various challenges in its solid waste management.

We used a combination of surveys, key informant interviews, a transect walk, observations, mapping, and a group interview to first get an overview of the existing waste management system in Kibugu, and then explore the factors influencing the gap between legislation and implementation. Overall the main types of waste identified in Kibugu were plastic, organic, and kitchen. It was identified that there has been a significant increase in plastic waste. Key challenges in solid waste management included; lack of adequate collection services, tensions between institutions and locals surrounding awareness, and lack of clear governmental roles. We identified key driving factors behind these challenges to be a lack of budget and a lack of political will. Note was also taken of the actors, both formal and informal as well as private and public, and their respective roles. This identified a drive for the privatisation of solid waste management.

Overall, factors affecting household solid waste management are most significant on an institutional scale. The impact of these institutional challenges leaves Kibugu without a functioning solid waste management system.

II. Acknowledgments

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III. Abbreviations

HSWM	Household Solid Waste Management
SWM	Solid Waste Management
KII	Key Informant Interviews
KI	Key Informant
SSI	Semi-Structured Interview
PHO	Public Health Officer
NEMA	National Environment Management Agency
CCEO	Climate Change and Environment Officer
CHP	Community Health Providers
SHoMAP	Smallholder Horticulture Market Accelerated Programme
KFCS	Kibugu Farmers Cooperative Society
KTDA	Kenya Tea Development Agency

IV. Responsible Authors

Chapter	Author(s)
1. Introduction	All
2. Methods	All
3. Results	All
4. Discussion	All
5. Conclusion	All

V. List of Figures

1. Introduction

Figure 1.1. The solid waste management hierarchy suggested by NEMA in the NSWMS as a method of implementing multiple methods, in order of preference, to achieve sustainable waste management (Source, NEMA, 2015)

Figure 1.2. Maps showing the location of Kibugu within Embu county and Kenya (Source Google earth 2023)

3. Results

Figure 3.1 Scheme of actors working in waste management in Kibugu.

Figure 3.2. Bar chart showing types of waste identified by households and frequency of identification

Figure 3.3. The map created by our local guides with the prompt of ‘draw a map of Kibugu identifying key waste hotspots, the types of waste and what happens to that waste’.

Figure 3.4. Flowchart showing the flow of waste from origin to final disposal

Figure 3.5. And Figure 3.6 On the a left the burning of plastic waste in the shamba, on the right a pit latrine which will be buried over

Figure 3.7. Stack chart showing the spread of strategies used for disposal of waste

Figure 3.8. Pie chart showing the spread of disposal strategies for chemical packaging

Figure 3.9. Image of Chemical Waste returns bay at KFCS

Figure 3.10. Stack chart showing the gender distribution of responsibility for waste management

Figure 3.11. Infographic showing health environmental and social impacts of solid waste management in Kibugu

Figure 3.12. Bar chart showing the sources of education or respondents. .

Figure 3.13. Bar chart showing responses to likert scale on whether respondents would be willing to learn if the county government provided education.

Figure 3.14. Pie chart showing the proportions of people who stated it was easy to buy plastic bags vs those who said it was difficult.

Figure 3.15. Image of the only functioning waste bin we found in Kibugu.

Figure 3.16. Bar Chart showing the amount of times each of the recurring themes was suggested as a method for overcoming the challenges in waste management.

Figure 3.17. Conceptual mind map showing how different actors envision the future of solid waste management in Kibugu. Boxes where there are two colours in the box show that two actors stated the same thing.

4. Discussion

Figure 4.1. Image taken Outside the waste collectors shop, plastic bottles and glass bottles separated.

VI. List of Tables

Results

Table 3.1 Waste composition in the past and present

Table 3.2 Table comparing our observations to the NEMA national solid waste strategy ideal approaches to solid waste management

Table 3.3 Challenges identified by actors and the overlap between who brought these challenges up

Table 3.4 Suggestions on how challenges in waste management could be overcome.

Table 3.5 The key themes identified in the responses by the actors

Table of Contents

I. Abstract.....	1
II. Acknowledgments.....	2
III. Abbreviations.....	3
IV. Responsible Authors.....	3
V. List of Figures.....	4
1. Introduction.....	4
3. Results.....	4
4. Discussion.....	5
VI. List of Tables.....	5
Results.....	5
Table of Contents.....	5
1. Introduction.....	7
1.1. Statement of the research problem.....	7
1.2. Research questions.....	8
1.3. Background - Literature review.....	9
1.3.1 The policy framework of SWM in Kenya and Embu County.....	9
1.3.2. Challenges in Household Solid Waste Management.....	10
1.3.3. Role of private actors in waste management.....	11
1.3.4. Role of gender in waste management.....	11
1.4. Study Site Description.....	12
2. Methodology.....	13
2.1 Quantitative methods.....	13
a. Survey.....	13
2.2. Qualitative methods.....	13
a. Observation.....	13
b. Transect walk.....	13
c. Key Informant Interviews.....	13
d. Group interview.....	14
e. Mapping.....	14
3. Results.....	15
3.1 Actors in Household Solid Waste Management.....	15
3.1.1. Waste Generators.....	15
3.1.2. National Institutions: NEMA.....	16
3.1.3. Local Government.....	16
a. Embu County Government.....	16
b. Authorities of Kibugu.....	17
3.1.4. Service Providers.....	17
3.2 Current Household Solid Waste Management in Kibugu.....	18
3.2.1. Waste Composition.....	18
Wastes Identified by Key Informants.....	19
3.2.2. Waste Sorting and Disposal Process.....	20

Organic.....	22
Kitchen.....	22
Manure & Ash.....	22
Textile, Paper.....	23
Chemical.....	23
2.3. Gender Distribution.....	24
2.4 Change in Waste and Management Over Time.....	25
3.3. Impacts of Solid Waste Management.....	25
3.3.1 Impacts of SWM in Environment and Social Well-being.....	25
3.4. Challenges.....	27
3.4.1. What is the gap between implementation and action?.....	27
3.4.2. Challenges Identified by Actors.....	28
a) Proximity and Accessibility.....	28
b) Collection services.....	29
c) Education.....	29
d) Implementation of Legislation.....	31
e) Lack of resources, and infrastructure.....	32
3.5. Future Vision.....	33
3.5.1 How can these challenges be overcome?.....	33
3.5.2. How do actors envision the future.....	34
4. Discussion.....	36
4.1. Why is there a gap between legislation and implementation?.....	36
a) Lack of clear institutional roles.....	36
b) Lack of infrastructure.....	37
c) Lack of awareness.....	37
4.2. Transversal Challenges.....	38
4.3. Actors filling gaps on waste management work.....	39
4.4. Waste management from a gender perspective.....	40
4.5. Discussion of Methods.....	40
5. Conclusion.....	41
5.1. Concluding remarks.....	41
5.2. Further research ideas.....	42
5.3 Reflections.....	42
6. Bibliography.....	43
7. Appendix.....	47
7.1. Overview of applied methods.....	47
7.2. Key-informant interview questions and notes.....	48
7.3. Group interview questions and notes.....	66
7.4. Mapping Method.....	71
7.5. Synopsis.....	72

1. Introduction

1.1. Statement of the research problem

The world is now facing an increasing volume of waste which is causing a serious risk to ecosystems and human health. This increase is mainly attributed to rising populations, and processes of urbanisation and industrialization (Shah et al., 2023; UNEP 2024; UNEP 2017). While waste generation per capita is low in Kenya (11kg/year/capita), in comparison to the world average (29kg/year/capita), 92% of the waste is mismanaged (IUCN-EA-QUANTIS 2020). Local municipal administration and national government bodies face challenges in effectively managing waste due to a lack of infrastructure and changes in consumption patterns (NEMA 2015).

The focus of this research is household solid waste, which we will define as all the waste generated by private persons in their households (Bernstard 2010). In this research, agricultural waste is also included under household waste, as many households have *shambas* attached to their homes. A *shamba* is a type of agroforestry system where crops are combined with timber (UNEP, 2019). Understanding the household solid waste management cycle and the challenges associated with it is vital to further understanding the global waste management issue as a whole. In Kenya, major cities like Nairobi, Mombasa, and Kisumu have received researchers' attention in exploring solid waste management (SWM) in urban areas and urban informal settlements (Mwangi et al. 2024; Sibanda et al. 2017; Anyango et al. 2024; Amugsi et al. 2022). However, the literature falls short of covering SWM in the context of rural villages.

Therefore, the objective of this research is to identify the key actors involved in SWM in rural Kenya, to further understand the factors affecting household solid waste management, and to comprehend the challenges faced by institutions and locals in implementing SWM legislation. In this context, Kibugu presents a compelling case study due to its location, demographic, and economic characteristics. Located close to the county capital and yet considered marginal, Kibugu's economic productivity and subsequent waste generation make the discrepancies between SWM legislation and practical implementation readily apparent. These intertwined elements give us the background to comprehend the challenges institutions and locals face when effectively implementing legislation on waste management in Kibugu.

1.2. Research questions

Main research question: Which factors affect current household solid waste management practices in Kibugu?

Sub-research questions:

- 1) What is the current background of waste management in Embu County?
 - 1.1. Who are the actors involved in the household waste management process?*
 - 1.2. How has the management of household waste changed in the last 20-30 years?*
- 2) How do households manage their solid waste in Kibugu?
 - 2.1. What kind of solid waste is produced within households?*
 - 2.2. What waste sorting and disposal strategies do households practise?*
- 3) What challenges are faced in Kibugu in household solid waste management?
 - 3.1. What challenges do locals and institutions identify in following the official waste management plan?*
 - 3.2. What are the impacts locals perceive of current solid waste management on their health and environment?*
 - 3.3. How do locals and institutions think these challenges could be overcome?*
 - 3.4. What future do locals and actors envision regarding waste management in Kibugu?*

1.3. Background - Literature review

1.3.1 The policy framework of SWM in Kenya and Embu County

Kenya's Constitution states that the responsibility for waste management lies with each citizen, who is obligated to collaborate with the state in safeguarding and preserving the environment to foster sustainable development. The Constitution of Kenya also empowers county governments to handle refuse removal, refuse dumps, and solid waste disposal (Nthambi et al. 2013).

Kenya's primary legal framework, the Environmental Management and Coordination Act (EMCA) of 1999, prohibits improper waste disposal, emphasising the need for licences to operate waste disposal sites and promoting measures for waste minimization, treatment, reclamation, and recycling (EMCA 2012). The National Environmental Management Authority (NEMA) was established under the EMCA, as an instrument of the government to address social and economic inequalities linked to the deterioration of Kenya's environment (NEMA 2024). In 2015, NEMA put forward the National Solid Waste Management Strategy (NSWMS) which seeks to attain sustainable waste management and a clean and healthy environment to achieve Kenya's Vision 2030 (NEMA 2015). The NSWMS sets

minimum requirements for county governments regarding solid waste management, covering aspects like waste collection, transportation, and disposal which are aimed to be achieved through various methods, shown in *Figure 1.1* in order of preference.

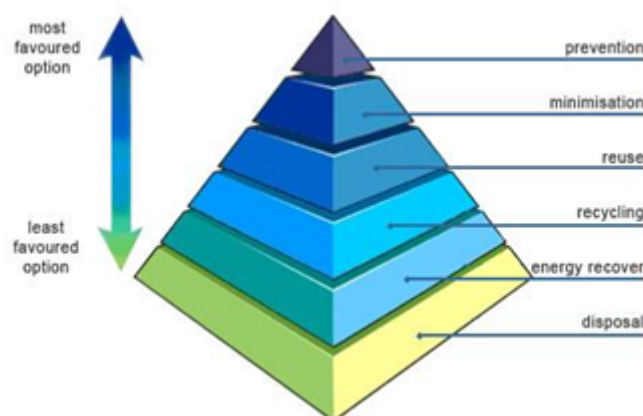


Figure 1.1. The solid waste management hierarchy suggested by NEMA in the NSWMS as a method of implementing multiple methods, in order of preference, to achieve sustainable waste management (NEMA 2015).

NSWMS has provided a common platform for action between stakeholders, including communities, and institutions, to systematically improve waste management in Kenya (NEMA 2015). As established by scientific literature, this collaboration and partnerships between stakeholders are vital in working towards improving waste through the integrated waste management hierarchy (NEMA 2015; Ogutu et al. 2021). However, in Embu County Muchiri (2013) states there is a lack of partnership between actors supporting SWM.

In 2017, Kenya passed a strict plastic bag ban making it illegal to use, import or manufacture single-use non-woven polypropylene bags (NEMA 2024). These bags were replaced by woven biodegradable bags to reduce plastic pollution, but the efficacy of this ban is debated. Omondi and Asari (2019) state that 67% of respondents in this study in 2019 believed that the ban had led to a cleaner environment, while Paul and Mironga (2020) suggest that despite the strict legislation there are significant challenges in implementing this.

1.3.2. Challenges in Household Solid Waste Management

Local municipal administration and national government bodies face challenges in effectively managing waste (NEMA 2015). In contrast to the urban areas, a study in 2020 shows that in Embu County, household SWM is a significant problem due to the unavailability of commercial service

providers (Mochache et al. 2020). The same study stated that 37% of households discarded their waste in open places, while 32% burned it and 24% recycled it, establishing that households often do not follow legislation on waste disposal (Mochache et al. 2020). With infrequent or no collection services, it is common to opt for the most viable disposal methods like dumping or burning the waste (Amugsi et al. 2022). In developing countries, waste collection rates are often lower than 70% with more than 50% being disposed of through uncontrolled landfills (Chalmin, P. and Gaillochet, C. 2009). A study in Nairobi and Mombasa found that the weak policy implementation and enforcement is due to corruption, lack of political will, and lack of cooperation from the citizens (Amugsi et al. 2022). Further research on challenges indicates that inadequate policy and legislation, lack of public commitment and awareness, lack of technical capacity, and poor budget have contributed to major challenges in waste management, evidenced in Kibugu (Sibanda et al. 2017). These challenges highlight significant discrepancies between the institutions and the locals which will be discussed in the paper.

1.3.3. Role of private actors in waste management

In Kenya, outside of institutions, there is a complex network of actors that make significant contributions to household solid waste management (Gutberlet et al. 2017). In weak institutional frameworks, informal workers make significant contributions to SWM through waste recovery and recycling. However, these are often excluded from the policy framework (Young 2018). Often, rather than acknowledging these actors, institutions will look towards outside investment to decentralise the SWM system (Opareh 2003). Privatisation is a compelling choice for institutions that are generally hampered by inadequate resource mobilisation, inadequate institutional capacity, and lack of law enforcement, as it provides a rapid cash flow solution to budgetary issues. However, privatisation can also contribute as a driving factor to corruption, land-grabbing, and resource misallocation within public administration (Opareh, N. 2003; Juma and Clarke 1995).

1.3.4. Role of gender in waste management

Studies show that across Kenya gender plays a significant role in the level of awareness of locals with generally women having more knowledge on waste management than men (Mwangi et al. 2021). This leads to women taking the brunt of responsibility when it comes to household solid waste management. Often children are also involved in this process with a study by Ngugi (2017) stating that 87.3% of the women sampled frequently involved their children (both male and female) in tasks such as taking the bins out. However generally policy documents do not recognise the importance of women and children in waste management (Amugsi et al. 2020).

Outside of the home, the gender spread in waste workers is more equal (Amugsi et al 2020), with both genders working in informal SWM. However despite this apparent equality, Amugsi et al (2020) indicate that women still have a subordinate status in paid SWM activities. Likewise women also take on a disproportionate health risk, given that women are largely taking on direct responsibility for managing waste (Amugsi et al. 2020). Resultantly we can perceive a strong gender bias in SWM in Kenya.

1.4. Study Site Description

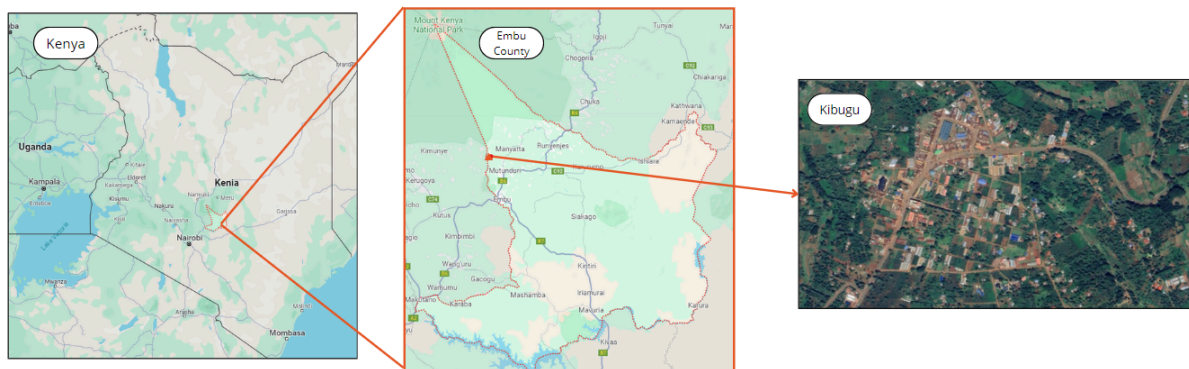


Figure 1.2. Maps showing the location of Kibugu within Embu county and Kenya. (Source Google earth 2023).

Kibugu village (See *figure 1.2*) is situated in Embu North, one of the five sub-counties of Embu County, with a population of 79,566 and an area of 110.6 km². Kibugu itself has a population of 2,959 people and 895 households (Statistics, K. N. 2019) It sits at the foot of Mount Kenya, with an elevation of 1647m and is skirted by the Kii River. The climate in Embu County is mild to moderate, with a mean yearly temperature of 19.2 C and around 1449 mm of yearly rainfall. Agriculture is Embu's main industry, with Embu North being particularly agriculturally productive due to its fertile soil. The agricultural sector employs 70.1% of Embu's population, while 87.9% of households are engaged in agricultural activities (Embu County, 2024). Embu's main cash crops are coffee, tea, and macadamia, while the main food crops are maize, beans, green grams, bananas, tomatoes, and avocado (Embu County, 2024).

As seen in *figure 1.2*, Kibugu is bisected by a main road. A hospital, two supermarkets, other businesses and households surround it. Subsidiary paths diverge from the main road, leading to other households. The Smallholder Horticulture Marketing Programme (SHoMaP) market is located at the centre of the village, where the main dumpsite can be found.

2. Methodology

2.1 Quantitative methods

a. Survey

Our survey was our main vector for acquiring data on household waste and attitudes towards waste. Our questions concerned the respondents' backgrounds, their waste management practices, their knowledge and attitudes towards waste, the challenges they identified, and how they thought these could be overcome. We enacted our survey early on in our research period, to provide a framework and identify gaps for us to build our key informant interviews around. We used a purposeful sampling strategy, with our guides identifying respondents in a range of locations around the village. Resultantly, we had a good spread of types of households, including those with shambas, those without, apartments, and households of varying distances from the market. We had aimed to survey between 25 and 30 households, ultimately ending up with 28 respondents because at this point we reached data saturation.

2.2. Qualitative methods

a. Observation

Throughout our stay in Kibugu we engaged in both direct and participant observation. Participant observation was undertaken at our three respective homestays. Field notes from this and direct observation allowed for insight into the daily lives of locals (e.g. the type and amount of household waste generated, waste hotspots in the village, daily practices of locals regarding waste management, etc.).

b. Transect walk

The first method used was a transect walk with our local guides, this allowed us to gain insight into locals' perspectives on SWM, and begin to understand the location and distribution of spaces, and landscapes that locals relate to waste management. During this walk, an informal interview was held with the guides regarding the general waste management system in the village.

c. Key Informant Interviews

We conducted KII with various actors who are actively involved in waste management in the Kibugu area. This helped us to examine the current state, the challenges, and gaps in waste management at the local and national levels. We used purposeful and snowball sampling to choose our respondents. This method along with the survey served as the backbone of our research.

Our key informants include:

1. Embu County director of the National Environment Management Authority (NEMA)
2. Local Chief
3. Climate Change and Environment Officer
4. Agricultural Officer
5. Public Health Officer
6. Kibugu Farmers Coffee Cooperative
7. Private Waste Collector
8. Metal Collector/Plastic Collector
9. Fruit Vendor
10. Pub Owner
11. Organic Farmer
12. Macadamia Factory Worker

d. Group interview

A group interview was conducted with five elders (average age 67) of the community, selected through snowball sampling, to understand the change in waste and its management over time in Kibugu. The interview allowed us to see the change in waste composition and lifestyle and the notable shift in waste types in the last five decades. The elders gave diverse perspectives on the change in household solid waste management and disposal strategies. This method was also effective in better understanding the local community, traditional waste management system, and the cultural practices in the village.

e. Mapping

As a final step in our data collection process, we conducted a participatory mapping exercise with our two guides from Kibugu, male and female, who we selected based on their fluency in English, familiarity with our research topic, and availability. We aimed to explore the relationship between space and waste by seeing where locals identify waste hotspots and the types of waste there (see appendix for a more detailed explanation of the process).

3. Results

3.1 Actors in Household Solid Waste Management

In the context of SWM in Embu County, we distinguished four main actors as shown in *figure 3.1*. These included national institutions (regulators), local government, waste generators (local community), and service providers. Each of these stakeholders played a different role in the waste management system. In this section, we will mention the institutional actors involved in SWM in Embu County and other stakeholders relevant to Kibugu, as well as their role in this area.

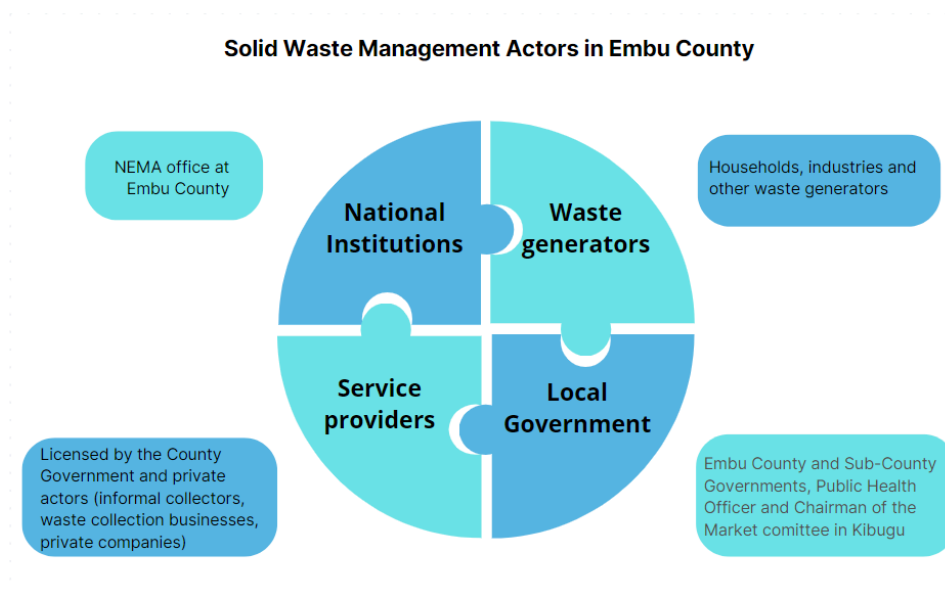


Figure 3.1 Scheme of actors working in waste management in Kibugu.

3.1.1. Waste Generators

Waste management starts with waste generation, which in the case of Kibugu, includes everyone: households, farmers, nonfarmers, markets, and industries (including factories, etc). The biggest sources of waste in the village were households, the SHOMAP market, pubs, supermarkets, the hospital, and the coffee, macadamia, and tea industries, which included agricultural and factory waste. However, for the purpose of our research, we just focused on the waste generated in households, including the farming waste generated within the compound of domestic units. It is important to mention that there was no clear divide between waste generators and other actors such as service providers, as some of the latter also contributed to waste generation, eg. Kibugu Farmers Cooperative Society.

3.1.2. National Institutions: NEMA

The National Environment Management Authority (NEMA), is the principal instrument of the Kenyan Government for the regulation and supervision of policies relating to the environment, including waste management. In Kenya, each county has a NEMA office, as is the case in Embu town.

During our interview with the Embu County NEMA director, he explained that the responsibility of managing solid waste in the county fell into county governments, while NEMA acted as the regulatory, supervisory, and facilitative body to ensure that environmental standards were being met. For instance, the standards for dumpsite facilities were defined by NEMA, as well as the licensing of waste collectors and vehicles. Furthermore, NEMA also carried out projects on waste management education to environmental inspectors from the county government staff, although their main focus was on licensing.

3.1.3. Local Government

a. Embu County Government

It was the responsibility of the Embu County Government to enforce the national laws on waste management, regulated by NEMA, at the county level. Therefore, waste management was a devolved function from the central government and regulatory institutions (NEMA) to county governments. Our key informant in this section, the Climate Change & Environmental Officer (CCEO) of Embu North sub-county, was one of the main actors in charge of managing waste collection, transportation, and segregation services in the region, as well as managing waste disposal sites. The County administration and NEMA worked jointly in the implementation of waste management laws and counselling. According to the CCEO,

"Where they (NEMA) need to, they go along but they always inform us, they always seek our opinion. We would advise on some issues, they might take their advice or not, but we work together jointly and mostly we help them implement most of the laws." (2024)

However, our NEMA and CCEO informants gave us contradictory information regarding their responsibilities. The NEMA director did not acknowledge any devolvement of licensing work to the county government, while the county officer mentioned being in charge of licensing waste collectors.

b. Authorities of Kibugu

The Public Health Officer and the Chairman of the SHOMAP Committee were the two main actors concerning waste management in Kibugu. Other informants, such as the senior chief of

the village and the agricultural officer, despite being aware of the state of SWM in Kibugu, did not claim any responsibility for it.

The Public health officer's (PHO) role was to make sure the County Government collects the waste from Kibugu's dumpsite at the marketplace when it is necessary. She was also in charge of managing Community Health Promoters (CHP), who visit and advise households on compost pits and develop monthly reports. However, none of the households we interviewed ever mentioned being visited and informed about waste management by CHPs. The Chairman of the SHOMAP Committee was the person concerned with the management of the marketplace and hence Kibugu's main dumpsite. Concerning waste, his role was to inform the PHO when the dumpsite grew, for her to inform the Embu Government and send collection services.

3.1.4. Service Providers

Regarding service providers, we could differentiate between licensed waste workers and private actors. Licensed waste workers included the waste collectors and drivers licensed by the Embu County Government. They collected waste from Kibugu's dumpsite and transported it to the Airstrip dumpsite near Embu Town. According to the NEMA Director and the CCEO, there were eight licensed workers and two licensed collection vehicles.

Private actors comprised door-to-door metal scrap collectors that visited households once every few months, according to local informants. Furthermore, we found a private waste collector in Kibugu, hired by apartments to collect the waste from bins outside their buildings and take it to the market dumpsite. There was also a scrap metal, glass, and plastic collection business in the village. The owner told us that people can bring their waste there and get paid for it. This waste is later sold again at a higher price to people in Uganda, Nairobi, and Isinya. The previous actors can be identified as informal actors. Finally, private companies in the area such as Gikirima Coffee Factory and Limbua Macadamia Factory collect chemical containers back from the farmers who bought their products to dispose of them at their factories. Some of these companies also educate farmers on organic agriculture and how to manage agricultural waste sustainably.

3.2 Current Household Solid Waste Management in Kibugu

3.2.1. Waste Composition

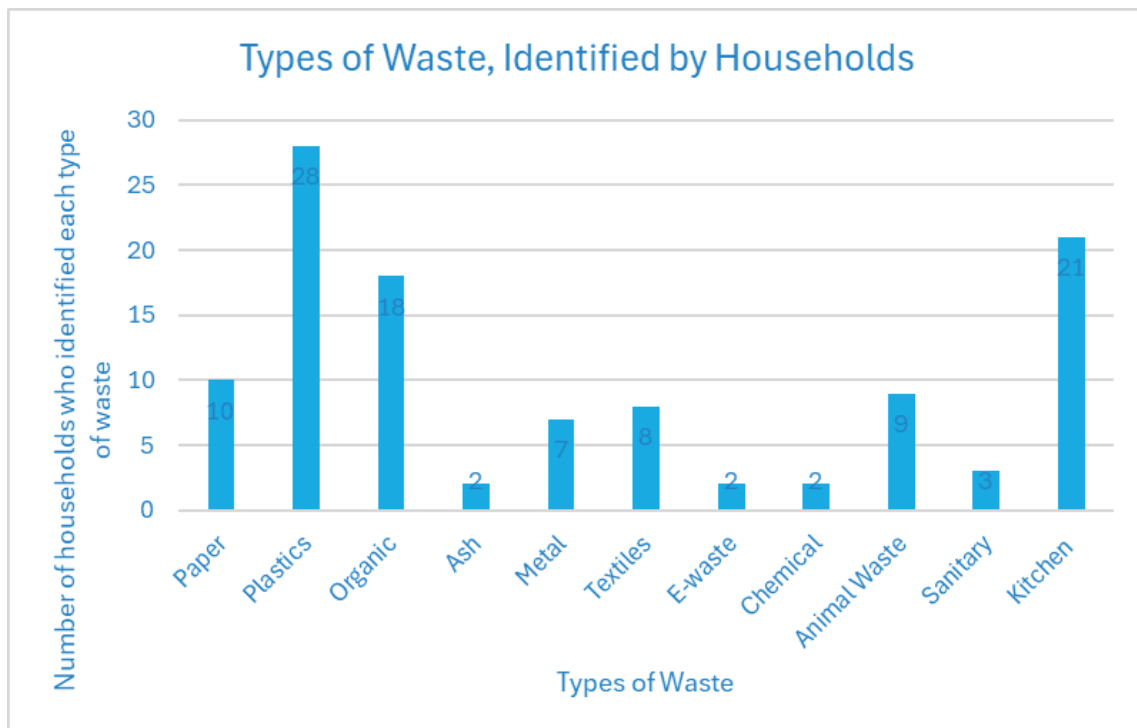


Figure 3.2. Bar chart showing types of waste identified by households and frequency of identification

Our household survey results identified eleven types of waste as shown in *figure 3.2*. Although organic waste would normally include kitchen waste, households tended to think of them as separate entities, with organic more likely to refer to vegetation or farm waste. Therefore, for the purposes of analysing the survey responses we will maintain a separation of the two. Of these 11 types of waste, 100% of households said they produced plastic waste, 75% said they produced kitchen waste and 64% said they produced organic waste.

We asked households to tell us which three types of waste they produced the most. Here, plastic was mentioned in the top three most frequently, with 75% of households naming it among their three most common wastes. Organic was identified as the second most frequent waste, with 57% of households rating it in their top three wastes. Kitchen waste was the third most frequent with 39% ranking it in their top three. Our observations at home with our host families largely supported this data.

However, there were several limitations to the survey data. Most importantly, the households we surveyed did not always necessarily identify types of waste we would expect to be universal, such as kitchen waste or organic waste. Our observations, along with our KIIs, often contradicted this data, and we frequently saw kitchen or organic waste, where households omitted to mention these in their

survey results. Likewise, when asked to describe waste disposal strategies for their most common types of waste, households often referred to types of waste they had not initially listed.

Wastes Identified by Key Informants

The wastes identified by households were supported by information we obtained from our KIIs. Whilst households themselves identified plastic as the common household waste, other major actors such as the CCEO or the NEMA Director suggested that organic waste was most prevalent, with CCEO claiming that 70% of waste from Kibugu would be organic.

Waste identified by Locals through mapping

Figure 3.3 shows the participatory method whereby locals identified key waste hotspots at their homes and around the dumpsite. The main types of waste identified were plastic, organic, metal, glass, and hazardous waste. The mapping gave us an overview of the most common waste disposal strategies by households, which will be addressed in the next section.



Figure 3.3. Map drawn by our local guides.

3.2.2. Waste Sorting and Disposal Process

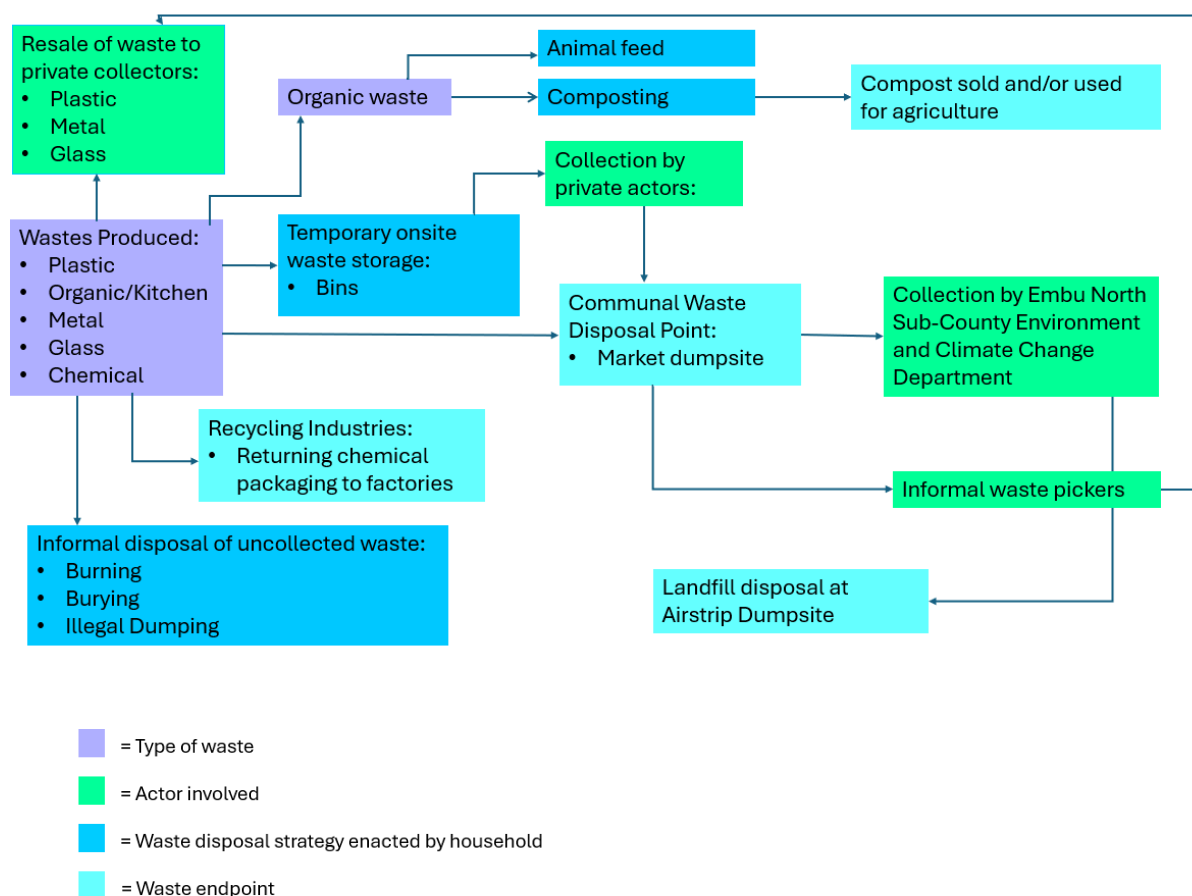


Figure 3.4. Flowchart showing the flow of waste from origin to final disposal

As shown in the flow chart in *figure 3.4*, within the types of solid waste produced at households, part of the plastic, metal, and glass waste was resold to private collectors. The organic waste produced was mainly used as animal feed and as compost for agriculture. In some cases, compost was sold. Other types of waste that were not collected, such as plastics and glass, were disposed of through burning, burying, or illegal dumping, as can be seen in *figures 3.5 and 3.6*. Other private actors, mainly private companies, collected chemical plastic containers back from households engaged in farming. This information was derived from our survey responses and KIIs.

When the amount of waste at the market dumpsite at Kibugu grew, the PHO and the Chairman of the Market Committee informed the County Government that collection was needed. Then, waste workers licensed by the Sub-County Government collect the waste from the market dumpsite, approximately once every month, and take it to the county's waste disposal area at the Airstrip Dumpsite, 7 km outside Embu Town. Once the trucks arrive, scavenger gangs sift through the waste and pull out

things they think they can sell. According to the CCEO, this leaves only glass bottles and organic waste as all the metal and plastic gets scavenged beforehand.



Figures 3.5 and 3.6. On the left the burning of plastic waste in the shamba, on the right a pit latrine which will be buried over:

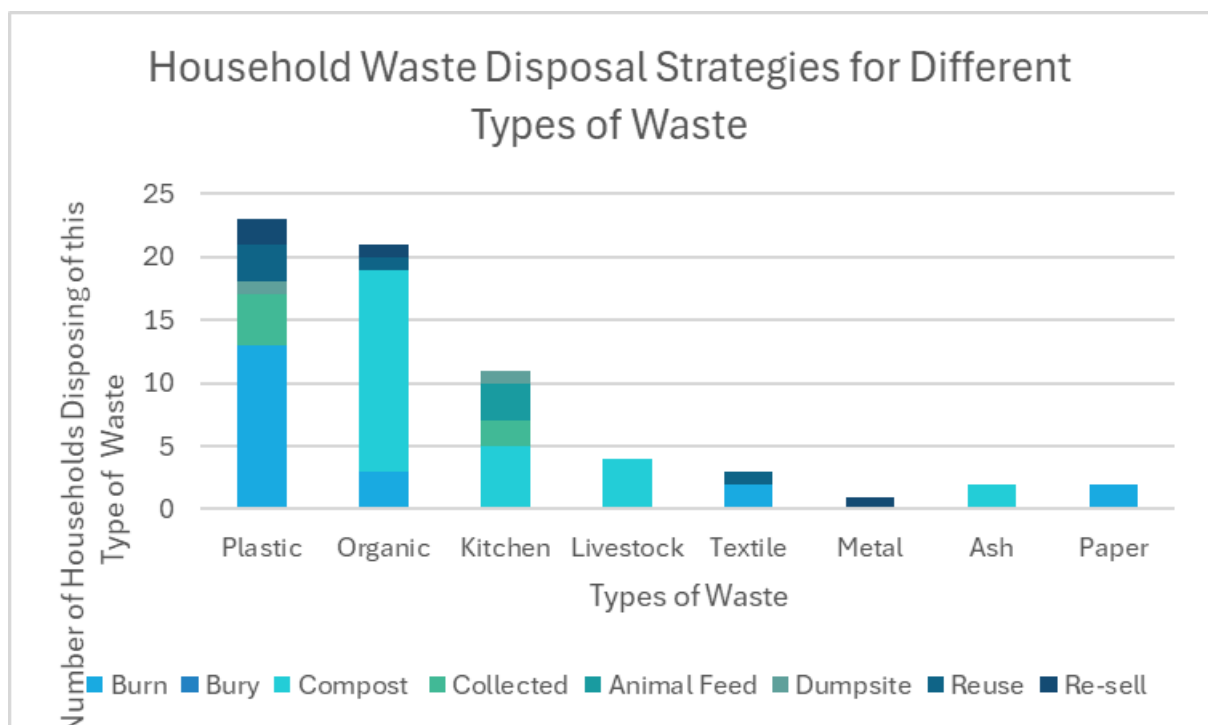


Figure 3.7. Stack chart showing the spread of strategies used for disposal of waste

A variety of different disposal strategies were used for each of the respective types of plastic, as shown in *figure 3.7*. Below we expand on these disposal strategies.

Plastic

Plastic was the most abundant waste identified by households. Households identified 5 methods of disposal: burning, burying, disposal at the market dumpsite, reusing, or reselling. The most common method of disposal for plastics was burning, with 57% of households who identified plastics as the most common waste burning their plastic waste. Households with easy access to the market dumpsite or a collection service would put their plastics in the market dumpsite for later collection by Embu County. Other private plastic collectors also operate in Kibugu, either buying plastic from households or informally collecting plastic to sell from the market dumpsite.

Organic

Organic waste was identified as the most prevalent waste in Kibugu by actors such as the CCEO and the NEMA director. Most households considered organic waste to be vegetation such as banana leaves and waste from the shamba. The primary household strategy for organic waste was composting, households would then use this compost as manure for the shamba. Some of these households also resold their composted waste to farmers. Other households also reused household wastes in other ways such as reusing trees as fencing for their plots. A minority of households indicated that they burn some of their organic waste. Households closer to the market dumpsite deposit their waste at the market dumpsite or leave it in a bin for collection, without separating it from the other wastes.

Kitchen

Kitchen, or food waste, was also amongst the most common wastes identified. Households largely used kitchen waste for composting (and then use on shambas) or animal (usually chicken or pig) feed. Households closer to the market dumpsite or living in the apartment block might have theirs collected and taken to the market dumpsite

Manure & Ash

Although animal waste can technically be considered organic waste, some households differentiated between the two. This waste is only ever composted and used as manure for the shambas. Those households who did not have a shamba, also generally did not have livestock. Ashes (presumably derived from burning organic waste) is composted and thrown on the shamba

Textile, Paper

Households that identified textile waste said they either burned it or reused it, usually as rags. Paper waste was fairly uncommon but all households who identified paper waste said they also burned it.

Metal

Households with metal waste usually resold theirs, however they said that the metal collector only came a few times a year which was difficult because they didn't have the storage space for the metal waste

Chemical

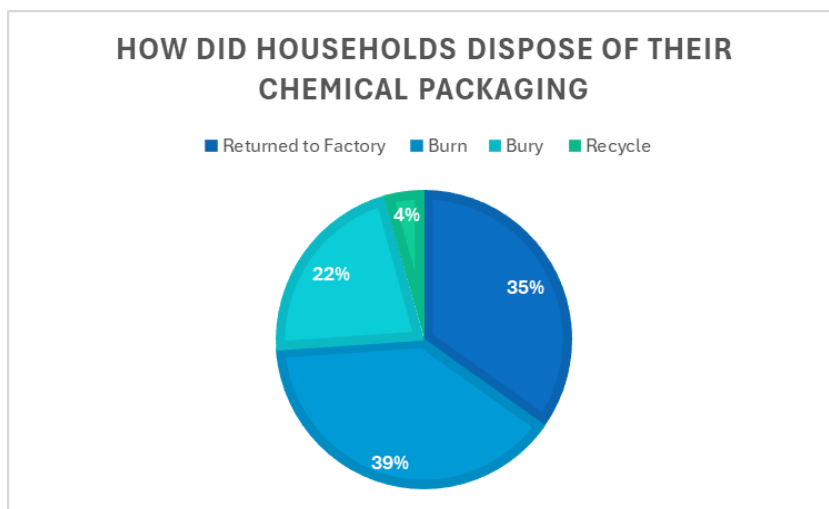


Figure 3.8. Pie chart showing the spread of disposal strategies for chemical packaging

As shown in *figure 3.8*, 24 out of 28 households said they used pesticides in their households, Chemical waste generally derived from packaging for pesticides. The majority of households either returned their packaging to the factory (8/24) or burnt it (9/24). Those households that returned their packaging to the factory were able to do so because they were members of the KTDA or the KFCS. An image of the return site is shown below (*figure 3.9*). The KFCS collected chemical packaging from farmers and also delivered sensitisation on the importance of proper disposal of waste. Chemical waste is not listed on the strategy section because no one referenced pesticides in their most common wastes.



Figure 3.9. Image of Chemical Waste returns bay at KFCS

2.3. Gender Distribution

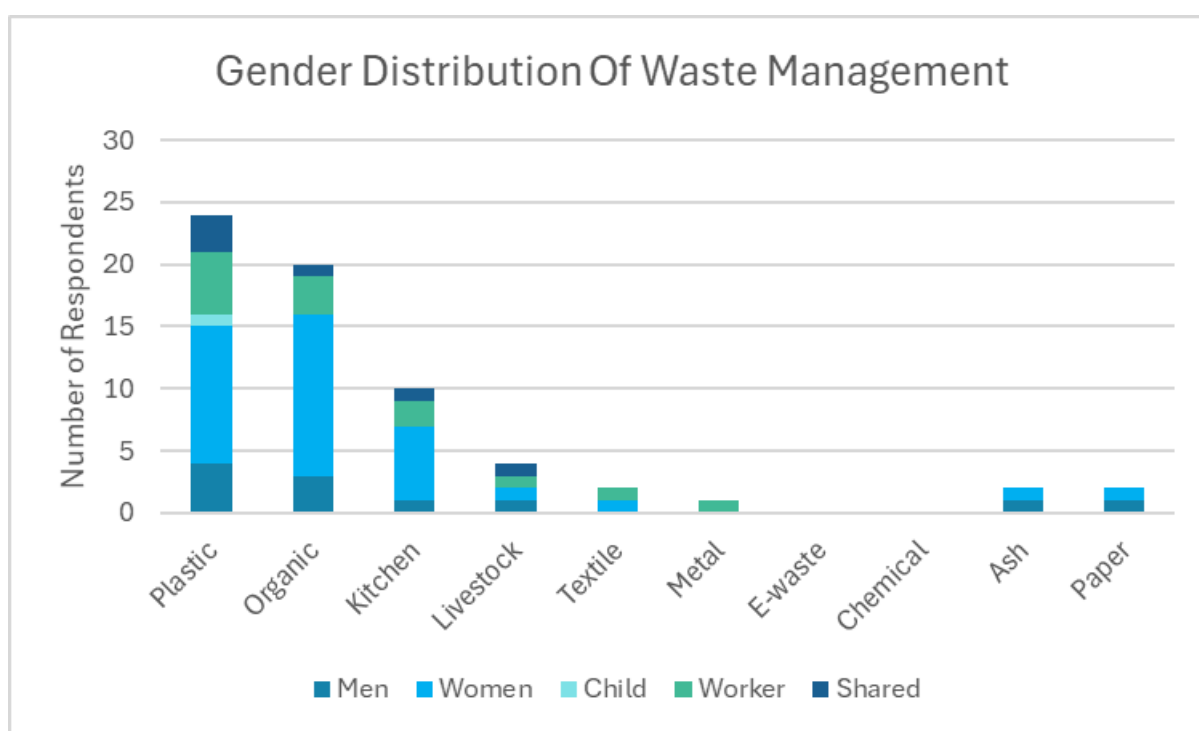


Figure 3.10. Stack chart showing the gender distribution of responsibility for waste management

Our survey results suggested that women shoulder more of the burden of waste management than men as shown in *figure 3.10*. However it must be noted that 79% (22/28) of survey respondents were female which did also impact the gender distribution of the results. Nonetheless, other key informants we interviewed such as the Public Health officer also indicated that waste management was a predominantly female endeavour.

2.4 Change in Waste and Management Over Time



We conducted a group interview with five elders in Kibugu ranging from 59-72 years old who all grew up in this village in order to identify the past waste composition and disposal strategies and perceived changes over time.

The composition of waste has undergone a notable shift over time, as shown in *table 3.1*. From largely organic to largely plastic. The elders stated that they had traditionally buried their waste, but with the shift to increased plastic waste, this strategy was severely impacting soil health. They concluded that the subsequent shift to burning plastic waste meant they were seeing less plastic in the *shambas* and less littering overall.

Past	Present
Wooden spoons, banana leaves	Plates
Baskets	Plastic bag
Clay pots	Metal pots
Cotton and skin footwear	New footwears
Organic waste	Metal and plastics are prominent
Manure	Chemical fertilizers and pesticides

Table 3.1 Waste composition in the past and present

3.3. Impacts of Solid Waste Management

3.3.1 Impacts of SWM in Environment and Social Well-being

21.4 % of the respondents perceived that there might not be any discernible impacts of SMW on the environment and social well-being. Conversely, a substantial majority of the respondents constituting 78.6% of the respondents all shared diverse perspectives regarding the impacts of SWM in Kibugu. *Figure 3.11*, will highlight the many multifaceted perceived impacts of SWM on health, environment and social aspects.

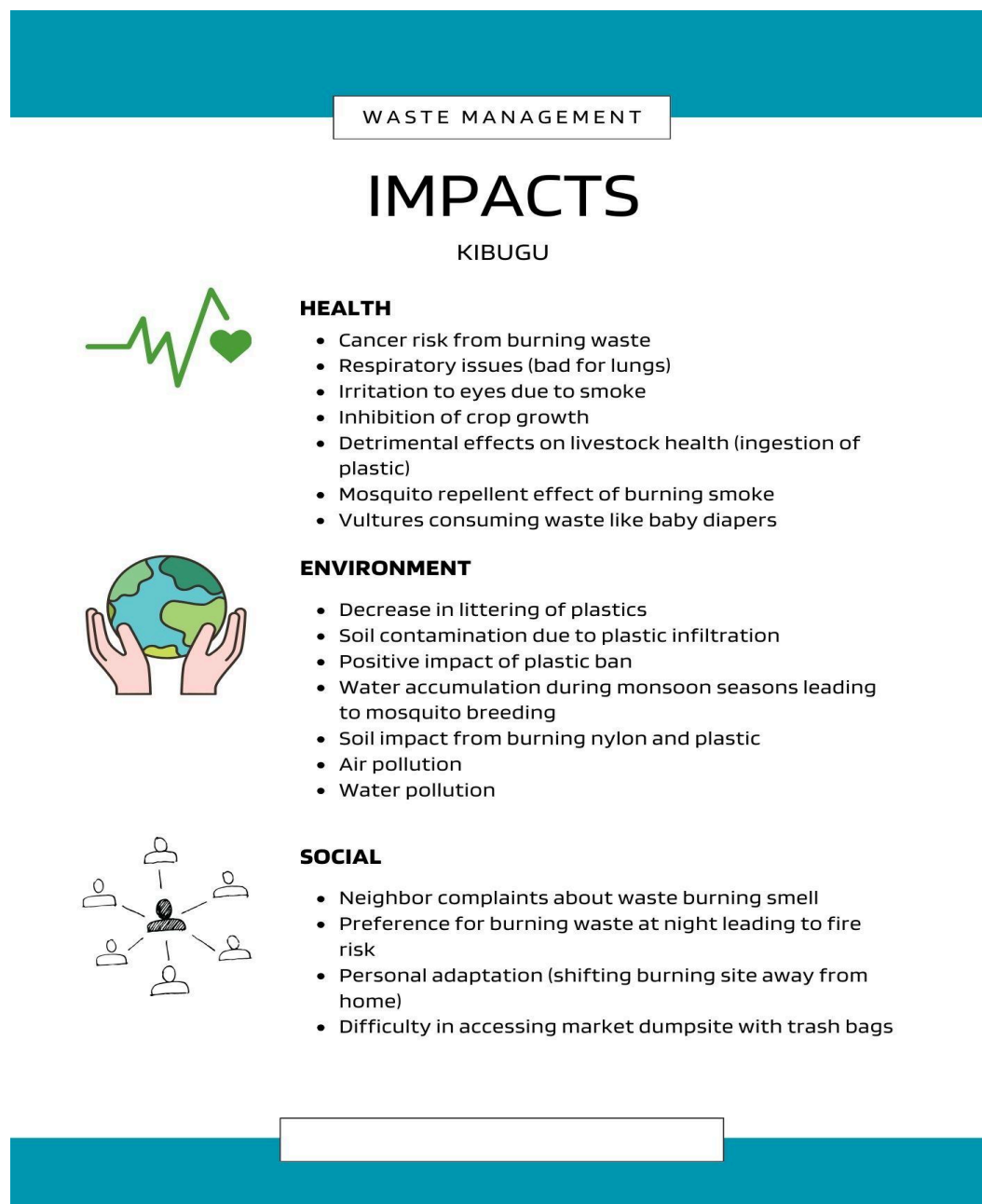


Figure 3.11. Infographic showing health environmental and social impacts of solid waste management in Kibugu

Health

Overflow of the dumpsite blocks the drains, accumulating water that becomes stagnant and serves as a breeding ground for mosquitoes increasing the risk of malaria transmission. Survey respondents identified, burning waste causes respiratory illnesses. However, the smoke acts as a deterrent to mosquitoes, although locals are aware that it leads to air pollution.

Environment

The locals state that the plastic waste infiltrates the soil, exacerbating environmental degradation as well as air and water pollution. The agricultural officer identified water pollution as an impact of agriculture. A respondent also added that the smoke from nylon and plastic impacts the soil. Additionally, according to farmers, the plastic waste that goes into the agricultural land also inhibits the growth of the crops. Livestock and vultures can also ingest discarded materials like baby nappies.

Social

The respondents expressed concerns of burning the waste, such as the smell that results in locals opting for night time burning. One respondent relocated burning away from home to mitigate impact. Furthermore, accessing the market dumpsite with trash bags in their hand is challenging.

3.4. Challenges

As shown in *table 3.2*, our observations, surveys and KII showed that there is a gap between the legislation and the implementation. This is due to various challenges identified by the different actors. The key themes in the challenges were identified and the actors who stated them are shown in *table 3.3*.

3.4.1. What is the gap between implementation and action?

Steps of waste management cycle	NEMAs ideal approaches (NSWMS)	Finding based on our research
<i>Waste Generation</i>	Reduce, reuse, refuse	This was not promoted
	Segregation of all waste into colour coded bags (provided by county government)	No indication of this, people generally separated organic/inorganic
<i>Waste Collection</i>	Collection point equipped for segregation	Indiscriminate dumping at dumpsite
	Collection point zoned by County Government	Dumpsite in the wrong place, due to land grabbing
	Measures put in place to avoid leachate from waste	None, when it rains the waterways get polluted
	Frequent and timely collection	Collection only really occurs when the PHO creates pressure

	Public-Private partnerships embraced	Private collectors play an important role
<i>Waste Transportation</i>	Adequate transport for each waste stream	There are no separate streams of waste
	Trucks are suitable and regularly serviced	Trucks old and often broke down
	Trucks Licensed by NEMA	Confusion in roles of licensing
<i>Waste Treatment</i>	Recycling should be embraced	Recycling only done by private actors
	Composting of all organic waste	Those with shambas composted, those without put onto dumpsite
	Waste to energy eg. Incineration, gasification, biogas	No indication of this
<i>Waste Disposal</i>	Landfills should be sanitary	Landfill was indiscriminate and unsanitary

Table 3.2. Table comparing our observations to the NEMA national solid waste strategy ideal approaches to solid waste management

3.4.2. Challenges Identified by Actors

Actor	Challenges				
	Proximity and Accessibility	Inefficient collection Services	Education	Legislation	Lack of resources and infrastructure
<i>Locals</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>NEMA</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Environmental Officer</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Agricultural Officer</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Public Health Officer</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Private Waste Collector</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Kibugu Farmers Cooperative Society</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Chief</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Table 3.3. Challenges identified by actors and the overlap between who brought these challenges up

a) *Proximity and Accessibility*

Respondents measured the distance to the waste collection point on a scale of 5, with 5 being very far and 1 being very close. 42% of the respondents identified the collection point as being quite close and is accessible for them because they live near the market, 24.92% of

respondents find proximity a challenge, while the rest are not aware of any official collection services. A Chi-squared test showed that there is a significant (p-value: 0.0147) association between perceived distance to the collection point and perceived accessibility. Therefore, those who stated collection was far from their home, suggested collection was inaccessible. However, this only includes respondents who used collection services, many didn't due to other accessibility issues.

b) Collection services

50% of respondents stated that better collection services would help overcome the challenges. Respondents wanted: door-to-door collection services, specific collection days and more frequent collection. There are individuals who collect and buy metal scraps or plastics from the farmgate which contributes to why the respondents thought the collection point was nearby, although the actual dumpsite was far. Collection services are only available at the market area meaning those living far away miss out. Market waste is not collected at a timely interval, only occurring around once a month, so infrequently, market stall holders will withhold rent until PHO pressures the county government. In apartments, collection services are often seen as too expensive, starting from 20 KSH per collection.

c) Education

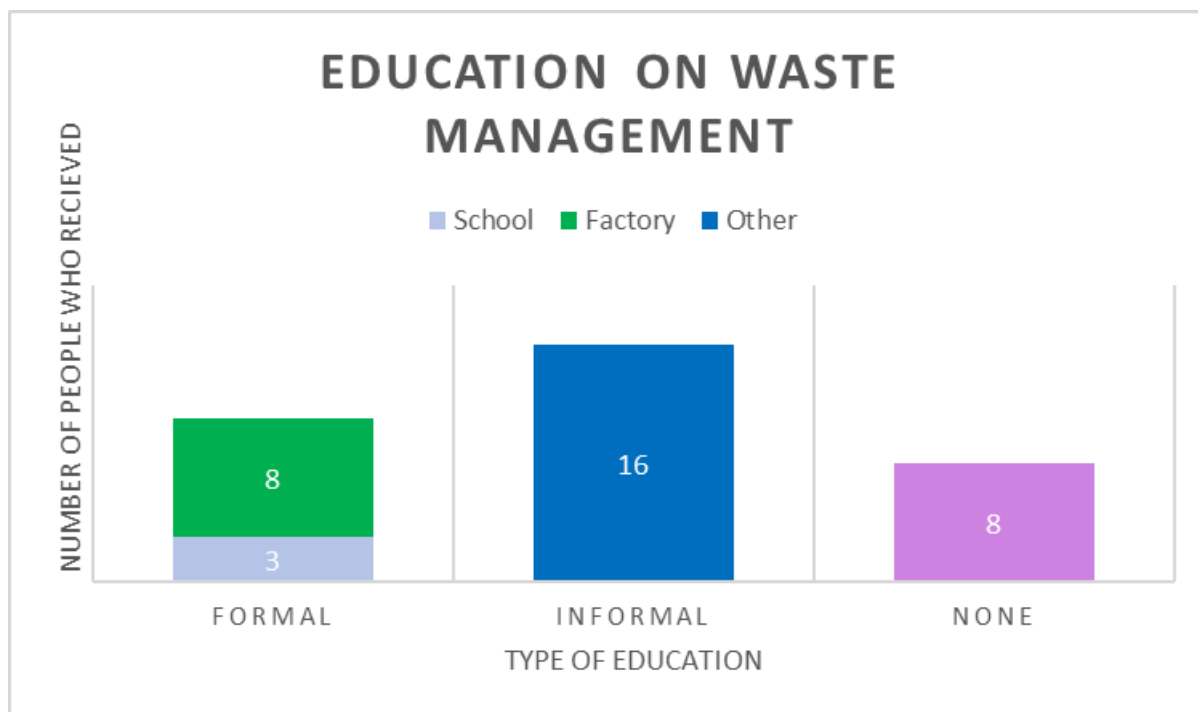


Figure 3.12. Bar chart showing the sources of education or respondents.

As shown in *figure 3.12.*, the majority of the respondents indicated that they have received very little education on SWM by the county government. 60.7% of respondents have received some education on waste management, 39.3% have not. Of the eleven respondents that received formal education, eight received this education from factories (KFCS, KTDA and Limbua Macadamia factory) they farm with, and three through schooling. Even though not many people had received formal education, 69.6% of respondents had educated themselves through other informal sources such as: a women's group, radio, TV, friends, the internet, and observations of the environment. Eight of the respondents had no education on waste management at all.

The CCEO stated that members of the county assembly are not interested in waste management. KFCS also raised that one of the main challenges is lack of cooperation from the members. The institution often lacks coordination with NEMA. The CCEO and Agricultural Officer stated that the training on SWM is not at the scale of what they want. He indicated a lack of awareness on waste management and suggested that households do not segregate their waste.

However, as shown in *figure 3.13*, when asked if they would be willing to learn more on a scale of 1-5 an equal number of people stated 1 as 5. In the survey, 79.2% of respondents stated that education helped in their waste management practices. The 20.8% that stated education has not been helpful had either not received any education or stated that regardless of their education the collection infrastructure is insufficient. Several respondents who stated they were not willing to learn more said they felt their current level of education was sufficient.

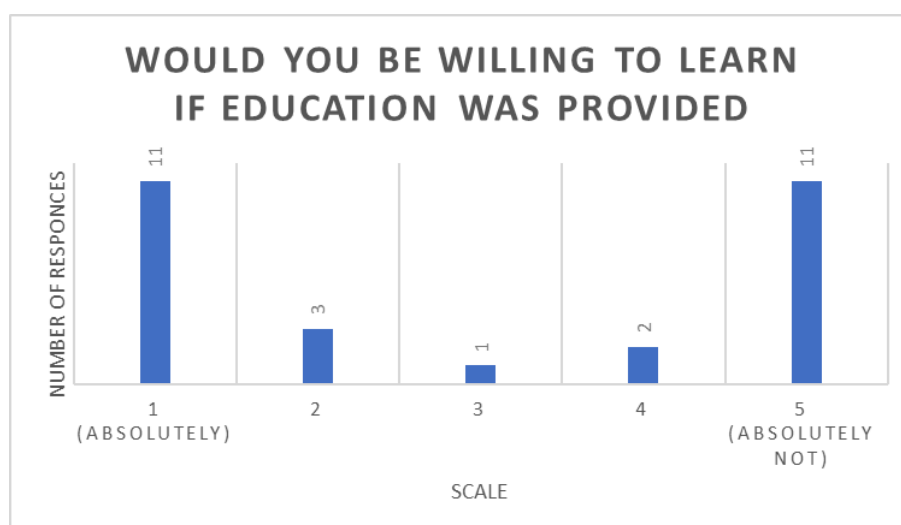


Figure 3.13. Bar chart showing responses to likert scale on whether respondents would be willing to learn if the county government provided education.

d) Implementation of Legislation

The respondents identified the weak enforcement of plastic ban as a main challenge to current SWM practice. People can still find single use plastics in the market. The Chief Agricultural Officer pointed out that there is a weak adoption or enforcement of the law which leaves a big gap between the laws and actions.

"There is a full legal framework about what should be done, but there is a big gap between laws and what people actually do"

However, as shown in *figure 3.14*, equal numbers of people said it was easy to still buy plastic bags (45.8%) as the amount of people who said it was hard to buy plastic bags (45.8%), 8.3% said they didn't know. Those who said it was easy said it was very secretive and businesses only sold to people they knew. A fruit vendor stated that it was now easiest to buy the banned plastic bags as their price has decreased. We likewise observed our hosts using single-use plastic bags.



Figure 3.14. Pie chart showing the proportions of people who stated it was easy to buy plastic bags vs those who said it was difficult.

Across responses there was an indication that there was little enforcement of the plastic bag ban, contradicting the NEMA director, who stated there have been 300 prosecutions for plastic bag usage in Embu County. However, he does not state whether these people have paid the fine. The CCEO stated that as far as he was aware, no one has paid the fine associated

with the plastic bag ban. Therefore although locals stated legislation such as the plastic bag ban is a start to help overcome problems, there needs to be enforcement and implementation of the legislation for it to be effective.

Within institutional bodies, there is confusion on the exact roles of each actor. The NEMA officer stated they are the only ones in charge of licensing, while the CCEO mentioned he has the responsibility to licence waste collectors. KII respondents indicated that this creates uncertainty meaning the bureaucratic process is overcomplicated. The CCEO states that this could be overcome by assigning all licensing to them while NEMA remains as a regulatory stakeholder.

Within the village there are also some informal private waste collection services who state that to overcome challenges to SWM, more private workers need to be employed by the government. They argued this could benefit both the government and the workers themselves. The government would be able to implement more regular waste collection. This would help overcome the existing challenges the workers face, such as receiving fair pay and being provided with sufficient protection gear.

e) Lack of resources, and infrastructure

Embu County Government has a limited SWM budget of one million KSH per year. The CCEO stated that most efforts go to the five largest towns, with the smaller towns often being ignored (and Kibugu happens to be the sixth largest, according to the CCEO). He also referred to a lack of funds and capacity to collect the waste frequently. NEMA identified serious problems with infrastructure for managing waste and no major investors. NEMA is understaffed, within the NEMA office in Embu there are only two paid officers, the rest being volunteers and students. The PHO and the agricultural officer both identified a lack of resources and infrastructure, with the PHO adding that there is a lack of availability of collection services. She stated that there are only two licensed trucks to empty the dumpsite which can only be refuelled twice a month due to budgetary limitations. Furthermore, these vehicles often break down which is why there is no timely collection of waste. The KFCS also raised challenges of lack of personal protective equipment while handling the chemical waste and transporting them. There is also a lack of bins in Kibugu, while there used to be more, most of these have been stolen or damaged, one of these bins is shown in *figure 3.15*.



Figure 3.15. Image of the only functioning waste bin we found in Kibugu.

3.5. Future Vision

3.5.1 How can these challenges be overcome?

In response to the survey question of "how locals thought the current challenges of waste management practices could be improved", various recurring themes were identified as shown in *figure 3.16.* below.

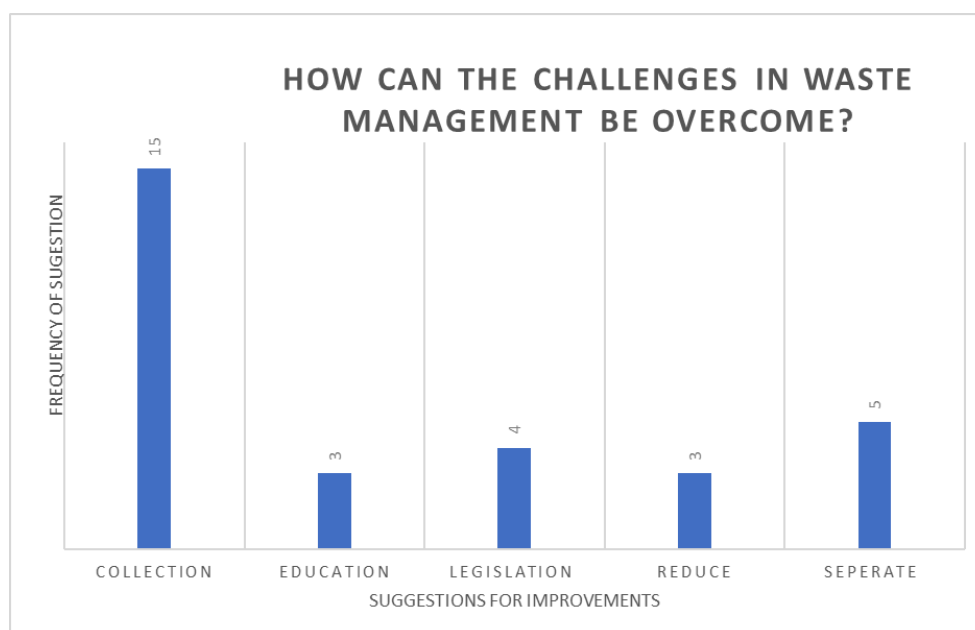


Figure 3.16. Bar Chart showing the amount of times each of the recurring themes was suggested as a method for overcoming the challenges in waste management.

We categorised the answers given in the survey into five key themes: the frequency at which each theme is shown in *figure 3.16*. However, since the question was open the responses were more detailed than the specific categories. The *table 3.4* below expands on the specifics within the categories.

Collection	Education	Legislation	Reduce Waste	Separate
Bins/tanks provided for every house	Training	Enforcement of banned plastics	Factories stop making plastics	Option for recycling not just burning
Collection near to house/from house	Workshops	Tougher implementation	Better packaging	More management of the dumpsite
Road access to dump site	Awareness on speration		Monitor from point of manufacture	Use organic as manure
Designated collection point				
Collection points actually get collected from				
Move dumpsite so collection is easier				

Table 3.4. Suggestions on how challenges in waste management could be overcome.

3.5.2. How do actors envision the future

As part of the semi structured interviews, key informants were asked on how they envision the future of waste management in Kibugu. This gave varied responses with, however, some key recurring themes, the themes and by which actors there were identified by is shown in *table 3.5* and *figure 3.17* shows a mindmap expanding on the specifics stated by each of the actors.

Actor	Future change in:						
	The dumpsite	Waste Collection	Collaboration	Innovation	Education	Legislation	Investment
Chief	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Environment Officer	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Agricultural Officer	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Public Health Officer	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Private Waste Collector	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Private Waste Dealer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Kibugu Coffee Coperative Society	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Elders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Table 3.5. The key themes identified in the responses by the actors



Figure 3.17. Conceptual mind map showing how different actors envision the future of solid waste management in Kibugu. Boxes where there are two colours in the box show that two actors stated the same thing.

4. Discussion

4.1.1. Why is there a gap between legislation and implementation?

In Kenya, there are sufficient laws, policies, and agendas to improve waste management. However, our research indicated that these policies were not being sufficiently implemented. This is shown in *table 3.2*. Based on our results, we identified various institutional challenges meaning the capacity for households to follow legislation is limited. We likewise ascertained that there is no functional waste management strategy in Kibugu. This is due to the following reasons:

a) Lack of clear institutional roles

In Embu County, there is a lack of clarity in the roles and responsibilities of different institutions involved in SWM, resulting in the ineffective implementation of legislation. Since effective SWM needs to be area-specific to adjust to the nuances of local needs, integration of national government and county government is essential (Henry et al. 2006). The lack of transparency of roles resulted in uncertainty in the role of licensing for waste collectors. The NEMA director states that one of their main roles in SWM is providing licences for waste collectors and waste transportation vehicles. However, the Embu North Sub-County CCEO indicated that NEMA had devolved the task of licensing collectors to the county government. The overlapping of responsibilities often leads to no actor taking the initiative in actualising the process (Batista et al. 2021). Therefore, as seen in Embu, despite NEMA and the CCEO both being aware of their responsibilities, the licensing of waste collection vehicles becomes delayed or abandoned entirely, further reducing the already lacking waste collection services.

Furthermore, the lack of clarity in institutions has also contributed to the partially unsuccessful implementation of the plastic bag ban (Omondi and Asari 2019). While our research shows that plastic pollution has significantly decreased since the ban, it is debatable whether the ban has made buying plastic bags any harder. For this ban to be effective there needs to be collaboration between stakeholders both within institutions and for locals (Behuria 2021).

For waste management to be effectively enforced, institutions' roles and obligations must be clearly defined (Oyake-Ombis 2015). The confusion over NEMA's and county governments' respective functions highlights a larger problem in environmental governance; overlapping duties result in inefficiency and poor cooperation.

b) Lack of infrastructure

There is a lack of infrastructure in Kibugu's SWM, as identified in this research by both institutions and locals. This represents a larger problem throughout Kenya, particularly outside of central business districts which is often where funding and resources are focused (Henry et al. 2006). In Kibugu, the issue that takes precedence is poor waste collection infrastructure, which is affected by the quantity of SW generated, the number of waste collectors, and the functionality of vehicles (Das and Bhattacharyya 2015). The lack of collection services is partially due to budgetary issues. An estimate from the World Resources Institute suggests developing countries spend around 30% of their budget on refuse collection but can only collect at most 50-70% of municipal solid waste (Henry et al. 2006). Likewise, NEMAs understaffing impacts licensing processes too, as well as their availability to monitor the areas and conduct activities. Households feel the brunt of this with the lack of infrastructure causing waste build-up, which has significant social, health and environmental impacts.

There is also the issue of the dumpsite infrastructure itself. In Kibugu, the dumpsite is open and not accessible by a suitable road. While we visited Kibugu in the dry season, Henry et al (2006) suggested that collection worsens during the rainy season due to inaccessibility to dumpsites. In Kibugu, the Public Health Officer mentioned there was an intention to move the dumpsite further away to reduce the existing infrastructural challenges, however, the land allocated was 'grabbed' and apartments were built there. The concept of land grabbing is contested but in this context refers to "the illegal or irregular acquisition of large tracts of land by state or private entities" (Kariuki and Ng'etich 2016: pg81). As stated in the literature review, corruption and neo-liberalisation in Kenya is an ongoing issue leading to irregular allocation of public resources (Klopp 2000).

c) Lack of awareness

Despite the governing bodies' perception of a lack of public awareness, the majority of respondents in our research had some form of education on SWM whether that be formal or informal. Locals and institutions can be seen as playing the 'blame game' when it comes to taking responsibility for waste management, with institutions blaming a lack of awareness amongst locals for poor SWM practices. However, whilst awareness at waste generation level is important, it is useless without effective institutional waste disposal strategies (Sibanda et al 2017).

Households we interviewed often used waste disposal strategies which would be considered to be environmentally damaging, such as burning plastic. Globally, research shows that in

solid waste management, a lack of pro-environmental behaviour does not always equate to a lack of awareness (Selin 2013; Grodzińska-Jurczak 2003). A study in Mutomo (Kenya) showed that while all participants were aware of the risks connected to waste and had a positive attitude to re-collecting, reusing, and recycling, pro-environmental behaviour was not always practised. As mentioned specifically to Kibugu, the choice of burning plastic stems not from a lack of awareness but from a lack of resources. For instance, locals expressed their awareness about the negative impacts of burying plastic waste on soil health and crops. As a result, some participants shifted their burying strategy to burning, as they considered it a more responsible and environmentally-friendly course of action, given the lack of proper disposal sites. Conversely, as shown in *figure 3.5* while most households composted their organic waste, this was not because of their knowledge of climate change but rather because it was beneficial to the soil health of their *shamba*.

4.1.2. Transversal Challenges

Whilst we identified specific issues in the lack of clear institutional roles in the government, we also saw wider cultural and structural issues across the governing bodies in Embu county. Our KIIs pointed almost universally to a lack of political will around engaging with SWM, with the CCEO arguing that SWM is seen as ‘unglamorous’ and that governing individuals prefer to fund other, more politically attractive ‘vote-winning’ NEMA sectors (Malama A. 2004). As a result SWM in Embu county is hamstrung by its limited budget and those institutional actors directly responsible for SWM have been forced to seek alternate means of funding. This has encouraged decentralisation of SWM and forced the county government to seek partnerships with the private sector (Henry et al. 2006; Opareh, N. 2003). Involving the private sector facilitates an easily accessible cash flow, something the government desperately lacks, as well as shifting the burden of responsibility onto firms and private actors. Both the PHO and CCEO suggested that collection services could be improved in purchasing collection trucks for each sub county, through private investment. Our KIIs found this solution to be highly appealing and all of our institutional KIs expressed a desire for increased private investment and involvement. The idealised system they described is a largely privatised system. Whilst increased privatisation can be a highly effective short term solution, it is a poor long term solution for Kibugu and could ultimately create more problems than it solves. Operating public services for profit can lead to serious social externalities, whilst the inconstant nature of the private sector leaves SWM at the mercy and whims of private interests and market pressures.

4.2. Actors filling gaps on waste management work

As established there is a significant gap between legislation and implementation as a result of various factors. This gap contributes to the ineffective waste management strategies in Kibugu, however there are private actors working to fill this gap.



Figure 4.1. Image taken Outside the waste collectors shop, plastic bottles and glass bottles separated.

Based on our research, informal waste workers, such as the private waste collectors and waste dealers, are the only actors in Kibugu actively working on the recycling of waste (*an example of such is shown in figure 4.1*) and door-to-door collection. The informal sector creates clear environmental and social benefits such as generating and supporting livelihoods and reducing litter and working towards a circular waste management system. However, these workers are often overlooked or disregarded by decision makers (Young 2018). This is because these actors often work under the radar. For example, informal waste collecting/scavenging is often not seen as an officially acknowledged form of waste processing within legislation

Our household surveys largely referred to private informal waste services, when identifying what waste services they used. County government waste services were barely indicated, most likely due to the unreliability of the service. Resultantly, it can be argued that Kibugu is very reliant on private actors. However, long term this is not sustainable because, as mentioned in our interview with the informal waste collector, these informal waste service workers can leave the industry for more profitable sectors leaving Kibugu without any operational waste management system. Therefore, to benefit all actors, a SWM strategy needs to be implemented that integrates the informal workers and CBOs. This will alleviate some of the pressure on the county government, acknowledge the actors

currently bridging the gap between policy and implementation and thus improve the state of SWM at the household level (Njoroge et al. 2014).

4.3. Waste management from a gender perspective

In the same way that the work of some informal actors goes unacknowledged, the role of women in SWM is similarly overlooked. Various studies suggest there is a gender imbalance in SWM, across Africa (Mwangi et al 2021; Amugsi et al 2020). Resultantly, we theorised that we might see a gender bias in SWM during our own research. Whilst our survey results did appear to show that women took greater responsibility for SWM in the home, we were aware that the majority of our survey respondents were female and that could have had an effect on our results. Nonetheless, it was clear from both our survey results and our KIIs that women disproportionately shouldered the burden of waste management. Our observations at home with our host families triangulated this information, where we frequently observed the women of the household disposing of the waste. These results are supported by literature with Amugsi et al (2020) stating that women have the sole responsibility of managing household waste, in part because they are usually the managers of the home (Amugsi et al. 2020). Likewise, a study in Kiambu, Kenya supports this perspective, stating women were disproportionately held responsible for waste management (Mwangi et al. 2021). However, the majority of our survey respondents were women, who often described waste management as a shared responsibility, this is similarly supported by Mwangi et al (2021), who concluded that 97.9% of women were more likely to view SWM as a dual responsibility, whilst 89.3% of men were far more likely to view SWM as solely the responsibility of women. Our KIIs likewise supported this, with the PHO and the AO describing SWM as a woman's responsibility. Summing this up succinctly, the AO concluded, *“this is Africa”*.

Parallel to our results, Amugsi et al (2020) agree that both men and women work in SWM outside the home, in roles such as sweepers or waste pickers. However they stated that women have a “subordinate status” when it comes to paid waste management activities (Amugsi et al 2020), not only affecting their access to resources but also exposing them to greater health and environmental risks than men (Jerie 2011; Amugsi et al 2020). Resultantly, our perceptions of gender bias in SWM in Kibugu can be reinforced.

4.4. Discussion of Methods

Our choice of methodologies had several different impacts when obtaining data and analysing our results. Our survey was significant to our research in forming the basis of our understanding of household SWM. It enabled us to question our key informants more specifically later on. However, our survey was fairly erratic in responses since our questions were quite convoluted and therefore

respondents often struggled to understand what they were being asked. For instance, some types of waste were not identified as such by our respondents showing that attitudes towards what classifies as waste can vary, based on the perceived value of the waste (Drackner 2005). Mwangi et al (2021) stated that there is a gendered aspect to this with men being less likely to identify food waste as waste. Likewise, the survey contained many open-ended questions and, given that each group member took a turn administering the survey, the written answers varied from person to person. Therefore it was very difficult to standardise our results, particularly in terms of data analysis. Some of our questions were also quite leading or irrelevant, such as asking respondents if they would follow government legislation which led to biased results.

One key potential weakness in our methodology was that we didn't follow up with any of our survey respondents with semi-structured interviews, instead choosing to take their results at face value. This choice was partly due to time and logistics but more detailed information from households could have justified some of our more erroneous responses and provided more comparative data against the KIIs.

From the perspective of analysing data, our observations were very useful for triangulation against both the household surveys and the KIIs. Especially given that both of these methods often had many discrepancies and contradictions. However, our observations were limited to what we were able to experience within the fieldwork's short time frame and we were unable to observe important elements of the waste management in Kibugu, such as the airstrip dumpsite, limiting our capacity to fully triangulate our results with the information we gained from our KIIs. In tandem, our observations often contradicted information gathered from KIIs, with some of their claims of waste management protocol not being substantiated, such as the claim that waste workers were fully equipped with PPE being contradicted by our direct observation of waste workers. Likewise, using triangulation between our survey results and our KIIs, we saw variance between household surveys, and KIIs, particularly when it came to education. Whilst actors such as the NEMA director, the CCEO, and the PHO claimed varyingly that they were delivering education to local people, our survey results often contradicted this

5. Conclusion

5.1. Concluding remarks

Despite some methodological limitations, this study has assessed the current solid waste management practices in Kibugu and identified major challenges that impede this. Even with solid legislation on SWM, there is a big gap in implementation, resulting in Kibugu being deprived of efficient SWM services.

We have identified tensions and contradictions between local communities and institutional actors in SWM. Locals demonstrate an awareness of the shortcomings of their current waste management practices, attributing them mainly to the lack of infrastructure and public services. At the same time, government actors acknowledge the existing challenges but struggle with the implementation of formulated laws due to unclear institutional roles and limited resources. Whilst the blame for poor SWM is often placed on the lack of awareness amongst locals, our results show most survey respondents had received some kind of education highlighting a fundamental disparity in the discourse.

Beyond the problems in infrastructure and education, there were more structural challenges inherent in government institutions and their attitudes towards SWM. Institutional actors remain fixated on the idea of privatisation or a large foreign investment as a solution to their budgetary issues, as opposed to empowering the smaller domestic private actors we encountered, already working in waste within the county. Waste generation in Kibugu will only continue to increase, as the population and economy continue to expand, making the need to implement a functional SWM system ever more pressing.

However, there are also positive aspects to be noted. Local communities exhibit effective SWM practices, such as the reusing of most of the organic waste. Moreover, there is a consideration made to solid waste management by institutions as shown in the ambitious solid waste management strategies, along with a desire among locals to deepen their understanding of the issue.

5.2. Further research ideas

Due to the practical limitations of our research, we have not been able to dig deeper into interesting topics that we encountered during our fieldwork and literature review. For instance, focusing on the economic aspects of waste management would be an opportunity to explore the financial constraints and opportunities in waste management. Furthermore, it could be interesting to do a more in-depth research on the informal waste workers who play a crucial role in filling the gap between legislation and implementation. Finally, we believe that a deeper exploration of the gender dimension of waste management is warranted, considering the unique roles, challenges and perspectives of men and

women in the context of SWM. Throughout our research the topic of the involvement of private actors was reoccurring, this indicated the desire for privatisation. While we briefly touched on this it could in itself be a whole report. Addressing these areas could enhance better understanding and inform more effective waste management strategies in Kibugu and beyond.

5.3 Reflections

The field study in Kibugu enabled us to work closely with the partner students and engage directly with the local community. Although ten days is a short time, participant observation with the host allowed us to immerse ourselves in the daily lives of the locals and get hands-on experience on data collection and field work. Collaborating with the Kenyan students as a team and working as a group gave us an invaluable opportunity to exchange knowledge, culture and mutual learning which is all part of the professional working environment.

An interesting take away was that what we considered as waste, was not always considered as such in the local community, showing diverse perspectives and practices and the importance of understanding them from the local point of view. Acknowledging these differences in culture and language brings us to talk about our positionality in Kibugu as researchers coming from outside. It was integral for us to critically reflect on our potential biases and stereotypes to appreciate the complexities of waste management in the village. Regardless of our attempt to strive towards ‘ethical research’, realistically we are not ‘experts’ by any means and our ten days in the village can only give a snapshot of what happens in the village. Coming to the village as researchers we were often attributed with more power than we actually have, therefore it was essential to reinforce the scale and scope of our research and capabilities.

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7. Appendix

7.1. Overview of applied methods

Methods	Notes
1. Survey	28 Respondents
2. Observation	Observation throughout the fieldwork
3. Transect walk	1 Transect walk with local guides
4. Key Informant Interviews	12 interviews: <ul style="list-style-type: none">- Embu County Director of the National Environment Management Authority (NEMA)- Local Chief- Climate Change and Environment Officer- Agricultural officer- Public Health Officer- Kibugu Farmers Coffee Cooperative- Private waste collector- Metal/plastic collector- Fruit vendor- Pub Owner- Organic Farmer- Macadamia Factory worker
5. Group Interview	1 Group interview with 5 elders of Kibugu
6. Mapping	1 Mapping exercise resulting in one map drawn by our guides and one by our research group

7.2. Key-informant interview questions and notes

a) Chief of Kibugu

- Could you explain to us how the current household solid waste management process works in Kibugu? Questions to ask if they do not talk about this:
 - ☐ Who are the actors involved and their roles in waste management awareness? (NGOs, CBOs, NEMA, business, governments)
 - ☐ The stages of the process (the cycle, from household collection of waste to dumpsite)
 - ☐ Are there any agencies, private enterprises taking care of the waste...?
 - ☐ Ask about the costs involved in waste management of Kibugu (e.g. are there any costs that locals must pay?)
- Are you aware of the current legislation of solid waste management in Embu County?
- How do you perceive waste management has changed in the last 20-30 years from your perspective? (types of waste, legislation, and consumption of products specifically in Kibugu)
 - What is your opinion and how effective it is in Kibugu?
 - What institutional challenges are faced when it comes to implementing waste management legislation/changes/improvements?
 - How could these challenges be overcome?
- What do you think are the environmental impacts of the current waste management practices in Kibugu, if any? And the social impacts?
- What future do you envision (not desire, not idealistic) for Kibugu in terms of waste management?
- **can ask chief if there is a NEMA officer for Kigubu?*

b) NEMA Office in Embu County

- How is NEMA involved in solid waste management in Embu County?

- What actors (both public and private) are involved in the management of solid waste in Embu County?
- What are the legislations on solid waste management other than the NSWMS? (We want to see if the laws are exhaustive and completely address the issue of solid waste management)
- What are the stages of the process of solid waste management? From collection from households to disposal (at the dumpsite in Embu).
 - Are the private collectors licensed
 - Is the airstrip secured with a fence, manned by security, is it quantified and recorded, easily accessible by trucks on road.
- About the ban on plastic bags, has the implementation of the law been effective?
 - Have there been any challenges in its implementation?
 - What was the attitude of the population towards the ban
 - There are still plastic bags being used, why do you think this is happening?
How can businesses contribute
- Why are primary plastic packages not included in the ban? Why only single use plastic bags?
- What are the waste collection services provided by the County? Ask about Kibugu?
 - ☐ Are there any costs for locals to access waste management services?
 - ☐ Is waste collection regular? If so why/why not?
 - ☐ Do you do regular patrols of local services/dumpsites/collection points/infrastructure
- Do you think there is a lack of awareness and knowledge about solid waste management among local people?
 - Is there a gap between legislation and practice?
- Does NEMA carry out sensitization and awareness training on solid waste management?
 - What kind of education, information, training etc and to whom?
- What institutional challenges are faced when it comes to implementing waste management legislation/changes/improvements?
- How could these challenges be overcome?
- Do you think there is adequate allocation of resources to solid waste management?

- Are you on track to achieve Vision 2030?
 - If so, how/if not why not??

c) Agricultural Officer

- What are the responsibilities of the Agricultural officer?
Several departments at the Ministry of agriculture (climate change, environment, livestock production, etc). Its their responsibility to see if there are good agricultural practices regarding waste management. Now they are dealing with a lot of agrochemicals. For example, they take care of the chemical packaging, because they are aware of their impact. So they put a lot of emphasis on how to manage these products. It's necessary to have lots of guidelines in agriculture regarding waste because agriculture generates a lot of waste. So they must have an elaborate program for managing the waste.
- What are some kinds of waste that you are aware of in agriculture?
Farm produce, chemical waste, industrial waste
- Are there any guidelines to help farmers with the disposal of agricultural waste?
Yes. They have placed bins in agricultural centers. Then the county government truck comes to pick up the bins and disposes of the contents somewhere else. In the market centers also, workers are employed to put the waste in bins and collect it.
- Questions to ask if they do not talk about this:
 - ☐ Who are the public and private actors (KTDA, LIMBUA, COFFEE FACTORY KATHAGWA, TROPICO, GIKIRIMA, KIBUGU FARMERS COOPERATIVE SOCIETY) involved and what roles do they play in supporting to manage their waste? (and what competencies do each have)
Yes. In the TEA sector, for example, there is the RAINFOREST CERTIFICATION PROGRAM. They have put bins on every tea buying center, for chemical packaging for example, and every 2 weeks there is a company contracted by the KTDA who comes to

pick it up. Another stakeholder is the Embu Government, another one is NEMA (who supervises all the activities on waste management), also the Minister of Health is supervising all of this and making sure that the standards are met.

☐ How is agricultural waste handled at the farm level/household level (from generation to disposal) Where is it disposed of?

☐ Is there any awareness or sensitization program to help farmers with waste management? If yes, which ones. If not, why not?

Yes. In the market, the farmers (coffee and tea), they are certified by the Rainforest Alliance. What the alliance has done is that they have recruited some agents to go visit. Document every farmer growing these crops. Then every farmer is trained in a meeting, its given a pit to deposit the waste 10-15m from their homestay. The Alliance makes an inspection every 6 months. For you to be a member of a factory/farmers association, you must have a bin.

- What are the laws/regulations guiding agricultural waste management?

NEMA Act (The Waste and disposal act) stipulates how waste should be disposed of. Pesticide Control Act (for chemicals). Market farm and urbanising Act. So you pay some levy for the waste of your unit to be collected.

- What is your view on the laws/regulations if there are any?

We might have good regulations, but what is important is to increase peoples awareness on regulations and actually practising them. The practising level is very important, The challenges are in IMPLEMENTATION. Because they put bins in the market, but if people still litter around and don't make use of it, it does not make sense. So there is still work to do on awareness, to be aware that if you litter, you are doing wrong. So laws are not 100% implemented.

- How do you think farmers manage the agricultural waste?

- Why or why not?

Let me appreciate it. We have a problem with safe and effective use and disposal of pesticides. Farmers nowadays are very aware that once we use the chemical containers you either burn them (not throw them on the river or reusing them for packaging of food) or ? (he didn't say). At farmers level the adoption is above 80%.

Why burn them? In the past there have been experiences of children getting in contact with the chemicals and causing accidents. So burning is more safe.

- What are the impacts of current solid waste management on the farms?

POSITIVE: One of the greatest impacts we are seeing now is the After the RAINFOREST Alliance came and started collecting litter from the farm, the cases of malaria have been reduced (less mosquitos) and other diseases. Second, the instance of the impact on the environment, now water is cleaner (it's not clear what he said). There is ONE negative impact. An organisation like RAINFOREST doesn't work for free, they must be paid (by KTCDA?), so for some farmers is expensive to undertake this (is farmers who have to pay?). But when you see the positive results, the amount that must be paid is tolerated. Another negative aspect is that sometimes farmers feel like they have been supervised, researched (when ppl from RAINFOREST come to check on their farms), so sometimes farmers might not be too comfortable).

How long has the rainforest alliance been here? This things (like human rights, agricultural laws etc) came in 1998 or 1988. That's when the Alliance arrived.

- Some of our survey respondents indicated that they burn/bury their waste/ and spread them in the field. What is your opinion on it?

As far as he is concerned, they have to continue training farmers on the issue of the environment, like on the issue of deforestation. He also comments again on the diseases that are avoided. He says it should be something continuous.

CLAIRE: Does all of this also apply to local produce? OFFICER: Did not manage to note his response.

CLAIRE: You said the problem is the lack of awareness, the implementation.

OFFICER: He said that it's not like implementation is zero, but that they need to keep working on increasing awareness.

GABRIEL: What about organic farming? A lot of companies are promoting organic farming. The issue of adoption of organic farming is quite low. Now that they have a program at National Level on promoting the adoption of organic farming, they

believe they can go far on this. (Pema noted one association that promotes organic farming). As far he is concerned, its okay but nowadays its below their expectations.

- What are the impacts of waste generated from agricultural machinery?

One of the greatest impacts and issues is water pollution. Because before there was no mechanism to control water pollution (there was a lot of tea and coffee production materials going to the rivers). This is at the same time NEMA came to be, and NEMA improved this issue. But nowadays, they have managed to control almost 90%, because if you go to TEa and coffee factories, you can see that they have pits to put all the waste, waste doesnt go to the river. He can assure us that the management of the factory waste is very controlled.

- What institutional challenges are faced when it comes to implementing waste management legislation?

One of them as its been common always, its the LACK OF RESOURCES and also the ADOPTION PROCESS. Nowadays, wer are supposed to manage of the market after every sunday, but you will find that the waste takes up to a week to be taken away. Another thing is the human mentality because if we can have that mentality that when you are littering you are doing the wrong thing, people would act differently (her points out to individual responsibility).

PEMA> You said somebody is supposed to be collecting waste from the market, are there laws about this? The laws are there, there is a full legal framework about what should be done, but there is a big gap between laws and what people actually do.

GABRIEL: Gender differences: we live in Africa, and we have gender roles. You will find it unique to find a man whipping the floor of the house. So traditionally, women take the responsibility of managing the waste at home.

- How could these challenges be overcome?

First, we must have the institutional awareness (he comments on individual awareness and mentality, which can be changed by training and awareness, that can be changed) enhance capacity building to create awareness. Also, some DEMO SITES should be set.

- What improvements do you think can be made in the current agricultural waste management?

- Which improvements?

What we need to encourage, is to have proper places to compost, to encourage the farmers to have a good source of manure. A safe pit that can be used to decompose and get manure.

- Do you believe increased government investments or aids to county governments could significantly improve household agricultural waste management practices? If yes, elaborate.

Yes he agrees, but he aslo doesnt like on emphasising so much on government involvement. He prefers to talk about involving the private sector. If the government just takes care of the policies, but the LEAD actor is the private sectors, that is the best way to go.

- What future do you envision (not desire, not idealistic) for Kibugu/Embu County in terms of agricultural waste management?

We have a lot to do, what we need to do is to have a recycling process. To me there is a business opportunity in recycling, becasue why are ppl going to buy teh product from Nairobi, if we have it right here in Kibugu. We must attract investors, maybe in Embu county. If we have a way of recycling this waste, we could make a business out of this.

FINAL COMMENT: There is a lot to be done on waste management, and we know that in Europe you have the capacity and technology to manage waste right, create employment out of it etc. So do not be reluctant to share that information with us, if you have any business opportunity come and tell us. LEPUA is a company that is originally from Germany, and its now starting a strong wave on Macademia farming here. Or if you have a machine to recycle agricultural waste and make it more profitable, we would appreciate it.

CLAIRE> Does RAINFOREST alliance also work with LEPUA? No.

d) Public health officer

- What are your responsibilities as the Public Health Officer regarding waste management in Kibugu?

Consents to be recorded

Responsibilities: environmental health is part of her work. Work is a hazard to the community and is produced daily. Her responsibility is to make sure its collected in time. She calls Embu County Environmental Office to come collect the waste when its necessary. But there are many challenges: sometimes its not collected in time, vehicles break down, and the County does not have enough economic resources. S oin the rural areas they do not have many resources. Now that the Public health unit is given the responsibility of carrying on public health, she thinks things will get better. People used to tell her that in the market waste was piling up way more than now.

She thinks the market is not a good place for the dumping site. So she went to the office to ask to put the dumping site in another place, but the place had already been occupied. So she is trying to move the dumping site away. For now, she is trying to do the correction through the office. So her responsibility is that the waste is not too much and gets collected when its necessary, as well as talking with the office about moving the dumping site.

PAUL: Where is the waste taken from the dumpsite by the vehicles? They have compacters, tractors, loaders and other two types of vehicles. They will come and do it well. Then they take it to Embu Town, where the dumping site is 7km away from town. Crude dumping.

- How do you manage medical waste?

Clinics and from the hospitals: most of the private clinics are registered for incineration (she thinks maybe its cheaper) and the chamber (of another hospital?). But here at the hospital, they have a combustion chamber themselves for the hospital waste.

About SEGREGATION: They segregate hospital waste in different bins (non-infectious, infectious and highly infectious (blood, placenta etc). They have a good system, but its not hte same for the community.

Dr. Linda: we saw that in the market ppl do not segregate their waste in the dumpstie. In the market, currently, as it is, do you think that at the market, fi they could segregate their waste would be helpful? RESPONSE: She also thoughts about it. A possibility would be to hire a private company to segregate the waste at the dumpsite. It worked for a while, she doesn't know what happened when the guy

disappeared and this project stopped. She felt HELPLESS and felt like her hands are tied, she KEPT SILENT.

- Are you aware of the local laws/regulations on solid waste management?

She knows about NEMA. She knows about infections and a bit more but is not aware of more.

They also have COMMUNITY HEALTH PROMOTERS: Their work is to report to her and talk to people about not burning etc. CHP are chosen by each community (village), and then they are trained by the hospital. The impact of these actors is GREAT: Since they have them, child mortality and morbidity has gone down. They visit households and educate them. They have 4 units (each of them has 10 people, so 40 CHPs in total). So they enter in households, if they see a pregnant woman, a baby, disease, then they refer them to the health facility. Regarding solid waste, they only advise households to have COMPOST PITS. And after composting they use it for manure later or they burn it.

PEMA: Are you training these CHP about waste management? Yes, and they actually have reporting books, they report monthly (ex: each CHP reports on how many compost pits are there in the area they look at). Every chair (each unit has a chair and an assistant, and this chair is responsible for the community health of the village).

Now the problem is that there is some resistance from the community: some people may refuse to build a pit, a toilet etc (they might not see the need for example), and then CHPs come to her to ask for enforcement.

She comments that changes are slow, but in progress.

- What impacts does the current waste management in Kibugu have on public health?

First, there is a positive response from the community, people are happy with her work because they see that she is trying a lot, working a lot to improve the market area dumping site. Also, they have reduced outbreaks around the market. She says there is a positive impact because there is no outbreak, and people see that there is a change.

Regarding the vehicles of waste collection, she says that now they are actually working and that it was in the past (before she was in her position that they got broken). Nowadays she thinks they are working well and actually collecting the waste.

- Have you observed people getting sick because of the waste they are

handling?

Not really. Actually people at hospitals workers get more sick because they handle more hazardous wastes. So she cannot say that she has observed.

CLAIRE: Regarding the smoke by burning of waste, do you think there are respiratory diseases in KIBUGU? She has not seen an increase. Maybe there can be a small amount.

- Ask about the practices of burning and burying if not addressed
She would prefer if ppl did the burning outdoors. IF burning is good, if its in an open area outside the town (like in the dumping site in Embu), then its fine.
- What is your take on the management of the dumping site near the market?
She complained her bosses on their meetings, took photos etc. She thinks the dumping site should not be on the market, and their bosses are aware of that. Another area should be designated, but where they thought about was occupied by the building of some houses.

PEMA: Do you think here are impacts on peoples health around the dupming site in the market? DEFINITELY. If it was in my hands, i would collect htat waste every day with ehr own hands, but she has no vehicle, time...

PAUL: About draining. RESPONSE: The drainign system is very poor, and here it can rain a lot. So when it rains it overflows, people have actually complained in Facebook. She went to complain (i dont know where), and they sent somebody to do some market draining and observe the situation. But for now its very poor in the market, and it affects a lot, because when ppl come sometimes they cannot put their stands on the floor because its full of water, so its a big challenge. But the officers have said that they will come soon.

- What are the challenges faced in carrying out public health measures regarding solid waste in Kibugu?

The only thing she thinks about is the AVAILABILITY of collection services. There are too few for Embu County, so having more vehicles would be better.

- How does public awareness on waste management impact health?
It would have a big impact because most diseases are caused by poor sanitation. So they would reduce diseases casued by contamination.

- How could the current waste management system be improved from a public health perspective?

By adding more vehicles and personnel for collection. There is Embu North, south, west, Embere north and south. So with more vehicles and personnel, the collection would be better, it could be done weekly and it would work.

- Ask about the effectiveness of educating the public if she doesn't address the topic + Have locals received any education on waste management?

Educating people would help a lot, if people did the composting at their households for example. She thinks people have not received good sensitization/education about the topic. Change is a process, and they keep trying to raise awareness on the importance of proper waste management. So they will continue telling them until it gets into their head. From 1 to 5, they are in 3.

She repeats that the COMMUNITY HEALTH PROMOTERS are KEY.

- What future do you envision (not desire, not idealistic) for Kibugu/Embu County in terms of waste management?

My vision would be, let people first recover the dumping site (i didn't understand this). Also, let the community be aware of what should be done with waste. And she wishes the County could afford to have 1 vehicle for each sub-county for collection, as well as get back a dumpsite outside of the market (did understand this)

GABRIEL (asking about the involvement of women in waste management at households and the markets): Nowadays the new gov regime have some women employed to swipe in the market. She doesn't know how it is done, because it's done by the County Government. If it was on her hand, she would employ both male and females.

ANY COMMENTS TO FINISH:

She is working hard to reduce the menace of waste. Also the County is trying. So solid waste now is not the menace that has been before. She knows that soon things will get better. THINGS ARE BETTER THAN HOW THEY USED TO BE. SHE says that even if her hands are tired, she is trying hard.

CLAIRE: Do you do patrols to check what the situation is? She usually checks and also The swipers inform her (the two ladies) of what the situation is in the market's dumping site.

e) Waste management service workers

- Could you introduce yourself?
- Could you describe your responsibilities/daily activities as a waste management worker?
 - He decided to do the business after observing people were throwing and littering the environment. He met the public health doctor where he explained the situation and they made a measure and made it mandatory to have a collection bin whereby he would collect the waste from the pits and take it to the dumpsite. He does it for a fee.
- For how long have you been working as a waste collector?
 - 8-10 years
- Why did you choose this occupation?
 - He was not pleased about the environmental pollution from the waste. He separates the waste like plastics and takes them to the shop to sell it.
- Where do you collect the waste from?
 - He collects from two bins: From permanently placed dustbins and portable bins. When the portables are full, he goes and collects them. When the permanent is almost full, he plans when to get it.
- Where do you dispose of it? (And why do you choose to do it this way?)
 - The larger organic waste is taken to the municipal dumpsites. The rest, plastic containers are sold in the shop that buys them. He collects the waste together and as he dumps, he segregates and bring them later to the shop. He also collects the plastic containers from the municipal dumpsite and takes them to sell them. He is sure the plastics can be recycled/reused into something which is why he is bringing them to the shop.
- What are the risks associated with waste management? (Ask about exposure to diseases, do you have personal protective equipment)
 - He doesn't have protected equipment like gloves but uses a shovel to collect the waste. Sometimes he is injured while collecting waste and thinks he is at risk because of the sanitary napkins that are also found.
- We know there is an official waste collection point and waste management services. Why do you think your clients have the need to hire a private service of waste collection like yours?

- We have the county sweepers whose responsibility is to sweep around the town. He can still find waste on the other side of the road. So, he talks with the public health officer and makes his services deemed necessary.
- What are the challenges/difficulties you face while carrying out your responsibilities?
 - Some people don't pay him after the collection services
 - Sanitary wastes and potential risks that exposes him
 - He contracted to collect waste from 10 apartments and available when requested on calls.
 - Lack of protective gears that are expensive
 - Low income from the work
- What could help overcome those challenges?
 - Acquiring protective gears will help him
 - Would you need any support from the County government?
 - Sceptic about the government; does not hope for anything
 - If the county government more garbage collectors in Kibugu
 - He wants the caretakers of the apartment to take care of the waste
 - Aspiring member of a county assembly came in and donated the carts to carry the garbage
 -
- Do you know about other people working as waste collectors?
 - The aspiring member donated by 5 carts to him and his friends but the others sold their carts and unable to carry their business
- How do you envision the future of waste management?
 - Since he started his business, he has observed there is an increase in solid waste and sees it increasing in the future as population increases. Every new building he sees, there is an increase in waste. He envisions a future where solid waste management will be difficult.
- Any comments

f) Fruit vendor

- What type of waste do you produce?

Organic waste: rotten melon, oranges, avocados, peels from people eating fruit

- How do you dispose of your waste?

She has a bucket where people eat and throw peels then she takes home and boils them and gives to the pigs so the animals get fat so she can make money

- How often do you dispose of your waste?

Every day, she produces 3 buckets a day

- How did plastic ban affect small businesses like yours?

Didn't really affect her business as she continued to use the banned plastic bags

- Do you still also use plastic bags?

Yes, or she would opt for cling film

- Is it easy to get single use plastics?

Yes as the cost went down after the ban (even though it was supposed to go up) so was more accessible

- What are you using instead of the plastic bags?

She still uses the plastic bags (for sliced fruit) but also has reusable bags for bigger stuff

- Do you have any opinions on the management of the dumpsite in the marketplace?

For her the dumpsite looks good and should be relocated to another place, doesn't affect her business as she is far away from her

(we observed burning of waste next to her stand and asked if this affects her business) she says the fumes are bad for her and the ash remaining is blown into her premise so she is forced to clean

- What challenges do you face in the management of your waste?

One of the challenges is that she must pay some money to get someone to collect her garbage

- Have you ever received any training on waste management?

Yes she has, from the public health person who has sensitised her on how to manage her waste

- How do you envision the future of waste management in Kibugu? - Improvements can be covered.

The nearby farms will find waste reaching to them and waste reaching livestock who may consume part of the waste

From her business from the increasing population and urbanisation she will get more waste

- Any comments

g) Plastic bottles /Metal collector

- Could you introduce yourself?
 - 40 years old.
- Could you describe your responsibilities/daily activities as a plastic/metal collector?
 - Collects and segregates metals, plastic bottles and glass bottles. Guys come with the waste and leave it with her. The boys are paid after measuring the waste.
- When did you start working as a plastic/metal collector?
 - She started her business a year ago. 2022.
- Why did you start doing this?
 - She used to do field agent in field, metal and glass collection. She used to work with a lady friend and piqued her interest. She started the collection centre and the business so that she can collect and earn for herself. Youths, children, adult men and women collect bottles for her and bring them to the collection centre.
- What type of bottles/metal do you collect and why?
 - She collects glasses- clear transparent ones that are more preferred by the collectors. The dark ones are usually not collected by the buyers as it is said that they are not in use. They are mostly collected by a person (who is usually a broker) who buys from her and takes it to Uganda, Nairobi and Isinya. She collects two types of plastic: plastic original and plastic counterfeit. Mineral water bottles are plastic counterfeit whereas ice cream containers are plastic original. Collection for plastics: Original: 10 shillings per kg and counterfeit: 3 shillings per kg. The cost given to the original is used to manufacture chairs. She doesn't know what counterfeit is used for. Metals: 25 shillings per kilo
- Where do you collect your plastic bottles/metal from? (And why do you choose to do it this way?)
 - They collect them from all over households, markets, and dumpsites of Kibugu. SHE gets her metals from garages, enterprises and old iron sheets from households and wherever they can be found. She does that for business. She doesn't use protective gears. She doesn't feel threatened or feel at risk. She didn't suffer from any disease.
- Where do you dispose of it?
 - Who do you sell to?
 - How much do you get from selling the plastic bottles/metal per kilo?
 - Original plastics: 15 shillings per KG Counterfeit: 6 shillings per Kilo.
 - Metals or good quality sheets: 30 shillings per kilo.
 - After selling the metals, it is taken for smelting by the buyer
- What is your opinion on the dumpsite?

- Her place is adjacent to the dumpsite and when the heap is big it smells bad. When it rains, it releases an awful smell and some of the waste water gets to the other businesses. The dumpsite should be allocated to another place. She benefits from the dumpsite because most of the materials for her business comes from the dumpsite.
- What challenges do you face?
 - She doesn't get the scrap metals as she needs it to be. She gets small ones a day. She hopes to get more so that she can expand. Bottles are readily available since people are using and consuming it everyday. They are readily available.
- What could help overcome those challenges?
 - The worker says if he had a bigger magnet, he would easily collect other metals.
- Would you require any government support/incentives?
 - Financial incentives to open her own business . She is currently an employee here.
- Have you ever received any training on waste management?
 - If the government provided training, would you attend?
 - Government banned the scrap metals at some point but they were later on trained on which metals to buy and which metals to avoid. They were taught not to buy electric wires and water pipes. They were taught how to assess if the person bringing the waste is the owner and not a vandalised item.
- Do you know about other people working as plastic/metal collectors?
 - She knows someone who is dealing with the same business. There are a lot of waste collectors and I don't wanna name them.
- How do you envision the future for waste management
 - She envisioned her future where plastics and metals waste are reduced. The government is putting tough measures to curb the usage of plastics. She is grateful for the team as she learned something from us haha
- Any comments

h) Kibugu Farmers Cooperative Society

- What does Kibugu Farmers Cooperative Society do?
- What type of waste do your farmers produce?
 - Who are the actors/stakeholders involved in waste management of the farmers?
- What waste management practices does your coffee farmers cooperative society currently have in place?
 - What kind for each type of waste?
- Do you train your farmers in solid waste management?
 - How? And why ?
- How do you manage organic waste produced by your farmers?
- How do you manage plastic waste produced by your farmers?
- What challenges do you face in terms of managing these waste?
- How come you overcome those challenges?
- How do you envision the future of waste management?
- Any comments

i) Pub owner

- What type of waste do you produce?
- How do you dispose of your waste?
- How do you dispose of glass bottles?
 - Where do you dispose of it?
 - Who is collecting the glass bottles? Is it a company or individual?
- How often do you dispose of your waste?
 - How did plastic ban affect small businesses like yours?
 - Do you still also use plastic bags?
 - Is it easy to get single use plastics?
 - What are you using instead of the plastic bags?
- How does solid waste regulations affect the way you work?
- Do you have any opinions on the management of the dumpsite in the marketplace?
- What challenges do you face in the management of your waste?
- Have you ever received any training on waste management?
- If the government provided training, would you attend?
- How do you envision the future of waste management in Kibugu? - Improvements can be covered.

- Any comments

j) Macadamia Processor

- What type of waste do you produce?
- How do you dispose of your waste?
- How often do you dispose of your waste?
- Do you still use plastic bags?
 - Is it easy to get single use plastic bags?
 - What are you using instead of the plastic bags?
- How does solid waste regulations affect the way you work?
- Do you have any opinions on the management of the dumpsite in the marketplace?
- What challenges do you face in the management of your waste?
- Have you ever received any training on waste management?
 - If the government provided training, would you attend?
- How do you envision the future of waste management in Kibugu? - Improvements can be covered.

k) Organic Farmer

- Introduction, age, years in Kibugu
- What do you grow on your farm?
- What does being an organic farmer mean?
- Do you use pest control chemicals?
 - How do you manage packaging wastes from fertilisers?
- Why did you choose to be an organic farmer?
- What kind of waste do you produce in your farm?
 - How do you handle this waste? (plant residues, innovative ways)
 - Why do you do it this way?
 - Is there any way you would prefer to manage your waste?
- What challenges do you face with managing your waste?
- How can the challenges be overcome?
- Would you require any incentives or government support in waste management?
- What future do you envision in waste management?

- Any comments

7.3. Group interview questions and notes

- Table of participants

Gender	Name	Age	Years living in Kibugu
1. Male	Jeremia	Born in 1952 72 years	Born in Kibugu, grew up here and has lived in the are since
1. Male	Arias	70 years	Born in Kibugu and lived here since
2. Male	Willson	1962 62 years old	All his life
3. Female	Angelina	Born in 1965 59 years old	?
4. Female	?	1954 70 years	All her life

- Has there been any traditional or cultural waste management practices in the community?

People used to throw the waste manure in the gardens instead of composting, but nowadays most people in the village have compost pits for manure.

- Are they still in use?

- Do you attach any cultural meaning to the environment? [FQ1]

Some ppl used to go to Mount Kenya to ask why rain wasn't coming. There were sacred places to carry prayers. These sacred places are called "Catchment areas". Nowadays people still digging tums to bury people facing Mount Kenya. So these areas were sacred and not everybody could go there.

Lilian's mom: pema was asking me why goats were slaughtered. I did not understand. Something about "only one colour" and then it was sacred?

They say that in sacred areas it was forbidden to cut down trees.

Clair: so you believe those sacred areas were provided by god (Ngiaga). YES.

The prayers were supposed to be made facing mount kenya. The people who would be sacrificed, could not sleep with women the days before, and women couldn't be on their periods etc.

They talk a lot about the purity and cleanliness of the water in Mount Kenya.

In those sacred areas people couldn't even break a piece of branch, not even take a stone away.

Back then people were not living in places where there were no trees. By then, in every home, there was a tree with bees because they knew the importance of honey (they mention pollination). Nowadays people do not have bees anymore.

They comment that the ENVIRONMENT WAS TOTALLY PRESERVED (they talk about the banana peels to make a drink etc).

PEMA: So those areas were sacred for you. What would happen then if somebody litter waste in that area? RESPONSE: Those sacred areas were far from the settlement areas, very far away from the home. PAUL: But what would be the punishment for for example stealing? During those years, if somebody was caught stealing something (during colonial rule), the only punishment that person would go through was to be put in a stiff place, rapped in a fabric and roll down hill.

Another punishment in African tradition (i couldn't catch it): castrated "hingut"?

Pema's note: IF THE GOD OFFENDED THEN MISFORTUNES

- Does this impact your waste management practices? /Opinions of waste management?
- What do you consider as waste?

They differentiate between 3 types of waste: Waste from chamber (after harvesting), house waste (kitchen waste), and body waste (poop and etc). Woman: she mentions "muching". This comment is followed by a discussion of what is considered waste or

not. They agree that polluting papers and plastics found in the streets and at home is also waste, as well as scrap metals.

- What kind of waste were they producing?

Back then there was no metal and no polluting papers. Those came recently. Metals for example came with the construction of houses with new materials. Before they used to have mostly organic.

Instead of bags, they used baskets to carry things around (they mention other things to carry “guans” but not made of plastics.

(?) were used as cups, when they cut them in half. They didn't have spoons, and they used sticks and wood to cook.

What did they use to cook? Pots (they bring an object (“carambas? calabases?”) that they used to cook)

- Can you share how waste was managed when you were young? [FQ2]
 - What can you remember of how your parents used to manage their waste at home?

In the compound, they had a certain area where they threw the waste. The inorganic (?) one was put in pit latrine. Their parents also threw the kitchen waste in another place of the compound.

TEXAS: In those years, our mothers were used to sweep the compound and throw that waste to the banana trees.

They comment that thanks to the fact that their parents were burying organic waste in trenches, nowadays the land areas where they did that, the crops grow better (they appreciate that of their parents' generations).

All this was during the colonial rule. After COLONIAL INDEPENDENCE, it's when people organized themselves and demarcated the villages (?). They say there was a difference between how people managed waste during the colonial time and afterwards.

- What are the main differences you see in waste type between now and when you were young?

They still see some practices carried out nowadays: composting bananas and coffee for example.

Main differences between now and then: back then there were not that many people, and the environment was okay because there were more trees and no industries. Nowadays it's more densely populated, there are less trees, more cars, more pollution etc.

Back then there was no contamination, plenty of oxygen, enough wood for everyone. The

environment was very proper for humans. So compared to today's environment and back then, there was a time when environment was well preserved, but nowadays the environment is contaminated by many things.

- What are the main differences you see in waste management [FQ3] [FQ4] between now and when you were young?

During the old times, ppl didn't know about HIGIENE. So you could even see children pooping very close to the households and kitchens and mothers would not care. But nowadays there is more awareness on Hygiene and cleanliness. Also, contamination was not that much back then, but nowadays it is. Nowadays the dirt stays mostly in the towns (settlements), because people have nowhere to put the trash.

Back then, if someone died, people would just take the body and put it aside in some bushes (ppl were not buried). Back then the areas were not cleared, there were many many bushes, and there were way less people.

People were also not wearing shoes, they were barefoot. They only wore one sheet made of cotton or skins. But that was a long time ago (one of the women's says, but the man says they saw their parents wearing that).

As white people came into Africa, ppl started wearing more clothes and even shoes. But actually, back then they didn't even realize they were naked, it was natural to them to wear little clothes.

- Considering the last 20 years, have you perceived a change in the type of waste you produce now? If yes, what are those changes? (Types of products they consume etc.)
- And the services provided?

- Do you think the new generation are taking care of the environment?

NO (they laugh). People are exploiting the environment. There is scarcity of employment and resources. So if you find somewhere a piece of land that is not used and you have the knowledge of how to work on it, you exploit it.

Angelina said a straight NO: These young people do not want to get tired, specially in farming. So they go to buy chemicals to make planting easier. So many people use chemicals and pesticides.

All of them agree that people are not taking care of the environment. There is a tendency of the younger generations to have everything FAST, but they DO NOT WANT TO PUT THE WORK. Impatience. They need to develop the

tendency of going slowly, because nowadays the burn grass to be able to grow something there, herbicides to clean the area fast etc.

TEXAS: There was a time where people were NOT ALLOWED TO CUT INDIGENOUS TREES. Nowadays, if young ppl see one of those trees, they cut them to earn money from timber.

- What are the causes/factors that have contributed to these changes or remained the same?

First, The increase of INDUSTRIES and the scarcity of “chambers”(?). So the amount of land we have, we are trying to divide it and its impossible. Example: the coffee factory (didn't understand what he said).

Second, the people knew how to make use of what was in the environment (and reuse it?).

Were you had planted a few years ago, you let the bushes and trees grow in the area and grow plants somewhere else, so the environment was more preserved.

Many people during that time were planting just a few crops to sustain themselves, there was no LARGE SCALE like nowadays.

- What are your thoughts on waste and waste management in your community?

Jeremiah: you the younger generations, will come up with improvements done with your effort and knowledge, because if you just walk barefoot along the market, you will regret.

Texas: we elders are from different areas. But as Kibugu community, waste management is very important.

They say laws should be stronger and make it illegal to litter plastic bottles, and build a proper dumping site. It's very important.

INGE QUESTION: How do you envision the future in Kibugu? What future would you like to see? Proper management of waste by introducing materials that can rot (decomposer). So those who are within the industry should come up with materials that are perishable. Also, something we haven't commented about is liquid waste from Kitchen, bathrooms etc that goes into rivers and springs, dwells. Nowadays we cannot drink that water, and when eating the aruroots (potatoes) you might be drinking spoiled water.

OTHER COMMENTS:

After the demarcation of land in 1959, people had the right to do whatever they wanted in their lands. Im not sure if i understood well, but did demarcation destroy or made sacred areas disappear?

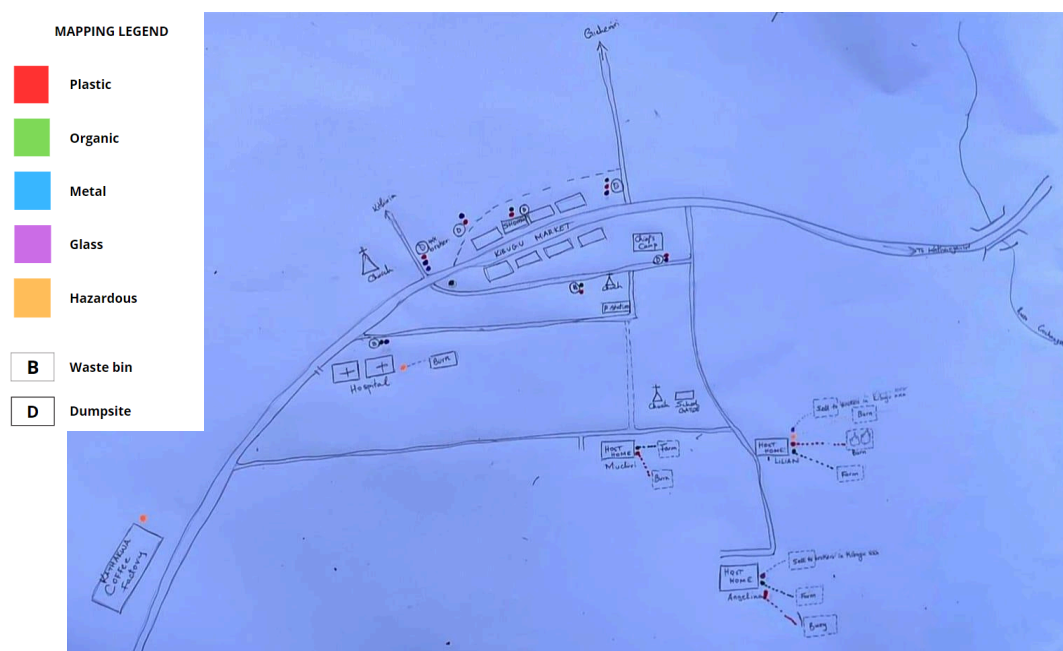
PEMA: What are the indigenous trees that you mentioned? These trees wehre preserving rain, bringing rain. They were used for honey (beehives), medicine. You couldn't cut them without the permission of the elders. Back them ppl kenw the purpose of those trees, nowadays people do not know and they cut them to get money.

7.4. Mapping Method

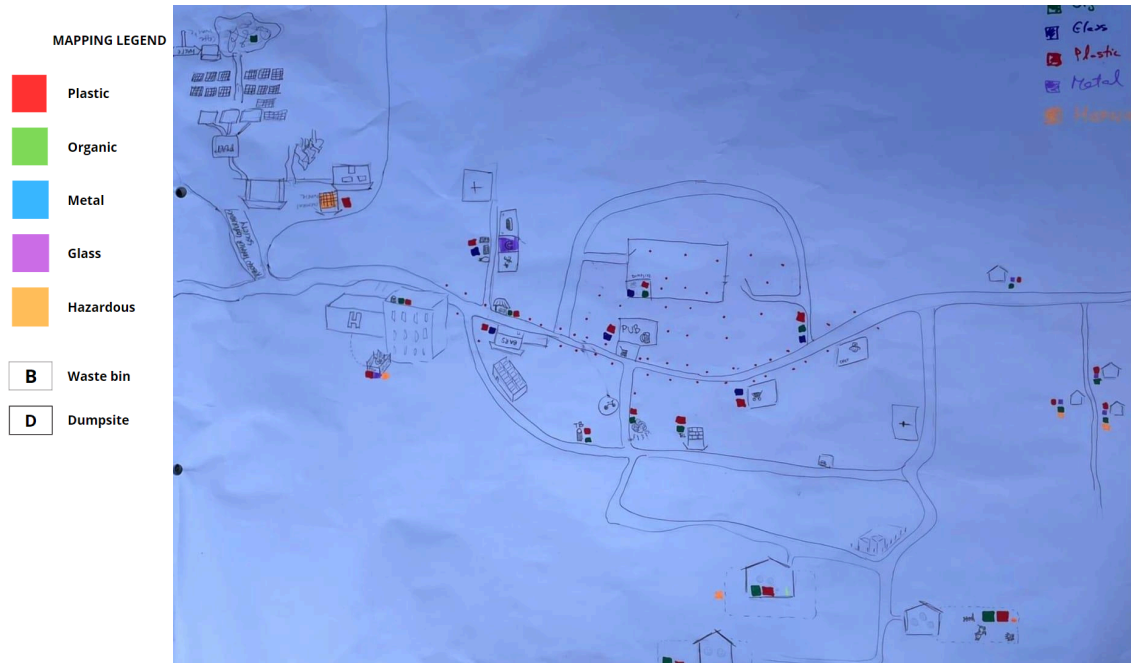
We created two maps through mapping. One drawn by our guides and another one by our research group. The steps of the exercise:

- Draw a map of Kibugu with the main road and dumpsite as reference. It does not need to be very accurate or detailed, or drawn to scale.
- Identify household solid waste facilities, such as dumpsites, bins, collection points etc.
- Draw where you can find each type of waste in the village (give each waste a colour and draw dots on the map)
- Specify what types of waste you produce at home and how you dispose of them.

a) Map drawn by our guides



a) Map drawn by our research group



7.5. SYNOPSIS

ASSESSMENT OF THE CHALLENGES OF HOUSEHOLD SOLID WASTE MANAGEMENT IN KIBUGU, KENYA

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TABLE OF CONTENTS

I. ACRONYMS.....	2
1. INTRODUCTION.....	3
2. RESEARCH QUESTIONS.....	4
3. METHODOLOGY.....	5
A. Observation.....	5
B. Transect walk.....	5
C. Survey.....	5
D. Key Informant Interviews.....	5
E. Semi-structured Interviews.....	6
F. Group interview.....	6
G. Mapping.....	6
4. SCHEDULE OF FIELDWORK AND PLANNED COLLABORATION WITH COUNTERPARTS.....	7
5. REFERENCES.....	9
6. APPENDIX.....	10
A. Data matrix.....	10
B. Draft questionnaire.....	16
C. Questions for Key Informant Interviews.....	19
a) With Chief.....	19
b) NEMA Office in Embu County.....	19
c) Embu County Government Staff.....	20
d) NGO.....	21
e) Waste management service workers.....	21
D. Questions for Semi-structured Interviews.....	22
E. Questions for Group Interview.....	23
F. Mapping: prompt and general guidelines.....	24

I. ACRONYMS

- CSO; Civil Society Organizations
- EMCA: Environmental Management and Coordination Act
- FHH: Female Household Head
- HH: Household Head
- HSW: Household Solid Waste
- KII: Key Informant Interviews
- MHH: Male Household Head
- NEMA: National Environmental Management Agency
- NSWMS: National Solid Waste Management Strategy
- NGO: Non-governmental Office
- SSI: Semi-Structured Interview

1. INTRODUCTION

The world is now facing an increasing volume of waste which is causing a serious risk to the ecosystems and human health. An estimated 11.2 billion tonnes of solid waste is collected worldwide, a major environmental and social issue (UNEP, 2017). While waste generation per capita is low in Kenya (11kg/year/capita), in comparison to the world average (29kg/year/capita), 92% of the waste is mismanaged (Paruta et al., 2020). Local municipal administration and national government bodies face challenges to effectively managing waste due to; increased population, change in consumption patterns, lack of infrastructure and policy, and weak enforcement of legislation, among other factors (NEMA, 2015).

Waste management is a process that involves handling, packaging, treating reducing, recycling, reusing, storing, and disposing of waste in a way that is environmentally sound for human health and environmental protection (Nthambi et al., 2013). As stated in Kenya's Constitution, each of the approximately 44 million citizens is obligated to collaborate with the State and fellow individuals in safeguarding and preserving the environment to foster sustainable development (Nthambi et al., 2013). The Constitution of Kenya also empowers County Governments to handle refuse removal, refuse dumps, and solid waste disposal. Furthermore, Kenya's primary legal framework, the Environmental Management and Coordination Act (EMCA) of 1999, prohibits improper waste disposal, emphasising the need for licences to operate waste disposal sites and promoting measures for waste minimization, treatment, reclamation, and recycling (EMCA, 2012).

Therefore, the National Environmental Management Authority (NEMA) put forward the National Solid Waste Management Strategy (NSWMS) which seeks to achieve sustainable waste management and a clean and healthy environment (NEMA, 2015). This is achieved through setting minimum requirements for County Governments regarding solid waste management, covering aspects like waste collection, transportation, and disposal. NSWMS has provided a common platform for action between stakeholders, including communities, and institutions, to systematically improve waste management in Kenya. Despite NEMA and other environmental regulators alike in place, it is very common to find household solid waste dumped in illegal dumping sites, as a result of challenges such as; lack of clear policy, lack of appropriate waste disposal infrastructure, and lack of public awareness (Sibanda et al., 2017).

Future projects aim to address weak implementation and poor waste management practices that have overwhelmed towns and cities, negatively impacting public health and the environment. Proposed strategies include zoning waste collection areas, ensuring timely and regular waste collection, and designating secure disposal sites. Efforts also target the enhancement of waste transportation methods, the establishment of proper disposal sites, and the improvement of management capacities at the county level (NEMA, 2015). These goals are assembled in the Kenya Vision 2030, a long-term-development blueprint aiming to create a clean and secure environment for all Kenyan citizens (Kenya Vision 2030).

Household waste is all waste generated by private persons in their household (Bernstard, 2010). A study in 2020 shows that, in contrast to urban areas, in Embu County household waste management is a significant problem due to the unavailability of commercial service providers (Mochache et al., 2020). The same study accentuated that 37% of households discarded their waste in open places, while 32% burned it and 24% recycled it, establishing that households often do not follow legislation

on waste disposal (Mochache et al., 2020). Therefore understanding the household waste management cycle and the challenges associated with this is vital to addressing the waste management problem as a whole.

There is an abundance of research focused on urban areas such as Nairobi, however, there is a lack of research on the implementation of household solid waste management legislation in rural villages. Therefore, Kibugu is taken as a case study to address the notable knowledge gap that exists on the factors influencing household solid waste management practices in rural communities. Despite the existence of regulatory frameworks, there are persistent barriers to effective sustainable waste management practices. This paper will explore the intricacies of these challenges faced by local people in Kibugu.

2. RESEARCH QUESTIONS

Main research question: Which factors affect current household solid waste management practices in Kibugu?

Sub-research questions:

- 1) What is the current institutional background of waste management in Embu County?
 - 1.1. Who are the actors involved in the household waste management process?*
 - 1.2 What are the institutions' guiding principles and goals for the future of waste management?*
 - 1.3. What is the intended household solid waste management strategy in Kibugu?*
- 2) How do households manage their solid waste in Kibugu?
 - 2.1. What kind of solid waste is produced within households?*
 - 2.2 What waste sorting and disposal strategies do households practise?*
- 3) What challenges are faced by locals in Kibugu in implementing the institutional plan of waste management?
 - 3.1. What challenges do locals identify in following the official waste management plan?*
 - 3.2. How has the management of household waste changed in the last 20-30 years?*
 - 3.3. What are the impacts locals perceive of current solid waste management in their livelihoods and environment?*
 - 3.4. How do locals think these challenges could be overcome?*
 - 3.5. What future do locals envision regarding waste management in Kibugu?*

3. METHODOLOGY

A. Observation

From the first day of field research; we will observe the dynamics, daily life of locals, spaces, and other aspects related to waste management in Kibugu. We will also take individual fieldnotes of these observations, to later analyse and compare these annotations within the group (e.g. identify recurring themes, reflect on what caught our attention, daily habits, small gestures or details we find important, etc.). Furthermore, we would like to conduct participant observation at our three respective homestays, through engaging in daily household activities and being part of the waste management system of the household. This method will be conducted throughout the entirety of our stay in Kibugu. Direct observation and participant observation will allow for valuable insight into the daily lives of locals (e.g. the type and amount of household waste generated, waste hotspots in the village, daily practices of locals regarding waste management, etc.) and the processes taking place in the village regarding household solid waste management.

B. Transect walk

We will conduct a minimum of two transect walks at the beginning of the field trip with ideally a household member and the local chief or a waste management worker of Kibugu. Having two transect walks will allow for a deeper insight into the perspectives of local people. The transect walk aims to see the village through the locals' eyes, understand the location and distribution of resources, as well as any elements, spaces, and landscapes that locals relate to waste management. During this walk, an informal interview will be held with the guide regarding the general waste management system in the village.

C. Survey

The survey will act as the backbone of the rest of the research, providing quantitative data of households and allowing for comparisons to be made. We would like to survey around 20-30% of the households which we estimate to be around 30-40 households. This will provide insight into several research sub-questions that we have in the survey guidelines. The participants include both the household head and their spouse, to get a gendered perspective.

The initial few days in the field will be devoted to identifying the survey sample. The first set of questions in the survey centers on gathering general demographic socio-economic background information of participants in Kibugu. This data is essential for understanding potential correlations between socio-demographic factors and waste generation and management patterns in the local context. The second set looks at the type of solid waste produced, waste sorting and disposal strategies that households practise, and change of management of waste over time, and the final questions revolve around challenges identified by locals in managing their waste.

D. Key Informant Interviews

We would like to conduct Key Informant Interviews with influential stakeholders who are actively working towards waste management in Kibugu town. This includes someone working at NEMA, the local chief of Kibugu, and a worker from the waste management service provider including private companies (and if possible and available, someone from an NGO working around waste management). The target participants will provide diverse perspectives regarding the first research

question. For example, NEMA will provide insights on the National Solid Waste Management Strategy (NSWMS), waste management workers, and the local chief may provide information on the efforts, initiatives, and policies made at the county level to manage the waste situation in the area. Furthermore, the key informant interviews will give us an understanding of the efforts and challenges of waste management at both the local and national levels.

E. Semi-structured Interviews

After completing the transect walks, key informant interviews, and survey, we want to identify 10-15 households for the semi-structured interviews (SSI). The first interviews will be conducted with our hosts, while other participants will be identified through snowball sampling and selected participants from the survey. We aim to interview the household head and their spouse who we assume are the most engaged in the waste management of solid waste in their household. SSI is an effective method to get rich, in-depth insights into the complex dynamics of household solid waste management. It will allow us to be flexible in terms of questioning and uncovering nuanced details and themes that do not emerge in the survey questionnaire. The SSI will provide both male and female experiences of household waste management, perceptions and attitudes towards initiatives and waste management practices in the locality, as well as their everyday waste management behaviors. This will help us to understand the dynamics, factors influencing waste management, challenges, and barriers to effective solid waste management. SSI will help to delve down to an individual level and understand the complex interplay of factors affecting their current attitudes toward waste management practices in Kibugu.

F. Group interview

This method aims to understand how attitudes towards waste management in Kibugu have changed in the last 20-30 years. Based on previous research concluding that household waste production has increased significantly, the type of waste is also likely to have changed as a result of changing consumption patterns. Therefore, perspectives on change in HSW and its management would be interesting to explore. Therefore, we aim to conduct two group interviews (semi-structured). First with female elders and second, with male elders. The group will comprise 3-4 individuals, who will provide us with gendered oral narratives and recollections of change around waste management. The sampling method used is snowball sampling beginning with the allocated elder of our group.

G. Mapping

Participatory mapping involves asking participants to draw a map of Kibugu village to address the relationship between space and waste (waste hotspots, distribution of waste according to waste type, etc.). We will identify the participants through snowball sampling departing from our homestay hosts and participants in the survey. We might conduct a pilot test of mapping with our hosts.

With the participants, we want to create four different maps. Four mapping groups of 3-4 people will be formed: a group of males, another group of females, a third group of children (under the age of 13, if possible), and finally, a map drawn by the researchers i.e. us. Participants will be given the necessary materials and a prompt (see in Appendix) to draw a map. We will be present in the process to provide any assistance they ask for and develop a conversation about their choices of visual representation of waste in Kibugu. We believe forming these four groups is an interesting strategy because it will provide gendered, age, local, and non-local perspectives of waste management in Kibugu.

4. SCHEDULE OF FIELDWORK AND PLANNED COLLABORATION WITH COUNTERPARTS

	<i>Monday</i>	<i>Tuesday</i>	<i>Wednesday</i>	<i>Thursday</i>	<i>Friday</i>	<i>Saturday</i>	<i>Sunday</i>
<i>Week 1</i>				Meet our Kenyan counterparts in Nairobi	<p>Morning: Arrive at Kibugu and start field observations, and get to know the community. Meet our host families.</p> <p>Evening: Meeting with our research group to debrief</p>	<p>Morning: Field observations, and getting to know the community</p> <p>Group meeting to decide on methods' sampling</p> <p>Evening: Get in contact with NEMA and other actors to get appointments for next week + Decide on visiting a dumpsite and interviewing waste workers/business</p>	<p>Morning: Wangari Maathai day short Ceremony in the morning</p> <p>Evening: Start conducting surveys and conduct transect walk</p>
<i>Week 2</i>	Morning: Conduct all surveys and identify participants for	Whole day: Conduct all Semi-structured interviews	Morning: Conduct mapping	Whole day: Other interviews: NGOs, business, waste management	Morning: Key informant interviews in Embu: NEMA and	Whole day: Any missing tasks from previous	Whole day: Any missing tasks from previous days +

	semi-structured interviews, mapping and group interviews Evening: Continue with the morning task		Evening: Group interviews w/ Elders + key interview with local chief	workers etc.	Embu County Government	days + start analysis and coding of data	start analysis and coding of data
<i>Week 3</i>	Farewell dinner/ Feedback meeting	Depart for Nairobi					

Planned collaboration with counterparts

Our Kenyan counterparts have been informed about our research proposal through video call. We have shared our expectations and interests regarding this research. They will gather information about sustainable waste management policies and frameworks in Kenya. At the beginning of the field trip, we will conduct a meeting to discuss more in-depth the research goals, methods, and upcoming activities.

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6. APPENDIX

A. Data matrix

Overall Objective:	Understand the current household solid waste management in Kibugu and what factors affect it						
Overall research question	WHICH FACTORS AFFECT CURRENT HOUSEHOLD SOLID WASTE MANAGEMENT PRACTICES IN KIBUGU?						
Definitions	<p>Solid Waste: Discarded and/or unwanted materials in a solid state that derive from household and commercial activities (ISWA).</p> <p>Solid Waste Management (SWM): The control, collection, transport, storage, processing, treatment and disposal of solid waste (ISWA).</p>						
Sub-Research Questions	Sub-Sub questions	Variables	Data Required	Data Collection Methods	Data Analysis Methods	Output	Limitations of the Methods
1) What is the current institutional background of waste management in Embu County?	1.1 Who are the actors involved in the household waste management process?	<p>LEVELS: National, County, Local</p> <p>ACTORS: Waste generators (households)</p> <p>Staff and institutions (NEMA, Embu</p>	A scheme/list of the actors and their responsibilities/dynamics	<p>Observation in the field site</p> <p>Literature review</p> <p>Key-informant interviews with the local chief, NEMA officer and possibly a waste management</p>	Summarise and compile the information	A scheme/mindmap/list of the actors involved in waste management in Kibugu and the three main levels (National, County, Local village)	We might get a very general overview of the actors, and thus we might ignore other actors who also play a significant but more silent role (ppl who clean the streets now and then...etc).

		County Government staff, the local chief)		worker or private companies.			The local chief might give us a very idealized image of the waste management context in Kibugu
		Service providers (waste workers, private companies)					
		Other actors in the system (NGOS, CSOs)					
	1.2. What are the institution's guiding principles and goals for the future of waste management?	Vision 2030 (Sustainable, plastic free Kenya) NSWM strategy (NEMA) EMCA	Institutional discourses/ideology/goals on solid waste management	Literature review of current waste management strategies and their future goals Key-informant interview with a NEMA officer and the local chief	Analyse literature and semi-structured interviews	The reasoning / rationale behind the National and county level waste management strategy	
	1.3 What is the intended household solid waste management strategy in Kibugu?	Types of waste addressed by institutions Processing of different types of waste (Collection, transportation and disposal)	Process/route of waste in Kibugu, from a household level (waste segregation) to county level (or whatever the main	Observation: village area and closest dumpsite Transect walk around the village area Key-informant interviews with the local chief, NEMA officer and possibly a waste management worker	Analyse interviews and merge that information with our own observations.	A flow chart with the different stages of household waste management from source to household to county level and types of waste + institutional actors that influence how this waste is managed A timeline of the process.	Actors may give an idealised view rather than what actually happens (we overcome this by looking at household/locals)

		Waste facilities	end point is)				
2) How do households manage their solid waste in Kibugu?	2.1. What kind of solid waste is produced within households ?	<p>HSW Composition:</p> <p>Organic Plastic Paper/Cardboard Tins and Metal Glass E-waste Hazardous Textile Animal waste? (Kenyan student)</p>	<p>Different types of waste produced and estimation of ratios (mostly organic, plastic...etc)</p>	<p>SURVEY→ SAMPLING METHOD: Stratified random sampling: Satellite image quadrat sampling (choose households according to geographical distribution (Strata: spatial: proximity to the main road/structure). 30-40 households.</p> <p>Observation and participant observation (at the 3 households we are staying)</p> <p>Literature review, looking at similar towns/villages in kenya (since there is no literature on Kibugu specifically)</p>	Analyse survey and merge that information with our own observations	<p>Pie chart showing the proportion of households which categorise each waste types by amount produced Eg. 30% of households say they produced most plastic, 10% say most metal etc (this may not be feasible)</p> <p>Description of what is observed and literature</p>	<p>This is only an estimation, not accurate.</p> <p>Respondents might not be aware of the different types of waste we ask about</p> <p>Respondents might not have an idea of the ratios for types of waste produced within their households</p> <p>Sampling method: we might leave out households that could be interesting for the research, such as households located further from the Kibugu village centre, etc.</p>
	2.2. What waste sorting and disposal strategies do households practise?	<p>Sorting strategies</p> <p>Disposal strategies: burn, bury, compost, reuse and recycle, deposit in trashcans, littering in street or environment</p>	<p>What methods are households using to sort and manage their solid waste and WHY they</p>	<p>Semi-structured interview (our hosts and with other HH and their spouses (separately)</p> <p>Survey (with locals, probably head of household)</p>	Analyse the survey and merge them with recurring themes from the semi-structured interview on how they sort, dispose and	<p>A flow chart with the different stages of household waste management types of waste using information from 2.1 and 2.2 (to show what is actually happening with HSW)</p>	<p>People may say what they are supposed to do not what they actually do</p> <p>Mapping:</p> <ul style="list-style-type: none"> - People may not be willing to take part, time consuming etc - Images may be biased to how they

			practice them	<p>Literature review (look at study on Embu)</p> <p>MAPPING (PRA)</p> <ul style="list-style-type: none"> - Group mapping 3-people 4 maps: women, men, children/teenagers? (to be decided in the field) and us - A conversation about the map they draw 	take care of waste	4 maps, showing where people take their waste, where it is collected, waste hotspots etc (will expand on this in methods)	want us the perceive the village
3. What challenges are faced by locals in Kibugu in implementing the institutional plan of waste management?	3.1. What challenges do locals identify in following the official waste management plan?	<p>Economic challenges (economic status)</p> <p>Distance/spatial location to waste collection points</p> <p>Gender</p> <p>Lack of awareness and knowledge</p> <p>Lack of infrastructure</p>	Local's subjective perceptions	<p>Semi-structured interviews (HH and their spouses, separately)</p> <p>Survey</p>	Analyses of interview, survey and comparison with literature review of waste management challenges in Kenya/Embu at household level	A table with the main household challenges (and root causes if this is expanded on sufficiently in SSI) (look in NEMA)	Maybe they do not want to be seen as having a lack of knowledge, awareness, money etc.
	3.2. How has the management of	Change in waste types, products they use, and management	Local perceptions of change	Two Group Interviews with female and male elders (40+)	Analyse and code the interviews and compare with	Narratives and recollections of change to understand whether there has been a change and whether this	Memory may have biases

	household waste changed over the last 20-30 years?	<p>strategies by households</p> <p>Attitudes towards waste (Also culture and norms)</p> <p>Regulations</p> <p>Change in waste facilities and services</p> <p>Change on perceived challenges</p>		<p>Semi-structured interviews with HH and their spouses (separately).</p> <p>Literature review (eg. past policy documents, change in regulations)</p> <p>Photo elicitation devices (to be decided in the field)</p> <p>Survey (bits)</p>	the literature review	aligns with the institutional waste management strategy and vision (have the acts and legislation been working)	
	3.3.What are the impacts locals perceive of current solid waste management in their livelihoods and environment?	<p>Social impact (health, spiritual impact, economy)</p> <p>Environmental Impacts</p>	Local's narratives	<p>Semi-structured interviews with household heads and spouses+elders</p> <p>Questions in Survey</p>	Conceptual and grounded coding of perceptions of impacts of current waste management	<p>How cultural values and beliefs define what local's perceive is harmful or beneficial for them and the environment, in terms of waste management.</p> <p>An understanding of local's perceived social and environmental impacts of waste management</p>	It can be hard for some interviewees to identify direct links between waste management and health or economic impacts
	3.4 How do locals think these challenges	<p>Legislation</p> <p>Education</p>	Local's opinions	Semi-structured interview with local HH and spouses	Analyses of interview, survey and comparison with literature review of waste	An understanding of potential changes in waste management following local's perceptions on possible solutions	Interest driven responses /bias: their responses might depend on if they think we can address these challenges

	could be overcome?	<p>More Resources (gov investments/aids)</p> <p>Incentives</p> <p>Ground level/Community organization, participation</p>			management challenges in Kenya/Embu at household level		
	3.5 What future do locals envision regarding waste management in Kibugu?	No preconceived variables. We are open to whatever they tell us: a completely different management plan, the same one ...etc.	Local's vision of future	Semi-structured interviews with HH and spouses +elders	Conceptual and grounded coding of visions of possible futures	Ideal state of waste management, Information of local needs and desires in terms of waste management	Limiting their expectations to what they already know or think it is possible

B. Draft questionnaire

Practicalities: <ul style="list-style-type: none"> • Presentation of us • Purpose of the questionnaire • Timeframe • Consent 	
<u>Question</u>	<u>Answer format</u>
Background information:	
Age	Number
Gender	<input type="checkbox"/> Male <input type="checkbox"/> Female <input type="checkbox"/> Other <input type="checkbox"/> Prefer not to say
Number of household members	Number
Number of children in the household	Number
Years of schooling	Number
Occupation or/and livelihood activities	Open
How long have you been living in Kibugu?	Number
Question 2.1. What kind of solid waste is produced within households?	
Can you rank the quantity of waste you produce at home, from least produced type of waste to most produced? (Expected possible categories: Organic (food waste, garden), Plastic, Paper and cardboard, Textile, Metal and tins, Glass, E-waste, Textile, Animal waste, Other)	Open
Question 2.2. What waste sorting and disposal strategies do households practice?	
Do you separate your waste at home?	Y/N
If so, how?	Open
If no, why not?	Open
Is waste collected from your home by waste management services? (Trucks etc)	Y/N
If yes go to question XY, if no go to question XX	

XY1. If yes, who collects your waste?	Open
XY2. Are there different collection services for different types of waste? If so, which ones?	Y/N Open
XY3. How often are different types (if collected separately) collected?	For each type of waste: <input type="checkbox"/> Every day <input type="checkbox"/> A few times a week <input type="checkbox"/> A few times a month <input type="checkbox"/> A few times a year <input type="checkbox"/> Never (Select just one)
Is there any cost involved in having your waste collected? <i>(we will get how much the cost is in the interview with local chief/NEMA)</i>	Y/N
Does the cost influence your decision-making in choosing the waste collection service?	Y/N
XX. How do you dispose of A, B, C types of waste? (A, B and C = the top 3 types of waste produced as established in survey question 2.1.) Eg. burning, burying, dumping, bringing to allocated disposal site, collected from home	A: Open B: Open C: Open
3.1. What challenges do locals identify in following the official waste management plan?	
Do you think the economic costs that imply following the official waste management plan are an obstacle for you to follow them?	Y/N
How far is the nearest waste collection point from your residence?	Multiple or scale 1. Very Close (Within walking distance) 2. Close (Short distance, easily reachable by foot) 3. Moderate (Requires a short drive or bicycle ride) 4. Far (Requires a significant drive or long bicycle ride) 5. Very Far (Considerable distance, difficult to access regularly)
Approximately how many meters away is it?	Open
Question 3.2. How has the management of household waste changed in the last 20-30 years? (If you are under 35 skip to question X)	
Have you perceived an increase of household waste in the last 20-30 years? If so, can you specify what type of	Y/N Open

waste?	
How would you rate this change?	<input type="checkbox"/> Great increase <input type="checkbox"/> Moderate increase <input type="checkbox"/> Small increase <input type="checkbox"/> No increase <input type="checkbox"/> Decrease
Is there any other type of waste you want to comment on regarding a change in its use?	Y/N
If so, which one?	Open
Have the waste management guidelines of the government changed in the last 10 years?	Y/N
3.3. What are the impacts locals perceive of current solid waste management in their livelihoods and environment?	
Does the current solid waste management have an impact on your natural environment?	<input type="checkbox"/> insignificant negative impact <input type="checkbox"/> slight negative impact <input type="checkbox"/> no impact <input type="checkbox"/> slight positive impact <input type="checkbox"/> significant positive impact
If the response is positive, then what impacts do you perceive?	Open (We keep these options in mind: <input type="checkbox"/> air pollution <input type="checkbox"/> water pollution <input type="checkbox"/> soil pollution <input type="checkbox"/> Unsure <input type="checkbox"/> None Any other?)
3.4. How do locals think these challenges could be overcome?	
To what extent do you believe stronger waste management legislation could help overcome the challenges in household solid waste management?	- Not at all - Slightly - Moderately - Very - Completely
How important do you think educating people on waste management is to achieve sustainable waste management practices at a household level?	- Not Important - Somewhat Important - Moderately Important - Very Important - Extremely Important

Do you believe increased government investments or aids to local governments could significantly improve household solid waste management practices?	Yes/No
On a scale of 5, How much do you think active participation from community organisations at the ground level could improve household solid waste management	1. Not at all 2. Slightly 3. Moderately 4. Very much 5. Extremely

C. Questions for Key Informant Interviews

- Local Chief of Kibugu
- NEMA Office in Embu County
- Embu County Government staff
- NGO in the county or Kibugu area
- With waste management workers from public services and/or private business workers operating in Kibugu)

a) With Chief

- Could you explain to us how the current household solid waste management process works in Kibugu? Questions to ask if they do not talk about this:
 - Who are the actors involved (and what competencies does each have)
 - The stages of the process (the cycle, from household collection of waste to dumpsite)
 - Are there any agencies, private enterprises taking care of the waste...?
 - Ask about the costs involved in waste management of Kibugu (e.g. are there any costs that locals must pay?)
- What is the current legislation of solid waste management in Kibugu?
- How do you perceive waste management has changed in the last 20-30 years from an institutional perspective? (types of waste, legislation, and consumption of products)
- What do you think are the environmental impacts of the current waste management in Kibugu, if any? And the social impacts?
- What institutional challenges are faced when it comes to implementing waste management legislation/changes/improvements?
- How could these challenges be overcome?
- What future do you envision (not desire, not idealistic) for Kibugu in terms of waste management?

b) NEMA Office in Embu County

- Could you explain to us how the current household solid waste management process works in Kibugu? Questions to ask if they do not talk about this:
 - Who are the actors involved (and what competencies do each have)
 - The stages of the process (the cycle, from household collection of waste to dumpsite)
 - Are there any agencies taking care of the waste...?)
 - Are there any costs for locals to access waste management services?
- What is the current legislation on solid waste management in Embu County?
- Do you think there is a lack of awareness and knowledge about solid waste management among local people?
- How do you perceive waste management has changed in the last 20-30 years from an institutional perspective? (types of waste, legislation, and consumption of products)
- What do you think are the impacts of unmanaged disposal of waste in local people's lives and the environment?
- What institutional challenges are faced when it comes to implementing waste management legislation/changes/improvements?
- How could these challenges be overcome?
- What future do you envision (not desire, not idealistic) for Kibugu in terms of waste management?

c) Embu County Government Staff

- Could you explain to us how the current household solid waste management process works in Embu County (or Kibugu)? Questions to ask if they do not talk about this:
 - Who are the actors involved (and what competencies do each have)
 - The stages of the process (the cycle, from household collection of waste to dumpsite)
 - Are there any agencies taking care of the waste...?)
 - Are there any costs for locals to access waste management services?
- What is the current legislation on solid waste management in Embu County?
- What are the responsibilities of the Embu County Government and NEMA?
- How are you involved with NEMA regarding waste management in the county?
- Do you think there is a lack of awareness and knowledge about solid waste management among local people?

- How do you perceive waste management has changed in the last 20-30 years from an institutional perspective? (types of waste, legislation, and consumption of products)
- What do you think are the impacts of unmanaged disposal of waste in local people's lives and the environment?
- What institutional challenges are faced when it comes to implementing waste management legislation/changes/improvements?
- How could these challenges be overcome?
- What future do you envision (not desire, not idealistic) for Kibugu/Embu County in terms of waste management?

d) NGO

- What does your work on waste management consist of?
- What needs do you identify in Embu County regarding waste management?
- How effective do you think the current waste management strategy by NEMA and Embu County Government is?
- What do you think are the impacts of unmanaged disposal of waste on local people's lives and the environment?
- What challenges do you think locals face that result in legislation not being followed?
- What improvements do you think could be implemented at the County level to improve waste management by locals?
- How do you envision the future of household waste management in Kibugu?

e) Waste management service workers

(From public service or private business in the County)

- Could you describe your responsibilities/daily activities as a waste management worker?
- Do you collaborate with the local authorities and regulators to improve waste management practices? (How, if they say yes).
- Could you describe the waste management process in Kibugu? From households to the endpoint of the process?
- Do you think the waste management strategy in the County could be improved? If so, how?
- What do you think are the impacts of unmanaged disposal of waste in local people's lives and the environment?
- What challenges do you think locals face that result in the official waste management plan of the County not being followed?
- What challenges do you face while carrying out waste management practices? How could they be overcome?

- How do you envision the future of household waste management in Kibugu?

D. Questions for Semi-structured Interviews

- a) With the local HH and their spouses (separately)

Sub-research question 2:

Questions 2.1 and 2.2:

- Do you sort different types of waste at home? If yes, how?
- Why do you do it this way?
- What do you do with it afterward (disposal strategies, depending on the type of waste)?
- Why do you do it this way?
- Who is the person at your household who takes care of waste (collection, sortage, disposal outside of home)? And why?

Sub-Research Question 3:

3.1. Challenges:

- Is there any way you would prefer to manage your household waste (sorting and disposal strategy) rather than the current strategy that you are engaged in?
- Do you think there are economic challenges that limit your capacity to manage waste following the official guidelines? If so, could you explain what those challenges consist of?
- Do you think that living closer to waste management services/facilities would change the way you manage your household waste? If so, could you explain why?
- Do you think there is a lack of infrastructure in Kibugu for the management of household solid waste?
- Do you find it challenging to adopt the legislation/rules on waste management? If so, why?

3.2. Change of management over time

- Considering the last 20 years, have you perceived a change in the type of waste you produce? If yes, what are those changes? (Types of products they consume etc.)
- According to your own experience, have you perceived any changes in your household's solid waste management strategy (sorting and disposal of waste)?
- Regarding the last 20 years, how have waste facilities and services evolved in Kibugu?
- Are there any cultural beliefs or traditions surrounding waste management and disposal in your community?
- If any, can you explain to me more about it?
- What new challenges do you think have arisen for locals regarding household solid waste management, in contrast to the past (10-20 years)?

3.3. Perceived impacts on livelihoods and environment

- Do you think the current waste management system in Kibugu has any positive impacts on local livelihoods?
- And negative impacts?

- Do you think the current waste management system in Kibugu has an impact on the natural environment? If yes, how is it impacting it?

Ask this if they do not address the issue in the previous question:

- Do you think that the current management of solid household waste in Kibugu is impacting locals' well-being? If so, how?
- Do you think the current management of solid household waste in Kibugu has an impact on the locals' economy?

3.4. How could these challenges be overcome

- How can the challenges you mentioned be overcome? (to each type of challenge or general)
- What would help you manage your household waste in a better way? What would help you to face these challenges? (incentives, waste segregation, and storage facilities?)

3.5. What future do you envision regarding household solid waste management in Kibugu? (Keep the question open, how do they think the future will look like)

- How do you envision the future in Kibugu in terms of waste management? How do you think the current management will change in the next few years?

(These don't need to specifically be asked in this order depending on what the interviewees say we can work with. Consider checking the variables before the interviews)

E. Questions for Group Interview

- Can you please share your experiences in the community? How long have you been living here?
- What are your thoughts on waste and waste management in your community?
- Can you share how waste was managed in the past?
- How has it changed/not changed in the last decades?
- What are the root causes/factors that have contributed to these changes or remained the same?
- Considering the last 20 years, have you perceived a change in the type of waste you produce? If yes, what are those changes? (Types of products they consume etc.)
- According to your own experience, have you perceived any changes in your household's solid waste management strategy (sorting and disposal of waste)?
- Regarding the last 20 years, how have waste facilities and services evolved in Kibugu?
- Are there any cultural beliefs or traditions surrounding waste management and disposal in your community?
- If any, can you explain to me more about it?
- What new challenges do you think have arisen for locals regarding household solid waste management, in contrast to the past (10-20 years)? We might also consider asking:
 - Do you attach any spiritual or religious meaning to your natural environment? (mountains, fields, rivers, trees around Kibugu?)
 - Are there any traditional local stories/myths about mountains, trees and rivers in

Kibugu that highlight the importance of the natural environment?

- Does this get considered when depositing waste outside your home?
- Do you think this has changed among the younger generation compared to when you were young?
- Do you think that the way you manage waste in the past is different from the present?
- How can the challenges you mentioned be overcome? (to each type of challenge or general)
- What would help you manage your household waste in a better way?
- How do you envision the future in Kibugu in terms of waste management?
- How do you think the current management will change in the next few years?

F. Mapping: prompt and general guidelines

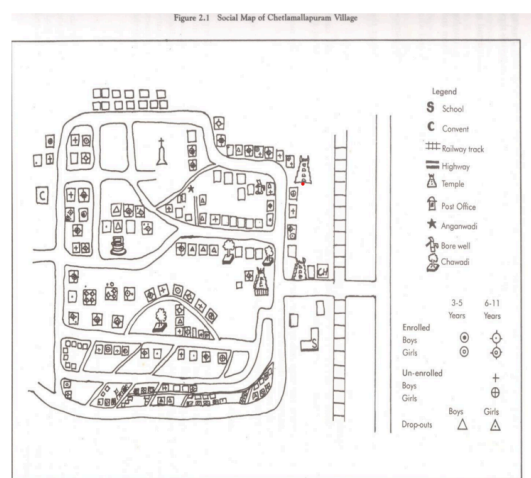
MATERIALS:

- Paper sheets (one for each group)
- Several color markers (at least 4)

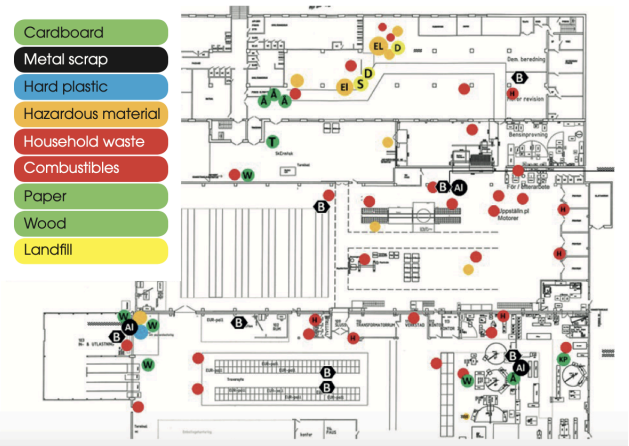
PROMPT:

1. As a starting point, we will ask them to sketch the village, maybe just the surrounding area of their houses, or anything they are capable of doing (we will specify that it does not need to be drawn to scale).
2. Mark where the official waste facilities are in the village and surrounding area, if you know about any (e.g. trashcans, dumping sites. However, “official” is a blurry concept, so we might avoid this question).
3. Taking into account the responses about the main types of waste produced in households (from the survey question 2.1.), assign each of them a color and mark in the village where you can find this kind of waste (specify that they can also mark spaces that are not official waste disposal spaces, it can also be: streets, alleys, rivers, etc.).
4. To know what they do with their household waste (**flow of waste**), we will ask them to draw the path their household waste follows starting from their houses to wherever they dispose of it (each type of waste might follow a different path, and then use a different color). And specify what they do with it (maybe burn? Just dump? Bury?
5. Other relevant actor/elements: if they know about actors who participate in the disposal, recollection and transportation of waste, we will ask them to draw them too (e.g. a truck, waste processing facility etc.)
6. If there are difficulties in following this plan, we might adjust the mapping method with a transect walk. For example, we can simulate with the participants how they dispose their household waste, what path they follow for each type of waste, etc.

Two previously done mapping exercises that can serve us as inspiration:



Social Map



From sources:

National Institute of Rural Development & Panchayati Raj (no date). Available here: http://nirdpr.org.in/nird_docs/gdpd/pra.pdf

Kurdve, M., Shahbazi, S., Wendin, M., Bengtsson, C., Wiktorsson, M. & Amprazis, P. (2017). Waste Flow Mapping: Handbook (eng). Mälardalen University, Eskilstune, Sweden. Available here: <http://www.diva-portal.org/smash/get/diva2:1199453/FULLTEXT01.pdf>