AN EXPLORATION INTO THE WASTE MANAGEMENT PRACTICES OF COMMUNITIES SURROUNDING DEMARCATED SMALL-SCALE FARMS IN LIMPOPO

by

BALOYI, NB
(201945819)
PHADU, TJ
(201908889)
RAMETSI, MD
(201918550)

RESEARCH

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SUPERVISOR: Dr D. Klopper

CO-SUPERVISOR: Miss C. du Plessis

1. Dedication

We would like to dedicate this research to our families. Mr WT Chauke, Mr and Mrs Baloyi, Ms RM Phadu, and Mrs MF Rametsi and all students in the Department of Geography and Environmental Studies in the University of Limpopo.

2. Declaration

We declare that 'An exploration into the waste management practices of communities surrounding demarcated small-scale farms in Limpopo' is our own work and that all the sources that we have used or quoted have been indicated and acknowledged by means of complete references and that this work has not been submitted before for any other degree at any other institution.

Full names   Date

   <u>Nsovo Bernnies Baloyi</u>   <u>09/10/2022</u>

Full names   Date

   <u>Thapedi Joy Phadu</u>   <u>09/10/2022</u>

Full names   Date

   <u>Masiribe Dephney Rametsi</u>   <u>09/10/2022</u>

3. Acknowledgements

4. Abstract

Waste poses risks on the health of the environment and they cause devastating effects globally. Waste management is a challenge in South Africa because of lack of resources and knowledge. This study sought to assess the waste management practices in communities surrounding demarcated small-scale farms in Limpopo. To achieve this, open-ended questionnaires were administered to 54 randomly selected households in 6 communities. Physical observations of wastes and management practices were also employed. The obtained data was analysed on Excel software by grouping responses into themes and the results reveal that different types of wastes are produced. The most used waste management practice is waste collection. However, communities with insufficient waste collection services resort to burning and dumping of wastes. The results can be used to understand the needs and ongoing practices related to waste management, and contribute to the improvement of the waste management practices of disadvantaged communities.

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1. INTRODUCTION

4.1. Background to the study

Solid waste refers to the materials that are produced because of our daily activities and are discarded because they are no longer useful nor wanted by the user. There are different types of waste, which includes municipal solid waste, industrial waste, and agricultural waste. Municipal solid waste is domestic waste produced from household activities such as cooking, cleaning, food products, grocery paper bags or plastic bags (Viljoen, et al., 2021). Municipal waste also includes commercial waste, which is produced by businesses such as cardboard boxes, retail packaging, paper, and food wrappers. Industries are also sources of waste as they produce wastewater with heavy metals, concrete, and gravel (Gaur et al., 2020). Agricultural waste is the waste that is produced on farms such as crop residues, livestock vaccines, fertilizers, pesticides, weeds, livestock wastes, and unsold goods from the farms (Adejumo and Adebiyi, 2020).

According to Gaur et al. (2020), the production of waste is increasing because of the growing population, as each individual uses materials and produces wastes to satisfy their daily needs. This waste has negative impacts on the environment if they are not properly managed because they contribute to air and environmental pollution and degradation (Ejaz et al., 2010). Developing countries experience challenges with waste management due to lack of resources, funding, legislative implementation, and municipal waste collection (Ejaz et al., 2010). The lack of waste collection services from the municipality lead to the creation of illegal dumping sites. These sites are created as a solution for the communities to dispose of the waste they produce, which causes a variety of environmental impacts. The wastes from illegal dumping sites block drainage systems, contributing to flooding during rainy seasons. Floods have negative impacts such as destroying businesses, infrastructure (homes and schools), loss of life, and loss of livestock (Ardales et al., 2016). Poor waste management also affects people's health as illegal dumping sites attract vectors of pathogens such as mosquitoes which are carriers of infectious diseases such as malaria. According to Ejaz et al. (2010), dumping sites are also habitats for rats which also transfer diseases and destroy electric cables in people's homes. Waste such as fertilizers and pesticides from farms also degrades water resources and contributes to the water scarcity of

semi-arid South Africa. The fertilizers in rivers cause eutrophication over a long period of time, which threatens ecosystems because it causes the death of aquatic fauna and flora. The degradation and destruction of river ecosystems affects the growing population because of the fish biomass decrease, which can lead to food insecurity and loss of income for the fishing industry. The polluted water also causes the death of wild animals on land as they depend on streams for drinking water (Val and Schindler, 2009).

4.2. Statement of the problem

There is a high generation of waste because of the rising population and improved lifestyles (Fakoya, 2018). This is a challenge in developing countries including South Africa because of lack of funds, limited waste treatment methods, lack of awareness and support from the government (Viljoen et al., 2021). Poor waste management such as lack of waste collection services, illegal dumping sites, unauthorised solid waste activities, and not applying the current waste regulations degrades the quality of the environment (Abdel-shafy and Mansour, 2018). According to Viljoen et al. (2021), high rates of waste generation put the waste management facilities under pressure, which are already insufficient due to the limited space to expand new landfill sites. Of all the waste produced in South Africa, only 10% is recycled while 90% ends up in landfills (Stats SA, 2016). According to the South Africa state report issued by the Department of Environmental Affairs, 95% of hazardous waste was directed into landfills (DEA, 2018).

This study will investigate the types of waste that is generated in communities surrounding demarcated small-scale farms and the methods used to manage this waste as most rural communities have insufficient waste management services, thus causing the degradation of the environment. Any successful methods of waste management identified during this study could be shared with other rural communities to improve waste management practices and reduce environmental degradation.

Problem statement: poor waste management such as lack of waste collection services, illegal dumping sites, unauthorised solid waste activities, and not applying the current waste regulations degrades the quality of the environment (Abel-shafy and Mansour, 2018).

4.3. Aim and objectives

The aim of this study is to identify the waste management practices of communities surrounding demarcated small-scale farms in Limpopo.

The objectives of this study are to:

1. To Identify the type of wastes generated in communities surrounding demarcated small-scale farms in Limpopo.
2. Identify the ongoing waste management practices of communities surrounding demarcated small-scale farms in Limpopo.

4.4. Study area

Study areas show villages (figure 1), which are in Limpopo province, South Africa. The names of the villages are Ntsima, Ga-Mothapo, Mankweng, Komaneng, Mamahule and Segoashi as shown by figure 1 below. The capital city of these villages are Polokwane city and the main ethnic group in these villages are Pedi people who primarily speak Sepedi language. The villages are warm and only receive rainfall during summer. In summer the maximum average temperatures are about 34 degrees Celsius and minimum average temperature of 19 degrees Celsius. The main economic activity in these villages is farming because of the favourable weather conditions and fertile soil.

Ntsima village has a relatively flat area, the predominant plant species is Aloe plants. The dominating economic activity is agriculture as a lot of people in the area practice crop, poultry and livestock farming to create employment, and to provide food for their families and to also sell to other people. Ga-Mothapo is in a flat area, the area is close to Paledi mall, and there are a lot of supermarkets within the village, which is the main source of income for most people in the area. Mankweng is highly populated, there is a shopping complex and other economic activities such as hardware, carwash, bottle stores, and internet cafes. The area also has a university, which has socio-economic benefits for the local people as they are employed to clean, plumbing and as security guards. Komanang has a predominantly flat area, with low lying mountains. The employment rate is low because of limited economic activities. Mamahule is in a flat area, it is not densely populated as there are many open spaces in the area. The village does not have schools, clinics, shops, water, and electricity. The people of

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Mmamahule depend on the services of the neighbouring villages. Segoashi is a mountainous area. There are steep slopes and valleys within the residences. There are limited economic activities as there are only schools, churches, and supermarkets. The area is far from the mall or shopping complex and has a low employment rate.
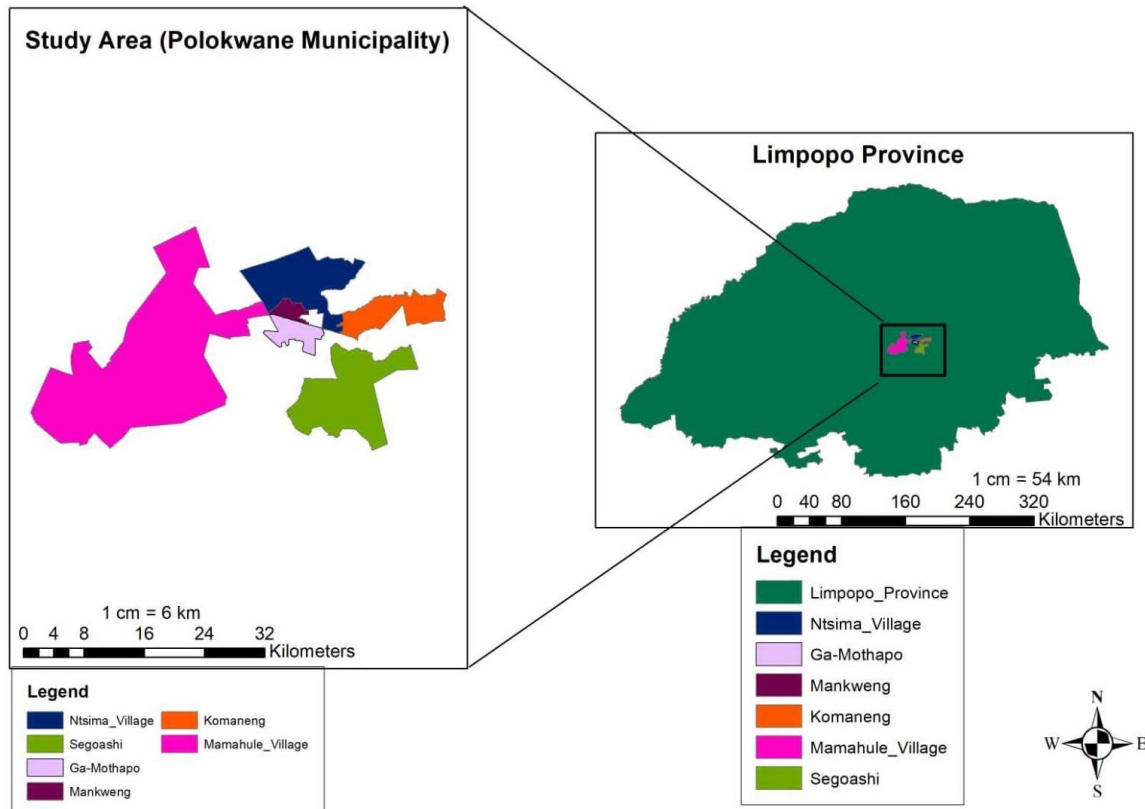
Figure 1: Map showing villages of the research study area in Limpopo *(source: Surveyor General, 2020).*

4.5. Limitations of the study

a) A language barrier between the participants and the researchers might pose a limitation since some of the researchers speak Xitsonga and English and the most commonly used language in the study area is Sepedi. Some participants do not understand English. This may require that all researchers be present when interviewing one participant so they could help with the interpretation.

b) Some participants may not be able to give accurate or relevant responses to research questions due to the limited knowledge about waste management. Many individuals may find it difficult to understand the questions, which means that they may need to be further explained to ensure they understand what the

question is asking or give examples to get relevant answers from the participants.

c) Finding people who are willing to participate in the study might be a challenge because some people may not be interested, streets are sometimes empty, and some people lock the gates of their homes.

d) The researchers may not be able to observe and identify all the waste management practices because of limited time to collect data, and inability to observe all parts of the community.

5.   2. LITERATURE REVIEW

Waste management is defined as the control of waste materials and how they are collected, transported, disposed of, and processed (Techen et.al., 2020). Waste is produced in many different forms; namely solid, liquid and gas (Rasmeni and Madyira, 2019). For this study, we review solid waste in small communities in the province of Limpopo and the methods of waste management that are practiced in these communities as waste contributes to environmental issues.

a.   2.1. Importance of waste management practices

Waste production is a big problem in many parts of the world. According to Ejaz et al. (2010), improper disposal of waste is common in developing countries due to a lack of equipment, financial resources, waste facilities, and lack of proper planning, which is the reason why developing countries experience more negative environmental impacts in comparison to developed countries (Ejaz et al.., 2010). This is worse in rural areas because they receive limited waste collection services, while urban areas receive better municipal services (Viljoen et al., 2021).

Waste does not only affect the environment but also affects our health and the economy when it is not efficiently managed (Ejaz et al., 2010). A study done on environmental impacts of the mismanagement of waste in Rawalpindi city found that waste disposed of in the streets caused traffic congestion and accidents (Ejaz et al., 2010). This study also found that mismanaged wastes caused water pollution, which affected ecosystems such as flora and fauna. Waste disposed in open areas attracts flies, which causes disease outbreaks (Ejaz et al., 2010). The lack of proper management of waste by the government also leads to the burning of waste by community members to manage the waste, which causes air pollution as the wastes release greenhouse gases such as carbon dioxide and methane into the atmosphere. Greenhouse gases emitted by burning wastes cause global warming which affects our climate (Purdy et al., 2017).

Climate change degrades the quality of the soil, which leads to issues such as soil erosion, resulting in siltation of rivers, thus contributing to water scarcity in semi-arid South Africa (Techen et al., 2020). Climate change also affects crop yields, which

leads to food insecurity and ultimately influences the economy and results in the loss of employment (Aitken et al., 2008). It is therefore important for us to be more aware of these impacts and have proper waste management to achieve the sustainable development goals, such as good health and wellbeing, clean water and sanitation, climate action, life below water, life on land, zero hunger and decent work and economic growth (Taghipour et al., 2015). It is also important to practice sustainable waste management since it helps to alleviate environmental pollution and mitigate the impacts of climate change (Purdy et al., 2017).

As part of the study, we will identify the types of wastes produced by the communities surrounding small-scale farms and identify the waste management practices used to manage this waste. Many of the farmers and households do not know how to effectively manage the wastes they produce due to limited knowledge on waste management methods (Adejumo and Adebiyi, 2020). The waste management methods depend on the type of waste generated; however, households do not produce the same type of waste. According to Birhanu and Berisa (2015) the types and amount of waste produced by households is dependent on the economic status, season and location as people in urban areas generate more waste than people in rural areas (Birhanu and Berisa, 2015). Birhanu and Berisa (2015) also stated that people with higher income produce more waste than people who receive less income.

b. 2.2. Studies done on waste management

As stated previously, developing countries such as South Africa have limited funds and waste management treatment facilities. The government has proposed a reduce, reuse, and recycle strategy to reduce waste generated in households and their impact on the environment (Department of Environment, Forestry and Fisheries, 2020).

Figure 2 below shows Ferrara's (2018) conceptual framework of household management of waste divided into three categories (on-site, off-site and curb-side).
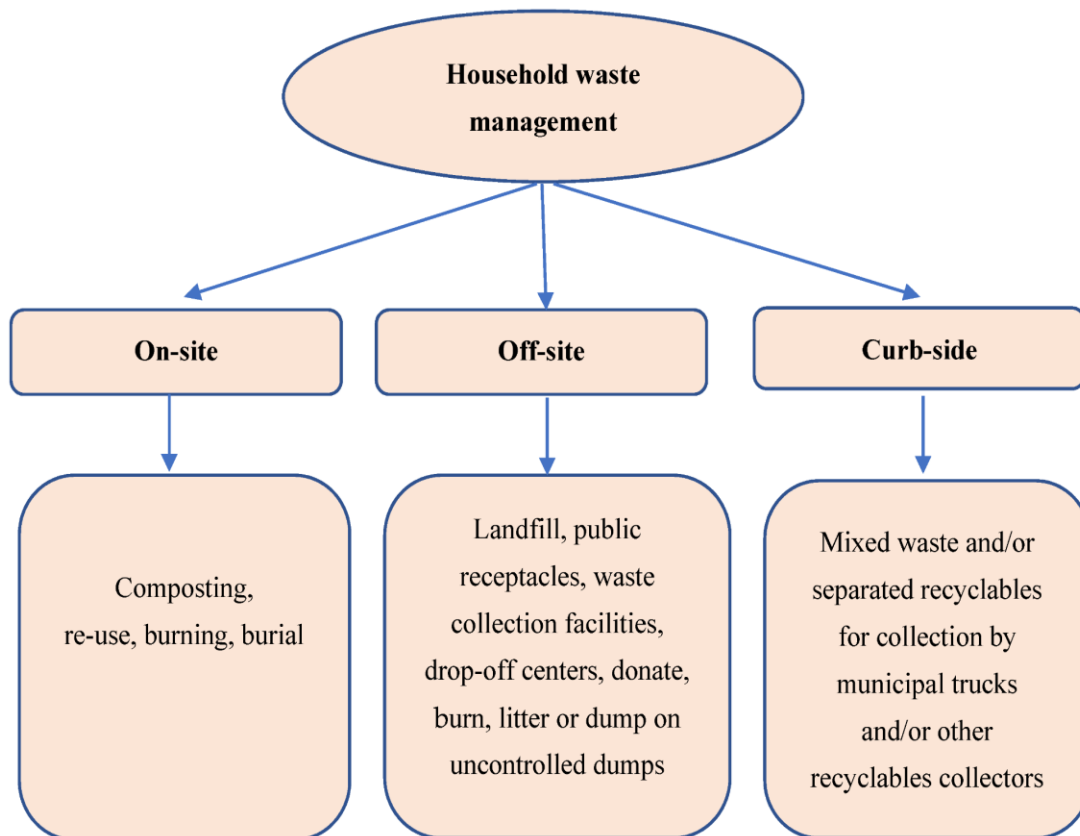
Figure 2: The waste management options available to households. *Source: Ferrara (2008).*

2.2.1. On-site household waste management

Composting is used to manage food wastes in households and farms. Composting refers to decaying organic wastes into humus substances through a biochemical process. Composting reduces the number of wastes transferred to landfills, decreases air pollution caused by greenhouse emissions from the waste, and decreases the chances of contamination of groundwater (Zhentong et.al., 2013).

According to Halmaciu et al. (2021) efficient waste management practices such as composting on farms improves the quality of the soil which increase crop yields and thus increase their profits. profits. Reusing refers to using a material repeatedly for the same or different purpose (for example bottles, cans and boxes are recyclable materials) (Birhanu and Berisa, 2015). Reusing materials will prevent and minimise the production of new materials, thus reducing the amount of waste generated (Birhanu and Berisa, 2015). Low-income communities reuse most of the waste such as crop residues, sawdust, cardboard boxes, and wood as heating sources (Mihai et

al., 2017). Recycling refers to the conversion of wastes into a material that has value (Birhanu and Berisa, 2015). Recycling reduces waste as new products are made using materials that are considered useless. According to Birhanu and Berisa (2015) composting, reusing, and recycling is not expensive, and they can be beneficial for all communities and reduce disposal of waste.

2.2.2. Off-site household waste management

According to Ferrara (2018) easy access to recycling facilities increase the recycling practices in households. However, Jenkins et al. (2003) argued that it only applies to certain and not all types of wastes. According to Wang et al. (2018), lack of information such as location of nearest waste collection facilities is a challenge and results in burning of waste especially in rural areas. Wang et al. (2018) found that off-site household waste management is affected by factors such as distances from households to disposal sites, and Abel (2014) noted that the lack of waste collection increased illegal dumping, littering, burning and mismanaged waste. Off-site and On-site household waste management was found to save time and reduce storage costs (Serret and Ferrara 2008).

2.2.3. Curb-side household waste management

Curb-side household waste management includes putting household wastes on the curb to be collected by the municipality or waste collection company (Jenkins et al., 2003). This includes separating recyclable waste materials from other solid wastes so that it can be sold to a recycling company, which means that people who participate also benefit from recycling of waste. Jenkins et al. (2003) found that curb-side recycling programs increase participation of households in waste management as it is convenient and inexpensive. Recycling done on curb-site also saves transport costs thus increasing the rate of recycling. According to Stats SA (2019) waste collection has decreased from 66.4% to 61.5% in 2019. If waste is not collected or the waste collection decreases it increases the chances of the burning and dumping of wastes in open spaces (Mihai et al., 2017).

Our study differs from what other writers found because there is limited research done about the waste management methods used in our study area (Ntsima village, Ga-Mothapo village, Mankweng, Komaneng village, Mamahule and Segoashi village) and

our study is important as it will explore what happens to the waste produced in communities surrounding demarcated small-scale farms, what methods are used to manage the waste, the resources required to efficiently manage the waste as this information is important in order to address the problems caused by improper waste management and it is also important in order to live sustainably and protect the earth and water resources so that they are in good condition to be used by the future generations.

6. 3. METHODOLOGY

c. 3.1. Population

People living in communities surrounding demarcated small-scale farms in Limpopo were the population of interest for this study. The demarcated small-scale farms are Ranty General trading and projects, Four rivers' projects, Hidyahinkwarhu Primary Cooperative, Rejakamoka Primary Cooperative, Vegethenti farm, Ramahwidi Farming, Motsame Farm, Mothikeng Farming, and Bomunu farms.

d. 3.2. Sampling

Participants were randomly selected from the population of our study area. This means that random people found in communities surrounding small scale farms were interviewed. Participants were randomly selected to reduce bias and to ensure that the results found would be the same results obtained if the whole population was interviewed. In this study, 54 participants were interviewed; 24 were males, and 30 were females. In each community (Ntsima, mankweng, komaneng, Mamahule, Segoashi and Ga-Mothapo), 9 participants were interviewed. The following figure (figure 3) shows the number of interviewees in each village, separated by gender.
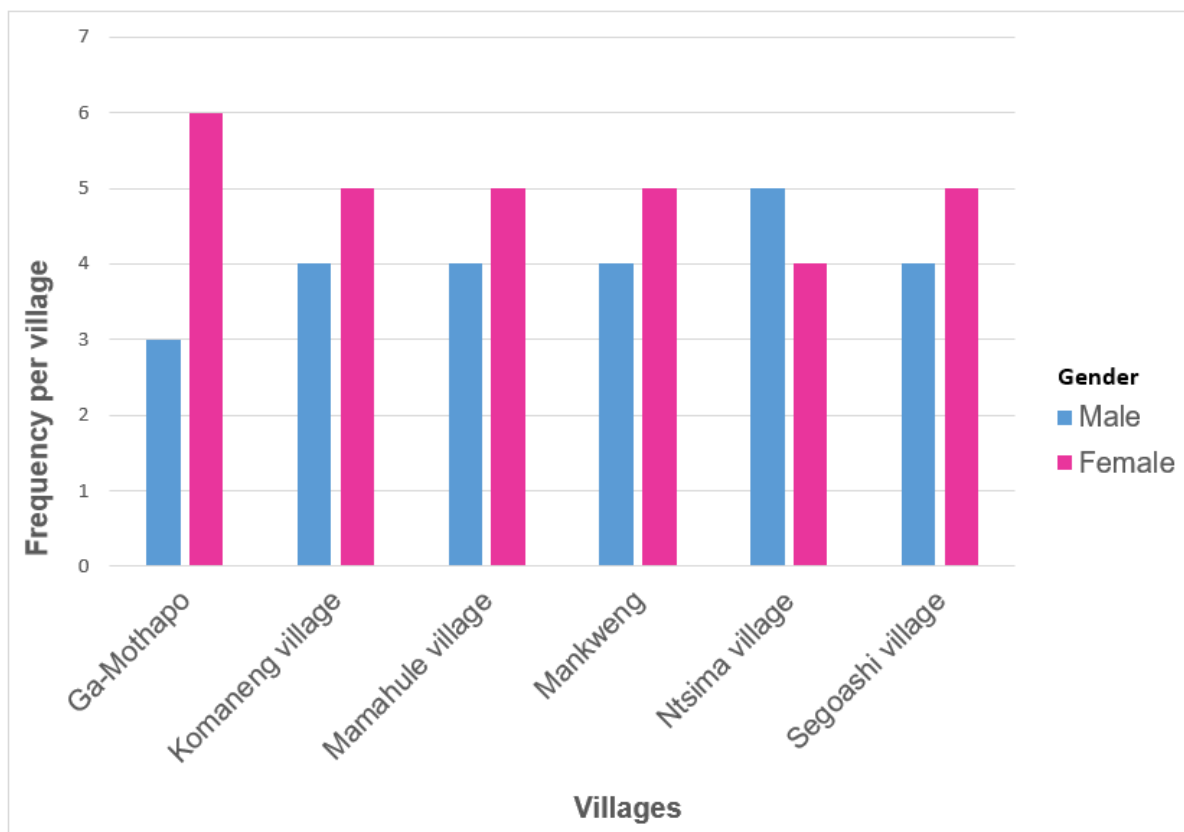
Figure 3: Graph showing the relative frequency of males to females of participants in each village of the study area.

e.   3.3. Data needed to achieve the study objectives

This research used a mixed methods approach, where qualitative data was collected, coded, and categorised into themes to produce quantitative data that was analysed and presented as narrative data. People of the communities surrounding small-scale farms were interviewed to identify the type of wastes they generate in their households and the methods they use to manage this waste. The communities were also observed to identify the most prevalent wastes produced in these communities. The collected qualitative data was coded (assign responses a numerical code), categorised and analysed as both qualitative and quantitative data. In this study, qualitative data was needed to measure the most common wastes that are generated and most preferred waste management practices in communities surrounding demarcated small-scale farms in Limpopo. The quantitative data was analysed by comparing numerical values and presented using charts or bar graphs.

f.   3.4. Data collection

3.4.1. Semi-structured interviews

Participants were interviewed using open-ended questions where they were not restricted or limited in their responses as they were also allowed to ask questions and gave more information related to the waste management practices in their communities. This method allowed us to have a discussion with the participants and ask follow-up questions to understand and clarify misunderstandings. We tape-recorded the interview to allow for accurate data collection and for us to refer back to for clarity and context if necessary. When the interview was completed, responses were recorded in an electronic spreadsheet.

Our semi-structured interview questions were as follows:

1. What types of waste is generated in your household/ business and how much per week?
2. Do you treat all waste the same or do you reuse or recycle some of the waste? And how do you reuse the waste?
3. What challenges do you experience in managing your household/business waste?
4. What type of waste is mostly generated in the community?
5. Are there any municipality services that collect waste? If yes, how often is waste removed? If no What happens to the waste
6. Are you aware of any waste pickers working in your community? If yes, how many do you think are working as waste pickers and where can we find them? If no, what would you say are the reasons?
7. How in your opinion does waste impact on the community / How will you describe the effect of waste on the community?
8. Who or what do you think suffers the most as a result of waste in the community?
9. Are there any community initiatives/projects in the community and or schools to keep the community clean? If no, what do you think are the reasons for people not initiating projects to keep the community clean? If yes describe the initiatives
10. What industries are in the community (Get names if possible)?
11. What type of waste that you are aware of is generated by these industries?
12. What happens to the waste generated by industries?

13. If you think the community can be a better place to live/work in, what skills and knowledge do you think the community needs to acquire to make the community a better place to live/work in?
14. If you think waste is a problem in your community what skills and knowledge do you think the community needs to acquire to manage waste better?

3.4.2. Physical observations

We physically observed the most prevalent waste types generated in communities surrounding demarcated small-scale farms. Economic activities in these communities were also observed to identify if there was any relationship to the type and amount of waste produced in the communities. Issues related to waste management were also observed, which includes illegal dumping sites and littering. These observations were made by all three researchers to identify the most prevalent waste types, waste management practices and economic activities. Economic activities were observed to find out if they had an influence on the production of waste and they were looked at to supplement the findings.

g. 3.5. Ethical considerations

This study involved human subjects for data collection and therefore research ethics were taken into consideration to protect the interest of the participants and researchers. The following are the ethical considerations while exploring the waste management of communities surrounding small-scale farms in Limpopo.

a) **Informed decision**
   The participants were given enough information about the study to decide whether they wanted to participate in the study or not. The information includes what the study is about, and their role in the study
b) **Voluntary participation**
   Participation was voluntary and participants were allowed to withdraw their participation at any time if they were no longer interested in the study.
c) **Confidentiality and anonymity**
   The identity of participants was protected and therefore their names, photos, addresses or any information related to their identification was not requested

from the participants. Their names were replaced with a code. For example, P1 represented participant 1.

d) Management of information

Information shared by the participants was protected. The information was not shared with people who are not part of this study. The information includes recordings and questionnaire responses.

e) Avoid harm or distress

Participants of the research study did not experience any harm from participating in this study.

h. 3.6. Data Analysis

Excel mathematical calculations (Sum function) was used to determine the total number of each waste type produced in households per week in each community. To identify the ongoing waste management practices in communities surrounding small-scale farms, thematic data analysis was used to analyse the qualitative interview data where responses were grouped according to themes (similarities). The themes used were the waste management methods, namely, recycling, reusing, composting, dumping, burning, and collection. Grouping responses into themes allowed us to determine how many people prefer a particular waste management method. These methods also determined the most preferred and least preferred waste management method. The responses of the observations were also combined and compiled into excel spreadsheet to analyse the most prevalent wastes observed and to also analyse if economic activities in each community influenced how much waste households generate.

i. 3.7. Presentation of results

Frequency tables were also used to show the ongoing waste management practices per household. The frequencies showed how many times or how frequent a certain method of waste management was used. Stacked bar graphs were also used to represent the types and amounts of waste produced in households per week. The stacked bar graph was used to make it easier to compare the waste types and their amounts between the different communities. Pie chart showing the comparison between the ongoing waste management practices in different communities within the

study area was used. The pie chart was used because it clearly shows the most used and the least used waste management methods as it shows how many percentages of people are using a particular method to manage waste. The results of the physical observations were also presented using a table and a bar graph.

7. 4. RESULTS AND DISCUSSION

j. 4.1 Interview results and discussion

The presented data below (Table 1 and Figure 4) shows the type and the number of plastic shopping bags generated by households per week in Ga-Mothapo, Komaneng, Mamuhule, Mankweng, Ntsima and Segoashi. The type of waste produced includes old food, plastics, glass bottles, sanitary pads, baby nappies, cans, animal manure and other wastes such as garden waste like leaves. The main waste produced are plastics, glass bottles as well as sanitary pads and baby nappies as shown on Table 1 and Figure 4. Animal manure is the least produced waste as most communities are for residential purposes only. Ntsima produces the highest amount of waste and produces an amount of 62,5 plastic shopping bags per week as presented on Table 1 and Figure 4. Ntsima followed by Mankweng are the biggest producers of waste and Segoashi produces less waste. This is mainly because of the number of population an area has, the kind of activities that take place and the location of the area (Soliman and Moustafa, 2020). According to a study done by Ayeleru et al. (2028), the generation of waste increases with the increase in the population. This is because a high number of materials are produced for the rising population, therefore resulting in high generation of waste materials.

Ntsima produces all types of waste mentioned above, which are 6 bags of old food, 10,5 bags of plastics, 9,5 bags of glass bottles, 7 bags of sanitary pads and baby nappies, and 8,5 bags of cans, 17 bags of animal manure and 4 bags of other waste (e.g papers and garden waste) per household per week. Animal manure is produced in the highest amount because farming is the most common economic activity in Ntsima village. Mankweng is the second highest producer of waste, which generates 36,5 bags per household within a week. The most generated waste in Mankweng is plastics as households produce 14 bags of plastics per week. Cans are the least produced waste since only 1 bag is generated per household per week. Komaneng has the third highest amount of waste production and produces a total of 30 bags. Glass bottles are the most prevalent waste, and 6 bags are produced in households per week as shown on Table 1. Ga-Mothapo produces 25,5 bags of waste per week with plastics being the highly generated waste with 8,5 bags produced per week. The least generated waste in Ga-Mothapo is animal manure as only 1 bag is produced by

household in a week. The community that produces less wastes is Segoashi. Households in Segoashi produces a total of 19,5 bags per week as presented on Table 1. Plastic is highly generated as 6,5 bags are produced and no animal manure is generated in the community. The households in these six communities produces a total of 199 plastic shopping bags per week.

The results adequately answer the question posed by the objective as we identified the types of waste generated in communities surrounding small-scale farms and the amount that is produced in a week.

Table 1: The type and amount (per plastic shopping bag) of waste generated per week by households.

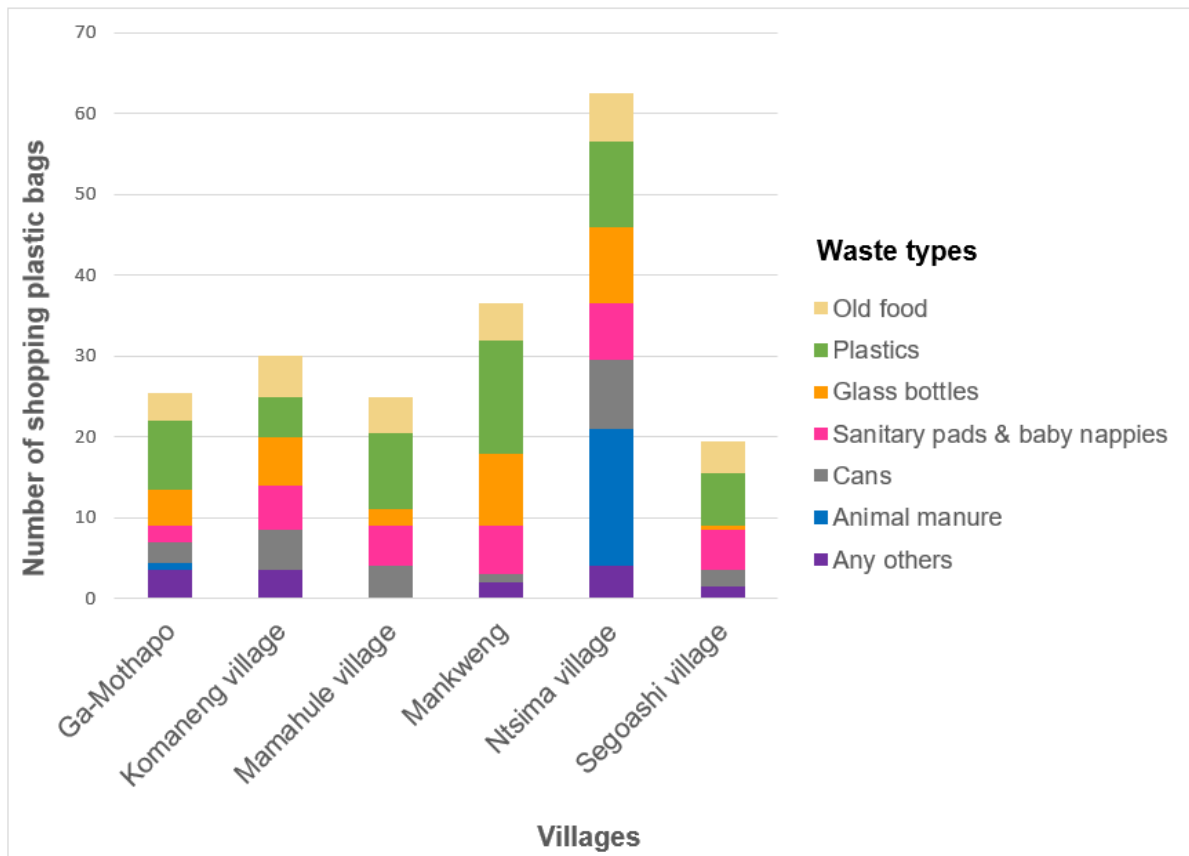| Villages	Animal manure	Cans	Sanitary pads & baby nappies	Glass bottles	Plastic bags	Old food	Any others	Total
Ga-Mothapo	1	2.5	2	4.5	8.5	3.5	3.5	**25.5**
Komaneng Village	0	5	5.5	6	5	5	3.5	**30**
Mamahule Village	0	4	5	2	9.5	4.5	0	**25**
Mankweng	0	1	6	9	14	4.5	2	**36.5**
Ntsima Village	17	8.5	7	9.5	10.5	6	4	**62.5**
Segoashi Village	0	2	5	0.5	6.5	4	1.5	**19.5**
Total	18	23	30.5	31.5	54	27.5	14.5	199

Figure 4: Stacked bar graph showing the type and amount (per plastic shopping bag) of waste generated per week by households from different villages.

Table 2 and Figure 5 shows the frequencies of the ongoing waste management practices per household in each community per week. Waste Collection is practiced on a large scale in most of the communities because majority of the areas are easily accessible through transport, and they are near waste disposal facilities. For instance, Mankweng is a semi-rural area with roads in between houses making it easier for waste collection transport to move around. Another method such as burning is practiced widely in Segoashi village because the area is too steep and hilly, which makes it hard for the garbage truck to access the area. Waste collection is also too expensive for many of the residents to pay as the majority depends on the government. Only a few wastes are recycled in Segoashi and the rest of the waste produced is burned as shown by Table 2 and Figure 5 below. Recycling is the least used method because of the limitations such as producing waste which is not

recyclable, lack of recycling facilities in rural communities, financial constraints, and lack of knowledge (Strydom, 2018).

The most preferred waste management method in Ntsima is reusing because most of the organic waste is reused in farming. For example, food waste is used to feed livestock and animal manure is used to enhance the fertility of the soil for crop production. The study also found that Ntsima is the only community that compost waste and this is because farming is the main economic activity in Ntsima. The waste management methods practiced in Ntsima are collection, reusing, recycling, composting, dumping, and burning. In Ga- Mothapo and Mankweng less waste is burned and dumped because the communities receive adequate waste collection services from the municipality. Komaneng does not have illegal dumping as the community receives waste collection services and most wastes are burned. As seen on the stacked bar graph (Figure 5), Mamahule receives less waste collection hence the common waste management practices are burning and illegal dumping of wastes. Burning and dumping of waste can have an impact on the environment. Burning of waste was found to release potent greenhouse gases such as methane and carbon dioxide into the atmosphere resulting in global warming and climate change (Alao et al., 2021). In another study, dumping waste caused harm to children, livestock and the toxic substances from waste caused contamination on the environment and water resources (Viljoen et al., 2021).

The study has adequately identified the ongoing waste management practices in communities surrounding small-scale farms which are collection, reusing, recycling, composting, dumping, and burning. Collection is the most preferred method and composting is the least used waste management method.

Table 2: Table showing the frequencies of the ongoing waste management practices per household per week.

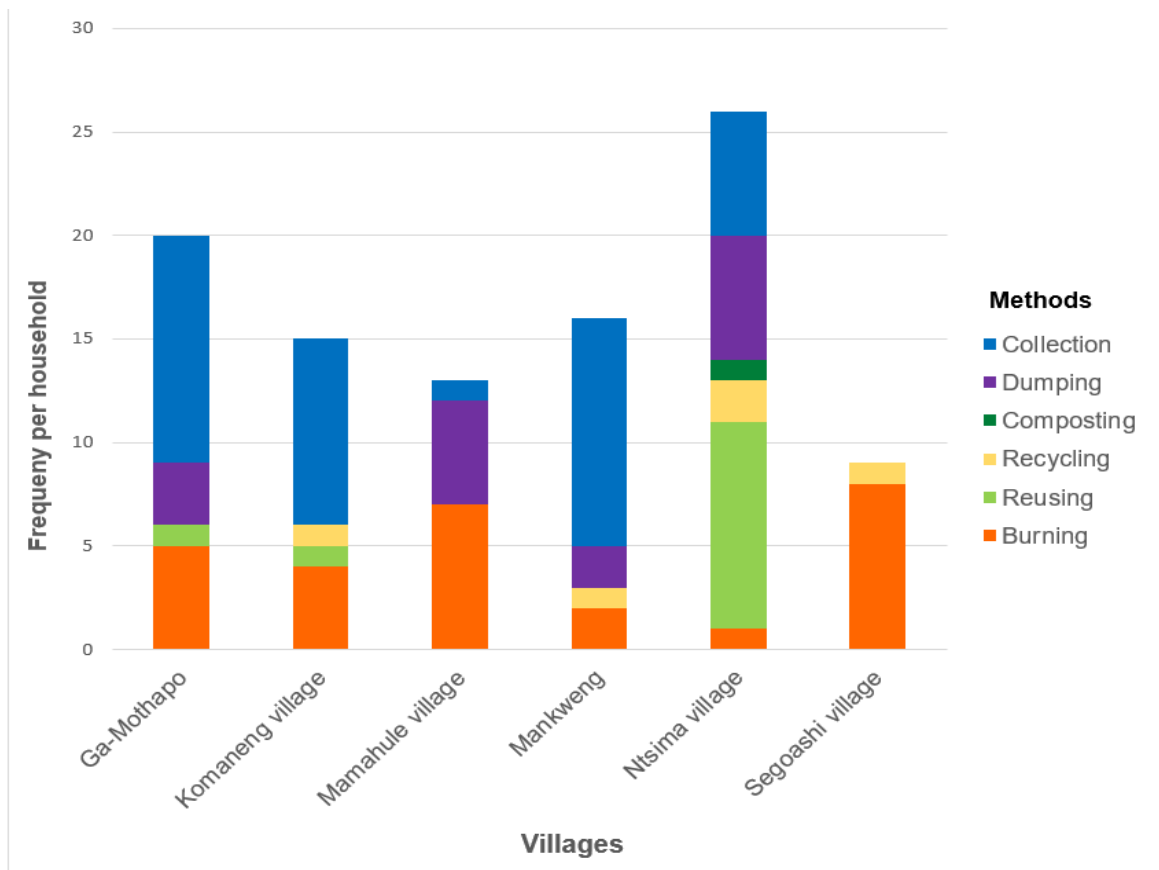| Methods	Frequency per household						Total
	Ga-Mothapo	Komaneng village	Mamahule village	Mankweng	Ntsima village	Segoashi village	
Burning	5	4	7	2	1	8	**27**
Reusing	1	1	0	0	10	0	**12**
Recycling	0	1	0	1	2	1	**5**
Composting	0	0	0	0	1	0	**1**
Dumping	3	0	5	2	6	0	**16**
Collection	11	9	1	11	6	0	**38**
Total	**20**	**15**	**13**	**16**	**26**	**9**	**99**

Figure 5: Stacked bar graph showing the frequency of ongoing waste management practices in households per week.

As shown on the pie chart (Figure 6), waste collection is a waste management practice that is preferred by many people (39%) in different areas, followed by burning (27%) and then dumping (16%). Reusing, recycling, and composting are the least preferred waste management practices. Burning is used in rural areas with less municipality waste management services, as shown on the table (Table 2) and graph (Figure 5). In Segoashi village and Mamahule village, most residents prefer this method as it is the easiest and cheapest. Most of the waste collected loses value as they are not useful and end up in the landfill. A study done on a review of landfill gas generation and utilisation in Africa, found that landfilling is the most used waste management practice in Africa because it is cheap (Njoku et al., 2018). However, landfills pose a threat to the environment because the toxic substances can potentially cause contamination of land when the leachate system is not controlled and monitored (Nyika et al., 2018). Landfills also require a large area of land, which could result in deforestation (Swilling, 2019).
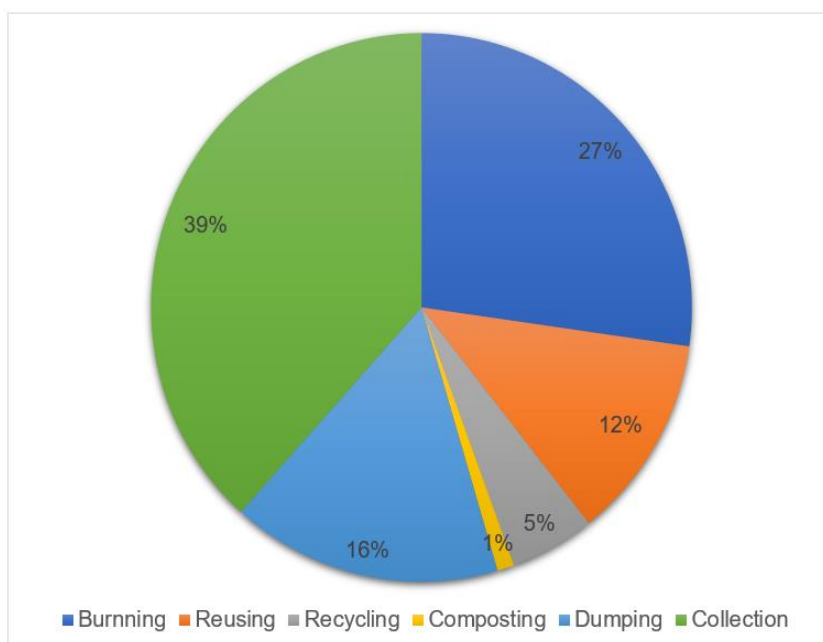
Figure 6: Pie chart representing the use of waste management practices in Ntsima, Mankweng, Komaneng village, Mamahule, Segoashi and Ga-Mothapo.

1.2. Observation results and discussion

Figure 7 shows the types and amount of waste observed in Ga-Mothapo, Komaneng, Mamahule, Mankweng, Ntsima and Segoashi village. In our study areas, plastics were observed as the most prevalent waste in all communities as shown in Figure 7. Dumping plastics causes pollution, thus making the streets and open spaces within the community look dirty because plastics get scattered easily due to mainly winds. Plastic is not easy to recycle and to reuse because they are easily torn once utilized, hence it is the most produced and easily found around in most regions especially in the study areas. Glass bottles are mainly found in areas with many taverns and bottle stores. As shown in Figure 7, animal manure was only observed in Ntsima village because of the occurring agricultural activities in the community. Old food and cans were difficult to observe, as most people reuse food waste by feeding pigs and dogs, and others compost the waste. Other waste such as paper and garden waste were also observed in each area of our study.

The findings of the observations answers the question posed by our first objective because the types of waste generated were identified, which are old food, glass bottles, plastics, sanitary pads and baby nappies, animal manure and other waste such as paper and garden wastes.
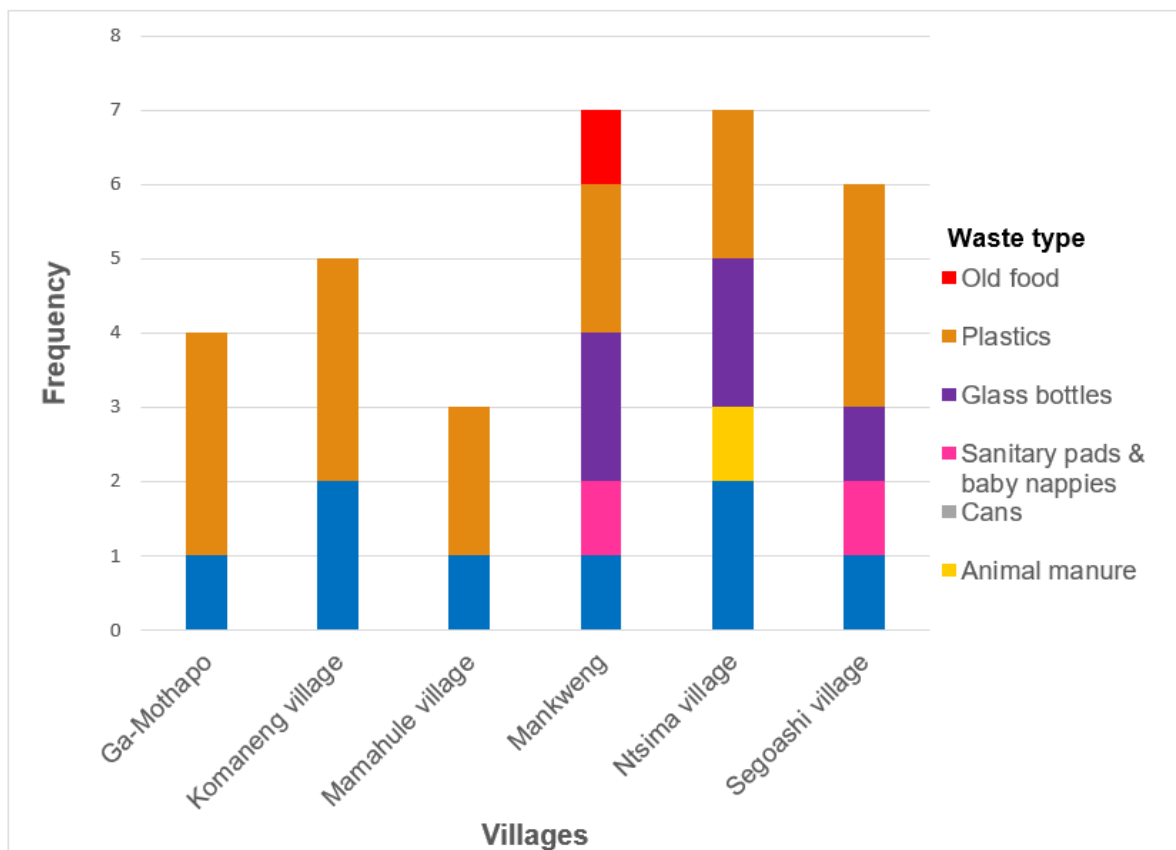
22

Figure 7: Stacked bar graph showing the type of waste observed.

The economic activities observed are supermarkets, agriculture, driving schools, hardware stores, taverns, shopping complexes, garage (filling stations), pharmacies, and lodges as shown in figure 8 below. Supermarkets are the most prevalent economic activities because supermarkets sell food to these rural communities as most do not have shopping malls or complexes. Food is in the most essential need, which is why it is one of the least produced wastes in many communities as seen in Figure 7. In Ntsima village food waste is reused to feed livestock as agriculture is the most occurring economic activity, hence food wastes were not observed in the community. The results show that communities with a lot of economic activities produce more waste. Figure 8 shows that Ntsima and Mankweng have the most economic activities, which results in high generation of wastes as shown in the graphs (Figure 4 and 7). According to Rogerson and Rogerson (2019) communities with a lot of economic activities were found to have a high population as a lot of people migrate to these areas due to availability of job opportunities and adequate service provision and this results in high generation of wastes in those communities.
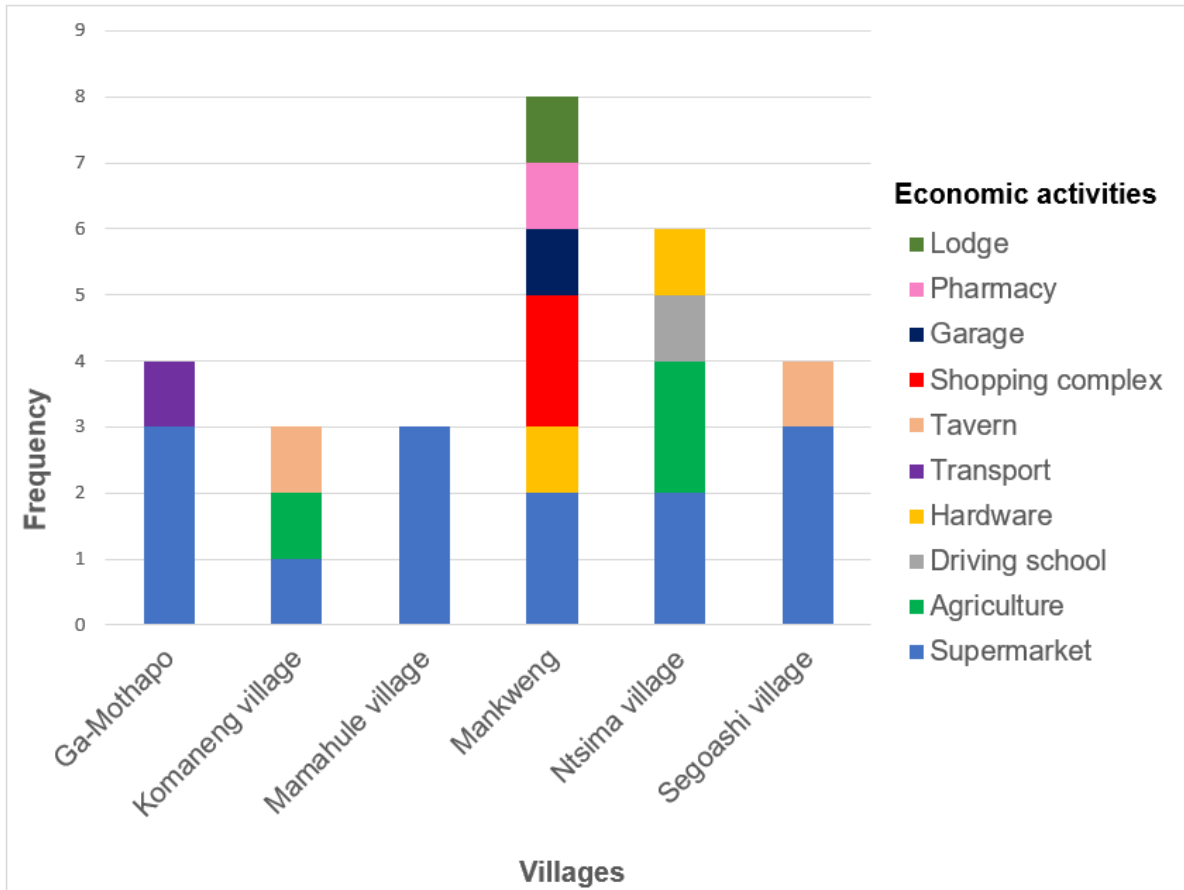
Figure 8: Stacked bar graph showing the economic activities observed in the study area.

8. CONCLUSIONS AND RECOMMENDATIONS

The objectives of this study were to identify the types of wastes and the ongoing waste management practices in communities surrounding small-scale farms in Limpopo. The results determined that different waste is produced depending on the available economic activities and the location of the community. The results also determined that plastics are the most prevalent wastes produced in all communities. High amounts of waste is generated in communities with more economic activities than in communities with less or no economic activities. Different waste management methods are used in rural communities to manage the produced waste. Although not all communities receive sufficient waste collection services, the results revealed that waste collection is the most used method in most communities and communities with limited waste collection resort to burning and dumping to manage waste produced in households.

Most people in rural communities do not know how to manage the waste in their households in a sustainable way due to lack of education and awareness. We recommend waste management awareness programs to be implemented in these rural communities to improve waste management practices. There should be waste management projects in all rural communities, which employ waste pickers and give information related to waste in the community, which will improve waste management. People need to be taught the types of materials that they can reuse in their households, what recyclable wastes are and where to sell or take these items to in their communities.

Communities with insufficient waste collection services should have municipality disposal bins in every street where people can dispose of waste to avoid dumping of waste in public areas and to avoid the environmental and financial costs of dealing with the impacts caused by illegal dumping.

This study has helped us to understand that waste management practices in rural communities can be improved. This will be possible if decision makers are aware of the challenges the communities experience and potential solutions to resolve the challenges. This study could benefit rural communities as the findings could be used to identify communities without sufficient waste collection services from the

municipality. This will enable decision makers to bring solutions, so that waste management methods are improved in these communities. It can also be used to check which communities do not have sustainable waste management practices. Workshops, training, or waste management projects are implemented to raise awareness and knowledge on how those disadvantaged communities can manage their waste. This will benefit every member of each community, including people who cannot afford to pay for waste collection services as they will learn how to manage the waste produced in their households using other sustainable methods such as reusing, recycling, and composting

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10. APPENDIX/APPENDICES, ADDENDUM/ADDENDA OR ANNEXURE(S)

k. Appendix A: Request letter to conduct a study in Polokwane Municipality

To	:	**Polokwane Municipality Mankweng Cluster Office**
From	:	**Ngwako Sekhula** **Community Engagement Officer: Rural Development and Innovation Hub**
Date	:	**08 September 2022**
Subject	:	**REQUEST FOR STUDENTS TO CONDUCT RESEARCH STUDY ON DUMPING SITES**

Dear Sir

The following letter serves as formal communication, in addition to the telephonic communication we had on **wed, 07 September 2022,** to request an opportunity for students of the University of Limpopo to go and conduct a research study on the Mankweng waste disposal site. These are students from Waste Management courses and this research forms part of their final marks. The students will visit the site for a single day between **Monday, 12ᵗʰ September and Wednesday, 14ᵗʰ September** and can be expected on any one of the days.

The students will be conducting the research on multiple waste disposal sites, including the informal ones found within communities. The communication also serves to notify that the students will not be the liability of the municipality while on site. However, where possible we request that a municipality personnel outline all the necessary safety precautions to the students on their arrival to the site.

I kindly thank you in this matter

Ngwako Sekhula

Communty Engagement Officer: Rural development and Innovation Hub

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