SUSTAINABILITY OF INDIGENOUS METHODS OF SOLID WASTE MANAGEMENT IN SIKHUNYANI VILLAGE, LIMPOPO PROVINCE, SOUTH AFRICA

By

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DECLARATION

"I declare that **SUSTAINABILITY OF INDIGENOUS METHODS OF SOLID WASTE MANAGEMENT IN SIKHUNYANI VILLAGE, LIMPOPO PROVINCE, SOUTH AFRICA** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. I further declare that I submitted the dissertation to the appropriate originality detection system which is endorsed by Unisa and that it falls within the accepted requirements for originality. I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution. Furthermore, the dissertation was also submitted to Turnitin for a plagiarism check. The Turnitin report is attached as Appendix A."

Signature_____ Date: 24/02/2023

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I would like to express my heartfelt gratitude and appreciation to God for enabling me to reach this stage and for providing me with strength during challenging times. Your power knows no limits, and you have made the seemingly impossible possible. I will forever exalt your name, Lord.

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DEDICATION

would like to express my heartfelt dedication of this thesis to my late maternal grandparents, Mr. Malapela Daniel Mahasha and Mrs. Mokgadi Mamohlatlego Mahasha (referred to as papa and mma), for their invaluable teachings and unwavering love towards me. Although you are no longer with us in the physical sense, your impact on my life remains profound, and your presence is deeply felt. Not a single day goes by without my thoughts being consumed by your memory. I am immensely grateful to you both and assure you that your legacy will never fade away. May you find eternal peace, Manyapje.

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Kolobe, ke motho wa Mahasha peu ya Bolobedu.

Ke Manyapje a lekhumelo lekopa balata.

Kgomo o nwa tja Molobedu tja moroka tja nwa ka morago.

Ke motho wa o boya khumeloni la Manyapje a bohosi.

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DISCLAIMER

Parts of Chapter 2 and Chapter 3 of this dissertation have been submitted for possible publication to two accredited and peer-reviewed journals. Appendix B contains proof of manuscript submission to publication.

ABBREVIATIONS

IDP	Integrated Development Plan
IK	Indigenous Knowledge
IKS	Indigenous Knowledge Systems
ISWM	Indigenous Solid Waste Management
GGLM	Greater Giyani Local Municipality
LEK	Local Ecological Knowledge
MSWM	Municipal Solid Waste Management
SPSS	Statistical Package for Social Statistics
SWM	Solid Waste Management
TEK	Traditional Ecological Knowledge
UK	United Kingdom
USA	United States of America
ZCC	Zion Christian Church

ABSTRACT

Most rural areas do not have access to basic amenities such as municipal solid waste (MSW) disposal services and use various indigenous methods of solid waste management and disposal. Most communities in developing countries also lack adequate infrastructure and financial resources to achieve sustainable levels of waste collection and proper disposal. Without these systems in place, the impact on these communities can be devastating. Therefore, it is important to further explore indigenous knowledge (IK) systems as a possible alternative to current MSW management systems and assess the sustainability of their waste management methods. This study seeks to examine the variables of indigenous knowledge (IK) systems, classify waste streams generated, identify indigenous methods of solid waste management, and evaluate the sustainability of the identified indigenous methods of solid waste management.

A mixed method was used to collect and analyse qualitative and quantitative data from selected households. This study used survey and observation for different research questions. Structured interviews and questionnaires were used to collect the data to answer the research objectives. Observations were used to support the survey by identifying waste streams and methods used by households. This study also included an in-depth review of peer-reviewed journal articles to evaluate the sustainability of indigenous solid waste management methods practised by households. Non-probability sampling was used to select households from non-urban households of Sikhunyani Village. A total of 108 questionnaires were collected from Sikhunyani village. The data were analysed through descriptive and cross-tabulation statistics. Microsoft Excel 2013 and SPSS were used to analyse the data and establish statistical relationships.

The study brought to the fore the influence of language, cultural practices, and religious beliefs as vital in dispersing IK in Sikhunyani village. The study also established the influence of language (as a proxy for local culture and traditions) on the adoption of traditions and cultures, including language transition and language dominance between the household head, the general household and intercultural marriage dynamics within a household setting. The influence of formal schooling (a

proxy of Western knowledge systems) and the resilience of IK sources within the community were also unravelled. This study highlights the significance of IK and shows that any knowledge system is indigenous to a community of its origin, thus neutralizing the strength of the discourse about IK. The study also revealed that for some knowledge to the classified as Indigenous, it must be locally developed; accumulated through experiences; it is a body of knowledge, is influenced by culture; it is unique; encourages socio-ecological interaction, promotes sustainability, and is a practice or skill or technique.

The study unearthed that organic waste is the most common waste stream and hazardous waste is the least common waste stream in Sikhunyani village. Various indigenous waste management practices including selective burning of waste were identified. Selective burning of waste was the most preferred indigenous method for managing various waste streams and it is only performed in the morning and evening to minimize human health risks. Indiscriminate dumping of disposable diapers in open spaces and streams is also prevalent in the study area. However, the empirical study found that most of the implemented indigenous methods adhere to the requirements of sustainability.

Keywords: Waste streams, Solid waste, Indigenous Knowledge Systems, Indigenous waste management methods, sustainability

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Chapter 1 : BACKGROUND OF THE STUDY

1.1 INTRODUCTION

Solid waste management constitutes a major environmental problem in most developing countries around the world. Amasuomo and Baird (2016) defined a solid waste management system as the efficient supervision and handling of waste during collection, storage, conveyancing, treatment and disposal, in a way that protects the environment and promotes sustainability. It is a procedure for collecting, transporting, and disposing of waste in the best way feasible to reduce or eliminate adverse effects thereof (Amasuomo & Baird, 2016). However, most municipalities in developing countries are not equipped with proper infrastructure and lack the financial resources to a achieve sustainable level of waste collection and appropriate disposal (Abd'Razack, Medayese, Shaibu, & Adeye, 2016; Ogheneriere & Chukwunenye, 2017; Kumar et al., 2017; Mihai & Taherzadeh, 2017; Rodseth, Notten & Von Blottniz, 2020). As a result, some households resort to the use of indigenous knowledge methods which include, amongst others, backyard pit disposal, animal feeding, composting and open dumping (Greater Giyani Local Municipality Integrated Development Plan 2021/22).

Warren (1989), Senanayake (2006) and Panta (2014) define Indigenous Knowledge (IK) as local knowledge or behaviour that the community adapts as a way of life to manage daily challenges. It is also referred to as knowledge that local communities use to preserve the ecosystem and is passed from generation to generation through traditional and cultural transmission (Noyoo, 2007; Mapira & Mazambara, 2013; Obiora & Emeka, 2015; Kanene, 2016; Magni, 2016). Many authors around the world agree that IK offers a sustainable alternative to modern technology in various disciplines such as ecology, climate, agriculture, medicine, clinical psychology and manual skills (Bhasin, 2002; Noyoo, 2007; Zagozewski, Judd-Henrey, Nilson & Bharadwaj, 2011; Mapira & Mazambara, 2013; Obiora and Emeka, 2015; Tharakan, 2015; Kanene, 2016; Magni, 2016). Nonetheless, various levels of government and environmental policymakers have ignored the importance of IK as a possible solution to a myriad of environmental problems in comparison to scientific knowledge (Bhasin, 2002).

The IK methods of waste management practised by rural and urban households in Bangladesh (areas such as Boira, Suitakhali, Beltali), India, Indonesia, Uganda (Kampala), Kenya (Nairobi), Tanzania (Dar Salem) Ghana (Accra, Kumasi, and Jaman South District) and Nigeria (Ngwa, and Riversdale) have proven to be less technology-dependent, low cost, simple, efficient and home-grown (Izugbara & Umoh, 2004; Ajibade, 2007; Jain, 2007; Zagozewski et al.,2011; Rahman, 2009; Mihai & Taherzadeh; 2017). Despite the observable successes of indigenous waste management practices in some non-municipal service areas of Nigeria (Izugbara & Umoh, 2004; and Ajibade, 2007), the Municipal Solid Waste Management (MSWM) systems remain the most widely used and preferred systems for providing government services (Noyoo, 2007; Mapira & Mazambara, 2013). Subsequently, the World Bank (2022) reported that modern technology is not the only viable solution and not the only factor to consider when managing solid waste. Therefore, countries that advance in indigenous knowledge methods of waste management are likely to succeed when they select locally appropriate solutions (World Bank, 2010).

Noyoo (2007) argues that scientific knowledge does not always present sustainable long-term solutions to environmental problems in the same manner that IK does. In support of the foregoing argument, international communities have resorted to the exploration of IKS as a possible solution to solid waste management (Bhasin, 2002; Mapira & Mazambara, 2013; Obiora & Emeka, 2015; Magni, 2016). Through this research, the study aims to uncover the hidden potential of indigenous waste management practices and highlight their contribution to environmental health. By acknowledging and understanding the methods used by these communities, the study may assist policy makers in developing strategies to improve and integrate their practices into broader waste management frameworks.

The findings of this study will not only benefit rural areas lacking access to municipal waste disposal services but also provide insights for policymakers, urban planners, and environmental organizations. Recognizing and valuing indigenous knowledge, may create inclusive and sustainable waste management solutions that benefit all communities, regardless of their location or available resources.

1.2 Problem Statement

Historically disadvantaged communities, in particular the former homelands, namely, Gazankulu, Lebowa, KaNgwane, KwaNdebele, KwaZulu, Bophuthatswana, Ciskei, QwaQwa, Transkei and Venda have not been provided refuse collection services by municipalities (Machate, 2018). Most of these rural communities have no access to municipal refuse collection services to date (Mihai & Taherzadeh, 2017). However, they have a rich experience of using local knowledge systems of waste management, which are indigenous to them (Machate, 2018 and Rodseth, et al., 2020). Comparatively, the majority of rural South African communities remain aesthetically clean than most urban townships (Rodseth et al., 2020). Notably, these rural communities use indigenous systems as opposed to their urban counterparts who rely on MSWM (Mihai & Taherzadeh; 2017; Rodseth et al., 2020; Senekane, Makhene, & Oelofse, 2021)).

Of key interest for this study is that indigenous waste disposal systems in South Africa remain undocumented (Machate, 2018), not recognised as waste management systems or alternative mechanisms for rendering this service, and not funded through public funds (Dlamini, Rampedi, & Ifegbesan, 2017). There is no formal model or framework of indigenous waste management systems (Adjibade, 2007). Despite the observable successes of indigenous waste management methods practised in non-municipal service areas of South Africa (Rodseth et al., 2020), the MSWM systems remain the most common and preferred systems of services delivery to the government (Noyoo, 2007; Mapira, & Mazambara, 2013). Henceforth, Izugbara and Umoh (2004) endorsed one indigenous approach to solid waste management as a sustainable solution to solid and liquid waste management due to its timely and practical approach. In South Africa, indigenous practices primarily revolve around traditional medicine and agricultural methods. However, there is a lack of literature regarding Indigenous Water and Waste Management (Naidoo, Longondjo, & Vrdoljak,2013).

The ultimate focus of this study is to assess the sustainability of indigenous methods of solid waste management within real communities and, appraise or evaluate them with a view of improving and adopting positive practices and discouraging high risk practices.

1.3 Rationale

Sikhunyani Village is a rural village situated on the outskirts of Giyani Town under the jurisdiction of Greater Giyani Local Municipality in Limpopo province of South Africa. The local authorities have never provided refuse collection services to the Sikhunyani community (Greater Giyani Municipality Integrated Development Plan, 2021/22). Despite this, the community uses several solid waste management methods common in the areaGreater Giyani Municipality Integrated Development Plan, 2021/22).

Currently, waste streams and management methods in Sikhunyani Village have not been assessed or documented in literature to enable transparent comparison with other previous studies. Several indigenous solid waste management methods have been identified in parts of Asia, Africa, and North America. There is, however, limited information available about how each method impacts the economic, environmental, and social aspect. The lack of literature regarding the sustainability of indigenous waste management practices in South Africa presents a challenge, as the socio-economic and environmental consequences are still uncertain. Most rural areas use various methods of solid waste management that are prevalent to them. It is also observed that research on the sustainability of indigenous methods currently used by the community in Sikhunyani village remains unknown. Thus, these methods may have significant effects on the ecosystem, and there are no prospects for improvements if the status quo persists. It is for the above reasons that the current study seeks to establish whether the knowledge systems are safe, convenient, cost-efficient, readily available, context-specific and sustainable to address the solid waste challenges.

In conclusion, this study aims to bridge the gap between traditional indigenous waste management systems and modern waste management practices. By exploring the sustainability of indigenous methods, the study can pave the way for more effective and inclusive waste management strategies. Ultimately, this research will contribute to a cleaner and healthier environment for rural communities around the world. The findings of this study will contribute to the waste management field by documenting the sustainable indigenous methods of solid waste management that can be used in both rural and urban areas across the world.

1.4 Research Outline

The primary research question for this study is:

Which indigenous methods of solid waste management in Sikhunyani village, Limpopo province, South Africa are sustainable? To achieve or answer the primary research question, the following sub-questions were addressed.

1.4.1 What indigenous knowledge is prevalent in Sikhunyani Village?

1.4.2 What are the characteristics of waste streams generated in Sikhunyani Village?

1.4.3 What indigenous methods of solid waste management are practiced by households in Sikhunyani Village?

1.4.4 Are the solid waste management methods used by the indigenous community in Sikhunyani Village sustainable?

1.5 Breakdown of Remaining Chapters

Chapter 2: Literature Review

This chapter presents an in-depth analysis of the available literature in relation to the primary research questions and sub-questions on indigenous knowledge of solid waste management methods. Thus, exploring and examining what constitutes indigenous knowledge (IK), a criterion for the characterisation of knowledge and practices as either indigenous or not, the waste streams identified by previous studies, indigenous solid waste management methods and appraisal of the sustainability of indigenous solid waste management methods. Ultimately, provide a basis for empirical research analysis about previous studies and fill in the gaps identified in earlier studies.

Chapter 3: Research Methodology

This chapter introduces the methods used to collect and analyse data as well as present results.

Chapter 4: Result discussion

This chapter presents results from the empirical study and addresses sub-research questions on the prevailing indigenous knowledge of Sikhunyani villagers. Also presents the results on specific waste streams generated by households and

indigenous methods used for the management of each waste stream are analysed. Finally, using the three pillars of sustainable development (social, economic and environmental), this chapter critiques the sustainability of any indigenous waste management methods.

Chapter 5: Conclusion and recommendations

This chapter reflects on the outcomes of the study in relation to its empirical data and literature, in their ability to answer the primary and sub-research questions. It is an inferential chapter and highlights possible future areas of research focus, should a reader wish to expand from the current research. The chapter also links the relevance of this study to the postgraduate studies of the candidate to justify relevance to the field of study and professional practice, both in the environmental management and the waste management field.

Chapter 2 : LITERATURE REVIEW

2.1 Introduction

There is a clear consensus in literature that the solid waste management issue is the biggest environmental problem for authorities in developing countries (Malik, Abdullah, and Manaf, 2015; Sukholthaman & Shirinda, 2014). These challenges vary from area to area and appropriate waste management is therefore not uniform. It requires, among other things, a comprehensive understanding of the traditional and cultural condition, local background, socio-economic factors, waste composition and associated environmental risks (Vergara & Tchobanoglous, 2012). A report submitted to the World Bank indicates that adequate and sustainable municipal solid waste management is likely to succeed when locally developed solutions are selected and implemented despite a lack of infrastructure and other resources (Kaza, Yao, Bhada-Tata, & Van Woerden, 2018). Therefore, countries with advanced indigenous knowledge practices of managing municipal solid waste are encouraged to adopt and implement such local systems for cost effective, efficient, and sustainable waste management. For this reason, indigenous knowledge of solid waste management is explored as a possible solution to local problems.

Another contribution of this chapter is an argument about the existence of any knowledge which on merit can qualify to be classified as non-indigenous. This paper submits through a systematic analysis of existing definitions of the latter, and infers that none exists, except when such knowledge is used in foreign communities than in its original space. For example, Ajibade, 2007; Mapira & Mazambara, 2013; Tharakan, 2015; Obiora & Emeka, 2015 and Kanene, 2016 suggest that before the introduction of Western scientific knowledge by the colonialists, indigenous people had traditional ways and practices of doing things in the form of cultural, moral, and social norms that have proven to be efficient and effective. The former argument suggests that the knowledge of the colonialists or the West is not indigenous. This knowledge is commonly referred to as Indigenous Knowledge (IK). Through an in-depth analysis of available literature on IK, a criterion for the characterisation of knowledge and practices as either indigenous or not was developed in this study by exploring and examining the elements found in 15 definitions of IKS. Thus, the literature needed to assess the variables that make a practice indigenous is important. Their meanings

were analysed, elements were determined, and the most suitable definition was adopted for the study. Scholars have termed IKS differently, including but not limited to Traditional Ecological Knowledge, Local Knowledge Systems, and African Indigenous Knowledge Systems.

The Protection, Promotion, Development and Management of the Indigenous Knowledge Act (Act 6 of 2019) define Indigenous knowledge as the knowledge that has been developed within the local community, integrated into the cultural and social identity of that community (Republic of South Africa 2019). This includes knowledge of a functional nature, natural resources, and cultural expressions such as verbal, musical, action, and tangible expressions. Sood and Sharma (2009) refer to Indigenous knowledge as the total information or practices that are based on people's accumulated experiences. The Indigenous knowledge system is a body of knowledge, beliefs, ideas and facts accumulated by local people through experiences, ancestral sources, informal experimentation, and a deep understanding of the environment (Rajasekaran, 1993).

Indigenous knowledge is local knowledge, which is unique to a given culture or society, accumulated over time and is aimed at solving socio-economic and agro ecological problems (Warren, 1989; Senanayake, 2006; the World Bank 2010). Similarly, Domfeh (2007) defines IKS as the multifaceted body of experimental knowledge systems and beliefs developed by a particular native community over a long period as they interact with the environment through cultural transmissions. It encompasses technological, economic, philosophical, learning and governance systems (Noyoo, 2007). Such knowledge originates in and symbolizes a particular community, region, or country. Therefore, the IKS is distinctly based on an area and is culturally bound (Osman, 2009).

Ajibade (2007) defines IKS as local knowledge that differs from one region to the other, transmitted through an intergenerational approach. Respectively, Wahab (2004) describes traditional knowledge systems as the handover or transfer of knowledge orally from the elderly to the younger generation either through religion or local cultural integrity in response to local environments and conditions. These transfers are not formally documented, but the knowledge and practices are transmitted orally through

language, storytelling, taboos, songs, proverbs, ceremonies and during cultural activities (Ajibade, 2007, Osman, 2009). Transfer of knowledge ensures consistency in the implementation of the system and the protection of the environment as well as guard against its extinction.

Gómez-Baggethun, Corbera and Reyes-García (2013) define Traditional Ecological Knowledge (TEK) as the body of knowledge, beliefs, traditions, practices, institutions, and worldviews that are created and sustained by local communities in interaction with their natural environments to strengthen socio-ecological systems. Similarly, Jimoh (2018) describes IKS as “an accumulation of practices, techniques, tools, intellectual resources, explanations, beliefs, and values acquired over time in a particular region, without interference or imposition from external influences”. The interference of colonialism within many indigenous communities led to the destruction of indigenous knowledge systems, as established by various authors (Ajibade, 2007; Osman, 2009; Tsiko &Togarepi, 2012; Mapira & Mazambara, 2013; Fakoya, 2014; Tharakan, 2015; Bello, Ismail, & Kabbashi, 2016; Jimoh, 2018; Oyegunle &Thompson, 2018; Kubanza & Simatele, 2019; Siragusa, & Arzyutov, 2020). Hence, Mahamud (2020) postulates that the “interference of colonialism alienated Africans from their past, resultantly affecting how the present and future are perceived among local communities”.

Noyoo (2007) refers to IKS as the complex set of knowledge, skills and technologies existing and developed around specific conditions of populations and communities indigenous to a particular geographic area. IKS constitute the knowledge that people in a given community have developed over time and continue to develop. IKS are regarded as technologies. However, due to the superiority of the modern system, IKS is often overlooked, belittled, marginalized (Siragusa, & Arzyutov, 2020), and regarded as inferior and primitive (Ogheneriere & Chukwenenye, 2017 and Jimoh, 2018). Mawere (2010) corroborates that the advent of colonialism in Africa marginalized and demonized IKS, leaving their potential for establishing and maintaining a moral and virtuous society unexploited. Though IKS is denigrated, it remains the primary foundation of knowledge and an irreplaceable knowledge system in rural communities. IKS continues to inform decision making and activities among locals.

Obiora and Emeka (2015) refer to the African indigenous knowledge system as practices built by local society through generations, living in close contact with nature while contributing to environmental sustainability. This knowledge encompasses norms, a system of classification of natural resources, empirical observations about the local environment, and a system of self-management that governs resource use. Similarly, Ogheneriere and Chukwenenye (2017) describe Local Ecological Knowledge (LEK) as an illustration of the interrelations between humans, the environment and sustainable development focusing on the importance of cultural norms, values, beliefs, and practices on multi societal functions. Chilisa (2012) also advocates for the connectedness and interdependence of all things in the universe (indigenous cosmology). IKS are carried out within a cultural setting in which rituals and traditions (some of which include songs, storytelling, taboos dances and fashion) are observed and are in harmony with nature (Osman, 2009). These rituals and taboos are extensively used to preserve the environment and keep it free from all diseases (Wahab, 2004).

The natural environment and traditions are intertwined and influence sustainability. Different authors have used different elements to define knowledge as indigenous. Most of these indicators or elements are commonly referred to and used to define and classify indigenous knowledge systems. However, as indicated by Osman (2009), culture remains a common variable within all the selected definitions, and all these practices are undertaken in the ambit of culture. Panta (2014) considers an indigenous solid waste management system as a local and cultural practice of collection, storage, handling, transporting and disposal of solid waste. In Figure 1, a total number of 15 (n=15) studies were reviewed and 32 characteristics of indigenous knowledge were identified.

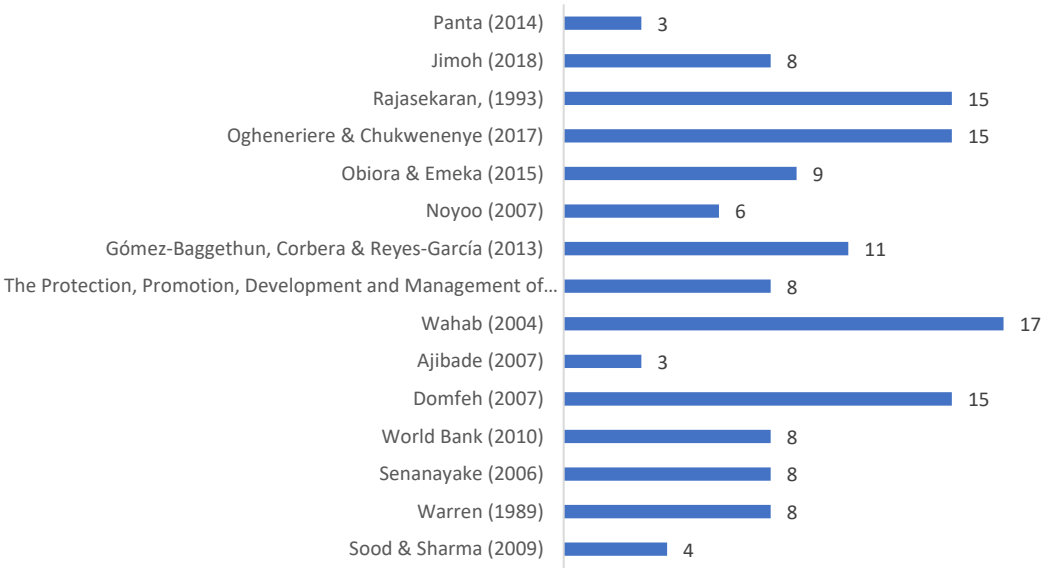


Figure 2.1: The number of characteristics of indigenous knowledge definitions per author(s)

Figure 2.1 shows that from the total of 15 (n=15) reviewed definitions or studies, the characteristics used in the definitions of indigenous knowledge ranged from 3-to-17 at an average of 4.3. The results show that many authors more than three (3) characteristics at a standard deviation of 4. The results show that there are elements of indigenous knowledge that are most frequently used and those that are used less frequently. In total, 32 characteristics were identified from the reviewed studies. The average number of characteristics used in these studies was 9.2, they ranged between a minimum of 3 and a maximum of 17, with the highest number of authors commonly using 8 characteristics (mode). It is also observed that over half (50%) of the studies used more than 8 characteristics. These analyses were conducted at a 4.4 standard deviation. In the current study, the revelations served to guide or inform the average number of elements that were present or required from a form of knowledge or practice to be qualified as being indigenous from the study area population. Figure 2.2 presents the most frequently used and least frequently used of these characteristics from reviewed studies. Therefore, the development of this criterion adds to the significance of the current study in the body of knowledge, by contributing a systematic and non-arbitrary method of deciding whether a conduct is indigenous or not.

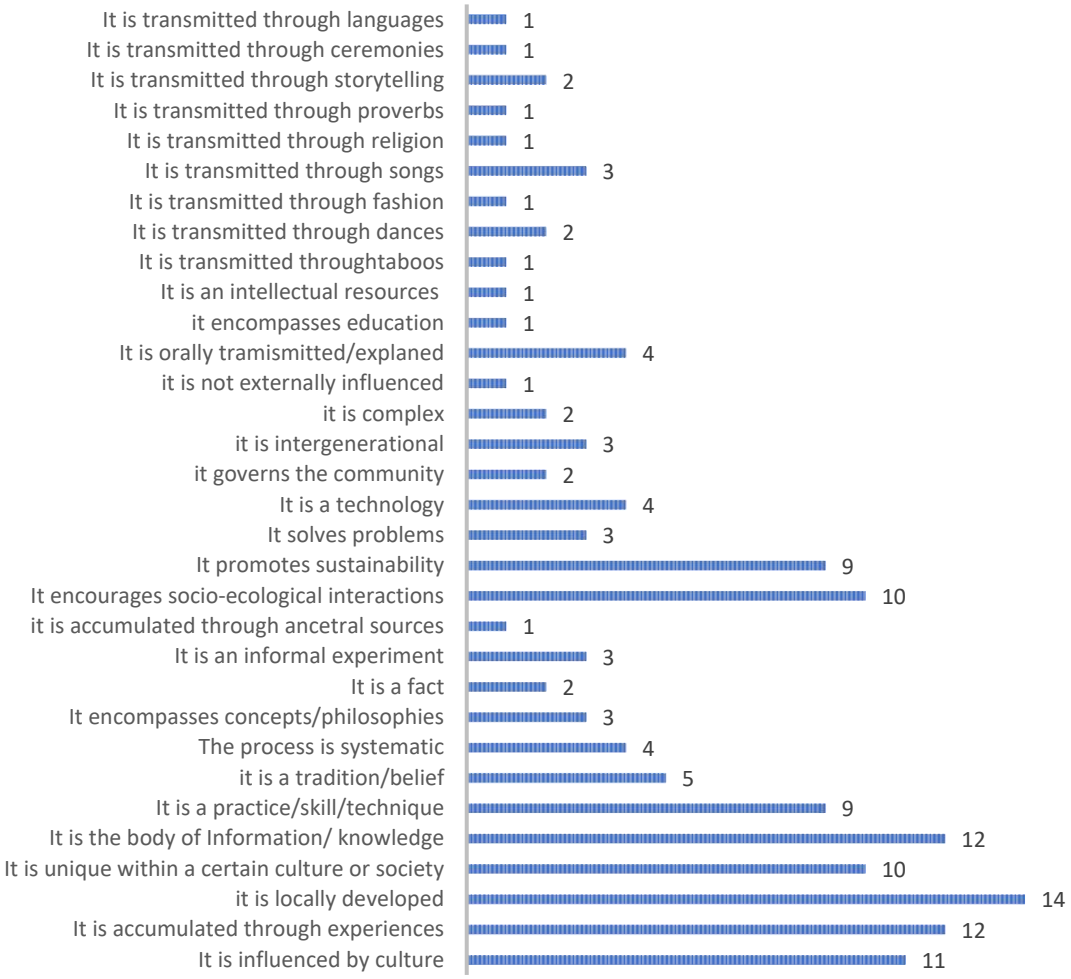


Figure 2.2: Number of times that each characteristic was mentioned in previous studies

Using descriptive statistical analysis, this study managed to select the top 8 frequently used characteristics of indigenous knowledge, through their high scores, namely:

a) it is locally developed (14) 44%,
b) accumulated through experiences (12) 38%
c) it is a body of knowledge (12) 38%,
d) it is influenced by culture (11) 34%,
e) it is unique (10) 32%,
f) it encourages socio-ecological interaction (10) 32%,
g) it promotes sustainability (9) 28%,
h) it is a practice or skill or technique (9) 28%.

The most frequently used elements served in this study as priority indicators of IK which should commonly be expected for local knowledge or practice to be characterized as indigenous. In this study, the presence of these priority indicators were used in the characterization of knowledge and practices within Sikhunyane Village as either indigenous or not. This approach helped to reduce the use of arbitrary methods in the characterization of IK, as has been evident from previous studies. Therefore, the current study identifies and systematically examines the prevalence of indigenous knowledge within Sikhunyane Village, in the Limpopo Province, Republic of South Africa.

2.2 History and Origins of Modern Solid Waste Management Systems

As early as 200 AD, the Romans were among the first people to introduce a solid waste disposal system, which was an organized form of garbage collection in which two men walked the streets collecting garbage using a cart (Roberts, 2015; Bello, et al., 2016). Gani (2019) states that landfill was introduced in England in 1297 and was traditionally known as controlled landfill. This type of disposal became common and preferred in England. In South Africa, a formal waste collection system was first introduced in the Cape Colony in 1786, using animal-drawn carts to collect solid waste weekly (CSIR, 2020). These services were limited only to whites in cities and urban areas (Tsiko & Togarepi, 2012). Interestingly, these landfills were in previously disadvantaged communities, yet they lacked basic services such as sanitation and refuse collection (Rasmeni & Madyira, 2019).

Since the 15th century, many African countries have been colonized by European powers (Oliver and & Oliver, 2017), leading to the introduction of western waste management practices (Environmental Studies & Kuemerle, 2021). Modernity refers to social systems and organizations that originated in Europe during the 17th century and later gained global influence (Noyoo, 2007). As a result of colonization, civilization, and the subjugation of indigenous peoples by the West, Africans began adopting Western models as a universal culture (Church, 2012). However, various literature sources have highlighted the negative impacts of adopting Western waste management systems in African countries. These systems are often not suitable or practical for the local context (Bhasin, 2002; Izugbara & Umoh, 2004; Ajibade, 2005; Sheheli 2007; Rahman, 2009; Zagozewski et al., 2011; Okot-Okum 2012; Boateng,

Amoako, Appiah, Poku & Garsonu 2016; Bello et al., 2016; Ogheneriere & Chukwenenye, 2017 and Kosoe, Diawo, and Osuanu, 2019).

Ogola, Chimuka, and Tshivhase (2011) confirmed that open dumping, incineration and landfill are modern waste management practices that originated in the western part of the world and were introduced through the process of civilization. These practices were later adopted inadequately by developing countries, specifically those influenced by Western culture and tradition (Noyoo, 2007; Asi & Günter, 2011). Consequently, modern waste management technologies are considered modern only in areas affected by colonialism and are native to Western communities, who were the initial proponents and enforcers of these systems (Noyoo, 2007). As a result, African societies have embraced these Western models as the norm and universally applicable (Church, 2012). The erosion of indigenous waste management practices has forced countries like Ghana, South Africa, Tanzania and Nigeria to rely on modern systems for which they lack the necessary skills and capacity to effectively manage (Izugbara & Umoh, 2004; Ajibade, 2007; Jain, 2007; Zagozewski et al. Rahman, 2009; 2011; Mihai & Taherzadeh, 2017). The consequences of adopting foreign waste management practices have been devastating and require significant financial resources to rectify (Asi & Günter, 2011). Waste collection is often irregular, leading to the indiscriminate dumping of waste in open spaces, storm sewers and roadsides resulting in poor sanitation and the spread of diseases (Okot-Okum, 2012; Kubanza & Simatele, 2019; Environmental Studies & Kuemerle, 2021).

2.3 Pre-and Post-colonization Solid Waste Management in Africa

The literature has proved that the ancient people lived peacefully and in harmony with the ecosystem, therefore environmental protection and human health were a principle (Magni, 2016). According to Ogola et al., (2011) the problems related to waste have existed since the dawn of civilization, then urbanisation emerged. At that time there was no landfill, the waste was disposed of naturally (Ajibade, 2007). The waste was biodegradable and served as compost, acting as a beneficial fertilizer for the environment (Environmental Studies & Kuemerle, 2021). However, the amount of waste generated increased as the population increased and villages grew into towns and then cities (Ajibade, 2007; Suthar & Singh 2015; Kumar, et al., 2017). As a result, rubbish was disposed of indiscriminately in waterways, wastelands and access roads.

Prior to colonization, waste in Africa primarily consisted of wood, food waste, vegetables and agricultural waste (Bello, et al., 2016). At that time, waste was mainly domestic and therefore predominantly biodegradable (Agarwal, Chaudhary & Singh, 2015). Industrialization was non-existent and the human population was relatively small (Bhasin, 2002 & Avci, & Celiker, 2015). The edible portion of waste was often utilized as animal feed (Jain, 1994; Ajibade, 2007; Niles, 2020), while the remaining waste could naturally decompose in the soil (Ogheneriere & Chukwenenye, 2017). Bello et al. (2016) identified the major problem in waste management in African cities to be the lack of adequate resources for collection, treatment, transportation, storage and disposal. This deficiency in resources has led to poor waste management practices. Ogola et al., (2011); Okot-Okumu (2016), and Ajibade (2017) support this claim, stating that the introduction of modern waste management systems in Africa has resulted in various issues such as indiscriminate dumping, uncollected waste, unpleasant odours, disease and water pollution among others.

2.4 Solid Waste Management Trends in Developed Countries

In most developed countries, solid waste management has reached a mature stage where collection and disposal are carried out at sanitary landfill sites (International Solid Waste Association, 2012, p. 4). As a result, these countries are now focusing on advancing their infrastructure and encouraging responsible behaviour among households to meet recycling targets. This involves the collaboration of interdisciplinary research experts (Crociata, Agovino, & Sacco, 2015). Environmentalists emphasize the importance of sustainable resource management, economists look at the financial benefits, psychologists study positive attitudes, sociologists examine social pressures and moral norms, engineers focus on infrastructure and technological development, and legal experts ensure compliance and enforcement of laws and regulations (Crociata, et.al., 2015 and Hage, et al., 2016). Consequently, countries like Italy, Romania, Bulgaria, Germany, and other European nations have successfully achieved the target of zero waste cities (Williams & Phillips, 2022).

2.5 Solid Waste Management Trends in Developing Countries

Local governments in developing countries are struggling to meet their responsibilities for the delivery of sustainable municipal waste services (Asi, & Günter, 2011; Shah,

Sharma, & Tiwari, 2012; Malik et al., 2015; Sukholthaman & Shirinda, 2014; Machete & Shale, 2015; Kumar, Smith, Fowler, Velis, Kumar, Arya, Rena, Kumar & Cheeseman, 2017). The waste collected is at risk of being incinerated or indiscriminately disposed of in uncontrolled and unregulated landfills (Moh & Manaf, 2014; AbdRazack et al., 2017). This in turn pollutes the environment and endangers public health.

In 2015, Brazilian authorities managed to collect and properly dispose of about 58.7% of solid waste collected only from cities, 41.3% was improperly disposed of in controlled landfills or open landfills, and only about 2.9% of municipal waste was diverted from landfills to composting, recycling and incineration (Alfaia, Costa and Campos, 2017). Jain (1994) found that garbage collection in urban areas of India is associated with indiscriminate dumping in low-lying areas prone to flooding. The current solid waste collection services in most African countries are therefore grossly inadequate, resulting in litter being released into the environment, including freshwater and marine environments (Kosoe et al., 2019). The implications of the adoption and implementation of this mature modern system by most developing countries became a major concern due to its unusual nature (Noyoo, 2007). These modern systems gradually developed in European countries over centuries, but there was neither space nor time for a gradual development in developing countries (International Solid Waste Association, 2012, p. 14). Iyamu, Anda and Ho (2020) reported that proper MSWM for some low-income countries requires an understanding of historical developments and local traditions to effectively address the problem.

2.6 Solid Waste Management Trend in South Africa

One of the challenges facing most municipalities in South Africa relates to proper management and final disposal of municipal solid waste (Machete & Shale, 2015). About 87% of rural areas in South Africa do not have access to municipal solid management systems (Rodseth et al., 2020) and use numerous local practices that are common to the area (Mihai & Taherzadeh, 2017 and Ajibade, 2007). According to Fakoya (2014), the problem of municipal solid waste service delivery was caused by the apartheid regime that created inequality among the rich and poor communities. As a result of earlier apartheid policies, which separated development priorities based on

race hindered the provision of MSWM services in low-income communities (Dlamini et al., 2017)

Rodseth et al. (2020) point out that lack of formalized waste management can result in unregulated waste management practices and contributes to contamination of water, soil and air. Seemingly, most landfills in South Africa are operated illegally and without a license presenting significant potential for pollution (Statistics South Africa, 2011 and Pienaar & Howard, 2014). In South Africa, there are approximately 540 landfill sites, of which 61% are permitted (Ogola et al., 2011). Regardless of the permit to dispose of waste, most landfill sites do not meet the standard requirements of a proper landfill (Polasi, Matinise, Oelofse, 2020). It can be concluded that most waste in South Africa is disposed of indiscriminately or unsustainably because of a lack of appropriate infrastructure to operate such landfill sites. The effects are far more devastating as unsanitary landfills contribute to pollution and harm human health (Ogola et al., 2011). Notwithstanding these discrepancies, Section 24 of the South African Constitution states that all citizens have the right to an environment not harmful to their health and well-being and to have the environment protected for present and future generations (Dlamini, et al., 2017). Therefore, providing a safe environment is a human right. Rodseth, et al. (2020) gave an overview of household refuse removal in South Africa by settlement type (rural, urban, and metro households) (Table 2.1).

Table 2.1: Household refuse removal in South Africa by settlement type (rural, urban and metro households).

	Total	**Rural**	**Urban**	**Metro**
Total Rural Urban Metro Refuse removed at least once a week	63.5%	9.6%	81%	88%
Refuse removed less than once a week	2.4%	1.0%	3.4%	2.7%
Communal refuse dump	2.9%	2.2%	2.0%	3.9%
Own refuse dump	28%	82%	10.0%	3.9%
Dump rubbish anywhere	2.8%	4.4%	3.1%	1.5%
Percentage of serviced households	69%	13%	87%	94.5%
Unmanaged un-serviced households	31%	87%	14%	5.5%
Other	0.4%	1.1%	0.40%	0.10%

The data presented in the Table 2.1 indicates that the collection of municipal waste in South Africa is primarily focused on urban and metropolitan regions. This aligns with the fact that households in metro and urban areas receive waste removal services, whereas rural areas have limited to no access to such services (Environmental Studies, & Kuemerle, 2021). Despite the lack of formal refuse removal, rural areas in South Africa sustainably manage domestic waste within their own premises (Machate, 2018). The practice of creating own refuse dumps is commonly observed in these rural areas, reflecting a traditional indigenous knowledge approach that is prevalent among a significant percentage of households in South Africa. As a result, many effective indigenous knowledge methods are implemented in rural areas of developing countries, as highlighted by studies conducted by Ajibade (2007), Niles (2020) and Siragusa & Arzyutov (2020).

2.7 Potential Improvements and Possible Solutions to Associated Indigenous Knowledge of Solid Waste Management

Although the academic community has done little in exploring and documenting the use of IKS as possible solutions to address the global waste management problems,

the system has improved on the management of municipal solid waste in some parts of Nigeria, Ghana, Bangladesh, India and the UK (Izugbara & Umoh 2004; Rahman, 2009; Agarwal, et al., 2015; Kosoe, et al., 2019; Gani,2019). The study provides a foundation for the possible adoption and incorporation of IK methods of waste management into formal systems. The study by Izugbara & Umoh (2004) identified positive impacts of indigenous methods practised by the Ngwa of Southern Nigeria. The successful methods practised by the indigenous community of Ngwa included ingenious and careful waste segregation and sorting, selective burning and burying, and composting and conversion (Izugbara & Umoh 2004). These practices are explored and currently practiced because the current waste management practices that are incineration, landfilling and open dumping cause much more harm to the environment and are incapable of effectively addressing solid waste management problems (Abubakar et al., 2022). Church (2012) asserted that Indigenous knowledge methods within certain communities are making a valuable contribution to the protection of the environment and natural resources.

Ajibade (2007) studied the indigenous knowledge systems of waste reuse and recycling in Nigeria and gathered that food and yard wastes were used as animal feeds and flour for human consumption in the western part of the country, while the northern part uses organic waste from food, animal excrement, agricultural waste, and dead plants as manure to grow more crops after decomposition. Ash was reprocessed into black soap, used as a detergent to clean pots or clean teeth. Animal parts were most reprocessed and reused as ornaments. The bark of plantains, cocoa and banana are used to prepare black soap. Coconut shells are used as fuel for cooking and used for making jewellery parts. Leaves are used to create woven baskets and mats, Palm tree remains are used for oil, wine and stems are used for benches. Ajibade (2007) further reported that the system has significantly reduced the disposal rate of recyclable and organic waste material.

The community of River State in Nigeria segregates waste in buckets before disposal in shallow pits in their backyard known as nkponkpo (Ajibade, 2007). The community believes the waste is for the spirits or ancestors to feast on. The waste in the pits is left to decompose for use as manure. The community maintains their pits in fear of punishment that may result from ancestral spirits such as illness and bad luck.

Disposal is limited only to daytime and traditional leaders impose fines on those that indiscriminately dispose of waste. The system significantly reduced the indiscriminate disposal of household waste.

The indigenous communities of Ghana used to participate in communal labour to clear waste to prevent the breeding of parasites and other health problems. Kosoe et al. (2019) noted that the entire community was subjected to clean-up campaigns as part of communal labour, not just a once-off government initiative or program by politicians. The study found that lack of communal labour in clean-up campaigns has contributed to filth, obscenity and indiscriminate dumping. Therefore, the study confirms the significance of IKS in waste management in Ghana.

Rahman (2009) studied the traditional recycling practices of the people of the Ganges and the Brahmaputra basins in Bangladesh and found that rural home-based and short-cycled solid waste management ensured zero depletion of organic soil content. The organic waste was decomposed and used as soil fertilizers for agricultural activities. The society believes that when solid waste management is unbefitting, the ancestors will depart from guiding and protecting the community. As a result, the practices ensured appropriate waste management activities in Bangladesh.

Jain (1994) made a comparison of urban and rural waste management systems to highlight the natural strength of IKS in dealing with rural waste. The types of waste generated by rural communities of India are mainly community waste (domestic waste), agricultural and/or agro-industrial waste, among others. To deal with food waste, India practices a biogas process where food waste is stored in containers and the gas from biodegradable refuse is used as gas for cooking (Ajibade, 2007). Cow dung is also used as energy for cooking and as fertilizers. Agricultural residues are used as animal food, fuel and construction materials. Traditional practices of using waste as fuel, animal feed and manure account for 90% of all waste utilization. However, Sheheli (2007) criticized the use of cow dung as an alternative to wood indicating its contribution to greenhouse gases.

Bhasin (2002) identified human waste as commonly recycled waste amongst the ancient people of Asia and Africa. Human waste has been used as soil fertilizers or

manure for agricultural practices. It is greatly regarded as a commodity for barren land. Although this method is least explored in academics and Western societies, it has proven to be efficient and cost-effective. The western method of flushing excreta requires the use of a large proportion of water amid a global shortage of water. This method is defiant of environmental sustainability. Mihai & Taherzadeh (2017) found that in China and India the indiscriminate dumping of waste and excrement in water bodies is affecting the quality of water resources.

Historical waste disposal methods were the same in rural areas, where the communities generated smaller quantities of waste and were commonly disposing of in background pits (Zagozewski et al., 2011). The indigenous people of Canada also practiced backyard disposal of waste. However, this method has been regarded as unsustainable and contributing to groundwater contamination, human health problems and compromised water quality as per the Canadian Drinking water quality guideline (Zagozewski et al., 2011). However, the pits are shallow and separation of waste was conducted according to the toxicity of the product.

Apart from the fact that IK practices are cost-effective, they are environmentally sound and conservative methods of waste management (Magni, 2016). The limitation of IKS in Nigeria is that reuse and recycling have not evolved to provide for the new types of waste and the production of waste is rapid and surpasses the rate of reuse and recycling (Ajibade, 2007). Kosoe, et al. (2019) assert that IKS provides massive solutions and rapid mitigation of waste management challenges when incorporated into the modern waste management systems. Considering the worldwide pursuit of sustainable solid waste management measures, the study reviewed scientific journals on indigenous knowledge (IK) methods on different types of waste streams commonly generated by indigenous communities globally. Only 29 scientific journals characterised waste streams as shown in Figure 2.3.

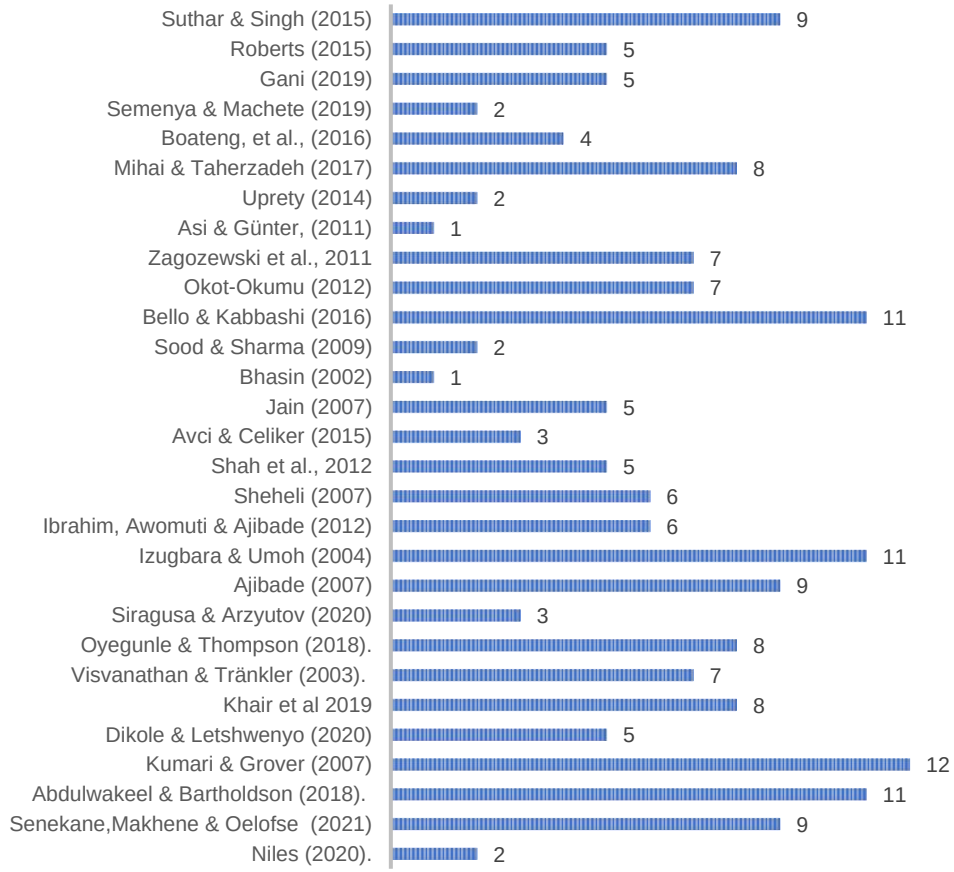


Figure 2.3: Number of waste streams per study.

Figure 2.3 shows the findings from the 29 research articles. It shows that there are several waste streams or items or materials that are commonly generated by indigenous communities. The waste streams ranged between 1 and 12, with an average of 2 waste materials per study. Most studies identified at least five waste streams within their respective studies with a standard deviation of five waste streams. Figure 2.4. presents the waste streams and the frequency at which they are generated within indigenous communities globally.

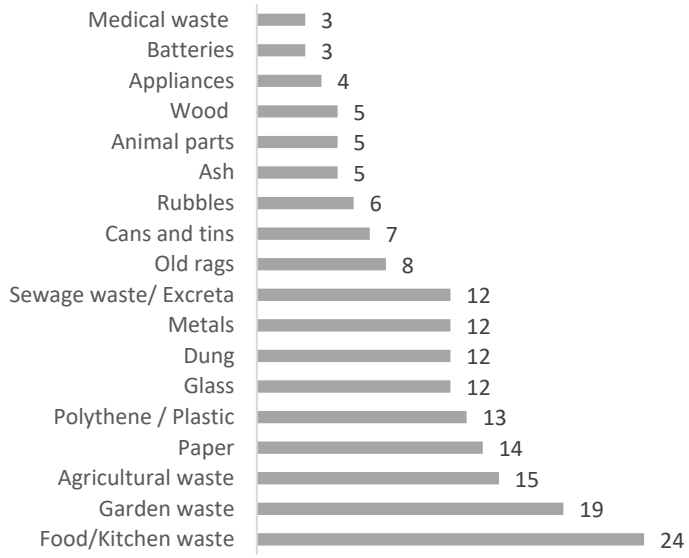


Figure 2.4: Frequency of each waste stream found per study.

Figure 2.4 shows that organic waste, particularly food waste, was recorded in 24 studies (75%), followed by garden and agricultural waste recorded in 59% and 46% of the studies respectively. Packaging waste streams are also common among indigenous communities, were recorded in 43% of the studies, polythene and plastic (40%) and glass (37%). It was observed that cow dung is more commonly produced in many Asian countries, mostly India than in other global communities. Similar to metals and sewage waste, cow dung was recorded in 37% of the studies. In addition, old rags were recorded in 25% of the studies, followed by tins and cans at 21%, rubble at 18%, and animal parts and ash are at 15%. Wood waste was recorded in 21%, e-waste (home appliances and electronics) and hazardous waste (batteries, medical waste, and car tires) were recorded in 9%, and miscellaneous waste was recorded in in 28% of the studies. Figure 2.5 illustrates the different methods used by indigenous communities to manage household waste.

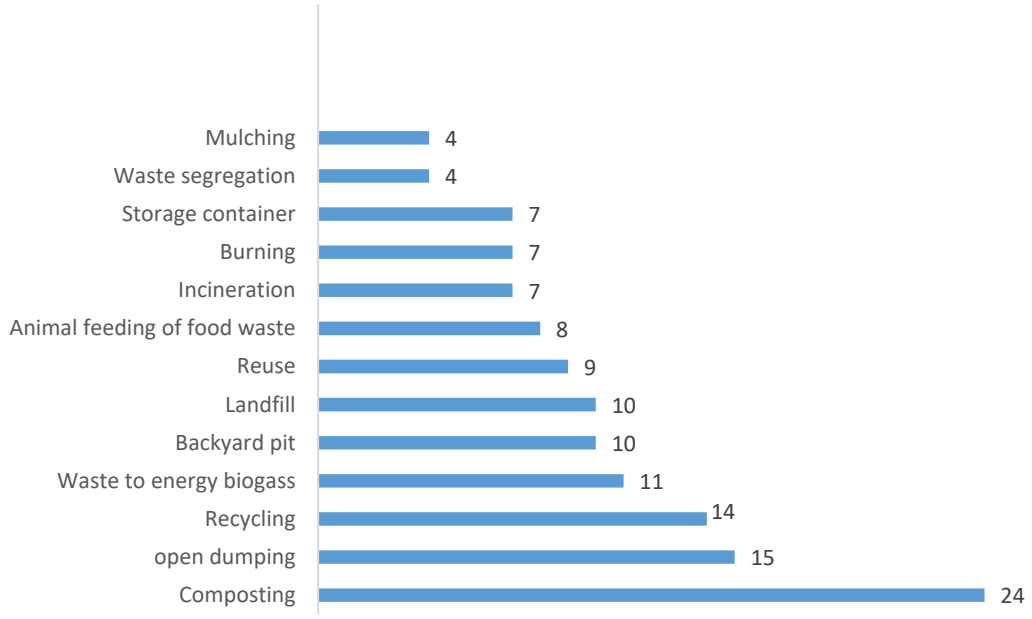


Figure 2.5: Indigenous methods of solid waste management from previous studies

The relationship between waste streams in Figure 2.4 and the management methods adopted by various communities in Figure 2.5 is evident. For example, composting of organic wastes was recorded in 24 studies (75%). The common waste streams which were turned into compost include food waste, human excreta, garden waste, cow dung, agricultural produce, animal waste, and ash. The review also revealed that open dumping of waste came out as the second highest method recorded in 15 studies (46%) The analysis also found that recycling of scrap metals, human waste cans and tins was recorded in 14 (43%). The practice of recycling human waste is acknowledged as an ancient Asian and African practice and is used for fertilizing barren land (Bhasin, 2002). Furthermore, 11 studies (34%) found that indigenous communities also convert waste to energy. These communities are known for their use of animal waste, e.g., cow dung and crop residues as alternatives to firewood (Mihai & Taherzadeh, 2017). Some components of organic waste were converted into biogas for electricity and heating (Ajibade, 2007). The use of cow dung as an alternative source of energy for cooking has also been confirmed as a common practice in South Africa. A study by Semenya and Machete (2019) found that 2% of the Senwabarwana community in South Africa use this method.

In addition, backyard pits and landfills were found in 10 of the studies (31%). The studies point out that landfilling remains prevalent in India, Africa, the United Kingdom (UK) and the United States of America (USA). The prevalence of waste landfilling in the UK and the USA are also associated with the two countries being recognised as the pioneers of landfilling (Gani, 2019). Landfilling is thus considered an indigenous method of waste management or disposal in the UK and the USA.

Furthermore, 9 (28%) of the reviewed studies identified reuse and reprocessing of household waste. The studies show that leftover food and garden waste are used to feed animals in most indigenous communities in Africa (Ajibade, 2007; Okot-Okum, 2012). The use of leftover food to feed animals was confirmed by 8 studies (25%) (Figure 2.5). The practice of feeding animals is also common in Oklahoma in the USA where pigs, goats and stray dogs are free to roam the streets as "biological vacuum cleaners" (Izugbara & Umoh, 2004). According to the modern or common western theories of waste management, the above practice falls within the 3R framework (reduce, reuse & recycle). Disposal methods such burning, incineration and storage containers were recorded in 21% of the reviewed studies. Burning of waste under a tree in the backyards aimed at clearing insects such as mosquitoes and flies, as well as snakes and scorpions while capturing greenhouse gases has also been found common among indigenous communities globally (Izugbara & Umoh, 2004). Re-purposing and multiple considerations of disposal methods by indigenous communities have been drawn from various indigenous practices of managing waste.

Preference for waste segregation and mulching is low in many countries, with only 4 (12%) of the reviewed studies recording this practice. Recyclable waste materials such as newspapers, cardboard, woody items, plastic containers, empty beverage and wine bottles and metal containers are usually separated by the households to sell to street hawkers or waste scrape shopkeepers in the market (Suthar & Singh 2015). Mulching of old textiles such as old clothes and fibre sacks is commonly used to produce animal bedding (Ajibade, 2007).

It is gathered from these studies that households manage a variety of solid waste using one or more methods. Utilisation of unsustainable practices of waste management such as unsanitary landfilling, indiscriminate dumping and incinerations within

indigenous communities is a result of the introduction of western systems that are not native to that area. Asi & Günter (2011) suggest that for a waste management technology to be effective and sustainable, it must be appropriate to the local cultural conditions in which it operates from a technical, social, economic, financial, institutional and environmental perspective. Moreover, waste management technologies must be able to self-sustain themselves over time without reducing the resources they need. Jain (1994), Izugbara and Umoh (2004), Ajibade (2007) and Kosoe, et al. (2019) inferred that the traditional methods are effective and adequate in handling and managing waste. However, various levels of government and environmental policymakers have ignored the importance of IK as a solution to the myriad of environmental problems in support of scientific knowledge. Thus, the need for documenting indigenous methods of solid waste management practised in the current study are to assess their sustainability using the three pillars of sustainable development, namely, (1) social, (2) economic and (3) environmental impacts. Methods that meet one or two pillars of the 3 pillars of sustainable development will be described as partially sustainable. Indigenous methods of waste management found to be sustainable will be replicated and recommended for use in various communities as an alternative solution to the growing challenges of poor solid waste management and lack of service delivery in South African communities and Africa in general. Other practices that are associated with sustainability risks may be modified and discouraged to reduce or possibly eliminate their associated risks to communities. The ultimate focus is to document knowledge or practices within real communities that are used to address solid waste challenges, appraise or evaluate such with a view of improving and adopting positive practices and discouraging high-risk practices.

2.8 Conclusion

Using the descriptive statistical analysis, this study managed to select the most frequently used characteristics of indigenous knowledge namely: a) it is locally developed (14) 44%; b) accumulated through experiences (12) 38%; c) it is a body of knowledge (12) 38%; d) it is influenced by culture (11) 34%; e) it is unique (10) 32%; f) it encourages socio-ecological interaction (10) 32%, g) it promotes sustainability (9) 28%, and h) it is a practice or skill or technique (9) 28%. The above characteristics served as the minimum criteria that was used to classify the knowledge or practices of communities as indigenous or not. The study found that there are various waste

streams or materials that are commonly generated by indigenous communities. Each study characterised at least two waste streams that were managed and disposed through indigenous methods. Organic waste is the most common waste generated followed by packaging waste streams while hazardous wastes are the least common. Most of the organic waste is composted, while packaging waste is mostly recycled and reused. Backyard pits are commonly used to dispose of hazardous waste. Because most IK practices are not formal and documented, and their sustainability is unknown, the sustainability of these practices must be assessed to determine their ecological and socio-economic impacts

Chapter 3 : RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methods and procedures used to collect, analyse, present and report research results. The chapter focuses on the description of the study area and the research methodology used. Each method is then described in detail, along with its relevance, strengths, weaknesses and rationale for the current study. The research questions are also answered using specific methods.

3.2 Description of the Study Area

The current study was conducted in Sikhunyani, a village located on the outskirts of Giyani Town and commonly known as KaNgove, in Limpopo Province under the jurisdiction of the Greater Giyani Local Municipality (GGLM) (Figure 3.1).

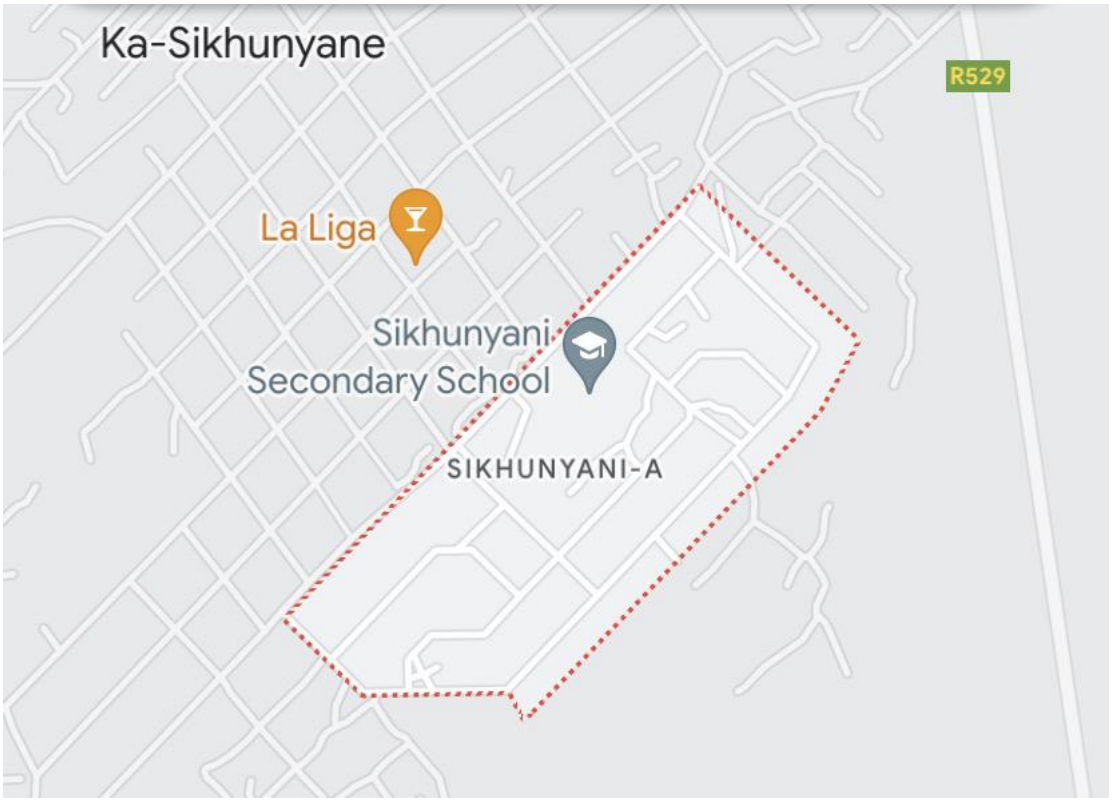


Figure 3.1: Map of Sikhunyane Village (*Google Maps, 2022)*

The GGLM consists of 10 traditional authorities and 91 villages (GGLM, 2021/22). One of the 91 villages is the current study area. According to the Integrated Development Plan (IDP) of the GGLM, Sikhunyani Village does not receive formal refuse removal services (Greater Giyani Local Municipality IDP, 2021/22).

3.3 Population and Sampling

According to Statistics South Africa (2011), Sikhunyani Village has 1545 households, a population unit of interest to this study since the it seeks to assess the sustainability of indigenous waste management methods used by households. Using a formula by Yamane (1967), the sample size was determined at a confidence level of 95% with an error margin of ±5%. In this formula **n** is the sample size, **N** is the population size, and **e** is the margin of error that is equal to 0.05 (Yamane, 1967). The formula is shown in Equation 1:

$$n = \frac{N}{1} + N(e)^2 \qquad (1)$$

$$n = \frac{1545}{1} + 1545(0.05)^2 \qquad (2)$$

N =155

The goal of sampling strategies in survey research was to obtain a sufficient sample that is representative of the population of interest. It was not feasible to collect data from an entire population of interest. Therefore, a sample size of n=155 was representative of the entire population. With limited resources, it was not possible to interview every household in the study area. Some of the questionnaires were not fully completed and 108 questionnaires (72%) were analysed. Purposive sampling was used to conveniently select households from non-urban households in Sikhunyani Village. Purposive sampling, as described by Bless and Higson-Smith (1995), entails the researcher's discretion in selecting individuals who possess specific characteristics. The researcher utilized a method to specifically focus on individuals who have expertise and experience in indigenous solid waste management. The heads of these households were interviewed and responded on behalf of all members of their respective families.

3.4 Research Design

Data was gathered from various households using two data collection methods, which encompassed a mixed method study design consisting of two stages. The initial stage involved conducting a survey through administering questionnaires. This survey was

used to gather information on common indigenous knowledge (IK) practices, the waste streams generated and the indigenous methods employed.

The second stage involved observation of the waste streams, indigenous methods and the sustainability of these methods. Boru (2018) describes research design as the procedures for gathering, analysing, interpreting and reporting data in research studies. The research design sets the procedure for the required data, the methods to be applied to collect and analyse the data, and how this is designed to answer the research question (Boru, 2018). The choice of research design is contingent upon the nature of the problem under investigation and the objectives of the study (Creswell, 2014). The study is descriptive in nature. The researcher can analyse and elucidate the distribution of one or more variables, without taking into account any causal or other hypotheses (Aggarwal & Ranganathan, 2019).

Data collection is an essential aspect of research that allows researchers to gain valuable insights into household behaviour and preferences. By utilizing two data collection methods, researchers can obtain a comprehensive understanding of their target population. In addition to questionnaires, other effective methods, such as direct observation and literature review, also contribute significant insights.

3.5 Surveys

Mathiyazhagan and Nandan (2010) defined a survey as a type of descriptive research that is designed to collect primary data (Mathiyazhagan and Nandan, 2010). The main methods used in survey research are questionnaires and interviews for data collection (Mathiyazhagan and Nandan, 2010). Questionnaires are typically administered individually or in groups by professionals and contain questions that align with the research objectives (Ponto, 2015). During the empirical study, participants were asked to respond to approximately three pages of questions, which included both closed and open-ended questions. These questions covered various aspects related to the objectives of the study, such as household demographics, indigenous activity performances, solid waste generation and management practices, transfer of knowledge and skills related to solid waste management practices and any additional input on proper waste management.

The researcher visited Sikhunyani village multiple times to obtain permission from the royal council. The research teams received training on ethical principles and proper questionnaire administration. The literature review played a significant role in guiding the researcher in analysing relevant issues and creating the questionnaire used in this study. Previous research provided valuable insights into investigating indigenous knowledge related to solid waste management methods.

Furthermore, questionnaires allow researchers to gather quantitative data by asking specific questions to a large number of participants (Mathiyazhagan & Nandan, 2010; Tanner, 2018). In this study, a total of 108 questionnaires from Sikhunyani village were analysed. Ponta (2015) also effectively collected data on the role of indigenous solid waste management practices (ISWMP) in urban waste management using surveys in PNG.

This method allows for collecting diverse responses, enabling statistical analysis to identify trends and patterns. On the other hand, open ended questions provide a more qualitative approach, allowing researchers to explore individuals' thoughts and opinions in greater depth. Through face-to-face interactions, researchers can gain a comprehensive understanding of participant motivations and preferences, facilitating precise analysis (Szolnok and Hoffmann 2013). By using descriptive statistical analysis, this study identified the most frequently used characteristics of indigenous knowledge. Considering the success of survey-related research, this study adopted the survey method to collect data.

3.6 Observations

To further enhance our understanding of the subject, the study employed the method of "direct observation" in Sikhunyani Village. Baker (2006) defines observation studies as those that “involve the systematic recording of observable phenomena or behaviour in a natural setting”. Observation is a widely used technique or tool, regarded by many as fundamental to research (Williamson,2018). The Observation approach was previously used by Kosoe, et al. (2019) to observe the practical implementation of indigenous solid waste management methods. Therefore, the adopted research designs are efficient to obtain a comprehensive understanding of

the sustainability of indigenous solid waste management and answer sub-research questions 1.4.2 and 1.4.3 in Sikhunyani village, Limpopo province, South Africa.

This approach allowed the researcher to gain first-hand knowledge about the types of waste generated and the methods employed for its handling and disposal. Through direct observation, the researcher was able to bridge any potential gaps in information that may have been missed during formal interviews. However, during our observations, we found a consistent alignment between the data obtained from interviews and the reality of waste management practices on-site. The researcher was able to observe the storage of food waste to feed domestic animals, backyard pits as well as burning of diapers and plastic bottles. This validation reinforced the reliability of the information gathered through interviews and added credibility to the research findings. By combining both survey and observational methods, the researcher was able to obtain a comprehensive and accurate understanding of the waste management situation in Sikhunyani Village.

3.7 Reliability and Validity of Data Collection Tools

The validity and reliability of research are essential factors that enable research to produce useful results (Sürücü & Maslakçi, 2020). Reliability means that the results of an instrument are stable and consistent (Yasar & Cogenli, 2014). According to Cresswell (2005), validity means that individual results of an instrument are meaningful and can be used to draw valid conclusions about the population.

For validity of the questionnaire a pilot study was conducted. It was confirmed that the items in the questionnaire measure what the instrument it is intended to measure, all questions were understood by respondents, all respondents interpreted the questions in the same way, and all answers were appropriate to the questions. The pilot study was carried out immediately after approval by the village headmen and about 15 respondents were interviewed. The study found that the questionnaire met the intended goals and effectively answered research questions. However, the team needed to explain the term “waste” to myriad respondents as many had no idea what it means. This was also the case during the actual data collection.

Supplementary to above, respondents' responses were also consistent among households and as well as their expected resolution. Respondents were confident that the study could bring about positive changes and improvements towards sustainable solid waste management in the study area. The study found that young respondents could answer the questionnaire within 15 minutes and mostly understood the questions. However, about 20 minutes was required for the older individuals mostly pensioners. The results of the pilot study are not included in the study. The questionnaire is attached in Appendix C.

The reliability of the instrument was conducted via a pilot study, where the researcher tested the survey instrument to validate the instrument's effectiveness and the value of the questions to answer the primary research questions. The purpose was to address any likely problems with the instrumentation or other elements in the data acquisition technique and make corrections prior to field work.

3.8 Data Analysis Techniques

The study collected nominal, ordinal and ration data through structured interviews. The survey data was captured into Microsoft Excel and SPSS Statistics version 25, from a coded structured interview questionnaire for statistical analysis and presentation through figures, tables and other graphics. The analyses included descriptive results with frequencies, percentages and charts. The results of the data analysis are presented in chapter 4.

3.9 Limitations of the Study

According to Price & Murnan (2004), “limitations are influences beyond the researcher’s control. They are the shortcomings, conditions, or influences that a researcher cannot control, and that may restrict the methodology and conclusions”. Although the researcher had assistance from interpreters, language was a barrier to effective communication between the researcher and participants. Based on the calculation of sample size, the researcher expected to analyse 155 questionnaires. However, only 108 questionnaires were analysed resulting in 72% response rate. About 47 of the questionnaires were erroneously captured and were ineligible. According to Fincham (2008), response rates of around 60% should be the goal of researchers for most research.

3.10 Ethical Considerations

Before conducting the research, the researcher obtained ethical clearance to conduct the study in the study area from the University of South Africa (Ref. Nr: 2018/CAES/141) attached in Appendix D. The researcher also consulted the Greater Giyani Local Municipality and two heads of Sikhunyani village regarding the application to conduct a study in Sikhunyani Village. Permission was granted to conduct the study and the approvals are appended in Appendix E.

In addition, oral consent was obtained from potential participants. The researcher informed all participants that their participation is voluntary, and they can withdraw from the study at any time. Participants were assured that their responses would be treated with confidentiality and anonymity and were not subjected to harm. In addition, the study was limited to adults only. The declaration of consent is appended in Appendix C.

3.11 Conclusion

The findings of the study shed light on the willingness of households to participate in research. Despite encountering a language barrier, the researcher successfully captured 108 error-free questionnaires out of the 155 respondents interviewed. This highlights the importance of effective communication strategies when conducting similar studies in the future. By addressing this limitation, researchers can improve the accuracy and reliability of the data collected. One possible solution could involve employing multilingual researchers or providing translation services to ensure clear communication with participants.

Moreover, the utilization of survey and observation research designs proves advantageous in this study. These methods have been proven successful by other authors, indicating their effectiveness in capturing comprehensive insights. However, it is worth considering the integration of additional research approaches to further enhance the understanding of participant behaviour. Descriptive statistical methods played a pivotal role in analysing the variables of interest. This allowed the researcher to gain valuable insights into the characteristics and preferences of the participating households.

The comparative analysis employed in the study provided a comprehensive exploration of the factors driving knowledge to be considered as indigenous. This approach allowed for a thorough examination of various perspectives and contributed to a richer understanding of the subject matter. To build upon this, future research could explore other cultural contexts or demographics to broaden the scope of findings

Chapter 4 : RESULTS AND DISCUSSION

4.1 Introduction

The prevalence of indigenous knowledge (IK) in Sikhunyani Village manifested through the rich tapestry of cultural practices and religious beliefs. These aspects not only shape the identity of the community but also provide valuable insights into their ancestral wisdom and traditions. Cultural activities play a pivotal role in preserving and passing down indigenous knowledge from one generation to another (Lebaka, 2019). Within the households of Sikhunyani Village, a myriad of cultural practices can be observed. From vibrant traditional dances that celebrate important milestones to intricate craftsmanship that showcases the community's artistic heritage, each activity contributes to the collective memory of the village. These cultural practices foster a sense of unity and pride among the residents, reinforcing their connection to their ancestral roots.

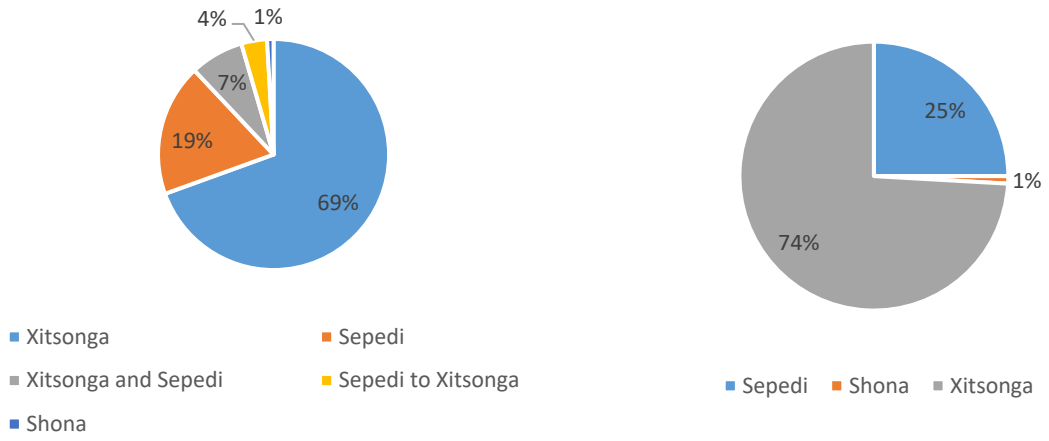
It is important to note that indigenous knowledge, encompassing language, cultural activities, and religious beliefs, is not static but evolves and adapts over time. While external influences may shape certain aspects, the essence of Sikhunyani Village's indigenous knowledge remains resilient. Recognizing and valuing this knowledge is vital for preserving the community's heritage and fostering intergenerational transmission.

This chapter presents the results from the empirical study and addresses the sub-research questions on the prevailing indigenous knowledge of Sikhunyani villagers. The chapter also presents the results on indigenous knowledge influences, specific waste streams generated by households and indigenous methods used for the management of each waste stream. Finally, using the three pillars of sustainable development (social, economic and environmental), this chapter critiques the sustainability of any indigenous waste management method.

4.2 What Indigenous Knowledge is Prevalent in Sikhunyani Village?

Four primary variables were identified and examined in this paper, namely, (1) the language of household, (2) the language of the household head, (3) the cultural activities in which household member(s) participate in and (4) the religious beliefs.

Figure 4.1 (a) and (b) show language use, transition and dominance across households within the study area. As indicated earlier, in addition to language being a standalone element of IK, it also serves as a proxy of dominant household traditions and culture.



(a) Language of the household (b) Language of the household head

Figure 4.1: Language dominance and transitions in households in Sikhunyani Village.

Figure 4.1 presents an analysis of the languages mostly spoken in Sikhunyani Village. The Sikhunyani Village is situated on the outskirts of Greater Giyani in the former Gazankulu area and the predominant language used by the local people is Xitsonga (Statistics SA, 2011). The analyses showed that the language that most spoken in the area is Xitsonga (69.4%), followed by Sepedi (18.5%). In some households, two languages were spoken concurrently. Intertribal marriages and the dominant language of the general community were among factors that influenced this language transitioning and multiple languages speaking (thus Xitsonga to Sepedi or the opposite accounts for 7.5% of households). Figure 4.1 (a) and (b) demonstrate the influence of language migration on household heads with Xitsonga increasing by 7.2% and Sepedi increasing by 31.5%. There was a strong influence of the local language on respondents who did not speak Tsonga. The Shona language showed consistency in both instances of the general household language and household head findings (0.9%). The study reveals that the influence of language on non-Tsonga-speaking respondents may have resulted in the adoption of the traditions and cultures of Tsonga people.

Indigenous waste management practices in Sikhunyani Village are deeply intertwined with the local language and its influence on indigenous knowledge. The connection between language and waste management practices sheds light on the cultural significance and traditional wisdom embedded within the community. Language serves as a conduit for the transmission of indigenous knowledge, including waste management practices, from one generation to another. It encapsulates the collective wisdom and understanding of the community's relationship with the environment. Through their language, the people of Sikhunyani Village have developed a comprehensive system of waste management that reflects their deep respect for nature and their commitment to sustainable living.

Within the context of waste management, the language used by the community plays a crucial role in shaping their perception of waste and their approach to handling it. Words and phrases related to waste management carry cultural meanings and values, reinforcing the importance of responsible disposal and the need to minimize environmental impact. The linguistic nuances embedded in conversations about waste management contribute to the preservation and perpetuation of indigenous knowledge in Sikhunyani Village.

Furthermore, the language used in Sikhunyani Village reflects the interconnectedness of waste management practices with other aspects of daily life. It highlights how waste is not seen as a separate entity, but rather as an integral part of the overall ecosystem. The language used by the community emphasizes the holistic approach to waste management, encompassing not only proper disposal but also prevention, reduction, and recycling. By recognizing the influence of language on indigenous waste management practices, the researcher gains a deeper understanding of the cultural and environmental values upheld by the community of Sikhunyani Village. Language serves as a powerful tool for preserving and transmitting knowledge, ensuring that traditional practices continue to thrive and adapt to contemporary challenges.

4.3 Sources of the Indigenous Knowledge Systems (IKS)

Several IK definitions have been analysed and their variables determined. The respondents gave various elements pertaining to IK within the community and the results are shown in Figure 4.2. The results show the extent to which the elements of

IKS are dominant in Sikhunyani Village (Figure 4.2). These include knowledge from formal education systems, traits from religious practices and knowledge from local initiation schools.

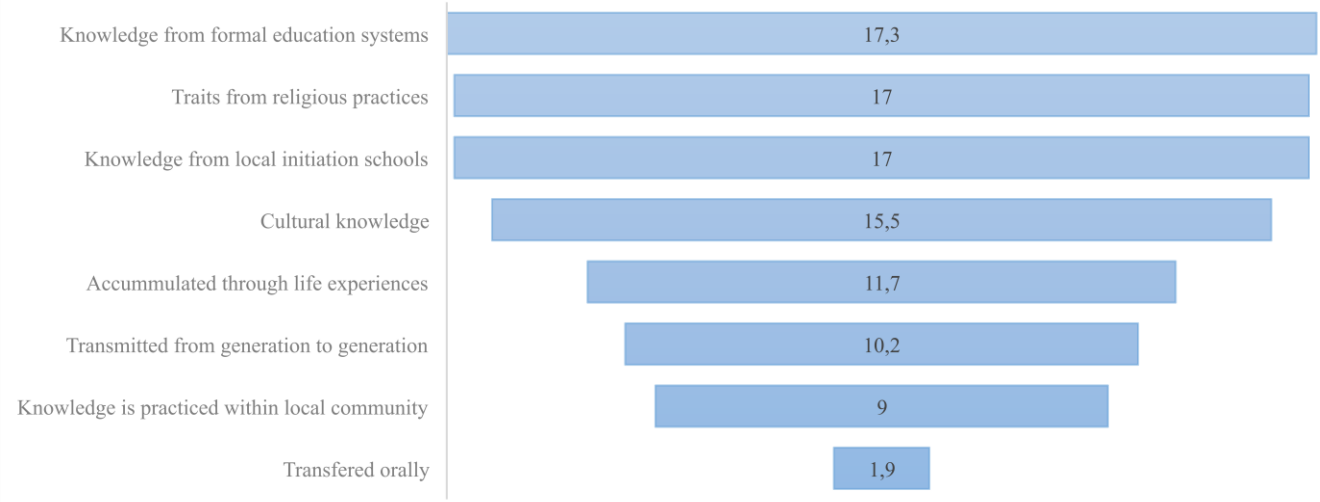


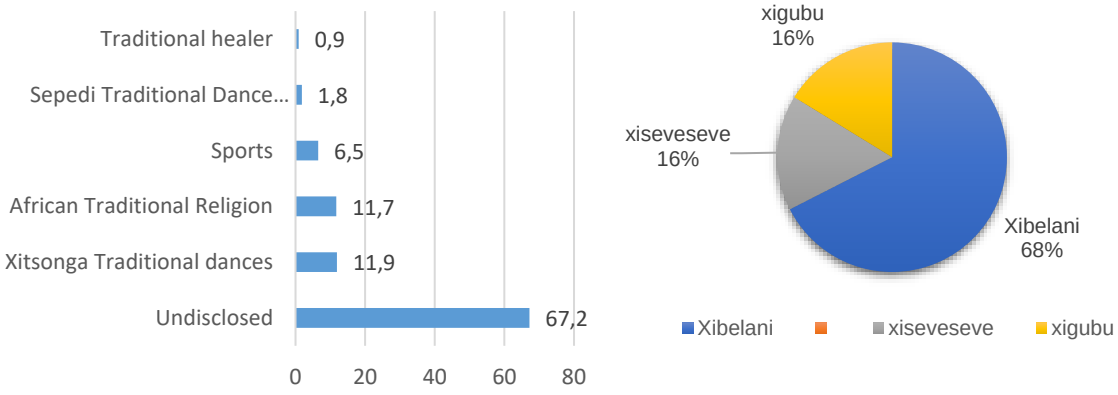
Figure4.2: Sources of knowledge within Sikhunyane Village

Despite its omission as an IK variable, knowledge from formal education systems (17.3%) has been examined for its impact on the development and progress of IK (Wahab, 2007). Among the 15 definitions reviewed earlier in this study, religious practices did not appear among the top elements of IK. However, in the study area, it ranked high as 17% of the households identified it. Religion also appears strongly as a key element from other studies on IK. This element was reported as a prevalent and common way of dispersing knowledge in the study area. Religion ranked equal with initiation schools (17%) as ways in which communities acquired knowledge and practices that they use for their livelihoods. Initiation schools, despite not being mentioned earlier studies, are an influential cultural practice in the study area. Consequently, respondents identified culture (15.5%), knowledge accumulated through life experiences (11.7%), knowledge transmitted from generation to generation (10.2%), knowledge practised within the local community (9%) and transferred orally (1.9%) as sources of IK in the study area (Figure 4.2). These have been identified as significant sources of transmitting knowledge in the study area.

Section 15 of the Constitutional Bill of Rights (Republic of South Africa, 1996a) gives everyone the right to conscience, religion, thought, beliefs, and freedom of expression. Even though Christianity is practiced by more than 60% of the population in the

country, South Africa is home to a diverse range of religions, including Hinduism, Islam, Judaism, and indigenous African traditions. According to Lebaka (2019), traditional African traditions are built or transmitted orally (hereafter referred to as oral traditions). Fundamental beliefs and ways of life are passed down from generation to generation orally (Lebaka, 2019). Furthermore, indigenous communities subscribe to a myriad of beliefs, which are often associated with myths, traditions, culture, taboos and rituals (Lebaka, 2019).

Figure 4.3 (a) and (b) shows the participation of household member(s) in cultural activities and the type of such activities are presented.



(a) Cultural activities of Sikhunyani Village (b) Sub-categories of Xitsonga traditional dances

Figure 4.3.: Participation of household member(s) in local cultural activities at Sikhunyani Village

The results show that most residents in Sikhunyani Village do not participate in any cultural activities (67.2%). However, the remainder are spread across several cultural, and to an extent ritual activities namely; (1) African Traditional Religion (11.9%), (2) Xitsonga traditional dances (11.7.8%), (3) sports (6.5), and (4) traditional healing (0.9%), (5). There is also negligible participation in the Sepedi Traditional Dance called Sekgapa (1.8%).

The results reveal a high dominance of Xitsonga Traditional Practices or dances within the study area (figure 4.3 (a)). Figure 4.3 (b) shows a breakdown of different Xitsonga traditional dances (sub-categories) namely: (1) Xibelani (68%), (2) Xiseveseve (16%), and (3) Xigubu (16%). Kosoe et al. (2019) observed that the traditional institutions and taboos were no longer observed and thus considered irrelevant immediately after

independence or post-democratic dispensation among many communities. Wahab (2007) supported the observation by concluding that the introduction of Christianity, modern civilization, and formal education are the greatest hindrance to traditional belief. The study found that many people now identify themselves more religiously than according to their indigenous groups or identities (Wahab, 2007).

According to Wahab, (2007) “there are two types of religion which are: proselyte religions (such as Christianity and Islam), and ethnic or tribal religions such as African traditional religions”. As a result, for Christians and Islam, the belief in God constitutes the major component element of the two contemporary religions. In addition, there are African Independent Churches that openly incorporate aspects of ancestral and traditional African religions into their practices. Among such churches, the largest is the Zion Christian Church (ZCC), which combines the worship practices of Christianity and traditional African religions (Lebeloane, & Mokhele, 2006).

Wahab (2007) mentioned that there are four component elements that make African traditional religion: (i) belief in the ancestors, (ii) belief in the divinities (iii) belief in the spirits (iv) the practice of magic and medicine by traditional healers. Rautenbach (2007) defines a traditional healer as “an educated or lay person who claims an ability or a healing power to cure ailments, or a particular skill to treat specific types of complaints or afflictions and who might have gained a reputation in his [or her] own community or elsewhere”. Figure 4.4 presents religious practices or affiliations of households in the study area, as a reflection of the religious influence on IK.

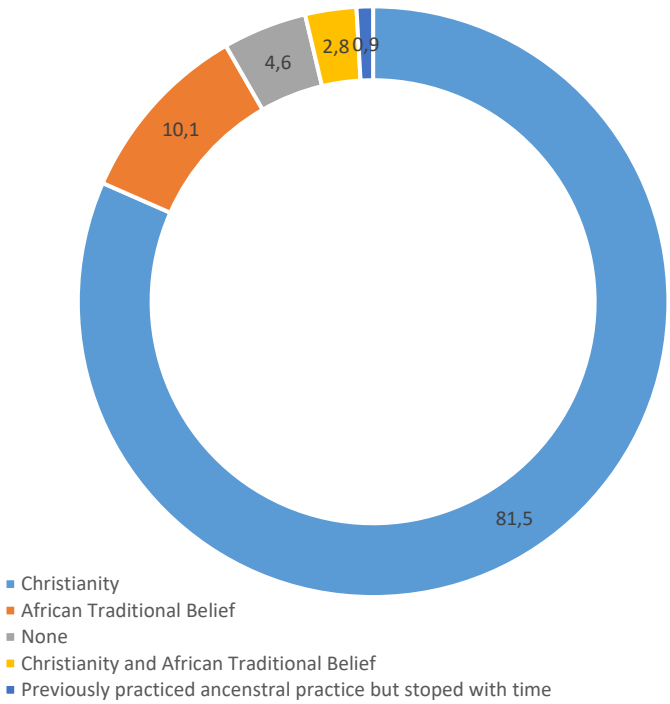


Figure 4.4: Number of households affiliated to different religious denominations

Figure 4.4 shows that 81.5% of the population were Christians,10.1% were followers of ancestral beliefs and 4.6% did not belong to any religion. There were also respondents who practice more than one religion simultaneously. The results show that 2.8% of the population practices both Christianity and ancestral beliefs while only 0.9 % of the population previously practiced ancestral beliefs but ceased over time. The results confirm that IK is spread by religious traits, which is why it was ranked highly by the respondents.

4.4 What are the Characteristics of Waste Streams Generated in Sikhunyani Village?

Figure 4.5 presents the solid waste streams generated by the households in Sikhunyani village.

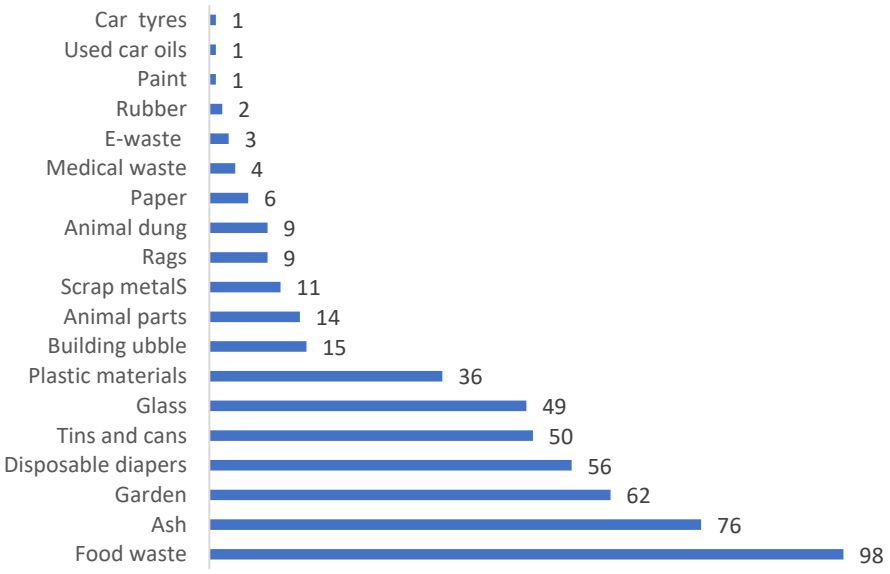


Figure 4.5.: Solid waste streams generated by households in Sikhunyani Village

Figure 4.5 shows that 98 (89.8%) of households generate food waste. The consistency and presence of common waste streams can be discerned from both literature and the findings from Sikhunyani Village. The most common waste generated is organic waste and the least common waste is hazardous waste. Packaging waste streams such as plastics, tins and cans and glasses are prevalent in the Sikhunyani Village, and this is supported by earlier studies. The results show that Sikhunyani village is no different from other indigenous villages and communities in terms of the common waste streams generated from these communities. Another interesting observation is the rate at which ash is generated in the study area i.e., it is ranking second after organic waste. Although ash did not rank high in literature, it remains a common waste stream generated in indigenous communities. Abdulwakeel and Bartholdson (2018) opine that inert waste such as ash and sand are commonly found among low-income earners living in unpaved areas that have no stoves and cooking gas.

Another waste stream of interest observed from the Sikhunyani Village is the high level of disposable diapers, which ranks fourth after garden waste. The increase in disposable diapers has been attributed to a rapid increase in population, urbanisation and income levels (Ajibade, 2007; Suthar & Singh 2015; Kumar, et al., 2017). After the detailed analysis or characterisation of the variety of solid waste streams generated in

the study area, the next focus was to determine how each waste stream was managed in the study area.

4.5 How is Each Solid Waste Stream Indigenously Managed in Sikhunyani Village?

The methods or practices used to handle and finally dispose of household waste by the local community of Sikhunyani village are summarised in Table 4.1.

Table 4.1: Indigenous methods of solid waste management in Sikhunyani Village.

	Animal feeding	Composting	Backyard pit disposal	Burning	Open dumping	Flooring	Repurposing	Trench backfilling	Pit latrine disposal	Recycling	Reusing	Burying	Landfilling	**Number of methods used per waste stream**
Food waste	89	5	10	5	2									**5**
Animal dung		6				6								**2**
Animal parts		2	5	4	1		2							**5**
Ash		17	16		3				39					**4**
Glass			3		10					12	5			**4**
Disposable diapers			3	26	24							1	2	**5**
Garden waste	8	8	1	39	3									**5**
Scarp metals										10				**1**
Builders' rubble			1				6	8						**3**
Tins and Cans			6	1	14					22				**4**
Plastic materials				31						10	4			**3**
Rags				9										**1**
Paper				5							1			**2**
Medical waste			1						2					**2**
E-waste			1		2									**2**
Rubbers			1	1										**2**
Paint											1			**1**
Used car oils			1			1								**2**
Old tyres				1										**1**
Number of waste management methods used per waste stream	**2**	**5**	**13**	**10**	**8**	**2**	**2**	**1**	**2**	**4**	**4**	**1**	**1**	

Thirteen (13) indigenous methods that that are used among Sikhunyani Village to manage their solid waste were identified (Table 4.1). 19 solid waste streams were identified by participants. Table 4.1 shows the number of households that use different indigenous waste management methods for each waste stream. The number of waste streams used per waste management method is also shown. It is evident that some waste streams are managed through several methods than others. It can also be observed that some waste management methods are used on multiple waste streams than others. In addition, some indigenous waste management practices of this community fall within a broad group of modern waste management systems. For example, use of food waste to feed animals and the use of cow dung to plaster floors have similar technical meaning to reuse, reduce and recycle.

4.6 Assessment of the Sustainability of the Indigenous Methods Practiced in Sikhunyani Village.

According to Al-Nawaiseh et al., (2021), an effective solid waste management system involves the adoption and implementation of various treatment methods, technologies and practices. Waste streams vary and composition differs per location and region (Dlamini et al., 2017) and as a result require different sustainable waste management methods. Sustainable solid waste management practices help to reduce negative health and environmental effects, preserves valuable resources and enhance the quality of life (Abubakar et al., 2022). While unsustainable practices cause adverse effects that encompasses air and water pollution, deterioration of land quality, release of methane and dangerous leachate, and contribution to climate change (Abubakar et al., 2022).

Accordingly, the effectiveness of the SWM methods reported at Sikhunyani village is assessed about their ability to protect the receiving environment through the three pillars of sustainable development namely environmental, social and economic sustainability as emphasised in the 2005 World Summit Outcome Document. Chauke, Sobiyi and Mbohwa (2018) argue that the pillars of sustainability include preventing environmental degradation, pollution, preserving natural resources, as well as ensuring a sustainable social and economic system. Furthermore, it supports the development of a circular economy that encourages the reduction of finite resource

consumption, promotes the reuse and recycling of materials to eliminate waste, reduces pollution, saves costs, and encourages environmentally friendly economic growth (Abubakar et al., 2022). The pillars are intertwined and cut across (Cotter & Hannan, 1999; Basiago, 1999) and any pillar that weakens the whole management system ultimately becomes unsustainable (Chauke et al., 2018). The pillars must be in equilibrium and will imply that sustainability is achieved (https://repository.nwu.ac.za). Due to the challenges in attaining equilibrium, both local and global initiatives to address issues typically concentrate on individual pillars separately (Chauke et al., 2018). Furthermore, Chauke et al. (2018) argue that environmental sustainability is frequently regarded as the primary pillar as it directly affects human well-being and mitigates the consumption of natural resources, while economic sustainability is positioned as the secondary pillar. Basiago (1999) defines the concept of economic sustainability as production systems that meet current consumption levels without compromising future needs. Purvis, Mao, and Robinson (2018) posit that social sustainability encompasses various concepts such as fairness, empowerment, inclusivity, engagement, cooperation, cultural identity and institutional stability. It aims to protect the environment by promoting economic development and reducing poverty. Cotter and Hannan (1999) emphasise the importance of recognising and involving the community to achieve social sustainability and believe that communities play a crucial role in monitoring the environment for equal benefit to the future generation. To evaluate the sustainability of indigenous solid waste management in Sikhunyani Village, this study utilised the sustainability assessment methodology of the three pillars by Basiago (1999) and the significance appraisal outlined in the research conducted by Naidoo et al. (2013) presented in Table 4.2 and Table 4.3, respectively.

Table 4.2: Indigenous Waste Management Assessment Methodology

Element	Assessment Criteria
Environmental Sustainability	The variable must amongst other things support the development of a circular economy that encourages the reduction of finite resource consumption, promotes the reuse and recycling of materials to eliminate waste, reduces pollution, saves costs, and encourages environmentally friendly economic growth. Diversion to landfill was considered.
Economic Sustainability	Simplicity and cost-effectiveness are crucial factors when assessing the construction, operation, and maintenance of the systems. The study also considers the economic viability and the possibility of recovering costs associated with the practice.
Social Sustainability	Encompasses various concepts such as fairness, empowerment, inclusivity, engagement, cooperation, cultural identity and institutional stability. It aims to protect the environment by promoting economic development and reducing poverty.

Table 4.3: Indigenous Waste Management Assessment Methodology

Sustainability significance appraisal	
1 =Low	It is not likely to be sustainable.
2. Medium	It has the potential to be sustainable but will need to be adapted to the area.
3. High	It will be sustainable anywhere, regardless of any adaptations.

According to Naidoo et al. (2013), the importance of indigenous people and their practices in environmental management is becoming more recognized. Incorporating indigenous knowledge (IK) and practices could be the solution to various development challenges that municipalities face. This section evaluates the sustainability of significant indigenous solid waste management methods about their potential contribution to future waste management solutions. The viability of these methods is substantiated by prior research findings documented in the literature. Thirteen (13) indigenous methods that are used in Sikhunyani Village to manage solid waste are appraised below.

a) Animal feeding

Feeding food waste or leftovers and garden waste to animals is a commonly preferred waste management practice amongst the households in the study area. This is a sustainable alternative compared to other resources to feed animals with organic waste, which becomes raw material while diverting food waste from landfill (McBride, 2021). As far as social action is concerned, households in the study area donate food to households with livestock. The waste is collected in wheelbarrows and buckets to prevent greenhouse gas emissions caused by motor vehicles (McBride, 2021). Utilising organic waste on feedlots reduces financial expenses on raw materials for farmers and households while contributing to environmental conservation. Effectively, the community manages possible negative and positive impacts on both the environment and human beings. The method meets the full criteria of sustainability.

b) Composting

Composting remains the most common method of recycling organic waste such as ash, animal dung, animal parts, food and garden waste. For generations, household composting has been a sustainable means of diverting organic waste from landfills (Mihai & Taherzadeh, 2017). The composting of organic materials has many economic and environmental benefits such as reducing raw material volumes and weights, decreasing greenhouse gas emissions (Abu Qdais, Wuensch, Dornack, and Nassour, 2019), decreasing leachate quantities, lowering the cost of disposing of organic residues and preventing the loss of bio-waste as well as providing an income of compost being used as a substitute to chemical fertilizers (Ayilara, Olanrewaju, Babalola and Odeyemi, 2020). On the other hand, communal composting promotes social sustainability while improving the quality of soil (De Boni, Melucci, Acciani & Roma, 2022).

c) Backyard pit disposal

The backyard pit disposal of organic waste, such as food, garden, paper and animal parts, was found to be beneficial to sustainable composting at the research site (Kosoe, 2005). The pits are generally shallow and not intercepting groundwater (Ogheneriere and Chukwenye, 2017). The impact associated with methane is minimal, saves money to purchase manure and addresses the food security problem amid a global food crisis (Ayilara et al., 2020). Organic waste in landfills generates methane, a potent greenhouse gas and contributes to climate change (Ayilara et al., 2020). When the waste pits are full, the community cultivates crops in the composted area.

On the downside, households use backyard pits to dispose of inorganic waste such as glass, diapers, rubble, tins and cans, e-waste, medical waste and used car oils. Disposing of hazardous waste and other inorganic materials in an unsanitary pit is environmentally, socially and economically unsustainable. In Canada, backyard pit disposal is reported to have contributed to contributing to groundwater contamination, human health problems, and compromised water quality as per the Canadian Drinking water quality guideline (Zagozewski et al., 2011). Therefore, proper and environmentally sound management of landfills is essential for health purposes

(Triassi et al., 2015). Most studies also endorse the view that household waste composition is instrumental in determining the appropriate type of technology for waste processing and disposal (Visvanathan & Tränkler. 2003; Suthar & Singh, 2015; Dikole & Letshwenyo, 2020). This approach is considered partially sustainable due to the improper disposal of hazardous waste.

d) Burning

The results also show that the respondents burn garden waste, plastic material, disposable diapers, old rags, paper, food waste and animal parts. Burning garbage results in the emission of large amounts of greenhouse gases into the atmosphere, including particulate matter, carbon dioxide and methane, which are all often linked to air pollution and can have a serious adverse effect on respiratory health (Cogut, 2016). According to Abubakar et al. (2022), burning of SWM poses a significant threat to respiratory health, leading to a range of conditions such as infections in the nose, throat, and chest, inflammation, breathing challenges, anaemia, weakened immune system, asthma and allergies. Open rubbish burning releases several contaminants that are harmful, particularly to the elderly and children's development (Cogut, 2016). According to Fernandez-Marcos (2022), some contaminants wind up in ash, which may have an impact on the quality of the soil, groundwater and surface water. This approach consequently has a negative impact on all three pillars of sustainability.

e) Open dumping

Open dumps are also prevalent in Sikhunyani village. Households indiscriminately dispose of organic waste, including food waste, animal parts, ash, glass, diapers, tin cans and e-waste in such dumps. This unsanitary method has been a challenge facing communities of both developing and developed countries while the latter have been adversely affected. This method is not sustainable and is proven to negatively impact environmental quality, social and economic well-being (Izugbara and Umoh, 2004). Additionally, pollutants affect surface and groundwater bodies, cause air and land pollution and cause diseases spread by flies and mosquitoes, as well as impacting an area's aesthetics and ultimately affecting its economic activity (Zagozewski et al., 2011; Mihai & Taherzadeh, 2017). Open dumps are also linked to significant emissions of methane, which is a prominent greenhouse gas (Abubakar, 2022).

The prevalence of single use disposable diapers has been identified as a challenge in the study area, and imperative sustainable measures are required to manage them. During the structured interview, it was revealed that disposable diapers are indiscriminately dumped in open areas, burned and buried in the soil. These disposal methods result in the spread of communicable diseases such as cholera, cause aesthetic nuisance and release carcinogenic chemicals (Ntekpe, Mbong, Edem & Hussain, 2020), eventually threatening the health of humans and the environment. Remigios (2014) found that it takes approximately 500 years for disposable diapers to decompose, and as a result, they contaminate the environment for an extended period.

f) Flooring

The results show that households use cow dung for flooring to insulate the floor and suppress dust, thereby preventing airborne hazardous particles. Gupta, Aneja and Rana (2016) describe cow dung as a cheap and easily available bio-resource. Compared with conventional slab flooring, cow dung is a more economical and environmentally friendly option, especially in rural areas where road accessibility is a challenge. By using readily available resources that would otherwise be lost to the environment, this practice saves raw materials used in cement production (Abdul-Wahab, Al-Dhamri, Ram & Chatterjee2021). It is socially viable to use cow dung as a floor covering because it disinfects and protects humans from diseases (Gupta, et al., 2016), acts as a prophylactic agent and thus purifies the atmosphere (Dhama, Chauhan & Singhal, 2005). Furthermore, considering limited hazardous waste landfills in Limpopo Province, the method can reduce disposal costs. Therefore, this method is sustainable.

g) Repurposing

It is common for households to repurpose waste products into different products. Repurposed animal parts are used as ornaments and building rubbles for concrete aggregates and pavers. The economic characteristic of repurposing items is reducing the cost of utilising landfill sites and minimising the overall costs for ornaments, pavers and other building materials. Pourkhorshidi, Sangiorgi, Torreggiani and Tassinari

(2020) support the reuse of building aggregates and indicate that repurposing rubble is a sustainable approach to addressing environmental concerns. This has been shown to lower the carbon footprint, preserve natural resources and reduce harmful emissions. The method improves road accessibility. Households at the Sikhunyani Village also polish their floors with used car oils. Lam, Russell and Chase (2010) report that used car oil is an environmental hazard and a high-volume waste that has become a major concern for society. In the event it is disposed of hastily, soil, groundwater and surface water can be contaminated. To protect the environment, it is important to recycle and repurpose used motor oil. The carcinogenic nature of hydrocarbons and related lubricants may harm humans if they are ingested or through dermal contact. However, this happens only in high exposure levels. Conversely, these practices adhere to all the pillars of sustainability.

h) Trench backfilling

The community of Sikhunyani uses rubble to backfill foundations and road trenches. As a result, this method encourages social and economic activities due to increased accessibility to the area and reduces the cost of transportation to landfill sites to dispose of rubble. It is a zero-waste solution to boost the recycling of construction materials and support the circular economy (DFFE, 2020). This practice is sustainable as it reduces the use of raw materials such as soil and other building aggregates (Pereira & Viera, 2022 and Godfrey, 2021). In recent decades, recycling C&D waste in road pavement layers has been widely studied as a solution with economic and environmental benefits (Pereira & Viera, 2022).

i) Pit latrines disposal

Most of the households in Sikhunyani village disposed of ash in pit latrines. Ash disposed in latrines prevents odour (Aragie, Wittberg, Aiemjoy, Melo, Smith, Nash, Tadesse, Keenan, 2020) and acts as an absorbent that prevents overflow (Monney &Awuah, 2016). The benefit of this practice is that it prolongs the use of latrines and saves the cost of excavating new pits. Additionally, it reduces seepage into groundwater, thereby preventing contamination (Mamera, van Tol, Aghoghovwia, Mapetere, 2020). Due to its higher alkaline properties, ash lowers moisture in toilets and can raise excreta's pH (Naughton, Orner, Stenstrom & Mihelcic, 2019). A latrine

containing ash increases soil potassium levels and is a safe material when dry (Morgan, 2004). In addition, pit latrines can be used as secondary composting sites for human excreta and ash (Morgan, 2004). As reported by Boot (2007), the method provides sanitation while improving food security in areas with water shortages.

The pit latrines are also used to dispose of medical waste in the study area. Although disposing of medical waste anywhere other than in a sanitary landfill is hazardous, the method provides an interim solution to safe disposal due to the lack of hazardous waste disposal facilities in Limpopo Province. The method ensures that medical waste is disposed of safely, protecting children from exposure to harmful substances. In the long run, this practice hurts human health and the environment. Therefore, it is rated as partially sustainable.

j) Recycling and reusing

Recycling and reusing of glass, scrap metals, tins and cans and plastics are also prevalent. The practices create socio-ecological benefits such as diverting waste from landfills, extending landfill lifespans, reducing the use of raw materials during production (Dladla, Machete, & Shale, 2016), reducing energy consumption and economic costs (Bing, Bloemhof, Ramos, Barbosa-Povoa, Wong, & Van Der Vorst, 2016), while increasing household income. In addition to preserving value, recycling and reusing ensure that products remain valuable after their initial use (Bing et al., 2016). The community works collectively to segregate, reuse and recycle waste to achieve sustainable waste management. Consequently, it promotes the circular economy and creates a sense of belonging within a community while solving common environmental problems. Mihai & Taherzadeh (2017) conclude that the reuse and recycling of various items such as glass, plastic bottles, construction material and metal at the household level mitigate the potential amounts of waste uncontrolled disposed. These methods are sustainable and are top of the hierarchy of waste management.

k) Burying

The least frequent method of disposal, which is exclusively applied to the disposal of disposable diapers, is burying garbage. Women in Kenya also dig trenches in their

yards to bury diapers (Ntekpe et al., 2020). The most dangerous of all chemicals associated with cancer is found in disposable diapers (Ntekpe et al., 2020). Burying disposable diapers can contaminate groundwater and lead to the spread of contagious diseases like cholera. Because of the negative effects on the ecosystem, a study conducted in Bangladesh found that severe water pollution can severely reduce a river's capacity to support life by changing critical variables like pH and dissolved oxygen content (Halder & Islam, 2015). Thus, this method is unsustainable.

l) Unsanitary Landfill

The majority of solid waste in developing countries is disposed of in insanitary landfills or open dumps (Abubakar et al., 2022). The results of this study also revealed that households dispose of disposable diapers at landfill sites. According to Mangizvo and Mupindu (2012), disposable diapers represent about 4% of solid waste and are the third largest single consumer item in landfills which are discarded after a single use. These diapers pose a great burden on landfill sites and have a health-related impact on the environment (Mangizvo & Mupindu, 2012). According to the Greater Giyani Municipality Integrated Development Plan (IDP) (2020/21), the municipality has two solid waste disposal sites. The legal status of the old site is challenged since it does not adhere to the requirements of the Department of Environmental Affairs. The site is located at the confluence of Murhongolo and Klein Letaba rivers and waste material overflows and contaminates rivers thereby causing health hazards. Therefore, disposal at these landfills may be regarded as open dump disposal. Ogola, et al., (2011) also found that only 5% of the 5 million tons of waste produced each year are disposed of in sanitary landfills. This indicates that most of the country's waste is dumped in environmentally unsafe locations. Unsanitary landfills have numerous negative impacts on the environment and human health as open dumping (Malik, et al., 2015 and Abd'Razack et al., 2015). The improper disposal of waste, through open dumping and the utilization of low-technology landfill sites, pose severe environmental concerns. These practices result in high levels of pollution that directly impact nearby aquifers, water bodies and surrounding communities (Abubakar et al., 2022). The best model to dispose of waste is in a sanitary landfill equipped with a system for collecting and treating leachate (Visvanathan & Tränkler, 2003) and daily compaction. However,

this type of system is rare in many South African regions. The practice does not adhere to the pillars of sustainability.

As mentioned previously, the appraisal of 13 indigenous methods used by Sikhunyani village to manage solid waste was made based on three sustainability pillars. As shown in Table 4.2, only 7 of the indigenous methods fully meet sustainability requirements, 2 are partially sustainable as they meet one or two pillars, while 4 methods are not sustainable. The efficiency of the appraised waste management methods yields a positive review in that about 53.85% of the methods are compliant, about 15% are partially compliant and about 30% non-compliant. The Local Authority's intervention is required to assist the community in the safe disposal of waste that cannot be managed sustainably and to improve the partially compliant methods so that they become fully compliant through environmental education, capacity building and awareness. From the appraisal, disposable diapers were identified as a challenge in sustainable disposal of waste. This is supported by the findings of Ajibade (2007) who observed that IKS has not evolved to accommodate new types of waste and that waste production exceeds reuse and recycling rates. Kosoe et al. (2019) argue that IK can efficiently solve waste management challenges when incorporated into modern waste management systems.

Table 4.4: Sustainability appraisal of the 13 indigenous methods practiced at Sikhunyani Village

No.	Indigenous Methods	Sustainability Variables		
		Environmental Sustainability	Economic Sustainability	Social Sustainability
1.	Animal Feeding	3	3	3
2.	Composting	3	3	3
3.	Backyard pit disposal Organic Waste	3	3	3
	Backyard pit disposal Hazardous waste	1	1	1
4.	Burning	1	1	1
5.	Open dumping	1	1	1
6.	Flooring or repurposing	3	3	3
7.	Repurposing	3	3	3
8.	Trench backfilling	3	3	3
9.	Pit latrine disposal of Ash	3	3	3
	Pit latrine disposal of medical waste	1	1	1
10.	Recycling	3	3	3
11.	Reusing	3	3	3
12.	Burying	1	1	1
13.	Landfilling	1	1	1

Based on the appraisal or sustainability rating of the 13 indigenous methods of solid waste management practiced by the community in the study area, seven (7) indigenous methods are fully sustainable (Table 4.3), two (2) are partially sustainable (backyard disposal and the use of pit latrine toilets for waste disposal of hazardous materials) and the remaining four are unsustainable. Unsustainable methods include burning, open dumping, burying and landfilling. It can thus be inferred that there are

indigenous methods of solid waste management that can be learnt and adopted by the government from local communities, which are also sustainable. Similarly, there are also practices within communities that need improvements, modification, and further research for continuous improvements. Finally, observations and practice appraisals also reveal that some of the indigenous methods used in communities are completely detrimental and have negative social, economic or environmental impacts, such as the burning of tins, cans, diapers and bottles. Open dumps of diapers near waterbodies were observed.

Chapter 5 : Summary, Conclusion and Recommendations

5.1 Summary of Results

5.1.1 What Indigenous Knowledge is Prevalent in Sikhunyani Village?

From the various definitions, this study evaluated the variables that determine what constitutes indigenous knowledge. This provides a basis to make comparison to scientific knowledge. Using descriptive statistical analysis, this study managed to select the most frequently used characteristics of indigenous knowledge namely: it is locally developed; accumulated through experiences; it is a body of knowledge; it is influenced by culture; it is unique; it encourages socio-ecological interaction, it promotes sustainability, and it is a practice or skill or technique. The above characteristics served as the minimum criteria that were used to classify the knowledge or practices of communities as indigenous or not. From the top 8 variables identified by earlier studies, the results of this study confirm that 5 out of the 8 variables were identified by the population of Sikhunyani Village.

The study reveals the influence of language on non-Tsonga speaking respondents that may have resulted in the adoption of the traditions and cultures of Tsonga people thereby confirming that location plays a significant role in IK. Even though many in the study area profess to be Christians and are not believers in Traditional African Religion, the community still uses religion to transmit indigenous knowledge. As a result, the study was able to report that the knowledge is indigenous in origin. The result of the study posits that to a large extent, IK is acquired mostly from initiation schools. Therefore, cultural activities play a significant role in the transmission of indigenous knowledge.

Four primary variables were identified and examined in this paper, namely (1) the language of the household, (2) the language of the household head, (3) cultural activities in which household member(s) participate and (4) the religious beliefs. Sources of indigenous knowledge in Sikhunyane village include knowledge from formal education systems, religious practices that did not appear among the top elements of IK, initiation schools, culture, knowledge accumulated through life

experiences, knowledge transmitted from generation to generation, knowledge practised within the local community and transferred orally.

5.1.2 Characteristics of Waste Streams Generated

The study found that 98 households (89.8%) generate food waste. The consistency and presence of common waste streams can be discerned from both the literature and the findings about Sikhunyani Village. The most common waste generated is organic waste and the least common waste is hazardous waste. Packaging waste streams such as plastics, tins and cans and glasses are prevalent in the Sikhunyani Village and this is supported by earlier studies. The results show that Sikhunyani village is no different from other indigenous villages and communities in terms of the common waste streams generated by these communities. Another interesting observation is the rate at which ash is generated in the study area i.e., it is ranked second after organic waste.

5.1.3 Indigenous Methods of Solid Waste Management that are Practiced in Sikhunyane Village

Indigenous waste collection methods in Sikhunyane village include animal feeding, composting, backyard pit disposal, burning, open dumping, flooring, repurposing, trench backfilling, pit latrine disposal, recycling, reusing, burying and landfilling. Several methods are used per waste stream.

5.1.4 Sustainability of the Indigenous Methods of Solid Waste Management used in Sikhunyane Village

The study assessed the sustainability of indigenous methods of solid waste management in Sikhunyani village, Limpopo province, South Africa. Previous studies did not measure the sustainability of the indigenous methods used in their studies. It remains unknown whether the documented methods used in previous research have significant environmental, social and economic impacts. In this study, 13 indigenous waste management methods were identified by Sikhunyani village residents. Similarly, the effectiveness of 13 indigenous methods identified in the Sikhunyani village was evaluated about their ability to protect the environment through the three pillars of sustainable development. Of the 13 indigenous methods studied, 7 met the

requirements of sustainability fully, 2 partially met the requirements of sustainability and 4 methods did not meet the requirements of sustainability.

5.2 Conclusion

The study examined the sustainability of indigenous knowledge and waste management practices in a rural indigenous village in Sikhunyani, Limpopo Province. It also examined how these practices and knowledge could potentially be transferred and used by households in urban areas and formalized by local authorities (municipalities). There is a need for a change in solid waste management research (Panta, 2014). This can result in a situation where indigenous societies seek solutions to address community waste management problems through foreign ideas and knowledge that focus on technologies and complex systems that are costly and difficult to understand and sustain over the long term. Indigenous knowledge can address complex political, sociocultural, economic, environmental, and religious issues in transitional societies where resources are limited and technologies are not viable options, leading to sustainability concerns."

5.3 Recommendations

Due to rapid global transformations in society, culture, environment, economy and politics, there exists a substantial concern regarding the potential permanent loss of Indigenous Knowledge (IK). This issue is particularly prominent in Africa, where IK is primarily transmitted through oral storytelling from one generation to another, with limited documentation. As the African proverb aptly illustrates, the passing of an elder equates to the destruction of a valuable repository of knowledge. Documentation of Indigenous knowledge (IK) is essential for development as it preserves traditional identities, bridges the gap between the past and the present, and transforms survival techniques into practical strategies for adapting to a dynamic environment.

The empirical study recommended the provision of waste containers for municipal disposal of diapers at a sanitary landfill. Several community members noted that these diapers are impacting water resources and aesthetics due to pollution. To assist communities in improving non-sustainable solid waste management practices, government interventions are required. Particularly on the sustainable disposal of

diapers at sanitary landfill sites. Authorities can draft legislation that considers the effectiveness and sustainability of some IK-based methods of waste management in rural areas and adopt sustainable methods for implementation as an alternative to the existing municipal solid waste management system.

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APPENDIX A– TURNITIN REPORT

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The first page of your submissions is displayed below.

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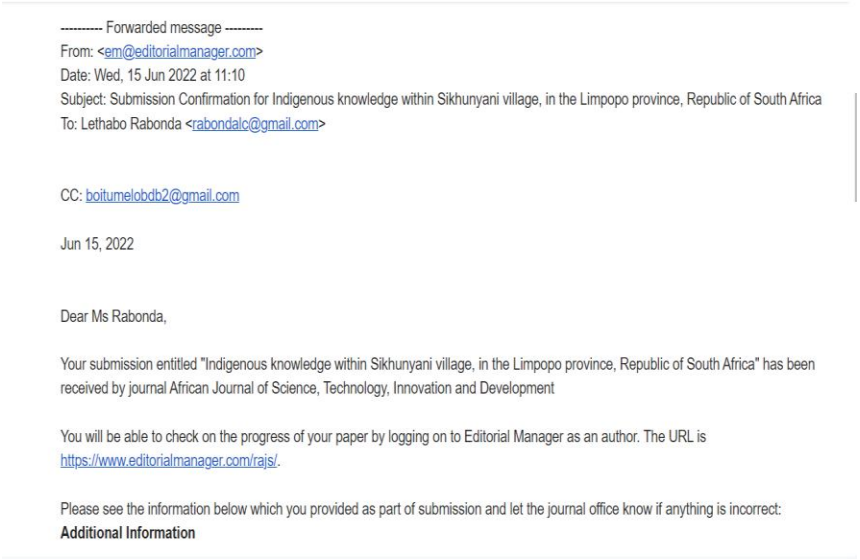
SUSTAINABILITY OF INDIGENOUS METHODS OF SOLID WASTE MANAGEMENT IN SIKHUNYANI VILLAGE, LIMPOPO PROVINCE, SOUTH AFRICA

By

Lethabo Caroline Rabonda

APPENDIX B– PROOF OF MANUSCRIPT SUBMISSION FOR PUBLICATION

Publication name: Journal African Journal of Science, Technology, Innovation and Development



---------- Forwarded message ---------
From: <em@editorialmanager.com>
Date: Wed, 15 Jun 2022 at 11:10
Subject: Submission Confirmation for Indigenous knowledge within Sikhunyani village, in the Limpopo province, Republic of South Africa
To: Lethabo Rabonda <rabondalc@gmail.com>

CC: boitumelobdb2@gmail.com

Jun 15, 2022

Dear Ms Rabonda,

Your submission entitled "Indigenous knowledge within Sikhunyani village, in the Limpopo province, Republic of South Africa" has been received by journal African Journal of Science, Technology, Innovation and Development

You will be able to check on the progress of your paper by logging on to Editorial Manager as an author. The URL is https://www.editorialmanager.com/rajs/.

Please see the information below which you provided as part of submission and let the journal office know if anything is incorrect:
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Publication name: Environmental Sciences Proceedings

[Environmental Sciences Proceedings] Manuscript ID: environsciproc-1966344 - Submission Received Inbox ×

Editorial Office <environsciproc@mdpi.com> Sep 27, 2022, 2:10 PM
to me, Lethabo, Machate

Dear Mrs. Rabonda,

Thank you very much for uploading the following manuscript to the MDPI submission system. One of our editors will be in touch with you soon.

Journal name: Environmental Sciences Proceedings
Manuscript ID: environsciproc-1966344
Type of manuscript: Editorial
Title: SUSTAINABILITY OF INDIGENOUS METHODS OF SOLID WASTE MANAGEMENT IN SIKHUNYANI VILLAGE, LIMPOPO PROVINCE, SOUTH AFRICA
Authors: Lethabo Caroline Rabonda, Machate Machate *
Received: 27 September 2022
E-mails: 46262903@mylife.unisa.ac.za, machef@unisa.ac.za

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APPENDIX C– CONSENT FORM AND QUESTIONNAIRE

PARTICIPANT INFORMATION SHEET

Ethics clearance reference number: REC-170616-051

Research permission reference number:2018/CAES/141

09-13 September 2019

SUSTAINABILITY OF INDIGENOUS METHODS OF SOLID WASTE MANAGEMENT IN SIKHUNYANI VILLAGE, LIMPOPO PROVINCE, SOUTH AFRICA

Dear Prospective Participant

My name is Lethabo Rabonda, and I am currently enrolled for a Master of Science in Environmental science at the University of South Africa (UNISA). For a successful research outcome, we are inviting you to participate in a study entitled Sustainability of indigenous methods of solid waste management in Sikhumyani Village in Limpopo Province, South Africa.

You were identified as a potential participant into this study because you're a resident of the community in which this study is conducted. The study has selected 155 households within the village to participate in this research project. The study involves survey (using *structured interviews and questionnaire) and observation of solid waste management sites.* The questions are appended on this document as appendix 1. You are requested to answer the questions during the structured interview that is expected to take 15-20 minutes maximum. Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason.

Participation in this study does not yield direct personal benefits to the participants. However, the result of the study helps the broader community by documenting the sustainable indigenous knowledge methods of solid waste management systems of used by households, increasing knowledge and assisting students to learn about local practices and systems and also offer the science community knowledge about the existence and impact of these systems in the provision of access to affordable basic services. There are no negative consequences to the participant for participating in this study.

Your name will not be recorded anywhere and that no one, apart from the researcher and identified members of the research team, will know about your involvement in this research. Your answers will be given a code number, or a fictitious name and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings. Anonymous data may be used for other purposes, such as a research report, journal articles and/or conference proceedings. Your privacy will be protected in any publication of the information.

Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet for future research or academic purposes; electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Hard copies will be shredded and/or electronic copies will be permanently deleted from the hard drive of the computer using a relevant software programme. There will be no payment made to participants for participating in this study and there will be no costs incurred by the participant for participating in this study.

This study has received written approval from the Research Ethics Review Committee of the College of Agriculture and Environmental Sciences, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish. If you would like to be informed of the final research findings, please contact Mrs Lethabo Rabonda on 0710849661 or Lethabo2008@gmail.com. Should you have concerns about the way in which the research has been conducted, you may contact the research ethics chairperson of the CAES General Ethics Review Committee, Prof EL Kempen on 011-471-2241 or kempeel@unisa.ac.za if you have any ethical concerns.

Thank you for taking time to read this information sheet and for participating in this study.

Thank you.

Ms. Lethabo Rabonda

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interview and taking photos of refuse disposal sites

I have received a signed copy of the informed consent agreement.

Participant Name & Surname…… (please print)

Participant Signature……Date……

Researcher's Name & Surname……please print)

Researcher's signature……..Date……

SURVEY

Demographics of the household	
1. Gender of household head	
2. Age of household head	
3. Highest level of education completed by the household head	
4. Employment status of household head	
5. Language spoken by respondent household head	
6. Household head (state his status in the household, e.g. father)	
7. Number of household members	
8. Number of household members completed grade 12	
9. Number of household members with post matric qualifications (high education qualifications)	
10. Total combined monthly household income	
11. Language spoken generally in the household (state if language changed over years), from which language to which language and why did the change happen	
12. Household culture (specify specific cultural activities that are practiced by the household)	
13. Household religion (state how long has this religion been practiced by the family)	
14. How long has this household existed in its current location?	
15. Where did this household been before its current location (state years in previous location)	
16. Has this household originated from another country (especially the household head(s), state the country of origin and the years. Give some ancestral history as far back as you possible can, with ages included.	

17. Does any household member participate in any cultural activities?	Y / N	If yes, specify the cultural activities: *you may tick more than one* a) Local Festival b) Volunteer activity for a charitable organization c) Traditional Dance and Festivities d) Local sporting event e) Poetry and show business f) Other, specify……
18. Does any household member participate in any environmental club?	Y / N	If Yes, specify the environmental or conservation clubs:

19. How does your household manage different waste materials (specify each waste type and how it is managed),i.e. food, garden, animal dung, builder's rubble, medical, diapers, household hazardous, e-waste (cell phones, ashes and etc)

Waste types	*How do you store?*	*How is it collected?*	*How is it processed or disposed?*
a)			
b)			
c)			
d)			
e)			
f)			
g)			
h)			
i)			

Please answer the following questions regarding the management of your waste

Item	Food Waste	Garden Waste	Animal Waste	Building Waste	Medical Waste including	Household Hazardous	Plastic and rubber waste products	E-Waste	Ash	Other, specify……
20. How long have you been using the waste management methods specified above?										

21. Other than through municipal collection, how could you prefer to management your waste as a community collectively			
Type of waste	*Storage*	*Collection*	*Disposal/treatment/recycling*
a) Xxx			
b)			
c)			
d)			
e)			

22. How did you learn this waste management methods mentioned above (chose the best in each)	
(a) Accumulated experience of life	
(b) Transferred orally	
(c) From generation-to-generation	
(d) Knowledge practiced within local community	
(e) Traits from religious practices	
(f) Cultural knowledge	
(g) Local initiation schools	
(h) Formal education	
(i) Other (specify)	

23. Any additional comments or inputs you would like to say in relation to the topic of this study

Thank you for your participation

APPENDIX D – ETHICAL CLEARANCE

UNISA university of south africa

CAES HEALTH RESEARCH ETHICS COMMITTEE

Date: 05/11/2018

NHREC Registration # : REC-170616-051
REC Reference # : 2018/CAES/141
Name : Ms LC Rabonda
Student # : 46252903

Dear Ms Rabonda

Decision: Ethics Approval from 01/11/2018 to 31/10/2019

Researcher(s): Ms LC Rabonda
LRabonda@environment.gov.za

Supervisor (s): Dr F Machete
machef@unisa.ac.za; 011-471-2075

Ms K Semenya
semerk@unisa.ac.za; 011-471-2138

Working title of research:

Documentation of indigenous methods of refuse disposal in Sikhunyani Village, South Africa

Qualification: MSc Environmental Management

Thank you for the application for research ethics clearance by the CAES Health Research Ethics Committee for the above mentioned research. Ethics approval is granted for a one year period. After one year the researcher is required to submit a progress report, upon which the ethics clearance may be renewed for another year.

Due date for progress report: 31 October 2019

Please note the points below for further action:

1. The researcher will gather indigenous knowledge, and is cautioned that there is a sensitivity involved in such research. Community protocol must be followed to get permission for the research, and local community/traditional leaders should be approached before data collection may commence. Furthermore, feedback to the community on the outcomes of the research is important. The researcher must give credit to the origin of the knowledge, and if any benefits accrue from this research the researcher must ensure that the community will share in them.

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2. The student has not signed the application form. A signed copy of the ethics application form must be submitted to the Committee for record purposes.
3. More detail is required on how participants will be selected. What is the inclusion/exclusion criteria that will be used?
4. The researcher mentions interviews but there is no interview guide. Can this be clarified?
5. There is a discrepancy between the number of participants mentioned in the consent form and in the application form. The application form indicates that there will be 155 households involved, whilst the consent form states that 357 households have been selected to participate. The researcher is requested to clarify the number of participants.
6. The researcher is cautioned that any photographs taken must not identify people, and that she must ask permission to take them.

*The **medium risk application** was **reviewed** by the CAES Health Research Ethics Committee on 01 November 2018 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original

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research. Secondary use of identifiable human research data require additional ethics clearance.

7. No field work activities may continue after the expiry date. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

*The reference number **2018/CAES/141** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

Prof MA Antwi

Chair of CAES Health REC

E-mail: antwima@unisa.ac.za

Tel: (011) 670-9391

Prof MJ Linington

Executive Dean : CAES

E-mail: lininmj@unisa.ac.za

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APPENDIX E – PERMISSIONS FROM AUTHORITIES

GREATER GIYANI MUNICIPALITY
RECORDS MANAGEMENT - RECEIVED
2018 -09- 07
PRIVATE BAG X9559 GIYANI 0826
TEL: 015 811 5311
MOPANI DISTRICT

UNISA university of south africa

Acknowledgement Receipt

Content: Letter- Request for permission to conduct academic research study at Sikhunyani Village under the jurisdiction of Greater Giyani Local Municipality in Limpopo Province, South Africa

I Sithole B.S declare that the letter to request permission to conduct research study at Sikhunyani Village has been delivered and received.

Organisation Name: Greater Giyani Municipality
Address: P/Bag X9559
Giyani
0826

Signature:
Date: 07/09/2018

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GREATER GIYANI MUNICIPALITY

OFFICE OF THE MUNICIPAL MANAGER

Enq : Nganyule RB
Tel : 015 811 5542
02/01/2019

To: Ms. Letabo Rabonda

Re: Request to conduct academic research in Greater Giyani Municipality in Sikhunyane village

The subject matter refers-

The Municipality hereby grants your request to conduct an academic research on Indigenous knowledge systems for rural waste management at Sikhunyane village. This approval is on the basis that the information to be collected during the research will be used for academic purposes only and that you will share the outcome of your study with the Municipality.

Do not hesitate to contact us for any further assistance in this regard.

Also contact and inform the Ward Councilor, Clr George Mthombeni at 073 914 5511 as well as the Ngove Tribal Council before you start with your fieldwork.

Regards,

Mzamani Khosa
Director Community Services

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Acknowledgement Receipt

Ethics clearance reference number: **2018/CAES/141**

Request for permission to conduct academic research study at Sikhunyani Village under the jurisdiction of Greater Giyani Local Municipality in Limpopo Province, South Africa

I, HEADMAN NKUNA declare that the letter to request permission to conduct research study at Sikhunyani Village has been delivered and received.

Organisation Name: NKUNA TRADITIONAL COUNCIL

Address: P.O. BOX 2587
GIYANI
0826

Signature: [signature]

Date: 19 APRIL 2019

DEPARTMENT OF CO-OPERATIVE GOVERNANCE HUMAN SETTLEMENT & TRADITIONAL AFFAIRS
HEADMAN NKUNA
SIKHUNYANI VILLAGE
19 APR 2019
P.O. BOX 2587 GIYANI 0826
MOPANI DISTRICT SUPPORT CENTRE
LIMPOPO PROVINCE

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Acknowledgement Receipt

Ethics clearance reference number: **2018/CAES/141**

Request for permission to conduct academic research study at Sikhunyani Village under the jurisdiction of Greater Giyani Local Municipality in Limpopo Province, South Africa

I, PHAZAMANI ELKAN CHABALALA declare that the letter to request permission to conduct research study at Sikhunyani Village has been delivered and received.

Organisation Name: HEADMAN CHABALALA

Address: STAND NO 93 SIKHUNYANI
P O BOX 5104
GIYANI
0826

Signature:

Date: 2019/04/16

HEADYAN CHABALALA
SIKHUNYANI BLOCK 20
MOPANI DISTRICT
2019 -04- 16
P. O. BOX 5104
GIYANI 0826
LIMPOPO PROVINCE

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