

**EXPLORING CHALLENGES AND INTERVENTION STRATEGIES FOR
HARVESTING MOPANE WORMS IN CONSERVATION AREAS: A CASE STUDY
OF SELECTED AREAS IN VHEMBE DISTRICT MUNICIPALITY.**

By

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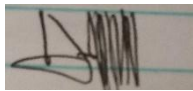
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2024

DECLARATION

I, **Dzhanngi Takalani Ernest**, hereby declare that this dissertation for Master of Arts in African Studies at the University of Venda hereby submitted by me, has not been submitted previously for a degree at this or any other University and that it is my own work in design and execution, and that all reference material contained therein has been duly acknowledged.

Signed (Student):



Date: 28 September 2024

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To the God Almighty, I would like to appreciate life and confident for believing in myself. I recognize His love, care and direction that managed to give me strength, positive mindset and surfaces the obstacles. My sincere appreciation and gratitude for having been kept in His shadow and empowered to reach to this level, and I view myself as extremely favoured.

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DEDICATION

I dedicate this thesis to my family for their guidance, love, motivation and support during this long journey of this study. To my mother Mrs Dzhanngi Mashudu and my father Mr Leornad Dzhanngi, I would truly like to thank them for incredible encouragement, financial support and for understanding the milestone goal that I intent to achieve. They encouraged me to focus and work hard to achieve my dream and I appreciate their inspirational words.

LIST OF ABBREVIATIONS AND ACRONYMS

IK	:	Indigenous Knowledge
IKS	:	Indigenous Knowledge System
NTP	:	Non-Timber Products
MW	:	Mopane Worm
FAO	:	Food Agricultural Organization
FMARD:		Federal Ministry of Agriculture and Rural Development

ABSTRACT

This study explored the challenges and intervention strategies for harvesting Mopane worms at *Ha-Gumbu*, *Matiyani*, and Bokmakieries Farm in the Vhembe District. It was observed that conservation areas in South Africa continued to use pesticides and deforestation, which could potentially lead to the extinction of Mopane worms. Pesticides were found to damage the leaves of Mopane trees, adversely affecting the mass production of Mopane worms. As Mopane worms are an indigenous staple crucial for local livelihoods, their decline poses significant concerns for the communities dependent on them. The overharvesting of Mopane worms without adequate ecosystem protection led to environmental unsustainability. This study highlighted the need for conservation areas to adopt alternative pest control methods and avoid deforestation to protect Mopane worm breeding habitats. The study was guided by the Afrocentricity Theory developed by Molefi Kete Asante in 2009, which emphasizes the recognition of African values and perspectives. A qualitative research design was employed, utilizing purposive and snowball sampling methods for selecting participants. Semi-structured interviews were conducted, and thematic data analysis was used to interpret the findings. Data saturation was achieved with the 13th participant. The study revealed that sustainable management and harvesting practices are essential for preserving Mopane worms for future generations. Implementing integrated pest management strategies and promoting conservation practices that do not compromise Mopane worm habitats are crucial for ensuring the long-term viability of Mopane worm populations. The study concluded that balancing conservation efforts with local economic needs is vital for the sustainable harvesting of Mopane worms. Effective measures must be taken to mitigate environmental impacts while supporting the livelihoods of the local communities.

Keywords: *Conservation, Harvesting, Indigenous food, Mopane worms, Sustainable management, Unsustainable.*

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CHAPTER 1

INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 INTRODUCTION

Mopane worms form part of the African indigenous people, with their roles visible in food security, livelihood, and health. In modern African indigenous communities, the Mopane worms are slowly disappearing due to several factors affecting their role or purposes in the lives of the African indigenous people. This chapter provides the introduction and background of the study. Therefore, this chapter aims to bring to light an overview of the study on challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas in the Vhembe District. In the introduction chapter, the study problem and significance of the study are provided, and an explanation is provided to explain why this study was conducted. The chapter also outlines the study aims, objectives, and questions that guided the study.

1.2 BACKGROUND OF THE STUDY

Many conservation areas have attempted to shift away from the narrow-minded and trade protectionism approaches that have characterised many of their histories toward a mode of thinking that embraces just and fair benefit-sharing processes and approaches, with a particular emphasis on rural neighbouring (Pimbert & Pretty, 1997; Brockington, 2002). Most conservation areas, such as private game parks and farms, continue to use pesticides to eliminate pests. These pesticides may harm the tree leaves of Mopane trees, resulting in a negative effect on Mopane worm mass production due to a lack of leaves on which the Mopane worms can survive (Kwiri et al., 2014). Mopane worms are called caterpillars of the emperor moth 'Imbrasia Belina,' and they feed on the leaves of the Mopane tree (Makhado et al., 2014). Trees, including *Carissa grandiflora*, *Diospyros*, *Ficus*, *Rhus*, *Sclerocarya caffra*, *Terminalia*, and *Trema*, are breeding grounds for Mopane worms. There is a need to implement

measures in conservation areas to develop alternate pest eradication methods and avoid deforestation that does not harm Mopane worms' breeding trees.

A literature review reveals that unsustainable commercial harvesting techniques are being used. According to Mufandaedza (2015), there are no laws and procedures for harvesting Mopane worms in Zimbabwe's rural districts of Chikombedzi and Mwenezi, threatening their supply. Similar observations have been made in South Africa. Toms (2003), for example, conducted a study on Mopane worm harvesting techniques in Limpopo Province and discovered that sustainable harvesting was not practiced. According to the findings of a study conducted by Togarepi (2020), human-induced factors like deforestation and overharvesting endanger the existence of Mopane worm populations by contributing to their decline.

Mufandaedza (2015) contends that poverty is the motivation behind Mopane worm overharvesting at the expense of environmental sustainability. Literature calls for a sustainable collection of Mopane worms to safeguard and conserve this resource. Sustainable harvesting practices enable population levels to be maintained or even increased over time (López-Hoffman et al., 2006). The challenge of establishing sustainability grows in direct proportion to the intensity and frequency with which resources are harvested (Belcher & Schreckenberg, 2007). As a result, various parties must work together to address this dilemma. A balance between forest resource consumption and sustainability must be the mandated sustainable harvesting practices.

Mopane worms are traded in rural and urban markets rather than harvested for subsistence. The rising relevance of Mopane worms in the urban diet has resulted in the insect's overexploitation. Unless this common property food resource is maintained sustainably, for example, the use of pesticides in private parks and farms, which could negatively influence Mopane worms' mass production, there could be deficient populations and market failure for the crop. Numerous studies have been done on Mopane worms, such as those by Mataboge, Mulaudzi, Wenhold, Nkunika, Dlamini, and Alders (2016) and Sekonya (2016) on the use of Mopane worms, livelihoods, and environmental change in Limpopo Province, South Africa. However,

no known studies have attempted to investigate and develop intervention strategies that may be used for harvesting Mopane worms in conservation areas.

1.3 PROBLEM STATEMENT

Most African communities, such as Vhavenda and Vatsonga, depend on *Mopane* worms as a viable source of food and income. It has been noted that from time immemorial, there has been a relationship between man and nature (Seymour, 2016). Additionally, it is rumoured that populations in the Vhembe District Municipality of Limpopo Province had long-standing socioeconomic reliance on *Mopane* worms. Researchers have shown that Mopane worm populations are declining in Southern Africa's most populous regions, and they urge sustainable resource management and harvesting (Ngwenya et al., 2021; Togarepi et al., 2020; Baiyegunhi et al., 2016; Maviya & Gumbo, 2015; Makhado, 2008). According to Mufandaedza (2015), the failure to protect the ecosystem results from Mopane worm overharvesting at the expense of environmental sustainability. Conservation areas may lead to a decline in Mopane worms because most conservation areas practice tree deforestation and use pesticides to eradicate pests in their private farms or parks, which could harm Mopane worm production.

This study sought challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas. Sustainable harvesting prevents further depletion of this resource and maintains population levels. Many conservation initiatives or projects have neglected the benefits of Mopane worms, exposing impoverished rural communities to socioeconomic issues (Makhado et al., 2009). Furthermore, this study seeks to address a gap in the literature on challenges and strategies for harvesting Mopane worms in conservation areas.

1.4 AIM OF THE STUDY

The study sought to challenges and intervention strategies that may be used for harvesting Mopane worms in Ha-Gumbu, Matiyani, and Bokmakieries farm in Vhembe district conservation areas.

1.4.1 Objectives of the study

The study sought to achieve the following objectives:

- To discover challenges faced by harvesters of Mopane worms in conservation areas
- To determine the challenges affecting conservation areas with unsustainable harvesting of the Mopane worms
- To establish strategies that may be used for harvesting Mopane worms in conservation areas

1.4.2 Research questions

To achieve the above objectives, the study attempted to answer the following research questions:

- What are the primary challenges faced by harvesters of Mopane worms in conservation areas?
- What are the challenges affecting conservation areas with unsustainable harvesting of the Mopane worms?
- What strategies may be used for harvesting Mopane worms in conservation areas?

1.5 SIGNIFICANCE OF THE STUDY

A growing body of data suggests that Mopane worms are a traditional cuisine eaten by many in Southern African nations like Botswana, South Africa, Zimbabwe, and Namibia. Due to issues related to human activity and climate change, the Mopane worm population is falling (Ngwenya et al., 2021; Togarepi et al., 2020; Baiyegunhi et al., 2016; Maviya & Gumbo, 2015). Overharvesting, which suggests that individuals

are engaging in unsustainable harvesting, is one of the prominent human actions causing this resource's decline.

The study may enable ethical harvesting of Mopane worms and sustainable harvesting in conservation areas. Rural households could use this resource to support their livelihoods, which benefits the environment (Makhado et al., 2014). This study aims to explore intervention strategies that may be used for harvesting Mopane worms in conservation areas on Bokmakieries farm and provide recommendations on sustainable harvesting methods. The research findings may aid in implementing rights for access to natural resources such as Mopane worms, from conservation areas where villagers in Bokmakieries farm can harvest Mopane worms. This study may supplement existing knowledge on sustainable conservation strategies for harvesting Mopane worms.

1.6 DEFINITION OF KEY TERMS

The following are the definitions of the study's key terms:

1.6.1 Indigenous knowledge systems

According to Mapara (2009), Indigenous knowledge systems mean cultural, traditional, and local knowledge unique to a particular group, society, or culture. Tharakan (2017) also defines Indigenous knowledge systems as the understanding of skills and philosophies developed by societies with long histories of interaction with their natural surroundings. In this study, Indigenous knowledge systems are a basis of local knowledge adequate for traditional food, which is culturally acceptable.

1.6.2 Unsustainable harvesting

The overharvesting of a resource to the point where it can no longer replenish the population level naturally (López-Hoffman et al., 2006). However, Hoffman (2006) defines unsustainable harvesting as harvesting that does not allow population numbers to be maintained or increase over time. In this study, Mopane worms can be

sustained by using cultural norms and principles to prevent overharvesting, as the species are mostly seasonally available.

1.6.3 Indigenous food

According to Ayanwale (2016), indigenous food refers to foods originating in a particular bioregion and other foods introduced from other countries. Kennedy (2021) defines indigenous foods as locally grown or produced foods that are either artificial or processed. In this study, indigenous food is referred to as Mopane worm.

1.6.4 Mopane worms

Mopane worms are referred to as caterpillars of the emperor moth *Imbrasia Belina*,” and they feed on the leaves of the Mopane tree (Makhado et al., 2014), whilst Mufandaedza (2015) defines Mopane worms as edible caterpillars that feed on Mopane leaves.

1.6.5 Livelihoods

A livelihood comprises capabilities, assets, and activities that are required for a means of living (Serrat, 2017). Mufandaedza (2015) defines livelihoods as the full range of means that individuals, families, and communities utilize to make a living, such as wage-based income in agriculture, fishing, foraging, other natural resource-based livelihoods, petty trade, and bartering.

1.7 DIVISION OF CHAPTERS

This section provided the division of the study chapters. This study consists of the following five chapters:

Chapter 1: Introduction and Background to the Study

This chapter introduced the study. It stated the research aim, objectives, and research questions. This chapter further outlined the following: problem statement, significance of the study, research methods, ethical considerations, and definition of terms.

Chapter 2: Theoretical Framework and Literature Review

Topics that were dealt with included the life cycles of Mopane worms, and the areas where Mopane worms are found in Vhembe. These strategies may be used for harvesting Mopane worms in conservation areas, and the challenges affecting conservation areas with unsustainable harvesting of the Mopane worms. This chapter also dealt with the theoretical framework employed in this study.

Chapter 3: Research Methodology

The research methods that were used by the researcher are discussed in this chapter. The focus was on the research paradigm, data collection methods, data analysis methods, sampling strategies, limitations of the study, and ethical considerations.

Chapter 4: Data Presentation and Analysis

This chapter presented and analysed the collected data. The analysis was guided by the research objectives. The data findings emerged from thematic analysis was discussed in this section.

Chapter 5: Summary, Recommendations, and Conclusion

This chapter concluded the research. A summary of the findings was given, suggested recommendations were stated, and last, a conclusion was made.

CHAPTER 2

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 INTRODUCTION

In the previous chapter, the introduction and background of the study were provided. In this continuous chapter, the central point is the study's theoretical framework and literature review. The first section of the chapter is the theoretical framework, which outlines Afrocentricity as the theoretical framework underpinned by the current study. The second section of the chapter is the literature review, which provides scholarly or literature debates on the challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas.

2.2 THEORETICAL FRAMEWORK

The theory is defined as a systematic explanation that provides a better understanding of any phenomenon (Grant & Osanloo, 2014). According to Amanda (2014), a theory mainly includes the explanation of any phenomenon with the predictions of what may be expected. In other words, theories are used to extend the researchers' understanding of the phenomenon being researched. According to Anfara and Mertz (2014), the application of a theory in research is known as the theoretical framework, which mainly refers to a group of collective ideas that the researchers adopt to guide their study. In addition, Anfara and Mertz (2014) state that the purpose of a theoretical framework is to lay a foundation for the research problem being researched. Therefore, the theoretical framework of this study is underpinned by Afrocentricity Theory that was adopted to provide a more profound understanding of the challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas of Vhembe district in Limpopo province.

2.2.1 Afrocentricity Theory

This study is grounded in the Afrocentricity Theory developed by Molefi Kete Asante in 2009. According to Asante, Afrocentricity is an approach that prioritizes African interests, values, and perspectives, emphasizing the importance of African historical narratives in the development of the continent (Asante, 2009). This cultural worldview encourages Africans to take pride in their heritage and indigenous knowledge systems, recognizing their significance in contemporary society.

Afrocentricity is particularly relevant to this study due to its relationship with Mopane worms, a vital resource in many African diets. The theory underscores the need for African Indigenous groups to honour and utilize their traditional ecological knowledge, which includes sustainable practices surrounding the harvesting of Mopane worms. This resource not only provides nutritional benefits but also plays a critical role in the cultural identity of various communities.

However, the increasing demand for Mopane worms has led to unsustainable harvesting practices within these communities, threatening both the resource and the traditional ways of life. By adopting the Afrocentricity framework, this study seeks to highlight the necessity of integrating African indigenous knowledge systems into resource management strategies, promoting sustainability and cultural pride. Ultimately, this approach aims to empower local communities, ensuring that their voices are central to discussions about conservation and resource use.

2.3 LITERATURE REVIEW

A literature review is defined as an academic assessment that involves the critique and analysis of recent and old literature (Snyder, 2019). According to Randolph (2019), a literature review can be defined as a systematic review of literature from already published works in relation to the study at hand or the study being conducted. This implies that a literature review mainly involves a critical assessment of the literature in relation to the new study that is to be conducted. Frank and Hatak (2014) state that the main aim of the literature review is to identify gaps in the field of research

that the researchers are embarking on. Thomas et al. (2020) further added that the aim of the literature review is to identify the gaps that the researchers may use to build their study. In support of this, Snyder (2019) posits that a literature review is used by the researchers as a foundation of their studies. In a more straightforward manner, the literature review is used to identify trends or gaps in a phenomenon that the researchers want to research. Thus, in this study, the literature review focused on the old and recent literature on challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas.

2.3.1 Mopane worms

Mopane worms are one of the indigenous biodiversity which cannot be separated from the African indigenous people. According to Bara et al. (2022) Mopane worms are known as caterpillars and their scientific name is *Gonimbrasia belina*. Several studies such as Shen et al. (2023) and Nemadodzi et al. (2023) have highlighted that the origin of the Mopane worms is from the Southern part of Africa in countries such as South Africa, Botswana, Zimbabwe, Malawi, and Mozambique. Hence these worms have been part of the indigenous biodiversity for these Southern African indigenous communities.

According to Bara et al. (2022) Mopane worms cannot be found in any areas; therefore, these worms are mostly hosted or found in specific trees namely the Mopane tree (*Colophospermum*). The tree is found in the Southern Africa countries. The tree has many other purposes such as firewood and making fence (Makhado et al., 2014). Despite these purposes, the Mopane tree is known as the primary host for the Mopane worms.

Several studies such as Madimutsa et al. (2023) and Bara et al. (2022) highlighted that Mopane worms appear seasonally; therefore, it is not all the time that these worms can be seen. In their studies Bara et al. (2022) and Manditsera (2022) accentuate that Mopane worms are mostly found during the rainy season which is mostly around November to January depending on the climate changes. Bara et al. (2022) added

that it is during the rainy season that the African indigenous communities get to see the Mopane worms.

2.3.2 The role of Mopane worms in African indigenous communities

Mopane worms have always been reliant on Mopane worms for several purposes. According to Baiyegunhi et al. (2016), the African indigenous people treated Mopane worms as their indigenous biodiversity that was worthy for protection because of the benefits it has for them. Even in this contemporary African indigenous communities, Mopane worms continuous to play a critical role for the African indigenous communities. The roles of the Mopane worms reviewed includes food security, livelihood and nutritional benefits.

2.3.3 Food security

Mopane worms are one of the famous traditional dishes for the African indigenous people. Baiyegunhi et al. (2016) posits that Mopane worms have been used by the African indigenous people as a cornerstone for food security. This implies that through Mopane worms, the African indigenous people ensured that they are food secured. According to Nantanga and Amakali (2020), during the season of the Mopane worms, they would be harvested in bulk with the intention of saving them throughout the year. This implies that since the Mopane worms cannot be harvested throughout the year, therefore, to remain food secured, they would be harvested in large quantities with the aim of food secured until the next harvesting season.

In their study, Kwiri et al. (2020) noted that to effectively use Mopane worms as a food security, several indigenous practiced were put in place to ensure that the Mopane worms remain available all the time. Kumirai (2017) alludes that sun-drying was and remains one of the most reliable indigenous methods that ensured long preservation of the Mopane worms. Stack et al. (2003) mentions that after harvesting, all the Mopane worms would be cooked and be exposed to the sun for them to dry which is a period that can take some days depending on the sun exposure or availability. According to Kumirai (2017) the purpose of sub-drying is to prevent decay of the worms by getting rid of the moist on the worms. In doing this, the Mopane worms can be

preserved for more than a year. In simpler words, such method allows the African indigenous communities to be food secured throughout the year.

2.3.4 Livelihood

The role of Mopane worms is also visible in the livelihood of the African indigenous people. According to Manditsera et al. (2022) Mopane worms serve as a crucial income source for many rural households, particularly during lean seasons when other food options may be scarce. As urbanisation increases, demand for Mopane worms in cities has also risen, impacting prices and accessibility for rural harvesters (Chisango et al., 2022). In other words, the Mopane worms are also sold in urban areas where they are scarce. This also explains that to those who are unable to make an income, Mopane worms is another opportunity for them to generate an income for themselves. In addition to this, Kozanayi et al. (2002) also highlight that by selling Mopane worms to outsiders, the African indigenous communities are boasting their economy.

2.3.5 Nutritional benefits

Like many other consumable or edible foods, Mopane worms have the nutritional values which are essential for the African indigenous people or anyone eating these worms (Mnisi et al., 202). Mnisi et al. (2022) state that although Mopane worms may not necessarily in the same group with meat, they are rich in protein which is good for human bones and muscle development. This implies that Mopane worms have proteins that are similarly found in meat.

In their study, Chiripasi et al. (2013) reveal that Mopane worms are a source of calcium and iron which are known for maintaining strong bones and teeth. In support of this, Mnisi et al. (2013) highlight that Mopane worms may be considered small but their ability to produce protein is good for maintenance of a human body. Chiripasi et al. (2013) added that food is considered a medicine, therefore, the same applies to the consumption of Mopane worms they could also be consumed to restore some tissues in a human body.

2.3.6 The areas where Mopane worms are found in *Vhembe*

The areas that consist of Mopane worms in Vhembe district, are *Matiyani, Zwigodini, Mphambo, Masisi, Ha-Gumbu* and Bokmakierie (Sekonya, 2017). These areas focus on sustainable harvesting of Mopane worms to rural livelihoods. The impact, result in limitations in the density of Mopane trees, vegetation changes and environmental change that had a significant impact on the availability of Mopane worms to the communities (Maviya & Gumbo, 2005).

Sekonya (2017) indicates that more studies will be required, in addition to improve relationship between traditional leaders, harvesters and local government as an option for management of the communal harvesting areas to ensure that Mopane worm populations do not decline any further. Often, the uncertainty which derives from such category for implementation tends to weaken local level resource management (Ainslie, 1999, Makhado et al., 2012). These worms thrive in Mopane woodlands, particularly in areas like the Kruger National Park and the surrounding regions of Thohoyandou and Tshikota, where Mopane trees (*Colophospermum Mopane*) are abundant (Kora et al., 2016). During the rainy season, local communities people harvest these worms for food, contributing to both nutritional diversity and local economies (Moleele et al., 2003). This traditional practice not only highlights the sustainable use of natural resources but also reflects the deep cultural ties that local people have with their environment (Chanda et al., 2016).

2.3.7 Challenges affecting conservation areas with unstainable harvesting and management of Mopane worms

Literature shows that climate change and human activities such as deforestation, as well as overharvesting, contribute to the decline of Mopane worms. These factors are discussed in the following section.

2.3.7.1 Overharvesting

Overharvesting of Mopane worms has contributed to the decline of this forest resource. The reasons for overharvesting include food shortages that causes a demand in food supply and trading of Mopane worms to generate income (Mataboge et al., 2016; Baiyegunhi et al., 2016; Yen, 2015). This is the result of absence of harvesting guidelines or regulations, or even failure to implement them, therefore, trading of the resource has increased and intensified harvesting competition among the local and outsiders (Mataboge et al., 2016). Ultimately, this also affects the worms' life cycle (Mataboge et al., 2016). In other cases, overharvesting results in the destruction of the Mopane trees (Maviya & Gumbo, 2005) and this threatens the survival of the remaining worms. The problem has elevated areas that used to have the resource in abundance while they have not experienced any outbreak for some time (Togarepi et al., 2020; Gondo et al., 2010; Akpalu et al., 2009).

2.3.7.2 Deforestation

A survey of literature show that uncontrolled harvesting of forest products has increased in South Africa and this in some instances lead to deforestation (Yen, 2015; Thomas, 2013). Activities that lead to deforestation include cutting down of trees including the Mopane trees to clear land that is needed for crop production, the trees are a source of firewood, the trees are also used for fencing and in construction of houses (Nikodemus & Hájek, 2015; Makhado et al., 2014). Deforestation destroys the host trees and in turn the leaves that are consumed by Mopane worms (Togarepi et al, 2020). In the end, the worm will not survive as there will be no more food to consume at the same time population regeneration will be affected, thus, threatening extinction of the resources (Mataboge et al, 2016).

2.3.7.3 Bush fires

Bush fires take place both within and outside urban areas that can extend widespread all over (Masona, 2013). The bush fire tends to be difficult to prevent from occurring, but proper mitigation can minimize the disaster on human and environment. Bush fires

have influence on reducing the Mopane woodland and as a result browse quality is reduced and this reduces the population decline (Togarepi et al., 2020; Senkonya, 2016; Chidumayo & Mbata, 2002). However, there have been attempts to conserve woodlands to maintain a balance between harvesting and conservation (Baiyegunhi et al., 2016).

2.3.8 African context on challenges of Mopane worm harvesting

In Africa, Mopane worm harvesting is confronted by additional region-specific challenges, many of which are linked to socio-economic, environmental, and policy-related factors. In Southern Africa, habitat loss due to agricultural expansion, urbanization, and deforestation has led to a reduction in Mopane woodlands, the primary habitat for Mopane worms (Hope et al., 2009). Overgrazing by livestock and the conversion of woodlands into farmland further exacerbate this issue, resulting in the decline of Mopane worm populations.

In regions like Zimbabwe, South Africa, and Namibia, erratic weather patterns, prolonged droughts, and unpredictable rainy seasons have affected the life cycle and abundance of Mopane worms (Chidumayo & Mbata, 2002). Drought conditions can significantly reduce the availability of Mopane leaves, which the larvae feed on, thereby affecting their survival and growth. In many African countries, Mopane worms are harvested without regard to their breeding and life cycles, leading to overharvesting. Often, collectors harvest the worms at all stages of development, including the eggs, which disrupt the reproductive cycle and leads to population decline (Raphela et al., 2021). Unsustainable harvesting practices, such as cutting down entire branches or trees to collect the worms, further damage the environment.

Mopane worm harvesting is an essential livelihood strategy for many rural communities. However, socio-economic challenges such as poverty, lack of alternative income sources, and limited access to markets can lead to overdependence on this resource (Stack et al., 2003). Cultural factors, including traditional harvesting practices, may not always align with sustainable management, posing additional challenges. The lack of formal regulations and policies governing

Mopane worm harvesting in many African countries has contributed to unsustainable practices. While some countries have attempted to implement community-based management systems, enforcement is often weak due to limited resources, lack of awareness, and socio-political dynamics (Hope et al., 2009). There is also a need for regional cooperation, as Mopane worms migrate across borders.

2.3.9 Challenges of harvesting Mopane worms in different African countries

Mopane worms (*Imbrasia belina*) are a crucial food source and income generator for communities across Southern Africa. Countries such as Botswana, Zimbabwe, Namibia, South Africa, and Zambia rely on these caterpillars, which are rich in protein and other nutrients. However, harvesting Mopane worms faces several challenges that vary across different African countries. These challenges stem from environmental, socio-economic, cultural, and policy-related factors.

2.3.9.1 Botswana

In Botswana, Mopane worms are highly valued both culturally and economically. However, their harvesting is beset by challenges such as overharvesting, environmental change, and unsustainable practices. Overharvesting is a major concern in Botswana, where Mopane worms are collected not just for local consumption but also for commercial purposes. Intensive harvesting, often without consideration for the breeding cycles of the worms, has led to a noticeable decline in their population (Makhado et al., 2009). The cutting down of Mopane trees during the collection process also results in habitat destruction, further threatening the sustainability of Mopane worm populations.

Botswana's semi-arid climate is characterized by frequent droughts and erratic rainfall patterns, which significantly impact the availability of Mopane worms. Prolonged dry seasons can reduce the growth of Mopane trees, the primary food source for the worms, leading to lower harvest yields (Hope et al., 2009). Climate change is thus a critical factor affecting Mopane worm populations in Botswana. Despite the significance of Mopane worms, Botswana lacks comprehensive policies regulating

their harvesting. Although some community-based management initiatives exist, their effectiveness is limited by a lack of enforcement and awareness among local harvesters (Stack et al., 2003).

2.3.9.2 Zimbabwe

Mopane worms are an essential part of rural livelihoods in Zimbabwe, providing a significant source of income and nutrition. However, the harvesting of these worms is challenged by ecological, socio-economic, and policy factors. The degradation of Mopane woodlands due to agricultural expansion and deforestation has affected the availability of Mopane worms in Zimbabwe. Habitat loss, combined with overgrazing by livestock, has led to a decline in Mopane worm populations (Gondo et al., 2010). Additionally, changes in land use practices have encroached on Mopane woodlands, limiting the natural habitat of these caterpillars. Zimbabwe experiences extreme weather conditions, including droughts and flooding, which can adversely affect Mopane worm populations. Erratic rainfall patterns disrupt the breeding cycle of Mopane worms, resulting in lower harvests (Chidumayo & Mbata, 2002). This climate variability poses a significant challenge to sustainable harvesting. Due to poverty and limited economic opportunities in rural areas, there is a heavy reliance on Mopane worms for income generation. This dependence often leads to overharvesting and unsustainable practices, as communities prioritize immediate economic gains over long-term sustainability (Musundire et al., 2016).

2.3.9.3 South Africa

In South Africa, especially in the Limpopo and Mpumalanga provinces, Mopane worms are not only a traditional food source but also a commercial commodity. The challenges to harvesting them in this context include socio-economic, environmental, and regulatory issues. Like Botswana and Zimbabwe, South Africa faces the problem of overexploitation of Mopane worms. Harvesters often collect worms in large quantities without leaving enough to mature and reproduce. Habitat degradation due to land clearing for agriculture and deforestation has further reduced the natural habitats of Mopane worms (Makhado et al., 2009).

In some cases, harvesters use unsustainable methods such as cutting down entire Mopane trees to collect the worms, which leads to a loss of Mopane woodlands. Such practices not only threaten the survival of Mopane worms but also result in ecological imbalances (Raphela et al., 2021). South Africa lacks specific policies governing the sustainable harvesting of Mopane worms. Although there are general environmental conservation laws, there is no targeted regulation to ensure sustainable practices in Mopane worm harvesting. This lack of regulation makes it difficult to control overharvesting and promote conservation efforts (Stack et al., 2003).

2.3.9.4 Namibia

Namibia, with its vast Mopane woodland areas, has traditionally been a significant site for Mopane worms harvesting. However, challenges persist in the sustainable use of this resource.

Namibia's arid and semi-arid climate makes it particularly susceptible to the effects of climate change. Prolonged droughts and desertification have adversely affected Mopane woodlands, leading to a decline in Mopane worm populations (Kashweka & Kasese, 2007). Additionally, deforestation and land degradation further threaten the worms' habitats.

Mopane worm harvesting is often a community activity in Namibia, but socio-economic pressures can lead to overharvesting. The commercialization of Mopane worms has resulted in increased competition among harvesters, sometimes leading to conflicts and unsustainable practices. Moreover, cultural practices that do not align with sustainable harvesting can exacerbate these challenges (Stack et al., 2003).

2.3.9.5 Zambia

In Zambia, Mopane worms are an important food source, but several challenges hinder sustainable harvesting. In Zambia, overharvesting due to increased demand has been a critical issue. The lack of effective management strategies and community awareness about sustainable practices has led to a decline in Mopane worm

populations (Chidumayo & Mbata, 2002). The climate in Zambia, particularly in the regions where Mopane worms are found, is characterized by unpredictable rainfall patterns. This variability affects the availability of Mopane worms and the timing of their life cycle, complicating harvesting efforts (Hope et al., 2009).

The challenges of harvesting Mopane worms in different African countries are multifaceted, involving environmental, socio-economic, cultural, and regulatory factors. Overharvesting, climate change, habitat destruction, and lack of effective management are common issues across Botswana, Zimbabwe, South Africa, Namibia, and Zambia.

2.3.10 Challenges for harvesting Mopane worms in different provinces in South Africa

Mopane worms (*Imbrasia belina*) are a significant source of food and income for many communities in South Africa. The harvesting of Mopane worms is particularly prevalent in the Limpopo, Mpumalanga, and Northwest provinces, where Mopane woodlands provide the primary habitat for these caterpillars. However, each of these provinces faces unique challenges related to the sustainable harvesting of Mopane worms. These challenges include environmental, socio-economic, and regulatory factors.

2.3.10.1 Limpopo Province

Limpopo Province is one of the key provinces in South Africa where Mopane worm harvesting is deeply embedded in local traditions and economies. The province's semi-arid climate and extensive Mopane woodlands provide an ideal environment for Mopane worms. However, several challenges affect sustainable harvesting in this region.

In Limpopo, overharvesting is a significant challenge. The increasing demand for Mopane worms as a food source and commercial commodity has led to intensive harvesting practices. Often, harvesters collect worms at all stages of development without allowing enough time for them to complete their lifecycle and reproduce

(Makhado et al., 2009). Unsustainable practices, such as cutting down entire branches or even whole Mopane trees to collect the caterpillars, exacerbate the problem, resulting in habitat destruction and declining Mopane worm populations.

(a) Climate variability

Limpopo's climate is characterized by erratic rainfall patterns and frequent droughts, which significantly impact the availability of Mopane worms. Dry conditions can limit the growth of Mopane trees, reducing the food supply for the caterpillars. Climate variability also affects the timing of the worms' breeding cycle, leading to inconsistent harvest seasons (Raphela et al., 2021).

(b) Socio-economic pressures

Rural communities in Limpopo Province heavily depend on Mopane worms for both nutrition and income. The commercialization of Mopane worms has increased the pressure on natural resources, leading to competition among harvesters. This competition can lead to overexploitation, as individuals focus on short-term economic gains rather than long-term sustainability (Toms & Thangwana, 2005).

2.3.10.2 Mpumalanga Province

Mpumalanga is another province where Mopane worm harvesting is an important livelihood activity. The challenges in this region are similar to those in Limpopo but are influenced by specific regional dynamics. In Mpumalanga, the expansion of agricultural activities and urban development has led to the loss of Mopane woodlands, the natural habitat of Mopane worms. Deforestation and land conversion reduce the areas where Mopane worms can thrive, resulting in a decline in their populations (Masekoameng et al., 2020). Additionally, overgrazing by livestock in some areas further degrades the environment, making it less suitable for Mopane worm's growth.

Like in Limpopo province, overharvesting in Mpumalanga province has led to a reduction in Mopane worm populations. Unsustainable harvesting methods, such as collecting worms before they have a chance to lay eggs, disrupt their reproductive cycle and prevent population regeneration. The lack of knowledge about sustainable harvesting practices among some harvesters contributes to this issue (Hope et al., 2009). While there are general environmental regulations in Mpumalanga, specific policies targeting Mopane worm harvesting are lacking. The absence of clear guidelines and enforcement mechanisms makes it challenging to regulate harvesting practices and promote sustainable use (Stack et al., 2003).

2.3.10.3 North West Province

The North West Province, with its arid and semi-arid conditions, is another area where Mopane worms are found and harvested. Both environmental factors and socio-economic conditions shape the challenges in North West. It faces significant environmental challenges, including changing climate patterns and desertification. Prolonged droughts and rising temperatures negatively impact Mopane woodlands, reducing the worms' availability and their food source (Makhado et al., 2014). These environmental stresses make it increasingly difficult to maintain stable Mopane worm populations.

In the Northwest, Mopane worm harvesting is a crucial livelihood strategy for many rural households. However, economic pressures, such as high unemployment rates and limited income-generating opportunities, drive overharvesting. Communities often prioritize immediate economic benefits over the long-term sustainability of Mopane worm populations, leading to overexploitation (Toms & Thangwana, 2005). Unlike some regions where community-based natural resource management (CBNRM) initiatives have been implemented, the North West province has limited formal structures to manage Mopane worm harvesting sustainably. This lack of management systems contributes to unregulated harvesting practices and habitat degradation (Stack et al., 2003).

2.3.10.4 Cross-provincial challenges

While the challenges in each province have unique aspects, some common issues cut across all three regions across Limpopo, Mpumalanga, and North West, there is a general lack of awareness and education about sustainable harvesting practices. Many harvesters lack knowledge about the life cycle of Mopane worms and the importance of allowing them to reproduce. Educational programs and awareness campaigns could help promote more sustainable practices (Hope et al., 2009).

South Africa lacks specific policies and regulations governing the harvesting of Mopane worms. Although general environmental conservation laws exist, they do not provide clear guidelines or enforcement mechanisms for sustainable Mopane worm harvesting. This policy gap makes it difficult to address the challenges effectively across different provinces (Makhado et al., 2014).

The challenges of harvesting Mopane worms in South Africa vary across provinces but share common themes, including overharvesting, habitat loss, climate variability, and socio-economic pressures. Limpopo, Mpumalanga, and Northwest provinces face environmental degradation and lack sustainable harvesting practices.

2.3.11 Conservation and management strategies of Mopane worms

Efforts to address the challenges of Mopane worm harvesting include promoting sustainable harvesting practices, habitat conservation, and community-based resource management. Some strategies involve educating harvesters on the importance of allowing some worms to complete their life cycle, which can help maintain populations (Thomas, 2013). Implementing controlled harvesting seasons and promoting selective harvesting can contribute to sustainability; empowering local communities to manage mopane woodlands through traditional ecological knowledge and modern conservation practices has shown promise (Toms & Thangwana, 2005). These approaches encourage the sustainable use of Mopane worms while providing economic incentives for conservation and developing and enforcing policies that regulate Mopane worms harvesting, including cross-border management strategies,

can help address overharvesting and habitat destruction. Collaborating with stakeholders at local, national, and regional levels is crucial for effective implementation (Stack et al., 2003).

2.3.12 Ensuring safety and quality of Mopane worms harvesting, government support, community support, and farm owner support

Ensuring the safety and quality of Mopane worms harvesting is crucial for the sustainability of this important resource (Wynberg & Silvestre, 2021). Mopane worms provide nutritional and economic benefits to many rural communities in Southern Africa. However, food safety, quality control, and sustainable harvesting must be addressed (Wynberg & Silvestre, 2021). Government intervention, community support, and the involvement of farm owners play vital roles in promoting sustainable harvesting practices and ensuring that Mopane worms remain a safe and quality food source

2.3.12.1 Ensuring safety and quality in Mopane worm harvesting

Safety and quality concerns in Mopane worm harvesting include contamination, processing methods, and storage practices. Effective measures to address these challenges involve implementing safe harvesting and processing practices and adhering to food safety standards. Harvesting and processing Mopane worms involve several steps, including collecting, degutting, boiling, and drying. Ensuring hygiene during these stages is crucial to prevent contamination and spoilage. Poor handling and unhygienic practices can lead to microbial contamination, which poses health risks to consumers (Madodonga & Mokgopu, 2021). Proper training for harvesters on hygienic practices can help ensure that the worms are safe for consumption.

Quality control is essential to ensure the safety and nutritional value of Mopane worms. This includes monitoring the processing methods, drying techniques, and storage conditions. Proper drying is crucial to prevent the growth of mold and bacteria, which can affect the quality and safety of the product. Packaging the dried worms in airtight containers can further prevent contamination and extend shelf life (Siwela et al., 2022).

Implementing food safety standards, such as Hazard Analysis and Critical Control Points (HACCP), can help ensure that Mopane worms meet safety and quality requirements. While formal food safety regulations may not be widely enforced in rural areas where Mopane worms are harvested, promoting awareness and adoption of basic food safety principles can significantly improve product quality (Wynberg & Silvestre, 2021).

2.3.12.2 Government support

Government intervention is essential in promoting sustainable harvesting practices, ensuring food safety, and supporting communities involved in Mopane worm harvesting. Governments can play a critical role in developing policies and regulations that support sustainable harvesting and quality control of Mopane worms. Some countries have started to recognize the importance of regulating the collection and trade of Mopane worms to ensure that harvesting practices do not deplete natural populations (Mudavanhu et al., 2020). However, specific policies on food safety and quality control for Mopane worms are often lacking, highlighting the need for government action to establish guidelines that ensure safety and quality standards.

Governments can support communities by providing training on sustainable harvesting practices, hygiene, and food safety. Capacity-building programs can enhance the knowledge and skills of harvesters, enabling them to adopt practices that ensure the safety and quality of Mopane worms. For instance, initiatives in some Southern African countries involve training sessions for harvesters on sustainable collection methods and processing techniques (Maunze et al., 2021).

Government support for research and development can improve Mopane worms' safety and quality. Research initiatives can explore ways to enhance processing methods, develop preservation techniques, and improve storage conditions to maintain Mopane worms' nutritional value and safety (Chakanya et al., 2023).

2.3.12.3 Community support

Communities play a central role in ensuring the safety and quality of Mopane worm harvesting. Collective efforts and knowledge sharing within communities can lead to the adoption of sustainable and safe practices. Community-based resource management (CBRM) initiatives can help ensure sustainable harvesting practices that protect Mopane worm populations. These initiatives involve local communities in decision-making processes, promoting sustainable use of natural resources, and implementing rules that prevent overharvesting (Ndlovu et al., 2022). By actively managing the resource, communities can ensure that Mopane worms are harvested in a way that maintains their quality and availability for future generations.

Traditional knowledge and practices can play a significant role in ensuring the safety and quality of Mopane worms. Indigenous knowledge on the optimal harvesting seasons, processing methods, and storage techniques can help prevent spoilage and contamination. Communities can draw on this knowledge to implement practices that promote food safety while maintaining the cultural significance of Mopane worms (Nyoka et al., 2022).

Forming cooperatives or community groups can help harvesters access markets and improve the quality of their products. By working together, communities can invest in better processing and packaging equipment, share knowledge on best practices, and negotiate better prices for their products. This collective effort can lead to improved quality control and food safety (Mavhunga et al., 2020).

2.3.12.4 Farm owner support

Farm owners who manage land where Mopane worms are harvested can contribute to ensuring the safety and quality of the harvest through various supportive actions. Farm owners can implement sustainable land management practices that protect Mopane woodlands and create a conducive environment for Mopane worms. By preserving Mopane trees and avoiding practices that degrade the habitat, farm owners

can support healthy worm populations and ensure a consistent and quality harvest (Macheka et al., 2023).

Farm owners can collaborate with local communities and harvesters to establish rules and guidelines for sustainable harvesting. This collaboration can include agreements on when and how harvesting should take place, ensuring that worms are collected in a manner that allows them to reproduce and maintain their populations. Such partnerships can also focus on adopting practices that ensure the hygiene and quality of the harvested worms (Nkomo & Dube, 2021).

Farm owners can invest in processing and storage facilities that meet food safety standards. Providing access to facilities where Mopane worms can be hygienically processed, dried, and stored can help prevent contamination and improve the quality of the final product. This investment can also contribute to value addition, increasing the marketability of Mopane worms (Sithole et al., 2022).

2.3.13 The possible strategies that may be used for harvesting Mopane worms in conservation areas

Unsustainable harvesting of plant species is one of the significant causes of the decline in their population. According to Mufandaedza et al. (2015), the harvesting of Mopane worms is generally guided by cultural beliefs, indigenous knowledge, and community leadership. Noorgaard (1984) believes that indigenous people have practiced sustainable harvesting since time immemorial. One of the reasons why people overharvest Mopane worms is because they lack traditional knowledge of harvesting the resource (Yen, 2015). Mbata and Chidumayo (2003) are of the view that people no longer have knowledge of managing the harvesting of Mopane worms because of the role played by western colonisers who discredited the consumption of indigenous food and as a result, people lost interest in the importance of Mopane worms. However, traditional knowledge can involve conflicting cultural differences that need to be considered (Yen, 2015).

The harvesting of Mopane worms is threatened by lack of rules governing the harvesting of Mopane worms in Zimbabwe (Mufandaedza, 2015). Togarepi (2020) is of the view that harvesters should always obtain permission (permits) before harvesting Mopane worms. In Zimbabwe, they have managed to prevent harvesters from other areas, but the locals are not restricted (Maviya & Gumbo, 2005). Unfortunately, these harvesters do not have knowledge on sustainable harvesting so, in other cases, trees have been felled during harvesting (Maviya & Gumbo, 2005). A study by Togarepi (2020) recommends that there should be collaboration between traditional leaders, harvesters and the local government and conservation initiatives owners to address the management of forests and forestry resources, in efforts to reduce overharvesting and deforestation.

2.3.14 Socio-economic factors affecting Mopane worm harvesting

Cultural and economic inclinations toward Mopane worms' activities are characteristics of households. Age and gender roles were established for various Mopane worm activities for their study regions (Stack et al., 2003). 80 percent of the harvesters in the Mwenezi area of Zimbabwe were female and over the age of 33, compared to 96 percent of the harvesters in Botswana. In addition, 8 percent of the harvesters in other parts of Botswana were female and over the age of 60. However, the study found more males gathering Mopane worms in the Mwenezi area than in Botswana, which was linked to the Mwenezi area's weak economic functioning. As a result, males rely on Mopane worms for a living. In addition, according to Lucas' (2010) study on the evolution and impacts of Mopane worm harvesting, 91 percent of Mopane worms' collectors are women, and the high participation of women is because rural men migrate to find better jobs outside their hometowns, leaving the women to attend to all household activities, including Mopane worms harvesting and farm work.

Mopane worms, the larvae of the emperor moth, are an important traditional food source in Southern Africa, and their harvesting and consumption are significantly influenced by various socio-economic factors. Cultural practices play a vital role in shaping the ways communities engage with this resource; knowledge about harvesting

and preparation techniques is often passed down through generations, ensuring that traditional methods are preserved (Mavhunga, 2021).

Environmental factors, including climate change and deforestation, threaten the habitats of Mopane trees, thereby affecting the availability of the worms (Mujera et al., 2023). Additionally, regulatory frameworks surrounding the harvesting of Mopane worms can influence sustainability practices and market access. As population growth and migration patterns shift, consumption trends also evolve, with urban areas seeing heightened demand for this nutrient-rich food source (Sithole & Muposhi, 2023). Technological advancements in processing and preservation methods have further improved the marketability of Mopane worms, enhancing their role as an essential nutritional resource in the region (Ndlovu et al., 2022).

The study discovered that a key element that favourably influences Mopane worms harvesting is the household head's age. According to Stack et al. (2003), most Mopane worm harvesters are older than 30 years. Therefore, authors make the case that gathering Mopane worms is labour-intensive, takes an inordinate amount of time, and is therefore, unattractive to the younger generation. Additionally, young people frequently leave their homes for job and study, which makes them unavailable during Mopane harvesting.

2.4 CHAPTER SUMMARY

This chapter covered two sections which were the theoretical framework and literature review. In the first section of the chapter, Afrocentricity was discussed as the study's theoretical framework. In the second section, a literature review was discussed in relation to the challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas. The literature review relied on old and recent published works. In the next chapter, the research methodology is presented.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The study was conducted to explore the challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas. Therefore, this chapter outlines the research methodology employed in conducting this study. It provides a detailed explanation of the methods used to achieve the study objectives. As part of the chapter, the research paradigm was first outlined as its justification for this study. The chapter also outlines the research design employed. The chapter further outlines the study area along with the study population and sampling technique used to sample the study participants. In addition, the chapter also provides a detailed explanation of the research data collection methods used and how they helped the study meet or achieve its desired objectives. The later parts of the chapter cover the ethical considerations and measures to ensure trustworthiness.

3.2 RESEARCH PARADIGM

Creswell and Creswell (2018) define paradigm as a researcher's perception of the world, shaping the interpretation of phenomenon. The paradigm that a researcher selects determines the methods that the researcher uses to collect and analyse data (Kothari, 2014). This was supported by Rehman and Alharthi (2016), who stated that a research paradigm serves as a foundation for research methods to be employed in a study. This implies that a research paradigm helps researchers adopt research methods that are applicable and suitable for their study. This study adopted an interpretive paradigm, which is also referred to as a constructivist paradigm.

3.2.1 Interpretivist Paradigm

The interpretive paradigm is a qualitative research paradigm that emphasizes understanding the subjective meanings individuals attach to their experiences within specific social contexts (Alharahsheh et al., 2020). Unlike positivist paradigms that

prioritize objective measurement and generalization, interpretivism focuses on the complexity of human behaviour and the influence of cultural and historical factors on individuals' perceptions (Goldkuhl, 2012). Researchers employing this paradigm often use qualitative methods, such as interviews and participant observation, to gain in-depth insights and engage in a co-constructive process of knowledge with participants (Creswell, 2013). This approach is particularly valuable for exploring nuanced social phenomena and recognizing the diverse perspectives that shape human experiences. The interpretivist paradigm aims to explore participants' views in relation to the study and relies on qualitative methods (Creswell & Clark, 2018).

This qualitative method is aligned with the interpretivist paradigm. The aim was to draw meaning from the qualitative responses from the study participants. The goal was to also understand the meaning of the social situation from the point of view of those who live it. In other words, the study adopted this paradigm to approach the research problem from an interpretivist view which is from the experiences of the participants. This allowed the researcher to exploratively study about the challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas from the participants experiences.

3.3 Research Methodology

According to Fletcher (2017) research methodology refers to a plan that guides the researcher in conducting research. It is known as a roadmap which researchers follows to achieve their objectives (Jamshed, 2014). Kang and Hwang (2021) state that a research methodology can be defined as an overall collection of research methods from sampling, data collection and analysis that the researchers adopt to approach their research focus or problem. According to Priya (2021) mainly three methodologies are often used by the researchers, and these are namely quantitative which focus on numerical data, qualitative which focuses on non-numerical data, and the mixed methods which is the combination of two. In this study, the qualitative research methodology was adopted over the others. The next discussions focus on the explanation towards the adoption of qualitative research methodology and its application to this study.

3.3.1 Qualitative Research Approach

Kothari (2004) points out that a qualitative research methodology enables the researcher to study a phenomenon in a social setting. According to Aspers and Corte (2019) a qualitative research methodology mainly involves an in-depth analysis of the research problem from the views of the participants. In support of this, Mohajan (2018) states that qualitative research methodology is often adopted in studies where the goal is to obtain or achieve a non-numerical data.

Qualitative research method was well suited for this study because the researcher sought to obtain a qualitative data on challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas. This methodology allowed the researcher to engage with participants and share their experiences with the researcher. This approach or methodology allowed the researcher to collect an in-depth data from the participants. This was done through the semi-structured interviews with the Mopane worms' traders, indigenous knowledge holders, and rural householders from the communities in the Vhembe District where Mopane worms are mostly found.

3.4 RESEARCH DESIGN

A research design is important in conducting research as it guides the whole process (Dannels, 2018). A research design is a plan of the investigation used to collect data, link data to the research objectives and make conclusions (Mbaka & Isiramen, 2021). This explains that a research design mainly refers to a plan how the researchers intend to approach a research phenomenon which in this study are the challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas. According to Swedberg (2020) when selecting or adopting a research design, the researchers are influenced by their research paradigm and methodology. Since this study adopted a qualitative methodology and an interpretative paradigm; it also adopted an exploratory research design.

3.4.1 Exploratory Research Design

According to Mbaka and Isaramen (2021) an exploratory is a research design that is intended to approach a research problem that has not been thoroughly studied before. Swedberg (2020) added that an exploratory is a qualitative design that allows the researchers to study a research problem in an in-depth approach from the participants' experiences. The study sought to explore the challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas. Therefore, the adoption of this approach allowed the researcher to gain new knowledge pertaining to the harvesting of Mopane worms in conservation areas.

3.5 STUDY AREA

This study focuses on three areas under the jurisdiction of Vhembe district municipality. The study areas are Ha-Gumbu, Matiyani, and Bokmakieries. Vhembe is a South African district municipality located in the far north in the Limpopo province. Indigenous communities of Tshivenda and Xitsonga speaking people dominate the district. However, the number of Tshivenda speaking people is higher than that of the Xitsonga speakers. Vhembe district municipality consists of four local municipalities: Thulamela, Makhado, Musina, and Collins Chabane. Three communities were selected from these local municipalities. The areas were selected because they have a distribution of Mopane trees, and therefore, Mopane worms are harvested from these areas. The maps below show areas that the study focused on under Vhembe District Municipality.

Bokmakierie Area Map

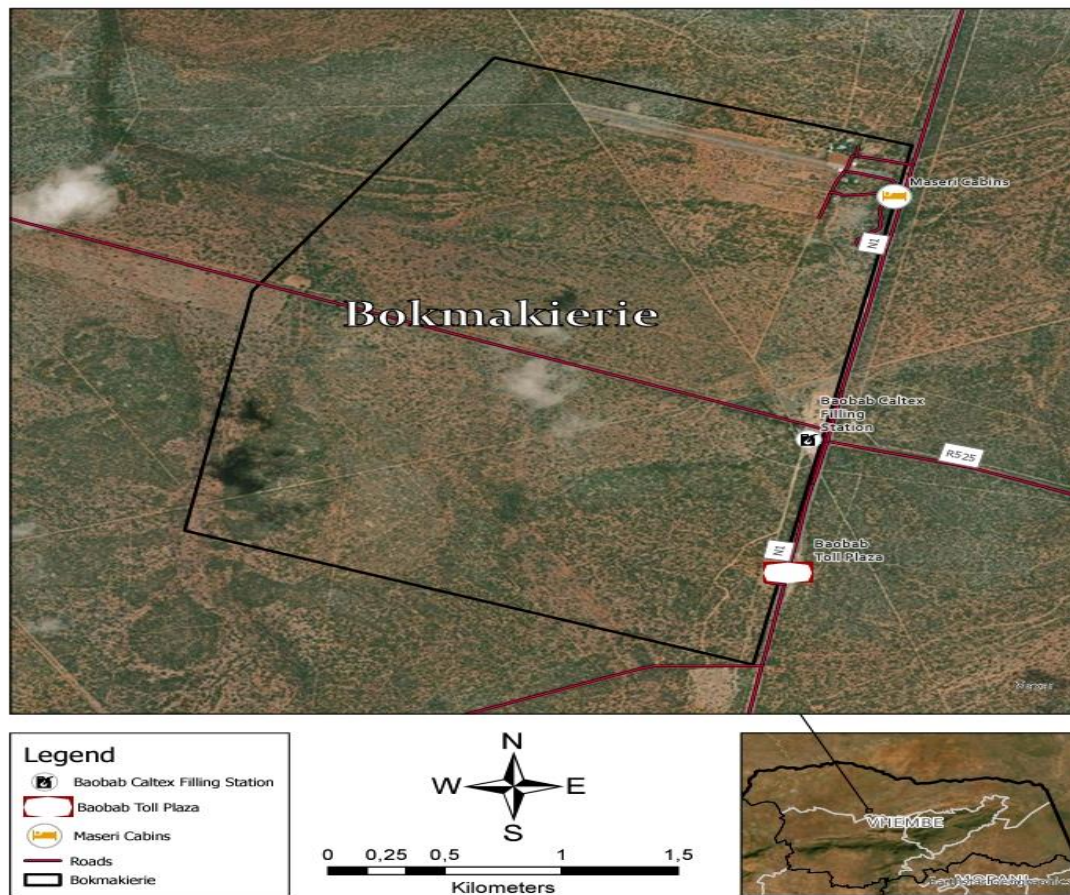


Figure 1: Bokmakieries Map

Matiyani Village Area Map

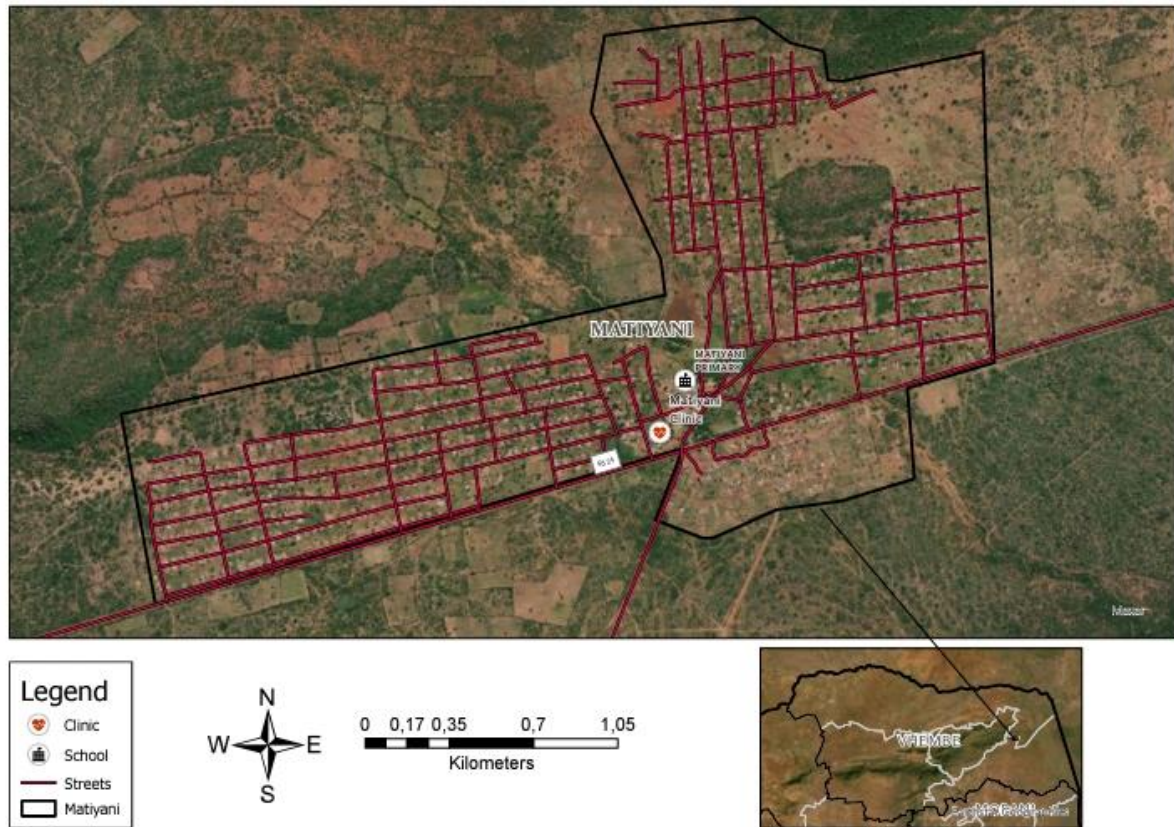


Figure 2: Matiyani Village Map

Ha-Gumbu Village Area Map

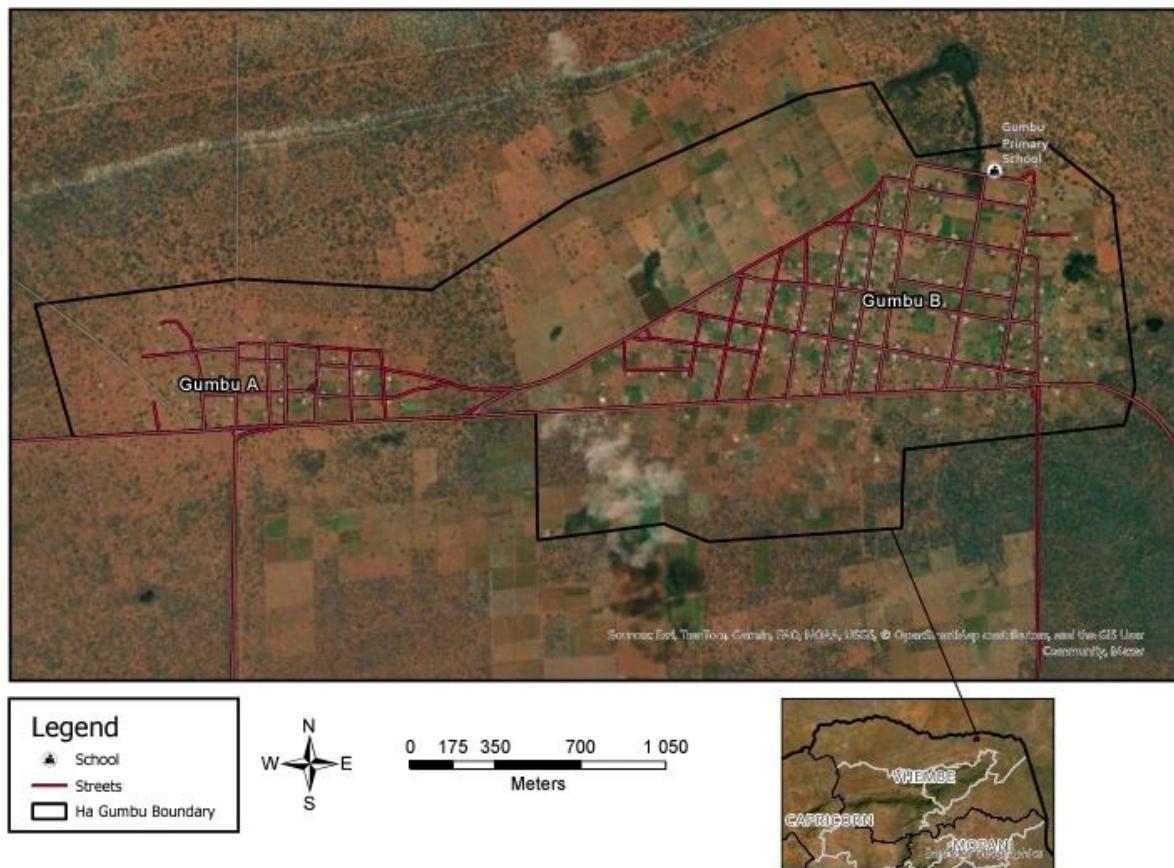


Figure 3: Ha-Gumbu Village Map

The study was conducted from three areas falling under the Vhembe District. These areas involved Bokmakiries, Matiyani and Ha-Gumbu which form part of the Vhembe District Municipality.

3.5.1 Bokmakiries

Bokmakiries is an area that is situated under Musina municipality. It is an area that is rich with the availability and accessibility of Mopane worms. The area is rich with Mopane trees which host caterpillars that hatch during summer. The strategy of managing Mopane trees is that they are fenced in farms, whereby during harvesting period permission should be sought and obtained first.

3.5.2 *Matiyani*

Matiyani is a *Vatsonga* indigenous community under Collins Chabane Municipality (CCM). The area is located 43.3km away from Malamulele and it is the area which is rich in Mopane worms.

3.5.3 Ha-Gumbu

Ha-Gumbu is a Vhavenda community under Musina municipality. The area is located 112,7km away from Musina town. The area is blessed with rich Mopane trees, therefore, during the rainy season, the area contains a large quantity of Mopane worms.

3.6 STUDY POPULATION

A study population refers to all items in any field of inquiry, (Kothari, 2004). The study population for this study comprises of all indigenous knowledge holders, Mopane worms' traders, and rural households living in the Vhembe District Municipality particularly in Bokmakiries, Ha-Matiyani and Ha-Gumbu. The table below provides justification for the selection of these targeted groups.

Table 3.1: Group Justification

Indigenous knowledge holders	These are members of the local communities who are knowledgeable about our cultures, traditions, including the commercial harvesting of Mopane worms. They are recognised in their communities for their expertise in indigenous knowledge. In this study, these are people who have knowledge about the sustainability of harvesting Mopane worms to rural households and the methods that are used to harvest Mopane worms.
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Mopane worms' traders	They are people involved in trading and in other instances, they are also involved in harvesting Mopane worms. They were able to inform the researcher of the commercial aspects and harvesting strategies that are used on Mopane worms.
Rural households	The researcher interviewed people from Ha-Gumbu, Matiyani and Bokmakieries. These people were selected on the basis that they reside in areas where Mopane worms are dominant and harvested.

3.7 SAMPLING PROCEDURE

As indicated by Khalefa and Selian (2021), sampling is a method of selecting a portion of the main population for study. There are two major types of sampling: probability sampling and non-probability sampling (Pace, 2021). In probability sampling, every item, event or person (sample) has an equal chance of being chosen, while in non-probability sampling, the researcher used their own judgment to select the units to be studied (Pace, 2021). For this study, the sampling method that was used was non-probability sampling. The non-probability sampling techniques that were employed included purposive and snowball sampling.

3.7.1 Purposive Sampling

Campbell et al. (2020) define purposive sampling as a non-probability sampling technique where the researcher uses their knowledge of the study to select the best group of people who can provide information to answer the research questions. Rai and Thapa (2015) adds that purposive sampling involves sampling participants based on the researcher's judgement that participants are knowledgeable about a problem being investigated. In this study, the researcher purposively sampled indigenous communities because they were knowledgeable challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas. From the study's population, the researcher sampled 20 participants. The researcher

continued interviewing participants until data saturation was reached on the 13th participant.

3.7.2 Snowball Sampling

Snowball sampling was also used by the researcher to select participants in this study. Snowball sampling refers to a non-probability sampling technique in which a group of people or selected participants recommend potential participants or directly recruit them to participate in the study (Ghaljaie et al., 2017). Emerson (2015) states that in snowball sampling the researcher first approach the first participants who later recommends other participants who meets the criteria to be included in the study or data collection process. In this study, this method was used to find individuals involved in harvesting Mopane worms. Traders and community members were requested to provide information and participated in the study.

3.8 PILOT STUDY

According to Lowe (2019) a pilot study is defined as a preliminary study that is intended to test the research methods. In conducting a pilot study, the researcher selects a sample of participants to test the semi-structured interviews. Although the data from this study is not included in the study findings, it allowed the researchers to refine the interview questions for the full study.

3.9 DATA COLLECTION METHODS

Data collection is the systematic process of acquiring and measuring information on variables of interest to answer specified research questions, test hypotheses, and evaluate outcomes (Denzin & Lincoln, 2018). According to Sadan (2017) there are mainly two types of data collection sources: primary and secondary. Primary data sources include questionnaires, interviews, surveys, photographs, and observations, while secondary data sources include books, journals, reports, and newspaper articles (Gill, 2008). The researcher collected data using semi-structured interviews. The reasons for selecting semi-structured interviews are explained below:

3.9.1 Semi-Structured Interviews

According to Adeoye-Olatunde and Olenik (2021), semi-structured interviews require drafted questions but do not require a formal sequence to be followed. The researcher conducted one-on-one interviews with all participants. The researcher first explained to the participants what the research was about and how it would benefit the community. The participants were made aware of their right to withdraw at any point if they felt they no longer wanted to be part of the study. The researcher then used the interview guide to conduct the interviews.

According to Gill (2008), semi-structured interviews enabled participants to voice their ideas freely. Therefore, it was vital for the researcher to create a warm environment to allow participants to express their views in relation to the study's objectives freely (Denzin & Lincoln, 2018). The researcher drafted questions related to the study's objectives that were used as a guide in the interviews. The aim was to ensure that participants shared their own ideas without being restricted. Additionally, this approach enabled the researcher to access more accurate information on the research topic by asking follow-up questions (Gill, 2008). The interviews were conducted in Ha-Gumbu, Matiyani, and Bokmakieries villages.

In collecting data, the researcher conducted the interviews face-to-face from all the study participants. These interviews were conducted from the homes of the participants where it was safe for all participants and the researcher. Each interview lasted about 30-40 minutes and depended on the participants' understanding of the questions.

3.10 DATA ANALYSIS

Kothari (2004) defines data analysis as the computation of certain indices or measures, along with searching for patterns of relationships that exist among data groups. According to Mezmir (2020) data analysis involves a critical examination of data done with the intention to derive conclusions of the study. This study was qualitative in nature; therefore, the thematic data analysis was adopted.

3.10.1 Thematic Analysis

Thematic Analysis was used to analyse data in this study. According to Braun and Clarke (2006), thematic data analysis is a method for identifying, analysing, and reporting patterns within data. This method enabled the researcher to extract themes from the data. Thematic analysis for this study was guided by the steps suggested by Braun and Clarke (2006). In the first step, the data collected through interviews was transcribed and then edited. The second step involved organizing the data into categories. In the third step, the researcher looked for potential themes in relation to each objective. The fourth step involved editing and reviewing the identified themes. The fifth step involved assigning names to the different themes that had been previously identified. Lastly, the researcher presented and analysed the themes. Below are the thematic analyses step employed by the researcher.

3.10.1.1 Familiarising with the data

The researcher started by familiarising himself with the data by going through the recordings and field notes from the first interview to the last one. After the data transcription, the researcher read and re-read the data and wrote down ideas as they emerged. The purpose of re-reading the transcription was for the researcher to be familiarised with the study data.

3.10.1.2 Generating initial codes

In the second step, the researcher assigned codes and provided a brief description of what was being said in each interview so that the data could be organized into meaningful groups. The researcher went through the transcript of each interview, highlighting all relevant information to the study. Phrases and sentences that matched the codes were highlighted, and all data was then classified with identification codes.

3.10.1.3 Search for themes

The researcher sorted the codes into themes by reviewing the codes, identifying patterns, and developing corresponding themes.

3.10.1.4 Reviewing themes

The researcher checked if the themes work in relation to the code extracts and the entire data. The researcher ensured that the themes are useful and accurately represent the data. Finally, the researcher made comparisons between the themes and the data to determine if changes are needed.

3.10.1.5 Defining and naming themes

There was an ongoing analysis to refine the specifics of each theme to have clear names when the researcher has the final list of themes. The researcher named and defined the themes by formulating what each theme means and how it helps to understand the data. Therefore, the researcher came up with easy, brief, and understandable themes.

3.10.1.6 Producing the report

The researcher discussed the analysis of the data which included the introduction, methodology used to produce the findings, conclusions and recommendations of the study. The researcher transcribed the interviews, analysed by using the color-codes and categorisation for analysis.

3.11 ETHICAL CONSIDERATIONS

According to Strydom (2005) ethics are moral principles that are generally accepted and offer certain rules. The steps should be taken to adhere to strict ethical guidelines to uphold participants' privacy, confidentiality, dignity, rights and anonymity (Strydom, 2005). The researcher followed a variety of ethical standards when conducting this

study. Conducting the research requires not only expertise and diligence, but also honesty and integrity (Horner, 2003). This was done in this study to recognise and protect the rights of human subjects.

3.11.1 Ethics Approval: University of Venda

The researcher started by applying ethical clearance from the university before collecting data and once an ethical clearance is out. Therefore, the researcher was approved by the University of Venda to conduct the study and/or before the data collection process. The researcher was granted the ethical clearance (Refer to Appendix 5)

3.11.2 Informed Consent

According to Creswell (2003), informed consent is a form that notify participants that their input is voluntary and that they can be able to withdraw at any time. According to Hardcre (2014), informed consent is the procedure in which individuals indicate whether to participate in an investigation or not. Nijhawan et al. (2013) points out that participants should be told at the beginning about all the risks that are involved in participating in this study. The researcher explained clearly to the participants what every participant must know and agree to before participating in the study. To achieve the informed consent, the researcher informed participants about the purpose of the interview and the nature of the investigation. The participants were informed verbally and using the informed consent form (Refer to Appendix 1)

3.11.3 Privacy and Confidentiality

According to Gibson et al. (2013), the participant during interview has the right to privacy with their personal information to be kept confidential. Creswell (2003) stated that if the data collection process is recorded, the participants who are not comfortable with being part of the study may be allowed to withdraw from the study. To achieve confidentiality the researcher did not share the personal information such as where they stay. Furthermore, the researcher ensured the participants that the recordings will only be used for the data analysis.

3.11.4 Anonymity

Saunders et al. (2015) describe anonymity as what occurs when the person supposes that no one, including the observer, will know who has done the activities. The researcher should ensure that the interviews will be conducted in a closed private area if it will be the request from the participant (Gibson et al., 2013). To achieve anonymity, the researcher excludes all personal names of the participants in data presentation. The strict anonymity was maintained throughout the study and the findings were reported in a way that prevented identification of respondents. The use of pseudo names instead of the respondents' real name allowed the researcher to strictly implement and ensure anonymity.

3.11.5 Honesty

Honesty is required from the interviewer to establish a position of trust with the prospective participants (Creswell, 2013). To achieve honesty, the researcher built-up a mutual relationship with the participants. This helped the participant to feel free and to reveal their inner most feelings and the beliefs during interview.

3.12 MEASURES TO ENSURE TRUSTWORTHINESS

Anney (2014) states that trustworthiness measures in research are used to ensure that the study findings are reliable. Ghafouri and Ofoghi (2016) adds that trustworthiness measures enable the researchers to demonstrate how they ensured that their study findings and results are reliable or worthwhile. This study was qualitative in nature and the measures used were confirmability, transferability, credibility, and dependability. These measures are discussed below.

3.12.1 Confirmability

According to Edgerton (2012) confirmability is a method of establishing effectiveness of the research. Therefore, it notifies that the data which is being implemented should apply neutrality to ensure the measures of trustworthiness. Furthermore, the neutrality is the verification of the two or more data of the qualitative for comparative to ensure

accurate data and not of the researcher's viewpoint. According to Sikolia et al. (2013), confirmability is a method to ensure neutrality of the study. The researcher ensured that the findings of the study are free from bias and resemble true reflections of the participants' responses during interviews. The researcher further ensured confirmability by using an audit trail where a track record of the decisions of the analysis was done. The researcher used an audit trail to verify that the decision made reflects the views of the participants and not of the researcher.

3.12.2 Transferability

According to Moon et al. (2016), transferability is used to ensure that the research findings can be applicable to other contents. To ensure transferability, the researcher kept record of the transcripts and recorded audios of interviews. The researcher made certain that the data accumulated from the participants was recorded and analysed at the best of the researcher's ability. The researcher ensured that the methodology is clearly explained, from sampling to data analysis.

3.12.3 Credibility

According to Guba and Lincoln (2012), ensuring credibility is the most significant factors of establishing trustworthiness. Therefore, ensuring credibility enables researchers to associate their study results with reality to find the truth of the research study's conclusions. In this study, the methods of collecting data were informed by literature, comparing methods with what other researchers previously used. In addition, the researcher ensures credibility by using a prolonged engagement with the study participants in the field. This allowed the researcher to collect data that was accurate and reliable. Further, the researcher allowed the peer Master o students to verify the study findings to avoid the researcher's biasness.

3.12.4 Dependability

According to Holloway (2015), dependability is related to the consistency findings which showcase that data could be used in similar context. The qualitative research instruments to assess consistency were the researcher and the participants. The

methods that were used in this study was clearly stated in detail so that if the study is replicated, similar findings can be obtained.

3.13 CHAPTER SUMMARY

This chapter has discussed the research methodology that carried or guided the study. Qualitative research method was outlined as the study's research methodology. The chapter has also outlined exploratory research design which guided the researcher's data collection and analysis methods. The chapter has also outlined sampling methods used for recruiting or sampling participants. Therefore, a discussion of the purposive and snowball sampling was outlined. In the last section of the chapter, the ethical considerations and measures to ensure trustworthiness were also outlined.

CHAPTER 4

DATA PRESENTATION, INTERPRETATION AND ANALYSIS

4.1 INTRODUCTION

This chapter present the data presentation and analysis as the researcher have achieved the aim of the study through the objectives which was adopted in the study. This was important as the interview questions were developed from the research questions and the themes were developed and discussed in order to assist the researcher to gain deeper and better understanding of participants perspectives and attitudes on the study.

4.2 DEMOGRAPHIC PROFILE OF THE PARTICIPANTS

For the research to be successfully, the researcher has to ask questions to the participants from Bokmakiries, Matiyani and Ha-Gumbu to give out their information. This was important for the researcher to gain more understanding towards exploring challenges and intervention strategies that may be used for harvesting Mopane worms in Bokmakiries farm Vhembe district conservation areas. The understanding of participants might differ due to age and categories of participants. The table below shows demographic of participant's information.

Table 3.2:Demographic profile of the participants

Categories	Pseudonym	Age	Gender	Marital Status
Indigenous knowledge holder	Participant 1	50-40	Male	Married
Indigenous knowledge holder	Participant 2	50-60	Female	Married
Indigenous knowledge holder	Participant 3	50-60	Female	Married

Indigenous knowledge holder	Participant 4	30-40	Female	Single
Mopane worms' trader	Participant 5	30-40	Male	Married
Mopane worms' trader	Participant 6	20-30	Female	Single
Mopane worms' trader	Participant 7	20-25	Female	Single
Mopane worms' trader	Participant 8	20-30	Female	Married
Rural household	Participant 9	30-40	Female	Married
Rural households	Participant 10	50-60	Female	married
Rural household	Participant 11	60-70	Male	married
Rural household	Participant 12	30-40	Male	single
Rural household	Participant 13	50-40	Female	Married

4.3 DATA PRESENTATION

This section presents the data that was gathered or collected from 13 participants. The data was collected from the semi-structured interviews and analysed using the thematic data analysis. The following themes with sub themes (research objectives) were identified during data collection.

The study was guided by the following research objectives:

- To discover challenges faced by harvesters of Mopane worms in conservation areas
- To determine the challenges affecting conservation areas with unsustainable harvesting of the Mopane worms
- To establish strategies that may be used for harvesting Mopane worms in conservation areas

4.3.1 Challenges faced by harvesters of Mopane worms in conservation areas

To have clear understanding the researcher interviewed participants on the challenges faced by harvesters. This was relevant because the harvesting of Mopane worms is a significant livelihood for many rural communities in the Vhembe District, which face numerous challenges that threaten its sustainability. These challenges not only impact the harvesters economically but also pose significant risks to the conservation areas where Mopane worms are found. This section discusses the challenges faced by harvesters encountered in the Vhembe District in Limpopo Province.

4.3.1.1 Legal and regulatory barriers

According to Marope et al. (2023), difficulties in obtaining harvesting permits often discourage local communities from engaging in legal harvesting practices, leading to non-compliance and potential penalties. Simelane and Kerley (2020) argue that the lack of clear and accessible information on the legal requirements for harvesting Mopane worms contributes to widespread non-compliance and legal infractions among rural harvesters. The following is how participants discuss legal and regulatory barrier:

“Ri na vhukonḁi vhunzhi kha u wana ṭhendelo ya u bata mashonzha. Nḁila dza hone dzi a lenga na u konḁa” (Participant 6)

Translated version:

“We have a lot of trouble getting the permits we need to collect Mopane worms. The process is slow and complicated.”

“Vhunzhi hashu ri a konḁelwa u tevhedza milayo, zwine zwa ita uri ri fhedze ri kho bata mashonzha ri sina thendelo ra fhedza ri khou wana zwiga zwa ndaṭiso.” (Participant 2)

Translated version:

"Many of us don't fully understand the rules, so we end up collecting without the right permits, which results in fines."

The study noted that navigating the legal and regulatory framework surrounding the harvesting of Mopane worms presents significant challenges for many in the community. The complex procedures and lack of clear guidance often create barriers, making it difficult for individuals to comply with the laws. These challenges are compounded by the limited awareness and understanding of the regulations, leading to unintentional violations and subsequent penalties. The study discovered that frequent changes in regulatory frameworks without proper dissemination and education for local communities have created confusion and mistrust towards authorities, hindering efforts for sustainable harvesting.

4.3.1.2 Accessibility and transportation issues

Nkuna and Muzungu (2022) express that the lack of infrastructure in rural areas severely limits the ability of harvesters to efficiently access and transport Mopane worms, leading to increased costs and reduced profitability. These make it difficult for them to compete in the market.

"Fhethu hune miri ya mipaini ya vha hone zwikondela vhathu uri vha kone u bata. Ri tshimbila lwendo lulapfu nga milenzhe uri ri kone u swika." **(Participant 1)**

Translated version:

"The remote locations of Mopane trees make it hard for us to access them. We have to travel long distances on foot."

“Ri na vhukondzi vhunzhi kha zwinamelo zwa uri hwalela mashonzha, fhedzi a huna dzindzila dzavhudi zwine zwa i ta uri zwi ri durele vhukuma.” (Participant 3)

Translated version:

“Transporting the harvested worms to the market is a major challenge. There are no proper roads, and it increases our costs significantly.”

“Nga tshifhinga tsha dzimvula dzindzila a dzi tshimbilei zwine zwa ita uri ri kundelwe u tshimbila ra swika fhethu hune ra khou tea u bata mashonzha.” (Participant 9)

Translated version:

“During the rainy season, the paths become almost impossible, making it even more difficult to reach the harvesting areas.”

“Zwi namelo zwine ra zwi shumisa u isa mashonzha vhathuni zwi a ri durela hone zwi dovha zwa konḁa u walana tshifhinga tshoḁthe zwine ri fhedza ri khou lwozwa masheleni.” (Participant 3)

Translated version:

“We often have to rely on expensive and unreliable transport services to get the worms to the market, which eats into our profits.”

Majority of participants appear to be saying that accessing and transporting Mopane worms possessed significant logistical challenges for harvesters, particularly due to the remote locations of Mopane trees and the poor infrastructure in these areas. These difficulties are especially pronounced during the rainy season when paths become nearly impassable, further complicating the journey. The high costs and unreliability of

transport services also have a direct impact on the profitability of this important livelihood activity.

4.3.1.3 Economic pressures and market dynamics

Kgatla (2020) argues that market volatility and a lack of access to reliable market information leave rural harvesters at the mercy of fluctuating prices and impacting their economic stability. These emphasize that the lack of value addition and diversification in Mopane worm products restrict economic opportunities for harvesters, keeping them trapped in cycles of poverty.

“Mutengo wa mashonzha u dzulela u shanduka zwi no ita uri tshinwe tshifhinga ri vhe na ndozwo ya mashelini.” (Participant 4)

Translated version:

“The market prices for Mopane worms are very unstable. Sometimes, we don’t even recover our costs.”

“Huna vhathu vhane vha ri vhaisa vhukuma nga u renga mashonzha nga mutengo mutuku vha fhedza vhaya vha rengisa nga mutengo muhulwane.” (Participant 7)

Translated version:

“Middlemen exploit us by buying the worms at very low prices and selling them at high prices in urban areas.”

“Hu na vhathu vhane vha ri vhaisa vhukuma nga u renga mashonzha nga mutengo muṭuku vha fhedza vhaya vha rengisa nga mutengo muhulwane.”

(Participant 12)

Translated version:

"The market prices for Mopane worms are very unstable. Sometimes, we don't even recover our costs."

Majority of participants revealed that economic challenges faced by Mopane worm harvesters are exacerbated by the volatility of market prices and the presence of exploitative middlemen. Many harvesters struggle to cover their costs, as the prices they receive are often unpredictable and insufficient. The middlemen further compound the problem by purchasing the worms at low prices and reselling them at a significant markup in urban markets, leaving the harvesters with minimal profits.

4.3.1.4 Environmental and climatic factors

Mtshali et al. (2020) illustrate that the combined effects of environmental stressors, including climate variability and habitat fragmentation, are reducing the resilience of Mopane worm populations, impacting the livelihoods of those who depend on them. This study also discovered that the environmental and climatic factors contribute to the availability and harvesting of Mopane worms.

“U shanduka ha mupo zwina masiandoitwa mavhi kha mashonzha ro zwi vhona kha kutshilele na vhuḍalo ha mashonzha.” **(Participant 5)**

Translated version:

"Climate change is affecting the Mopane worms. We have noticed changes in their lifecycle and availability."

“Mishonga i ne ya shumisiwa nga vhalimi vha tsini i na masiandoitwa asi avhuḍi kha mashonzha na vhupo zwino ita khaedu kha mashonzha na mitakalo yashu.” (Participant 10)

Translated version:

“Pesticide use in nearby farms is contaminating the Mopane worms and their habitat, posing a risk to both the worms and our health.”

“Huna u fhungudzea ha mashonzha avhuḍi nga masiandoitwa a shunduka ha mupo zwine zwa kwama mbuelo yashu.” (Participant 6)

Translated version:

“We have seen a decline in the quality of Mopane worms due to changes in the environment, which affects our income.”

The participants showed that environmental challenges are increasingly impacting the sustainability of Mopane worm harvesting, with harvesters observing noticeable changes in the ecosystem. Moreover, climate change, along with harmful agricultural practices, is altering the lifecycle and habitat of Mopane worms, leading to a decline in their availability and quality. These environmental shifts not only threaten the health of the worms but also have serious implications for the livelihoods of those who depend on this resource.

4.3.2 Challenges affecting conservation areas with unsustainable harvesting of the Mopane worms

The participants were interviewed to give the challenges affecting conservation areas with unsustainable harvesting of the Mopane worms. This question is important to provide the challenges on the conservation areas that house the Mopane worms. These challenges are discussed as sub-themes below:

4.3.2.1 Decline in Mopane worm populations

Makhado et al. (2021) report that unsustainable harvesting practices, coupled with habitat destruction, have led to a notable decrease in Mopane worm populations, impacting both ecological balance and local economies.

“Ho no vhesa na u fhungudzea ha tshivhalo tshinzhi kha ya mbalo ya mashonzha u swika kha tshifhinga tsha zwino, zwi konda u wana mashonzha zwino.” (Participant 8)

Translated version:

“We have seen a significant decrease in the number of Mopane worms over the past few years. It’s becoming harder to find them.”

“Ro vha rina mashonzha manzhi fhedzi ari tsha kona u tshila ro ditika nga nga mashonzha u nga kale.” (Participant 11)

Translated version:

“The worms used to be plentiful, but now we can’t rely on them for our livelihood as much as we used to.”

“U sa wanelesa ha mashonzha zwi kho fhiledza. Nyofho khulwane ndi uri a nga fhela asi tsha wanala arali ha sa dzhiwa maga.” (Participant 8)

Translated version:

“The decline in Mopane worm populations is worrying. We fear that they might disappear if nothing is done.”

The above discussion showed that the declining populations of Mopane worms have become a major concern for those who depend on them for their livelihood. Over recent years, harvesters have noticed a significant decrease in the number of worms

available, making it increasingly difficult to find them. This reduction not only affects their immediate ability to gather the worms but also threatens their long-term economic stability.

4.3.2.2 Habitat degradation

Makuya and Mutshinyalo (2021) discuss how habitat degradation caused by agricultural expansion and logging activities poses a significant threat to Mopane worm habitats. Similarly, Sibanda and Dube (2019) illustrate that unsustainable land use practices, such as overgrazing and deforestation, are contributing to the degradation of Mopane woodlands, which are crucial for the survival of Mopane worms.

“Fhethu hune miri ya mipaini ya wanala hone hu kho shumiwa zwa ndimo zwino i ta uri mashonzha a konḡe u wanala.” (Participant 1)

Translated version:

“The areas where Mopane trees grow are being cleared for agriculture, reducing the habitat for the worms.”

“U remiwa ha maḡaka zwina khaedu khulwane, nga uri zwi ita uri ha remeswa mipaini ri vha na mashonzha maḡuku kha ṛwaha.” (Participant 12)

Translated version:

“Deforestation is a big problem. We see fewer Mopane trees each year, which means fewer worms.”

The study discovered that the ongoing deforestation and land conversion for agricultural purposes are severely impacting the habitat of Mopane worms. As areas previously covered with Mopane trees are cleared, the natural environment that supports these worms is being rapidly diminished. The study also discovered that this

loss of habitat is directly linked to a decline in the Mopane worm populations, further exacerbating the challenges faced by harvesters.

4.3.2.3 Biodiversity loss

Nhemachena and Hassan (2019) express that the decline in Mopane worm populations leads to significant biodiversity loss, affecting other species that rely on them for food and ecological interactions.

As participant 3, 12 and 9 observe:

*“U fhungudzea ha tshivhalo tsha mashonzha zwina masiandoitwa mavhi kha”
zwine zwipuka zwino tshila nga u la zwone.” (Participant 3)*

Translated version:

“The decrease in Mopane worms affects other species that rely on them as a food source”.

“U xeletwa nga mashonzha zwi amba uri r ikhou do xeletwa nga zwimelwa na zwipuka zwino tshila nga mashonzha.” (Participant 13)

Translated version:

“Losing the Mopane worms means we’re also losing other plants and animals that depend on the same habitat.”

“U khakhisea ha vhupo vhukati ha zwipuka na zwimela zwikho i twa nga zwithu zwine vhathu vha i ta.” (Participant 9)

Translated version:

“Biodiversity in our area is declining because the ecosystems are being disturbed by unsustainable practices.”

The above response indicated that the decline in Mopane worm populations is having a cascading effect on local ecosystems, impacting not only the worms themselves but also the broader web of species that depend on them. As Mopane worms are a key food source for various animals, their reduction is causing disruptions throughout the food chain. Additionally, the loss of Mopane worms is indicative of broader environmental changes affecting other plant and animal species within the same habitat.

4.3.2.4 Conflicts between conservation and livelihoods

According to Simelane and Kerley (2020), conflicts between conservation policies and local livelihoods arise when regulatory frameworks fail to incorporate the socio-economic needs of local communities. Moreover, these indicate that balancing conservation efforts with the livelihoods of local communities requires an inclusive approach that considers both ecological sustainability and economic necessities.

As participant 7, 8 and 2 express:

“Ri tshila nga u rengisa mashonzha fhedzi milayo ya u a bata ndi yone i no konda.” (Participant 7)

Translated version:

“We depend on Mopane worms for our income, but conservation rules make it difficult to harvest them.”

“Hu dzulela u vha na khuḁano vhukati ha milayo ya u langa vhupo na vhabati vha mashonzha.” (Participant 2)

Translated version:

“There’s always a conflict between protecting the environment and making a living from Mopane worms.”

“Milayo ya tsireledza vhupo a i sedzi thodea ya miṭa i no tshila nga mashonzha.”
(Participant 8)

Translated version:

“Conservation efforts don’t consider our need to sustain our families, leading to tensions with authorities.”

Majority of participants said that balancing environmental conservation with the economic needs of local communities presents a significant challenge. Harvesters who rely on Mopane worms for their income often find themselves in conflict with conservation rules that restrict their activities. These regulations, while important for environmental protection, can undermine the livelihoods of those who depend on harvesting Mopane worms to sustain their families, leading to tensions with authorities and difficulties in reconciling conservation goals with economic realities.

4.3.3 Strategies that may be used for harvesting Mopane worms in conservation areas

The participants were interviewed to give strategies that may be used for harvesting Mopane worms in conservation areas. This question provided important aspects of which strategies may be used for harvesting Mopane worms in conservation areas.

4.3.3.1 Ensuring safety and quality in Mopane worm harvesting

Quality control is essential to ensure the safety and nutritional value of Mopane worms. This includes monitoring the processing methods, drying techniques, and storage conditions. Proper drying is crucial to prevent the growth of mould and bacteria, which can affect the quality and safety of the product. Packaging the dried worms in airtight containers can further prevent contamination and extend shelf life (Siwela et al., 2022).

"Inwe ya dzindila ya khwine i ne ya nga shumisiwa ndi ya u sedzuluswa ha vhathu vha no omisa mashonzha uri avhe zwiliwa zwinga u thusa u tsireledza."

(Participant 13)

Translated version:

"One of the strategies that can be used is that if they can evaluate how we process Mopane worms it can help in ensuring control and safety."

"Ndi vhona u ngari arali muvhuso wanga thusa kha ndila dzavhuḽi dza omisa mashonzha zw inga thusesa kha tsireledzo." **(Participant 8)**

Translated version:

"I think if government can check how harvester store and process Mopane worms can increase the quality and safety."

The study discovered that evaluating food safety standards, such as Hazard Analysis and Critical Control Points, can help ensure that Mopane worms meet safety and quality requirements. Furthermore, formal food safety regulations may not be widely enforced in rural areas where Mopane worms are harvested, promoting awareness and adoption of basic food safety principles can significantly improve product quality

4.3.3.2 Government support

Majority of countries have started to recognize the importance of regulating the collection and trade of Mopane worms to ensure that harvesting practices do not deplete natural populations (Mudavanhu et al., 2020). Furthermore, specific policies on food safety and quality control for Mopane worms are often lacking, highlighting the need for government action to establish guidelines that ensure safety and quality standards.

“Arali muvhuso wanga dzhenelele nga u thusa vhabati vha mashonzha kha bata mashonzha nga ndila yavhudi.” (Participant 8)

Translated version:

“If the government can intervene and support harvesters on sustainable with harvesting it can help a lot.”

“Ndi zwa ndeme uri muvhuso u tutuwedze vhadzulapo uri vha di dzhenise kha u di sikela milayo ya bata mashonzha.” (Participant 8)

Translated version:

“It is important for government to encourage community to be fully involved in harvesting Mopane worms and create policy.”

The above comments showed that government intervention is essential in promoting sustainable harvesting practices, ensuring food safety, and supporting communities involved in Mopane worm harvesting. Governments can play a critical role in developing policies and regulations that support sustainable harvesting and quality control of Mopane worms.

4.3.3.3 Farm owner support

Farm owners can collaborate with local communities and harvesters to establish rules and guidelines for sustainable harvesting. This collaboration can include agreements on when and how harvesting should take place, ensuring that worms are collected in a manner that allows them to reproduce and maintain their populations (Macheka et al., 2023).

“Vhalangi vha bulasi dzine mashonzha a wanala vha tea u shumisana na vhabati vha mashonzha.” (Participant 6)

Translated version:

"The farm owners who have occupied the land where Mopane worms are found have to collaborate with the harvester."

"Vhalangi vha bulasi vha tea u langa mupo une ha batiwa khawo uri huvhe ho tsireledziwa." **(Participant 8)**

Translated version:

"Farm owners can implement sustainable land management practices that protect Mopane woodlands and create a conducive environment for Mopane worms."

The above comments indicated that farm owners who manage land where Mopane worms are harvested can contribute to ensuring the safety and quality of the harvest through various supportive actions. Moreover, farm owners can implement sustainable land management practices that protect Mopane woodlands and create a conducive environment for Mopane worms. By preserving Mopane trees and avoiding practices that degrade the habitat, farm owners can support healthy worm populations and ensure a consistent and quality harvest.

4.3.3 Health benefits

Mopane worms are a significant food source in Southern Africa, particularly in the Vhembe District. Known for their nutritional benefits, these larvae are not only a staple in local diets but also contribute to food security and economic well-being. Understanding their health benefits requires a nuanced examination of various aspects, including nutritional value, dietary diversity, health outcomes, sustainable food sourcing, economic impacts, and potential health risks.

4.3.3.1 Nutritional value

Mopane worms (*Gonimbrasia belti*) are not only a delicacy in many Southern African cultures but also serve as a vital source of nutrition for local communities. These larvae are recognized for their high protein content, which ranges from 50% to 60% by dry weight, making them a significant alternative protein source, especially in regions where traditional animal proteins are scarce (Monyai, 2012). In addition to protein, Mopane worms are rich in essential micronutrients, including iron and zinc, which are critical for combating nutritional deficiencies prevalent in many rural populations. Research indicates that Mopane worms can contain up to 12 mg of iron per 100 g, providing an important dietary supplement for individuals at risk of anemia (Rukazambuga et al., 2000). Their consumption can enhance dietary quality and overall health, addressing malnutrition effectively in vulnerable communities. Given their nutritional richness, Mopane worms play an essential role in local diets, helping to improve health outcomes and combat malnutrition.

“Mashonzha a na mushumo wa ndeme kha vhupo hashu sa izwi khao ri wana pfushi a dovha a fara mitakalo yashu wavhudi.” (Participant 1)

Translated version:

"Mopane worms provide a remarkable protein source, crucial for a balanced diet in our communities."

“U shumiswa ha mashonzha sa zwiliwa zwa duvha na duvha zwi thusa u vha na pfushi nnzhi mivhilini.” (Participant 11)

Translated version:

"Incorporating Mopane worms into our meals has significantly improved our nutritional status."

As one participant noted, *"Mopane worms provide a remarkable protein source, crucial for a balanced diet in our communities."* Studies show that Mopane worms contain about 50-60% protein by dry weight, making them a valuable alternative protein source

(Monyai, 2012). *“Incorporating Mopane worms into our meals has significantly improved our nutritional status,”* is supported by findings that highlight their role in alleviating malnutrition in vulnerable populations (Hoffman et al., 2013).

4.3.3.2 Dietary diversity

The consumption of Mopane worms significantly contributes to dietary diversity within Southern African diets. As an integral part of traditional cuisine, these worms are often prepared in various ways, adding unique Flavours and textures to meals. The importance of dietary diversity cannot be overstated, as it is linked to better nutritional outcomes and overall health (FAO, 2018). Mopane worms not only enhance the variety of foods consumed but also serve to preserve cultural heritage and traditional practices surrounding food preparation and consumption. They are often collected and shared within communities, reinforcing social bonds and cultural identity. As the community member noted,

“Mashonzha ndi a ndeme kha zwiliwa zwa sialala nga mudifho na pfushi.”

(Participant 3)

Translated version:

"Mopane worms enrich our traditional meals, adding both flavour and nutrition."

“Mashonzha kha riṅe a fhira u vha zwiliwa fhedzi ngauri ndi tshipiḽa tsha sialala na maitele ashu.” **(Participant 4)**

Translated version:

"These worms are more than just food; they are a part of our heritage and cultural practices."

“Mashoznha a ri thusa kha mutakalo sa zwiliwa ngauri ana pfushi nnzhi.”

(Participant 1)

Translated version:

"The addition of Mopane worms helps us diversify our diets, which is vital for health."

As one participant noted that, Mopane worms enrich our traditional meals, by adding both flavour and nutrition. Their inclusion helps combat dietary monotony, which can lead to nutritional deficiencies (Kinyanjui et al., 2014). The cultural importance of Mopane worms is underscored by their historical use in local customs. Makhura et al. (2020) state that “these worms are more than just food; they are a part of our heritage and cultural practices,” highlighting their role in preserving traditional diets. A community member expressed that, *"The addition of Mopane worms helps us diversify our diets, which is vital for health."* This perspective is supported by FAO (2018), which emphasizes that diverse diets lead to better health outcomes.

4.3.3.3 Impact on health outcomes

The impact of Mopane worm consumption on health outcomes is profound, particularly concerning malnutrition and related health issues. Numerous studies indicate that communities that regularly consume Mopane worms exhibit lower rates of malnutrition, especially among children (Mabhaudhi et al., 2019). This is largely due to the worms' high protein and micronutrient content, which supports growth and development in young individuals. Participants often report personal health improvements associated with their consumption, noting increased energy levels and overall vitality. As one local respondent expressed that:

“Vhathu vhanzhi vho tanzila uri musi mashonzha a tshipiḁa tsha zwiliwa zwavho, mutakalo wavho u vha wavhuḁi nga maanḁa.” **(Participant 8)**

Translated version:

"Many people report feeling healthier and more energetic after including Mopane worms in their diets."

"U leswa ha mashonzha ndi zwino kho khwaṭhisa mutakalo wa vhathu vhuponi."
(Participant 2)

Translated version:

"Sustained consumption of Mopane worms has been linked to better health outcomes in local populations."

Studies indicate a correlation between Mopane worm consumption and lower rates of malnutrition. Research by Mabhaudhi et al. (2019) demonstrates that communities consuming Mopane worms regularly have lower rates of childhood malnutrition, suggesting their importance in improving food security. Participants report personal health benefits, with one stating that, *"Many people report feeling healthier and more energetic after including Mopane worms in their diets."* This aligns with the finding that link protein-rich diets to the improved energy levels and the overall health (Meyer-Rochow, 2009). Long-term consumption of Mopane worms has been linked to better health outcomes. Oguntona and Afolabi (2018) conclude that *"Sustained consumption of Mopane worms has been linked to better health outcomes in local populations,"* emphasizing their role in enhancing community health.

4.3.3.4 Sustainable food sources

Mopane worms are considered a sustainable food source, contributing to food security and resilience in local communities, especially during times of drought or food scarcity. These edible insects can be harvested with minimal environmental impact, making them an eco-friendly alternative to conventional livestock (Dreyer et al., 2020). During periods of food insecurity, Mopane worms serve as a critical nutritional resource, helping families sustain themselves when other food sources are limited. As noted by

a community member that, *"Mopane worms are a crucial food source, especially in times of drought and food shortages."*

"Mashonzha ndi zwiliwa zwa ndeme zwine zwa thusa kha tshifhinga tsha gomelolo namusi zwiliwa zwi tshi shayea." **(Participant 1)**

Translated version:

"Mopane worms are a crucial food source, especially in times of drought and food shortages."

"Mitani ine ha lesiwa mashonzha nga zwifhinga zwa ndala vhone a vha lili zwilwa" **(Participant 9)**

Translated version:

"Having access to Mopane worms helps families remain resilient during difficult times."

"U bata mashonzha nga ndila yavhudzi zwi thusa uri tshifhinga tshotha a dzule a hone." **(Participant 10)**

Translated version:

"Harvesting Mopane worms sustainably ensures that we can rely on this resource for generations to come."

Mopane worms are particularly valuable during times of scarcity. As stated, *"Mopane worms are a crucial food source, especially in times of drought and food shortages."* Dreyer et al. (2020) reinforce this by noting their role in enhancing food security during challenging conditions. The reliance on Mopane worms helps communities navigate food insecurity. One community member mentioned, *"Having access to Mopane worms helps families remain resilient during difficult times,"* supported by Kakudidi et al. (2017), who found that diverse food sources enhance community resilience.

Sustainable harvesting practices are essential for the longevity of Mopane worm resources. *"Harvesting Mopane worms sustainably ensures that we can rely on this resource for generations to come,"* highlighting the importance of sustainable management (Van der Merwe et al., 2011).

4.3.3.5 Economic impact on health

The economic benefits derived from harvesting Mopane worms significantly impact community health and well-being. These edible insects provide a source of income for many households, enabling families to purchase other essential food items and healthcare services. As one participant highlighted that, *"The money we earn from harvesting Mopane worms allows us to buy healthier foods for our families."* This economic empowerment is crucial in rural areas where employment opportunities may be limited. Increased income from Mopane worm harvesting can improve access to healthcare, leading to better overall health outcomes. Research indicates that local resources such as Mopane worms can enhance community resilience by providing economic stability and fostering self-sufficiency (Thompson et al., 2019). As communities thrive economically, they are better equipped to address health challenges, demonstrating the interconnectedness of economic and health outcomes.

"Tshelede ine ra i wana kha u bata mashonzha i ri thusa kha u kona u renga zwiliwa zwa mutakalo zwa miṭa yashu." **(Participant 3)**

Translated version:

"The money we earn from harvesting Mopane worms allows us to buy healthier foods for our families."

"Tshelede ine ra i wanala ngaa u rengisa mashonzha i ita uri ri kone u ḡi badelela kha madzilafho a zwa mitakalo." **(Participant 7)**

Translated version:

"With the income from Mopane worms, many community members can afford basic healthcare services."

"U rengisiwa ha mashonzha zwo thusa miṭa minzhi uri i kone u vha na vhutshilo havhuḍi." **(Participant 2)**

Translated version:

"Selling Mopane worms has empowered local families economically, improving their overall well-being."

The economic returns from harvesting are substantial. *"The money we earn from harvesting Mopane worms allows us to buy healthier foods for our families,"* demonstrating the link between income and nutritional access (Rukazambuga et al., 2000). Increased income translates into better access to health services. *"With the income from Mopane worms, many community members can afford basic healthcare services,"* highlighting the relationship between economic stability and health outcomes (Thompson et al., 2019). The economic advantages extend beyond individual families. *"Selling Mopane worms has empowered local families economically, improving their overall well-being,"* which aligns with finding that local resources can enhance community empowerment (Cocks et al., 2008).

4.3.3.6 Potential health risks

While the benefits of consuming Mopane worms are significant, it is essential to acknowledge and address potential health risks associated with their consumption. Food safety is a critical concern, as improper harvesting or preparation can lead to foodborne illnesses. Community education on safe handling practices is vital to prevent such risks (Feng et al., 2021). Additionally, while most people enjoy Mopane worms, there is a possibility of allergic reactions in some individuals, which necessitates awareness and caution. One community member noted that,

“Ndi zwa ndeme u funza vhabati nga u ɗi ʒhongomela musi vha khou bata hu u i tela uri vha ɗi thongomela kha mañwe a malwadze musi vha kho bata mashonzha.” (Participant 1)

Translated version:

"It's essential to educate harvesters about safe practices to prevent foodborne illnesses related to Mopane worms."

“Musi huna vhathu vhano ɗifheliwa nga u ʒa mashonzha, ri dovha ra vha na vhañwe vhane a vha vhaisa.” (Participant 4)

Translated version:

"While most people enjoy Mopane worms, we must be aware that some individuals may have allergic reactions."

“U dzhiela nzhele khombo dzine dza ambeliwa mashonzha ndi zwa ndeme kha mutakalo wa vhadzulapo.” (Participant 3)

Translated version:

"Increased awareness about the risks associated with Mopane worm consumption is necessary for community health."

Education is vital for safe practices. *"It's essential to educate harvesters about safe practices to prevent foodborne illnesses related to Mopane worms,"* this statement indicates the need for health education (Feng et al., 2021). Awareness of potential allergic reactions is necessary. *"While most people enjoy Mopane worms, we must be aware that some individuals may have allergic reactions,"* highlighting the need for caution in consumption (Friedman, 2015). Increased awareness can lead to better health outcomes. *"Increased awareness about the risks associated with Mopane worm*

consumption is necessary for community health," emphasizing the importance of comprehensive health education initiatives (FAO, 2018).

4.4 CHAPTER CONCLUSION

This chapter presents the data collected in Ha-Gumbu, Matiyani, and Bokmakieries. about the study of exploring challenges and intervention strategies that may be used for harvesting Mopane worms in Bokmakieries farm Vhembe District conservation areas. This chapter covered the challenges faced by harvesters as well as challenges on conservation areas and the strategies that may be used for harvesting Mopane worms in conservation areas. The following chapter presents discussion of the study and recommendations.

CHAPTER 5

DISCUSSION, LIMITATIONS, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

The study sought to explore the challenges and intervention strategies for harvesting Mopane worms in conservation areas in the Vhembe District Municipality, Limpopo Province of South Africa. This is the final chapter of the study which covers four aspects namely discussion, limitations, recommendations, and conclusions of the study.

5.2 DISCUSSION

This section presents the discussion of the study findings. These discussions are led by the research objectives which were:

- To discover challenges faced by harvesters of Mopane worms in conservation areas in Vhembe District of Limpopo Province.
- To determine the challenges affecting conservation areas with unsustainable harvesting of the Mopane worms in Vhembe District of Limpopo Province.
- To establish strategies that may be used for harvesting Mopane worms in conservation areas in Vhembe District of Limpopo Province.

5.2.1 Findings on challenges faced by harvesters of Mopane worms in conservation areas

The discussion of the study findings is outlined in the sub-themes below:

5.2.1.1 Legal and regulatory barriers

The study revealed that obtaining permits to harvest Mopane worms is a significant challenge for local harvesters. Many respondents highlighted the cumbersome and

time-consuming process involved in securing these permits, leading to non-compliance and subsequent fines. This finding aligns with Marope et al. (2023), who emphasize that bureaucratic hurdles in permit acquisition discourage legal harvesting practices, resulting in widespread non-compliance and potential penalties. Furthermore, Simelane and Kerley (2020) note that the lack of clear and accessible information about legal requirements exacerbates this issue, contributing to confusion and mistrust towards authorities. Respondents indicated that the permit process is not only complicated but also expensive, making it difficult for small-scale harvesters to comply. One respondent noted that, obtaining permits to harvest Mopane worms is a significant challenge for us. The process is cumbersome and time-consuming, leading to non-compliance and subsequent fines. This sentiment is echoed by other harvesters who feel that the system is not designed to accommodate the realities of rural livelihoods.

According to Marope et al. (2023), the difficulties in permit acquisition discourage legal harvesting practices, resulting in widespread non-compliance and potential penalties. This issue is compounded by the fact that many harvesters lack access to the necessary resources and information to navigate the regulatory framework effectively. As Simelane and Kerley (2020) note, the lack of clear and accessible information about legal requirements exacerbates this issue, contributing to confusion and mistrust towards authorities.

Furthermore, there is a significant disparity between policy formulation and implementation. While policies may be designed with sustainability in mind, their implementation often fails to consider the socio-economic context of rural communities. For instance, Dlamini (2021) discusses the disconnect between policy intentions and practical realities, highlighting those regulations often do not consider the economic hardships faced by local harvesters. These disconnects lead to resistance and non-compliance, as harvesters prioritize their immediate economic needs over long-term sustainability goals. Additionally, enforcement of regulations is often inconsistent, leading to further challenges. Harvesters reported instances of corruption and selective enforcement, where only certain individuals or groups are targeted for penalties. This uneven application of the law creates an environment of

uncertainty and fear among harvesters, who feel vulnerable to arbitrary fines and sanctions. As Sibanda and Dube (2019) point out, the inconsistent enforcement of regulations undermines trust in the legal system and hinders efforts to promote sustainable harvesting practices.

The lack of community involvement in the regulatory process is another critical issue. Many respondents felt excluded from decision-making processes that directly impact their livelihoods. They expressed a need for more inclusive and participatory approaches to policy development and implementation. Research by Mokhothu and Nyirenda (2019) supports this view, emphasizing that engaging local stakeholders in the regulatory process can lead to more effective and sustainable outcomes.

5.2.1.2 Accessibility and transportation issues

Accessibility and transportation emerged as critical challenges, particularly due to the remote locations of Mopane trees and the poor infrastructure in these areas. Respondents reported that they often travel long distances on foot and face significant difficulties in transporting the harvested worms to markets. These challenges are supported by Nkuna and Muzungu (2022), who highlight the lack of infrastructure in rural areas as a significant limitation to efficient access and transport of Mopane worms. Similarly, Mulaudzi et al. (2021) discuss the impact of poor road conditions and limited transport options on the quality and quantity of the products reaching markets.

5.2.1.3 Economic pressures and market dynamics

Economic pressures and unstable market dynamics also significantly affect Mopane worm harvesters. Respondents indicated that market prices are highly volatile, and middlemen often exploit them by purchasing the worms at very low prices. Makhado et al. (2021) confirms that economic pressures and the presence of intermediaries in the trade chain result in minimal returns for harvesters, exacerbating their economic vulnerability. Kgatla (2020) further highlights that market volatility and lack of access

to reliable market information leave rural harvesters at the mercy of fluctuating prices, impacting their economic stability.

5.2.1.4 Environmental and climatic factors

Environmental and climatic factors were frequently mentioned by respondents as major challenges. Changes in climate, such as increased temperatures and altered rainfall patterns, have significantly impacted the lifecycle and availability of Mopane worms. This is consistent with Chidumayo and Mbata (2020), who highlight that climate change is a primary factor affecting Mopane worm populations. Additionally, pesticide use and habitat degradation due to human activities pose severe threats to the sustainability of Mopane worms harvesting. Makuya and Mutshinyalo (2021) and Nhemachena and Hassan (2019) both highlight the detrimental effects of habitat degradation and pesticide use on Mopane worm populations and biodiversity.

5.2.2 Challenges affecting conservation areas with unsustainable harvesting

The challenges are discussed in line with the emerged sub-themes.

5.2.2.1 Decline in Mopane worm populations

Unsustainable harvesting practices led to a noticeable decline in Mopane worm populations. Respondents expressed concerns about the decreasing availability of Mopane worms, which directly impacts their livelihoods. This concern is supported by Makhado et al. (2021), who report that unsustainable harvesting and habitat destruction have led to a significant decrease in Mopane worm populations, affecting both ecological balance and local economies.

The decline in Mopane worm populations is a pressing concern, as highlighted by respondents who observe fewer Mopane worms during the harvesting season. This decline is attributed to several factors, including overharvesting, habitat loss, climate change, and increased predation.

One harvester remarked, *"There used to be plenty of Mopane worms during the season, but now we struggle to find enough to sustain our needs."* This decline is indicative of overharvesting, where the increasing demand for Mopane worms both locally and internationally puts significant pressure on their populations. According to Marope et al. (2023), overharvesting is a major threat to Mopane worm sustainability, as it reduces the reproductive capacity of the species, leading to long-term population declines.

Respondents also pointed to habitat loss as a critical factor in the decline of Mopane worm populations. The conversion of Mopane woodlands into agricultural lands and the ongoing deforestation for timber and fuelwood significantly reduce the available habitat for Mopane worms. One respondent noted that, *"The fields where we used to harvest have now being turned into farms. There's no place left for the worms to thrive."* This sentiment is supported by Makuya and Mutshinyalo (2021), who discuss the impact of habitat fragmentation and land-use change on Mopane worm populations, emphasizing the need for sustainable land management practices.

Climate change is another factor contributing to the decline of Mopane worm populations. Changes in rainfall patterns and rising temperatures affect the life cycle of Mopane worms, disrupting their breeding and feeding patterns. One respondent stated, *"The rains are unpredictable now, and it's affecting the worms. They don't come out like they used to."* This observation aligns with research by Chidumayo and Mbata (2020), which highlights the sensitivity of Mopane worms to climatic changes and the resulting impact on their populations.

Increased predation by birds and other wildlife, driven by changes in the ecosystem, also plays a role in the decline of Mopane worm populations. As other food sources become scarce due to environmental changes, predators turn to Mopane worms as an alternative food source. A respondent mentioned that, *"We see more birds preying on the worms now. It's like everything is changing, and the worms are suffering the most."* This increased predation pressure further exacerbates the decline in Mopane worm populations. Phiri and Dzerefos (2022) describe the ecological implications of

increased predation on Mopane worms, noting that it can lead to significant population declines, especially when combined with other stressors.

The decline in Mopane worm populations has significant implications for the livelihoods of local communities who depend on them for food and income. Harvesters face economic challenges as the availability of Mopane worms decreases, leading to reduced income and food security. This economic pressure often drives unsustainable harvesting practices as harvesters try to meet their immediate needs. According to Dlamini (2021), the economic dependence on Mopane worms highlights the need for sustainable management practices that balance ecological sustainability with community livelihoods.

5.2.2.2 Habitat degradation

Habitat degradation due to agricultural expansion, deforestation, and overgrazing was highlighted as a major issue by the respondents. The reduction in suitable habitats for Mopane worms is a critical concern, as discussed by Makuya and Mutshinyalo (2021). They emphasize that habitat degradation poses a significant threat to Mopane worm populations, and immediate action is required to address this issue. The respondents frequently mentioned the negative impact of agricultural expansion, deforestation, and overgrazing on the habitats of Mopane worms. One harvester remarked that, "*The areas where Mopane trees grow are being cleared for agriculture, reducing the habitat for the worms.*" This sentiment underscores the urgent need to address land-use changes that threaten the sustainability of the Mopane worm harvesting.

Agricultural expansion into the Mopane woodlands is driven by the need for increased food production to support growing populations. However, this expansion often occurs at the expense of natural habitats. As Makuya and Mutshinyalo (2021) discuss, the conversion of Mopane woodlands into agricultural land not only reduces the available habitat for Mopane worms but also disrupts the ecological balance, affecting other species that depend on these woodlands. Similarly, Nhemachena and Hassan (2019) highlight that habitat degradation due to unsustainable agricultural practices contributes significantly to the decline of Mopane worm populations.

Deforestation, often for timber and fuelwood, further exacerbates habitat loss. The removal of Mopane trees, which are essential for the lifecycle of the Mopane worms, leads to a decrease in the availability of these crucial habitats. Respondents noted that *"deforestation is a big problem. We see fewer Mopane trees each year, which means fewer worms."* This observation is supported by Phiri and Dzerefos (2022), who emphasize the need for sustainable forest management practices to preserve Mopane woodlands.

Overgrazing by livestock is another significant factor contributing to habitat degradation. Livestock trample and overconsume the vegetation, preventing the regrowth of the Mopane trees and other plant species. This degradation not only impacts the Mopane worms but also reduces the overall biodiversity of the area. According to Sibanda and Dube (2019), overgrazing leads to soil erosion and the depletion of plant cover, making it difficult for natural habitats to recover.

5.2.2.3 Biodiversity loss

Biodiversity loss emerged as a significant concern among respondents, who noted that the decline in Mopane worm populations has far-reaching implications for the broader ecosystem. The interconnectedness of species within the Mopane woodlands means that the reduction in Mopane worms' impact other species that rely on them for food, leading to a cascading effect on biodiversity. One respondent stated that, *"We used to see many different birds and small animals around the Mopane trees, but now there are fewer because the worms are not as abundant."* This observation highlights the role of Mopane worms as a crucial food source for various bird species and small mammals. When the Mopane worm populations decline, these species must compete for other limited food resources, potentially leading to declines in their populations as well. Nhemachena and Hassan (2019) support this by noting that the decline of the Mopane worm populations can disrupt the food web, affecting species diversity and ecosystem stability.

Another harvester mentioned that, *"The diversity of plants and animals in the Mopane woodlands is not the same as before. The ecosystem is changing."* This reflects the

broader ecological impact of reduced the Mopane worm populations. Mopane worms contribute to nutrient cycling in the soil through their feeding and excretion processes. As their numbers dwindle, the nutrient dynamics of the soil are altered, potentially affecting plant growth and the overall health of the woodland ecosystem. Mufandaedza et al. (2022) emphasize that the ecological role of Mopane worms in nutrient cycling is critical, and their decline can lead to reduced soil fertility and plant diversity.

The impact of biodiversity loss extends beyond ecological functions to the cultural and economic aspects of local communities. Many respondents expressed concerns about the loss of traditional knowledge and cultural practices associated with Mopane worms harvesting. One community elder remarked that, *"Our traditions and knowledge about Mopane worms are disappearing with the worms themselves. It's part of our heritage that we're losing."* This highlights the cultural importance of Mopane worms, not just as a food source but as an integral part of the community's identity and traditions. According to Makhado et al. (2021), the cultural significance of the Mopane worms and other non-timber forest products underscores the need for their conservation to preserve indigenous knowledge and cultural heritage.

The loss of biodiversity due to unsustainable harvesting practices and habitat degradation also has economic implications. The respondents noted that the decline in Mopane worms affects their livelihoods, as they rely on harvesting and selling the worms for income. This economic pressure can lead to further unsustainable practices as harvesters try to meet immediate financial needs, creating a vicious cycle of environmental degradation and economic hardship. Phiri and Dzerefos (2022) argue that sustainable management of natural resources is essential to ensure the long-term viability of both the environment and local economies.

5.2.3 Strategies that may be used for harvesting Mopane worms in conservation areas

The study has established that Mopane worms contribute to the food security of Vhavenda communities. Thus, the study discovered that quality control of the Mopane worms is essential to keep the indigenous communities' food secured. The study has revealed that proper sun-drying and packaging of Mopane worms would be ideal for

successfully harvesting Mopane worms and ensuring that the indigenous communities are food secured. Furthermore, the study discovered that the government support may provide regulation of the harvesting process of Mopane worms. The supported discovered by the study was the development of policies that will enable the safety of the harvesters and quality control of Mopane worms. Additionally, the study discovered that conservation areas belong to the specific people who are mostly farmers. Thus, the study discovered that there is a need to support to establish a good relationship with the farmers through the support.

5.3 CONCLUSIONS

The study sought to explore the challenges and intervention strategies for harvesting Mopane worms in conservation areas in the Vhembe District Municipality, Limpopo Province of South Africa. The communities involved in the study were Bokmakieries, Ha-Gumbu, and Matiyani. The study employed a qualitative research methodology. Furthermore, the study consisted of the 20 participants who were sampled using purposive and snowball sampling. The participants included in the study were the indigenous holders, Mopane worms' traders, and rural households. The study findings reveals that the primary challenges faced by harvesters of Mopane worms in conservation areas in the Vhembe District, include legal and regulatory barriers, accessibility and transportation issues, economic pressures, and environmental and climatic factors. These challenges not only impact the harvesters' livelihoods but also contribute to broader issues such as habitat degradation, biodiversity loss, and conflicts between conservation efforts and local livelihoods. Addressing these challenges requires a comprehensive and inclusive approach that considers both the ecological sustainability and the socio-economic needs of local communities.

5.4 LIMITATIONS OF THE STUDY

The study may have been limited by the sample size of respondents, which could affect the generalizability of the findings. A larger sample would provide a more comprehensive understanding of the challenges faced by harvesters. Focusing on Bokmakieries Farm in the Vhembe District may have limited the applicability of the

findings to other regions with different ecological and socio-economic conditions. Seasonal variations were also a limitation data collection during a specific season might not capture the full extent of the challenges and variations in Mopane worm populations throughout the year and the availability of recent and relevant literature on certain aspects of the Mopane worm harvesting may have been limited, affecting the depth of the discussion.

5.5 RECOMMENDATIONS

This section provides recommendations of the study. These recommendations are provided in two categories namely recommendations for the community and recommendations for future studies.

5.5.1 Recommendations for the community

- Encourage the adoption of sustainable harvesting techniques to ensure the long-term viability of the Mopane worm populations. This includes adhering to seasonal harvesting guidelines and leaving a portion of the population to mature and reproduce.
- Establish community-based management committees to oversee the sustainable use of the Mopane worms. These committees can facilitate cooperation among harvesters, ensure compliance with regulations, and promote best practices.
- Implement educational programs to raise awareness about the ecological importance of the Mopane worms and the impacts of overharvesting. These programs should target both adults and children to foster a culture of conservation.
- Strengthen communication and collaboration with local authorities to ensure that the legal and regulatory framework supports sustainable harvesting practices. This includes simplifying the permit process and providing clear information on legal requirements.

5.5.2 Recommendations for future studies

- There is a need for Longitudinal Studies to be conducted in future research. Conduct long term studies to monitor the population dynamics of Mopane worms and the impacts of harvesting practices over time. This will provide valuable data for sustainable management.
- Perform detailed ecological impact assessments to understand the broader effects of the Mopane worm harvesting on the ecosystem, including plant biodiversity and soil health.
- Investigate the socio-economic factors influencing Mopane worm harvesting, including market dynamics, economic pressures, and cultural practices. This research can inform policies that balance economic needs with conservation goals.
- There is need for research on Climate Change Effects Study, that aims on understanding the impacts of climate change on Mopane worm populations and their habitats. Understanding these effects is crucial for developing adaptive management strategies.
- Conduct comparative studies between different regions and communities to identify best practices and successful conservation models that can be replicated in other areas.

5.6 CONCLUSION

The study highlights the multifaceted challenges faced by Mopane worm harvesters in conservation areas, with a focus on Bokmakieries Farm in the Vhembe District. Key issues identified include legal and regulatory barriers, habitat degradation, biodiversity loss, and the decline in Mopane worm populations. These challenges are interconnected, with each exacerbating the others, leading to significant ecological, economic, and cultural impacts. The legal and regulatory framework presents a

significant barrier to sustainable harvesting, with cumbersome permit processes and inconsistent enforcement undermining compliance. Habitat degradation due to agricultural expansion, deforestation, and overgrazing reduces the available habitat for Mopane worms, further contributing to their decline. Biodiversity loss is a critical concern, as the reduction in Mopane worm populations impact other species and disrupts ecological functions. Addressing these challenges requires a holistic approach that integrates sustainable harvesting practices, community engagement, and supportive legal frameworks. Recommendations for the community include adopting sustainable practices, establishing community-based management, developing alternative livelihoods, raising awareness, and engaging with authorities. Future studies should focus on long-term population monitoring, ecological impact assessments, socio-economic research, the effects of climate change, and comparative studies. Despite the study's limitations, it provides valuable insights into the complex dynamics of Mopane worm harvesting and offers a foundation for developing strategies that balance conservation with the livelihoods of local communities. By implementing the recommended actions and continuing research, it is possible to promote the sustainable use of Mopane worms and ensure the health of the ecosystems they inhabit.

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APPENDIX 1: INFORMED CONSENT

RESEARCH ETHICS COMMITTEE

UNIVEN Informed Consent

Appendix B

LETTER OF INFORMATION

Title of the Research Study : Exploring challenges and intervention strategies for harvesting Mopane worms in conservation areas

Principal Investigator/s/ researcher: (Takalani Ernest Dzhanngi, MA)

Co-Investigator/s/supervisor/s : (*Justice Makhanikhe, PHD*

Thizwilondi Joanbeth Madima , PHD)

Brief Introduction and Purpose of the Study: Mopane worms have been part of the African indigenous people for many years and have been used as food. In this contemporary there has been shortage of Mopane in worms which may lead to their scarcity. The purpose of this study is to is to explore challenges and intervention strategies that may be used for harvesting Mopane worms in conservation areas in Bokmakieries and Vhembe district.

Outline of the Procedures : *(Responsibilities of the participant, consultation/interview/survey details, venue details, inclusion/exclusion criteria, explanation of tools and measurement outcomes, any follow-ups, any placebo or no treatment, how much time required of participant, what is expected of participants, randomization/ group allocation)*

The research data will be collected in the conducive places of the research participants. The participants suitable for this study are people from Ha-Gumbu, Matiyani and Bokmakieries, who are the indigenous knowledge holders, Mopane worms' traders and rural households. The researcher will make use of semi-structured interviews to conduct one-on-one interviews. The estimated time for participation in this study is 50 to 120 minutes. The collected data will be analyzed through thematic data analysis with consideration of confidentiality and anonymity.

Risks or Discomforts to the Participant: *(Description of foreseeable risks or discomforts to for participants if applicable e.g. Transient muscle pain, VBAI, post-needle soreness, other adverse reactions, etc.)*

The information that will be provided by the participants will not be publicly shared or accessed by everyone except the researcher. Names of the participants will be protected by using pseudonyms during analysis of data.

Benefits : *(To the participant and to the researcher/s e.g. Publications)*

This study may not directly have benefit to the participants, however, the information that will be obtained from this study may help to establish intervention strategies for harvesting Mopane worms in conservation areas. In addition, three articles will be developed from the study.

Reason/s why the Participant May Be Withdrawn from the Study: *(Non-compliance, illness, adverse reactions, etc. Need to state that there will be no adverse consequences for the participant should they choose to withdraw)*

Participants will not be forced to participate in the study should they choose to withdraw under any circumstances and there will be no consequences or punishment

Remuneration : *(Will the participant receive any monetary or other types of remuneration?)*

Costs of the Study : *(Will the participant be expected to cover any costs the study?)*
NO towards

Confidentiality : *(Description of the extent to which confidentiality will be maintained and how will this be maintained)*

The participant during interview has the right to privacy. Interviews will be recorded on tape and participants who are not comfortable with being part of the study will be allowed to withdraw. To achieve confidentiality the researcher will not share the personal information such as writing names and also the recordings will be kept in a safe place where only the researcher and supervisor can access them.

Research-related Injury: *(What will happen should there be a research-related injury or adverse reaction? Will there be any compensation?)*

-There are lower chances that there will be any challenges, therefore, the researcher will conduct the study in conducive places to both the researcher and participants. In that regard, there will be no any compensation.

Persons to Contact in the Event of Any Problems or Queries:

(Supervisor and details) Please contact the researcher Dzhanngi Takalani Ernest (tel no. 0818063922), my supervisor Dr Justice Makhnikhe (tel no 072 531 0936.) or the University Research Ethics Committee Secretariat on 015 962 9058. Complaints can be reported to the Director: Research and Innovation, Prof GE Ekosse on 015 962 8313 or Georges Ivo.Ekosse@univen.ac.za

General:

Potential participants must be assured that participation is voluntary and the approximate number of participants to be included should be disclosed. A copy of the information letter should be issued to participants. The information letter and consent form must be translated and provided in the primary spoken language of the research population

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, (Takalani Ernest Dzhanngi), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: FHSSE/24/IKS/01/1207,
- I have also received, read and understood the above written information (*Participant Letter of Information*) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.

- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

Full Name of Participant	Date	Time	Signature
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I, ...			
.....			

(*Name of researcher*) herewith confirm that the above participant has been fully

Informed about the nature, conduct and risks of the above study.

Full Name of Researcher

.....	Date.....
Signature.....	

Full Name of Witness (If applicable)

.....
Signature.....

Date

Full Name of Legal Guardian (If applicable)

.....
Signature.....

Date.....

Please note the following:

Research details must be provided in a clear, simple and culturally appropriate manner and prospective participants should be helped to arrive at an informed decision by use of appropriate language (grade 10 level- use Flesch Reading Ease Scores on Microsoft Word), selecting of a non-threatening environment for interaction and the availability of peer counseling (Department of Health, 2004)

If the potential participant is unable to read/illiterate, then a right thumbprint is required and an impartial witness, who is literate and knows the participant e.g. parent, sibling, friend, pastor, etc. should verify in writing, duly signed that informed verbal consent was obtained (Department of Health, 2004).

If anyone makes a mistake completing this document e.g. a wrong date or spelling mistake, a new document has to be completed. The incomplete original document has to be kept in the participant's file and not thrown away, and copies thereof must be issued to the participant.

References:

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APPENDIX 2: KEY INFORMANT SCHEDULE FOR INDIGENOUS KNOWLEDGE HOLDERS

My name is Takalani Ernest Dzhanngi (16000545), I am a master's student at University of Venda in the Department of African Studies. I am undertaking research study titled **EXPLORING CHALLENGES AND INTERVENTION STRATEGIES FOR HARVESTING MOPANE WORMS IN CONSERVATION AREAS: A CASE STUDY OF BOKMAKIERIES FARM VHEMBE DISTRICT**

The case of Bokmakieries farm Vhembe District.” I humbly request your assistance by taking part in my interview sessions. Your responses to the interview questions will solely be used for academic purposes and the information collected from you will be treated with utmost confidentiality.

Kindly sign here to acknowledge consent

.....

Section A: The areas where Mopane worms are found in Vhembe

1. What is the history behind the Mopane worms around this area?
2. Where are Mopane worms
3. What kind of weather conditions are favourable for Mopane worm production?
4. What are the benefits of having Mopane worm to the villages and the district?

Section B: Harvesting processes of Mopane worms

5. Which areas are rich in the harvesting of Mopane worms around Vhembe District and for how long does the harvesting process take?
6. How long does it normally take for Mopane worms to reach maturity enabling them to be harvested?
7. How are Mopane worms harvested in line with your indigenous knowledge?
8. On average, how many kilograms of Mopane worms are harvested within a single harvesting season?
9. Explain the preservation processes that take place when preserving Mopane worms?

Challenges affecting conservation areas with unsustainable harvesting of Mopane worms

10. What kind of challenges are currently being experienced with regards to harvesting Mopane worms in Vhembe?
11. In your own opinion, are there any socio-economic issues that impact negatively on the harvesting of Mopane worms?

Section C: Strategies for harvesting Mopane worms

12. Based on your knowledge and experience, what can be done to ensure sustainable management of Mopane worms within your area?
13. What kind of strategies can be adopted to enhance the production and harvesting of Mopane worms?

14. How can the people around this area help in mitigating negative effects associated with the production process of Mopane worms?

15. Do you have any other issues that you would like to bring to the attention of the researcher?

APPENDIX 3: KEY INFORMANT SCHEDULE FOR MOPANE WORMS' TRADERS

My name is Takalani Ernest Dzhanngi (16000545), I am a master's student at University of Venda in the Department of African Studies. I am undertaking research study titled **EXPLORING CHALLENGES AND INTERVENTION STRATEGIES FOR HARVESTING MOPANE WORMS IN CONSERVATION AREAS: A CASE STUDY OF BOKMAKIERIES FARM VHEMBE DISTRICT**

The case of Bokmakieries farm Vhembe District." I humbly request your assistance by taking part in my interview sessions. Your responses to the interview questions will solely be used for academic purposes and the information collected from you will be treated with utmost confidentiality.

Kindly sign here to acknowledge consent
.....

Section A: To identify the areas where Mopane worms are found in Vhembe

1. Which areas around Vhembe do you normally buy Mopane worms for resale?
2. Why are these areas preferable than others?
3. To what extend do you think that Mopane worms' business is sustainable to enhance your livelihoods?

Section B: Harvesting process of Mopane worms

4. As Mopane worms' traders, what kind of benefits does this provide to you and your households?

5. Examine the challenges affecting the conservation areas with unsustainable harvesting of Mopane worms based on your trading experience?
6. What activities do you do as traders to ensure that there are sufficient Mopane worms produce in the market?
7. How do you determine the quality of Mopane worms as a basis for pricing determination?
8. What is the importance of Mopane worms as tradable commodity?

Section C: Challenges affecting conservation areas with unsustainable harvesting of Mopane worms

9. As Mopane worms' traders, what kind of challenges affect the harvesting process of this protein worm?
10. In what ways does the conservation areas process of harvesting Mopane worms affect your business?
11. Are Mopane worms businesses regulated by any authoritative body around your area?
12. Are there any challenges of harvesting Mopane worms in conservation area based on your experience as traders?

Section D: Strategies for harvesting Mopane worms

13. What kind of strategies do you think are important to sustain the harvesting of Mopane worms and your business around this area?

14. From your own perspective, identify possible ways that can be adopted by the traders to sustainably harvest Mopane worms within Vhembe?

15. Are there any other issues that you would like to convey to the researcher?

APPENDIX 4: KEY INFORMANT SCHEDULE FOR THE RURAL HOUSEHOLDS

My name is Ernest Takalani Dzhanngi (16000545), I am a master's student at University of Venda in the Department of African Studies. I am undertaking research study titled **"EXPLORING CHALLENGES AND INTERVENTION STRATEGIES FOR HARVESTING MOPANE WORMS IN CONSERVATION AREAS: A CASE STUDY OF BOKMAKIERIES FARM VHEMBE DISTRICT"**

: The case of Bokmakieries farm Vhembe District." I humbly request your assistance by taking part in my interview sessions. Your responses to the interview questions will solely be used for academic purposes and the information collected from you will be treated with utmost confidentiality.

Kindly sign here to acknowledge consent
.....

Section A: Areas where Mopane worms are found in Vhembe

1. Is your rural area rich in the production of Mopane worms?
2. What kind of activities do you do during the harvesting of Mopane worms?
3. What is the importance of Mopane worms as a source of food?
4. As the residents of villages where Mopane worms are found, what kind of benefits does this provide to you and your households?

Section B: Harvesting processes of Mopane worms.

5. What are the various methods that are employed when harvesting Mopane worms?

6. Does the expansion of villages in Vhembe District contribute to the loss of habitat for Mopane worms?
7. What factors affect the availability of Mopane worms in your area?
8. In what ways do you also take part in the harvesting of Mopane worm in the conservation area?
9. How do you preserve and store Mopane worms to enhance sustainability in conservation areas?

Section C: Challenges affecting conservation areas with unsustainable harvesting of Mopane worms

10. As the villagers, what challenges do you face in harvesting of Mopane worms?
11. How does the challenges affect conservation areas with unsustainable harvesting of Mopane worms in Vhembe District?

Section D: Possible strategies for harvesting Mopane worms

12. What kind of strategies do you think are important to sustain the harvesting of Mopane worms around the conservation areas?
13. From your own perspective, what are the possible ways that can be adopted by the villagers to sustainably manage Mopane worms within Vhembe?
14. Are there any other issues that you would like to convey to the researcher?

APPENDIX 5: ETHICAL CLEARANCE

ETHICS APPROVAL CERTIFICATE

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Mr TE Dzhanngi

STUDENT NO:
16000545

PROJECT TITLE: **Exploring challenges and intervention strategies for harvesting mopane worms in conservation areas: a case study of Bokmakieries farm Vhembe district.**

ETHICAL CLEARANCE NO: FHSSE/24/IKS/01/1207

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Dr TJ Makhanikhe	UNIVEN, Indigenous Knowledge Systems	Supervisor
Dr TJ Madima	UNIVEN, Indigenous Knowledge Systems	Co-Supervisors
Mr TE Dzhanngi	UNIVEN, Indigenous Knowledge Systems	Investigator – Student

Type: **Masters Research**

Risk: **Minimal risk to humans, animals or environment (Category 2)**
Approval Period: **July 2024 – July 2025**

The Research Ethics Social Sciences Committee (RESSC) hereby approves your project as indicated above.

General Conditions

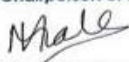
While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following.

- The project leader (principal investigator) must report in the prescribed format to the REC:
 - Annually (or as otherwise requested) on the progress of the project, and upon completion of the project.
 - Within 48hrs in case of any adverse event (or any matter that interrupts sound ethical principles) during the course of the project.
 - Annually a number of projects may be randomly selected for an external audit.
- The approval applies strictly to the protocol as stipulated in the application form. Would any changes to the protocol be deemed necessary during the course of the project, the project leader must apply for approval of these changes at the REC. Would there be deviation from the project protocol without the necessary approval of such changes, the ethics approval is immediately and automatically forfeited.
- The date of approval indicates the first date that the project may be started. Would the project have to continue after the expiry date; a new application must be made to the REC and new approval received before or on the expiry date.
- In the interest of ethical responsibility, the REC retains the right to:
 - Request access to any information or data at any time during the course or after completion of the project,
 - To ask further questions; Seek additional information; Require further modification or monitor the conduct of your research or the informed consent process.
 - withdraw or postpone approval if:
 - Any unethical principles or practices of the project are revealed or suspected.
 - It becomes apparent that any relevant information was withheld from the REC or that information has been false or misrepresented.
 - The required annual report and reporting of adverse events was not done timely and accurately,
 - New institutional rules, national legislation or international conventions A it necessary

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE
Date Considered: July 2024

Name of the RESSC Chairperson of the Committee: Prof M. Mwale-Manjoro

Signature




APPENDIX 6: ENGLISH EDITING LETTER

DR SHUMANI ERIC MADIMA

Tel: +27-015 962 9311

Cell: 082 073 8313

Email: eric.madima@univen.ac.za/ericmadima@gmail.com

20 January 2025

TO WHOM IT MAY CONCERN

This serves to confirm that I, Dr Shumani Eric Madima, edited and formatted the dissertation titled "EXPLORING CHALLENGES AND INTERVENTION STRATEGIES FOR HARVESTING MOPANE WORMS IN CONSERVATION AREAS: A CASE STUDY OF BOKMAKIERIES FARM, VHEMBE DISTRICT" by Dzhanngi Takalani Ernest (16000545)

Kind regards



.....
Dr SE Madima (PhD)
Department of English, Media Studies and Linguistics
UNIVERSITY OF VENDA