An Ethnobotanical study of indigenous knowledge of the medicinal plants used by traditional healers in the rural communities of Nkomazi Local Municipality, Mpumalanga province

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ABSTRACT

Traditional medicine continues to significantly impact many people's lives amid all the advancements in modern medicine. Many rural communities in Mpumalanga province depend on indigenous traditional medicines to manage various ailments. The available research on the traditional usage of medicinal plants among rural communities in Mpumalanga is highly fragmented and under-researched. The decline of medicinal plant populations has led stakeholders to take various initiatives to counteract over-exploitation, including cultivation as a viable conservation approach. However, the scientists' inadequate understanding of the acceptance of cultivated medicinal plants by traditional healers is one of the issues contributing to the failure of medicinal plant cultivation programs. Consequently, this study aimed to document medicinal plants utilised by the Nkomazi Local Municipality's traditional healers and assess opportunities and constraints for medicinal plant conservation in the Nkomazi Local Municipality. The ethnobotanical data was obtained through semi-structured questionnaires and guided field walks with traditional healers. Individual interviews were conducted with ten traditional healers from eight villages across Nkomazi during field visits between July 2021 and February 2022. The study employed qualitative and quantitative approaches to understand traditional healers' perspectives concerning the ethnobotanical significance and medicinal plant conservation. The study found that the indigenous knowledge of medicinal plants in the Nkomazi Local Municipality is diverse, encompassing 111 species from 59 different families employed to treat 70 ailments. Most of the reported medicinal plants for this study are of Least Concern. Additionally, the top fourteen most reported species in the Nkomazi Local Municipality included commercially valuable plants such as *Psidium guajava*, *Ricinus communis*, *Sclerocarya birrea*, *Aloe ferox*, *Aloe maculata*, *Leonotis leonurus*, and *Moringa oleifera*. Most of the Nkomazi Local Municipality's traditional healers did not know about protected plant species and the National Environmental Management Act (NEMA). Traditional healers were aware of the decline in wild populations of medicinal plants, which they attributed to various factors such as overharvesting. Diviner's and herbalist perception of using cultivated plants did not differ significantly ($\chi 2$=0.4762, df=1, P= 0. 490). The study provided a comprehensive inventory of medicinal plants utilised by Nkomazi traditional healers and essential data for future assessments of the use local use of indigenous medicinal plants.

Keywords: ancestors; attitudes; conservation; cultivation; diviners; herbalist; indigenous knowledge; legislation; medicinal plants; traditional healers.

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LIST OF ABBREVIATIONS

IK - *Indigenous knowledge*

IKS - *Indigenous Knowledge Systems*

NRF -*National Research Foundation*

THO - *Traditional Healers Organisation*

WHO - *World Health Organization*

DECLARATION

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

School of Animal, Plant and Environmental Sciences

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I, Nompendulo Khoza (Student number: 1162598) am a student registered for Master Science (Dissertation) in the year 2023. I hereby Declare the following:

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DEDICATION

This master's Dissertation is dedicated to my late grandmother N'wa Khoza. *Etlela hiku rhula Ntombi yaka Khoza marisane, marisa huku hiku landza!*

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CHAPTER 1

INTRODUCTION

1.1 Background

Traditional medicine is integral to African religion and culture (Ajima and Ubana, 2018). Traditional medicine continues to significantly impact many people's lives amid all the advancements in modern medicine (Mabogo, 2012). Traditional medicine is utilised by nearly 80% of South Africa's black population (Nxumalo *et al*., 2011). Around one-third of the global population currently have no access to lack access to modern medicine. As a result, traditional medicine is regarded as an affordable and accessible healthcare service, particularly by those in rural communities (Mathibela, 2013). Africans have depended on traditional medicines for centuries, and medicinal plants are vital to their countries' healthcare systems (van Wyk *et al.,* 2018). Traditional medicine adopts a holistic approach to treating ailments and diseases and encouraging health, in contrast to Western treatment, which is technical and empirically oriented (Hammond-Tooke, 1998). Success or misfortune are not perceived as random events in traditional medicine systems but are believed to be linked to the conduct of patients and ancestral spirits as per the connections that person has with the universe and their ancestors (Mbongwa, 2018).

South Africa has two distinctive categories of traditional healers: the diviner (Swati- sangoma/inyanga; Tsonga- mungoma/nyamusora and the herbalist (Swati- lugedla/ inyanga yemitsi; Tsonga- n'anga) (Shilubane, 2008; Ngobe *et al*., 2021). However, the difference between the two categories has become unclear as they both use herbal medicine (Steenkamp, 2003). Traditional healers in other tribes are known as inyanga (Zulu), ngaka (Sotho), nanga (Venda), amaquira (Xhosa) (Van Wyk *et al*., 1997; Steenkamp, 2003; Mabunda and Ross, 2022). Traditional healers are medicine knowledge holders and play a crucial role in African communities (Moeta *et al*., 2022).

Traditional healers are essential in providing healthcare within their communities (Masupha *et al.,* 2012). The main reasons for consulting traditional healers are the belief that specific ailments cannot be cured by western medicine, the firm belief that ancestors exist, and the expensive cost associated with western medicine (Mahwasane *et al.*, 2013). Traditional healers acquire a large portion of their medication from plants (Van Wyk *et al.,* 2018). It has been observed that these medicinal plants have a substantial impact as an income source in

developing countries where rural communities are heavily reliant on natural resources (Xaba *et al*., 2022).

Many South African wild medicinal plants have significantly declined because of unsustainable harvesting practices, over-harvesting, the growing human population, and habitat destruction, amongst other factors, requiring traditional practitioners to travel long distances to acquire the needed medicinal plants for their practices (Coopoosamy and Naidoo, 2012; Chen *et al.*, 2016). In the past, better law enforcement has been suggested to eradicate the exploitation of medicinal plants, however, this has proven ineffective (Mbongwa, 2018). According to Vermeulen (2009), the challenges are brought on by the socioeconomic situation of many South African communities, impediments in establishing a sustainable harvest system, Insufficient understanding and resources to support the successful implementation of the legislation and policy, and an increase in the number of commercials.

Cultivation is a viable conservation strategy that could mitigate pressures on wild plant populations from the increasing demand (Van Wyk *et al.,* 2018). Demand is among the critical drivers of over-harvesting, whereby plants in high demand are the most vulnerable (Xego *et al.,* 2016). However, there have been concerns that cultivation is unsustainable since some plants are slow growing (Moeng, 2010). Additionally, traditional healers prefer wild-collected medicinal plants over cultivated ones because they perceive them as less potent and ineffective in treating specific ailments (Semenya and Potgieter, 2014). Considering the ongoing demand for rare medicinal plants, cultivation can benefit traditional healers who currently do not have access to certain plant species (Mbongwa, 2018). Many medicinal plants valuable to traditional healers, such as *Ocotea bullata, Siphonochilus aethiopicus,* and *Warburgia salutaris,* have been reported by researchers as being of concern due to shortage of supply from the wild and the high demand (Moeng, 2010; Williams *et al.,* 2013; Mbongwa, 2018).

Regardless of the possible concerns with cultivated plants, such as their perceived reduced effectiveness, there are reports of some traditional healers using cultivated medicinal plants in their practices (Mbongwa, 2018). For instance, traditional healers in the Malolotja region in Swaziland and parts of South Africa have embraced cultivated medicinal plants as a substitute for wild harvested medicinal plants (Cunningham, 1993; Mathibela, 2013). The acceptability of cultivated medicinal plants is influenced by the declining wild population of medicinal plants and the increased travel distance to harvesting areas (Mbongwa, 2018). However, some traditional healers have hesitated to use cultivated medicinal plants and are usually excluded

from cultivation initiatives, and their cultural perspectives on cultivation have not been thoroughly examined (Ndawonde, 2015). Although many diverse strategies, such as cultivation, are implemented to reduce biodiversity loss, awareness of habitat loss and the related loss of biocultural diversity is not yet achieved (Kelatwang, 2005; Mbongwa, 2018). However, there have not been any solid justifications for the slow adoption rate. According to Kelatwang (2005), reluctance to adopt any innovation can be related to a person's inability or unwillingness to do so. A person's unwillingness is indirectly and directly associated with their attitudes, perceptions, and lack of need. While most studies focused on the trade in medicinal plants and how traditional healers used them, little consideration has been given to how extensively healers use cultivated plants (Kelatwang, 2005; Mbongwa, 2018). This knowledge gap has led policymakers to concentrate on promoting species cultivation rather than considering factors influencing healers' behavioural patterns (Kelatwang, 2005; Mbongwa, 2018). These factors might explain the slow adoption rate of medicinal plant nurseries. Cultivated plants must be consistent with the traditional healing belief systems to be acceptable to traditional healers (Kelatwang, 2005).

1.2 The rationale for the study

The traditional way of life in many South African villages is rapidly transforming because of economic development, western education, urbanization, improved access to health care services, and climate change, among other influences, which lead to the degradation of crucial indigenous knowledge on the application of medicinal plants (Mahwasane *et al.*, 2013). This knowledge is orally passed down through generations without documentation, and traditional healers do not have a written record-keeping system (Anongu and Akunoko, 2023). Therefore, it is relevant to document and preserve this knowledge since this written record could help discover and use novel medicines (Mlilo and Sibanda, 2022). Additionally, recording shared indigenous knowledge on the utilisation of medicinal plants can assist in preserving crucial cultural heritage aspects of indigenous people for the coming generations (Mahwasane *et al.*, 2013).

The available research on the traditional use of medicinal plants by the rural communities of Mpumalanga is highly fragmented and under-researched, encompassing only the Jongilanga tribal council, which falls under the Bushbuckridge Local Municipality (Tshikalange *et al.*, 2016). There is no comprehensive account and documentation of the indigenous knowledge of the Nkomazi Local municipality's medicinal plants and their associated applications. Therefore, a thorough investigation and documentation of the medicinal plant usage by the

community of Nkomazi Municipality are necessary to preserve the indigenous knowledge the locals share. Documenting this indigenous knowledge of medicinal plant use will assist with conserving medicinal plants. Additionally, it might serve as a starting point for further research into the pharmacology and phytochemistry of the reported plants for the creation of novel medicinal products.

The scientists' insufficient understanding of the acceptance of cultivated medicinal plants by traditional healers is one of the issues responsible for the failure of medicinal plant cultivation programs (Mbongwa, 2018). Herbalists' use of traditional medicine is informed by deeply ingrained cultural beliefs, whereas diviners' practices are guided by their ancestors (Mbongwa, 2018). People have different attitudes and perceptions toward using cultivated medicinal plants based on their cultural beliefs and location (Wiersum *et al.*, 2006). Limited research has been done to investigate and comprehend the cultural beliefs and practices related to medicinal plant utilisation (Mbongwa, 2018). Despite the appearance of uniformity within the traditional healing practice, traditions vary among ethnic groups, and these variations may impact the acceptance of cultivated medicinal plants (Mbongwa, 2018). According to Obradović *et al*. (2023), people's perceptions, attitudes, and values toward natural resources differ from region to region and significantly impact the effectiveness of medicinal plant conservation strategies. Understanding these value systems will help ensure that cultivated plants are more acceptable to traditional healers and could benefit nurseries that are now struggling to draw traditional healers.

Considering the aforementioned, the present study is thus motivated by the urgent need to fill this knowledge gap, document aspects of medicinal plant usage, and evaluate the attitudes and beliefs of traditional healers in the Nkomazi Local Municipality towards cultivated medicinal plants. The study also sought to determine the level of traditional healers' knowledge regarding the harvesting and sustainability of medicinal plants in the Nkomazi Local Municipality, as well as their awareness of environmental regulations.

Information concerning medicinal plants used will be valuable to the provincial environmental authorities responsible for developing conservation plans for the area. This study provided the first documentation of medicinal plants used by the Nkomazi Local Municipality's traditional healers and offered essential information to operating nurseries to advance and overcome conflicting viewpoints and disinterest among traditional healers. Additionally, the local medicinal plant's indigenous knowledge will be recorded and conserved for future use by the next generation. Ethnomedical and ethnobotany research are the most powerful tools for

discovering novel medicinal plants or to re-investigate plants documented in previous research to examine their bioactive compounds (Süntar, 2022).

1.3 Personal Experience

I was born in Mangweni village situated in the Nkomazi Local Municipality, into a family of Tsonga and Siswati heritage. At the age of two, my father was offered a permanent position as a miner in one of the mining companies in Klerksdorp in the North West Province. This new opportunity forced my parents to relocate and settle in Kanana Township. This move presented a tremendous transformation in our lives as we adapted to a new community and surroundings. Kanana township was predominantly inhabited by the Basotho and Batswana-speaking people, growing up in this township presented me with a unique perspective on indigenous knowledge. One significant obstacle we encountered was the lack of schools that taught in my home language. This compelled my parents to enrol me in a school that offered Sesotho as a home language, which further disconnected me from my cultural heritage.

Nevertheless, my connection to the medicinal plants and traditional healing knowledge of my Tsonga and Siswati heritage continued during school holiday visits to my grandmother in Mangweni village. These visits provided me with invaluable opportunities to learn about medicinal plants directly from my grandmother, who was a matriarch and healer in our family. Her knowledge and wisdom were deeply rooted in the indigenous healing practices passed down through generations.

Tragically, after several years of nurturing our family's health and well-being, my grandmother passed away. Her departure left a profound void, not only in our family but also in the preservation and transmission of her traditional healing legacy. The realisation that her vast knowledge had not been fully documented or passed on to our mothers and other family members became a driving force for me to undertake this research. It became my mission to honor her memory by capturing and preserving her indigenous knowledge of medicinal plants and traditional healing practices for future generations

As a researcher, my positionality is shaped by the experiences of straddling multiple cultural contexts, the limitations of my formal education, and the immense loss of my grandmother's wisdom. This reflexivity prompts me to engage in this research with a sense of humility cognisant of the need for acquiring knowledge from the people and communities that possess it. It is through this lens that I approach this study, aiming to bridge the gap between my

upbringing in Kanana Township, the Tsonga and Siswati cultures of Mangweni village, and the traditional healing practices that were cherished by my grandmother.

Through this research project, I aimed not only to gain a deeper understanding of medicinal plants and traditional healing but also to reclaim and celebrate my cultural heritage. By documenting and preserving this knowledge, I hoped to contribute to the intergenerational transmission of indigenous knowledge, fostering a greater appreciation and awareness of the rich cultural heritage embedded in traditional healing practices.

1.4 Research aims and objectives

This study aimed to document medicinal plants utilised by the Nkomazi Local Municipality's traditional healers and assess opportunities and constraints for medicinal plant conservation in the Nkomazi Local Municipality. This study was based on the indigenous knowledge and perceptions of traditional healers from rural communities within the Nkomazi Local Municipality.

Objective 1

Provide an inventory of medicinal plants utilised by traditional healers in the Nkomazi Local Municipality (Chapter 4).

Key questions :

- Which Medicinal plants are utilised by traditional healers, and what are the various ailments treated in the Nkomazi Local Municipality?
- Which medicinal plant species are most popular?
- What are the conservation statuses of the medicinal plants cited by traditional healers?
- Which parts of the plants are used the most?
- How are medicinal plants prepared and administered?
- How are medicinal plants harvested, stored, and packaged?

Objective 2

To assess the level of knowledge amongst traditional healers regarding environmental management regulations relating to the harvesting and sustainability of indigenous medicinal plants in the Nkomazi Local Municipality (Chapter 5).

Key question:

- What level of knowledge exists amongst traditional healers regarding environmental management regulations relating to the harvesting and sustainability of indigenous medicinal plants in the Nkomazi Local Municipality?

Objective 3

To assess the level of awareness amongst traditional healers regarding the decline of some medicinal plants in the Nkomazi Local Municipality (Chapter 5).

Key question:

Are traditional healers in the Nkomazi Local Municipality aware of the decline of some medicinal plant species?

Objective 4

Investigate the differences in the Nkomazi Local Municipality Traditional healers' attitudes and perceptions of using cultivated medicinal plants (Chapter 5).

Key question:

- How do diviners' and herbalists' attitudes and perceptions of using cultivated medicinal plants differ?

1.5 Dissertation structure and overview

This Dissertation consists of six chapters. Chapter 1 discusses the study background, rationale, aim, and objectives. This chapter additionally provides an outline of the Dissertation. Chapter 2 presents a literature review. The literature review was based on the study's objectives, which focused on ethnobotany, traditional healing, indigenous knowledge, conservation, and cultivated medicinal plants. Chapter 3 presents the research methods, including the study area, research design, data collection and instruments, sampling method, data analysis, the study's trustworthiness, ethical considerations, Covid- 19 precautions, and a section summary. Chapter 4 presents an inventory of the medicinal plants used by the Nkomazi Local Municipality's traditional healers. Chapter 5 focuses on the opportunities and constraints for medicinal plant conservation in the Nkomazi Local Municipality. The Dissertation is

concluded in Chapter 6, which presents a summary of the research findings, conclusions, and recommendations.

1.6 Summary

The background for this study was presented in this chapter. The rationale, aims, objectives, and the study's research questions were discussed, I also placed myself as a researcher through my personal experience. The chapter concluded with an outline of how the Dissertation is structured. The literature review is covered in the next chapter.

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CHAPTER 2
Literature review

2.1 Introduction

In an effort to put things in perspective, the previous chapter described the study's background, problem statement, research aims and objectives, questions, and rationale. A literature review is fundamental to a research study as it provides insight into previous studies and perspectives on the explored topic (Leedy and Ormrod, 2010). A literature review might aid in avoiding undertaking a study that has previously been undertaken (Maluleka, 2017). Additionally, it also provides new perspectives, identifies the data sources, and demonstrates how other researchers have approached methodological and design constraints (Leedy and Ormrod, 2010). Additionally, it can explain how previous researchers have approached challenging issues that may arise in that research area (Maluleka, 2017). The critical components of this chapter include a brief discussion on ethnobotany, indigenous knowledge, traditional healing systems, the legislative structure regulating the practice of traditional healing, medicinal plant conservation, South African legislation, and the use and acceptability of cultivated medicinal plants by traditional healers.

2.2 Ethnobotany

Ethnobotany is a field of study that explores how humans interact with plants, and it commonly concentrates on traditional medicine for its potential application in modern medicine (Süntar, 2020). John Harsberger formulated the concept of ethnobotany in 1895 (Jain, 2010). The original definition of ethnobotany was “the usage of plants by indigenous people” over time, and the definition was amended to consider how various societies perceived useful plants (Jain, 2010).

The field of ethnobotany underwent a significant expansion as of 1895, following Harsberger’s clarification on the concept of ethnobotany and its significance (Nortje, 2011). The interest in ethnobotanical research further expanded in the late 1900s as more papers were published (Nortje, 2011). Scientists have acknowledged that indigenous knowledge is at risk of extinction due to the demands and pressures of modern living. Therefore, indigenous communities have received increased attention as part of an attempt to document and preserve indigenous knowledge (Van Wyk *et al.*, 2008; Nortje, 2011).

Ethnomedicine is one of many disciplines that emerged from ethnobotany (Jain, 2010). Ethnomedicine studies the indigenous medicinal utilisation of plants and can be classified into

three areas. Medicinal ethnobotany involves identifying types of medicinal plant species utilised in traditional medicine and exploring the cultural systems used to categorise these plants (Jain, 2010). It includes the compilation of a medicinal ethnobotanical inventory, herbarium voucher specimens, and use records derived through interviews which serve as a repository for plant data (Jain, 2010).

Medicinal anthropology studies how different cultures understand illnesses and the characteristics of local traditional medicine systems (Jain, 2010). Additionally, medical anthropology explores how people from various cultures view and interpret conditions covering the function of traditional healers, symbolic components of disease, and social institutions (Jain, 2010). Ethnopharmacology provides a scientific assessment of bioactive chemical constituents of traditional medicine by extracting, pharmacologically analysing, and identifying them (Jain, 2010). Indigenous communities have traditionally used tannin-containing roots, barks, and leaves to treat ailments in humans and livestock (Nefhere, 2019).

Medicinal plants contribute to broader social and economic development in their dual function as an income and healthcare source (Nefhere, 2019). Unfortunately, some valuable medicinal plants are already endangered and, in short, supply, threatening human health and wild populations (Nefhere, 2019). Therefore, urgent intervention is needed to ensure that medicinal plant species' harvesting and trading are conducted sustainably (Mathibela, 2013).

2.3 Indigenous knowledge

Indigenous knowledge is a repository of knowledge accumulated by a community over many generations of constant interaction with the natural environment (Nortje, 2011). Such knowledge develops in the local setting, being adapted particularly tailored to the specific needs of locals and their circumstances (Knopf, 2015; Nortje, 2011). Additionally, it is experimental and innovative, combining internal and external factors to adapt to changing realities (Warren *et al.,* 1995). This knowledge is the foundation for local decision-making concerning many essential aspects of day-to-day tasks in a community, such as food production, maintaining health, veterinary care, and adapting to societal and environmental changes (Turner *et al*., 2022).

The transfer of indigenous knowledge is crucial for preserving local knowledge and for thriving traditional medicinal usage (Nefhere, 2019). The chain of knowledge gets broken if no one in the family is interested (Tshisikhawe, 2012). Indigenous knowledge is at risk of being lost because most eligible youth to practice as traditional healers are migrating to urban settlements,

boarding schools, and tertiary institutions, and most are not interested in learning about the practice (Maluleka, 2017). Indigenous knowledge is mainly oral and not documented and could thus be changed or lost throughout the years unless it is documented and archived for generations to come (Maluleka, 2017). In the past, indigenous knowledge was underappreciated by the government and scientific scholars (Madlela, 2017). Owing to the precarious essence of this knowledge, a sound legislation framework by the government and documentation by scientific scholars are essential to safeguard indigenous knowledge for future generations (Mathibela, 2013).

2.4 Traditional medicine

The World Health Organisation describes traditional knowledge as the sum of all the understanding, expertise, and processes founded on ideas, belief systems, and traditions that are unique to different societies that are employed to maintain health and to protect, diagnose, cure, or enhance both mental and physical ailment (World Health Organisation, 2013). The utilisation of medicinal plants is an integral element of the African healthcare system (Van Wyk and Prinsloo, 2018). Most medicinal plants are widely utilised in creating homoeopathic and ayurvedic medications (Ozioma and Chinwe, 2019). Traditional medicine practices remain prominent in rural areas such as Chipinge District in Zimbabwe (Ngarivhume *et al.*, 2015) and Massingir District in Mozambique (Rabeiro *et al.*, 2010). In South Africa, daily medications are still sourced from plants, and a considerable amount is traded in formal and Informal economic sectors (Van Wyk and Prinsloo, 2018).

2.5 The South African traditional healing systems

Traditional healers are found in nearly all African black communities, and South Africa is estimated to have 200 000 traditional healers (Louw, 2020). Traditional healers are the custodians of invaluable knowledge valuable to their immediate and global communities (Mathibela, 2013). They render medical services to all age groups and treat spiritual and physical conditions, using medicinal plants which are easily obtainable, affordable, and accessible (Shilubane, 2008).

South Africa has two distinctive categories of traditional healers: the diviner (Swati *Sangoma/inyanga; Tsonga mungoma/nyamusora* and the herbalist (Swati: *lugedla/ inyanga yemitsi; Tsonga: n'anga*) (Hammond-Tooke, 1998; Shilubane, 2008; Ngobe, 2015). The ancestors guide diviners' healing and diagnosing practices, while herbalist healing practices are

not guided by ancestors (Mbongwa, 2018). Diviner's ability to identify illnesses and the cause of misfortune and 'bad luck' is guided by ancestors (Sobiecki, 2014).

Additionally, ancestors offer guidance to diviners on the specific plant species to use and where to obtain the plant (Mbongwa, 2018). A person gets chosen by the ancestors to practice as a diviner, and often the person is born with the "gift" (Hammond-Tooke, 1998). The chosen person often experiences signs throughout their lives that indicate they might have an ancestral calling, such as seeing visions of future events or being able to foretell things like a family member's death (Hammond-Tooke, 1998; Louw, 2020). Some people experience symptoms that affect their physical and mental well-being, such as shortness of breath, backaches, headaches, fainting, and psychosis (Hammond-Tooke, 1998; Louw, 2020). It is believed that if a called individual rejects their ancestral calling, these symptoms worsen, and they might lose their ability to function in social and professional settings. In rare instances, they can pass away (Hammond-Tooke, 1998; Louw, 2020). Accepting the ancestral calling is believed to be the only way of surviving and healing from the symptoms (Ngobe, 2015). In tandem with the physical and mental well-being symptoms, the called individual is shown in a dream or vision as the qualified and knowledgeable diviner who has been selected as their trainer (Hammond-Tooke, 1998). The selected diviner will instruct the called individual on the various facets of traditional healing during the initiation phase known as *kwetfwasa* (Swati) *or ku thwasa vun'anga* (Tsonga) (Hammond-Tooke, 1998; Shilubane, 2008; Ngobe, 2015).

Diviners can employ divination by throwing bones *kuphengula nge tinhlola* (Swati) or *Ku hlahluva* (Tsonga), which is used to identify the illness's root cause (Shilubane, 2008; Ngobe, 2015). The diviner will examine the bones after a few tosses when they have formed various patterns and then clearly spell out a message in lyrical Xitsonga or Siswati (Shilubane, 2008; Ngobe, 2015). Although divination is their fundamental purpose, most diviners also prescribe herbal and other traditional medicine to their patients (Mothibe and Sibanda, 2019). Diviners believe that interaction between the environment and the human and spiritual worlds is essential to human existence (Petrus and Bogopa, 2007; Mothibe and Sibanda, 2019). According to this paradigm, a diviner prescribes plant and animal-based medicines, frequently utilised in conjunction with rituals or ceremonies that are said to have been prompted by the ancestors (Petrus and Bogopa, 2007; Mothibe and Sibanda, 2019).

A herbalist is a traditional healer who voluntarily chooses the healing profession, and the knowledge is usually inherited from skilled family or community members (Peters, 2021).

Herbalists do not use divination; they make diagnoses based on physical or psychological symptoms (Peters, 2021). In contrast to diviners, any family member can become a herbalist (Ngobe, 2015). Herbalists are voluntarily guided by experienced herbal practitioners (Semenya and Potgieter, 2014; Peters, 2021). Participants for this study consisted of diviners and herbalists.

2.6 The use of medicinal plants in South Africa

Traditional medicine remains the foundation of rural healthcare systems in many African nations, such as South Africa (Van Wyk and Prinsloo, 2018). It adopts a holistic approach and has a comprehensive geographic coverage such that every village has its traditional healer (Ngobe, 2015). In southern Africa, approximately 3400 plant species (accounting for 10 % of the South African flora) are utilised as traditional medicine by about 200 000 traditional healers (Louw and Duvenhage, 2016).

A study by Mathibela (2013) has reported that locals in the Blouberg Mountain in the Limpopo province believe that certain illnesses can only be cured by traditional medicine. They, therefore, still prefer traditional medicine over western medicine to treat some diseases. Thus, the utilisation of medicinal in South Africa is deeply embedded in cultural beliefs (Ngobe, 2015).

Owing to the shortage of Western-trained medical professionals and limited medical equipment and facilities in most rural regions of South Africa, traditional medicine is used as an informal healthcare alternative (Van Wyk *et al.,* 1997; Vergunst, 2018). The government's improved financial support and scientists' realisations of the economic benefits of medicinal plants have led to an increase in ethnomedicinal research (Van Vuuren, 2008). Several publications have documented the ethnobotanical uses of medicinal plants across South African provinces such as Limpopo (Mathabe *et al.,* 2006; Mahwasane *et al.,* 2013; Semenya and Maroyi, 2013; Rasethe *et al.,* 2019); Kwazulu Natal (Grace *et al.,* 2003; Coopoosamy and Naidoo, 2012; Mhlongo and Van Wyk, 2019), Eastern Cape (Afolayan *et al.,* 2014) and Mpumalanga (Tshikalange *et al.,* 2016; Mashile *et al.,* 2019). Some of the widely used South African medicinal plants species include *Hypoxis hemerocallidea* (African potato), *Aloe ferox* (Mill.) (Bitter aloe), *Agathosma betulina (*Buchu), and *Siphonochilus aethiopicus* (African wild ginger) (Van Wyk *et al.,* 1997; Street and Prinsloo, 2012). The South African government has suggested integrating traditional medicine into the country's health care system. However, numerous issues prevent this from succeeding (Mothibe and Sibanda, 2019). Some of these

issues include limited ethnobotanical research in some parts of the country and the lack of a formal framework to regulate prescriptions and the utilisation of traditional medicine (Mhlongo, 2019). Taking this into consideration, Bodeker *et al*. (2007) emphasised that the South African government should consider encouraging ethnomedical research and developing sound policies and regulations on the use and trading of traditional medicinal plants.

2.7 The legal framework governing the practice of traditional healing

South Africans have diverse perspectives on indigenous healing because they were subjected to and compelled to behave in a particular manner under the South African colonial government (Maluleka, 2017). The disparities between African and Western belief systems continue to cause conflict for many South Africans; these differences mainly relate to sexuality, spirituality, health care, traditions, and many other African-specific practices (Mokgobi, 2014). In the past, South Africa banned the practice of traditional medicine (Maluleka, 2017). The Suppression of Witchcraft Act was enacted by the South African apartheid regime in 1957 (Pemunta and Tabenyang, 2022). The Suppression of Witchcraft Act deemed divination unlawful, theoretically rendering the practice of traditional healers impractical (Maluleka, 2017). As a result, traditional healing began to be associated with witchcraft, this perception has persisted over time, and the practice still bears a stigma (Maluleka, 2017). Notwithstanding all the obstacles and bans, indigenous healing was still secretly practised (Pemunta and Tabenyang, 2022). Additionally, introducing missionaries in Africa adversely impacted indigenous healing (Maluleka, 2017). African indigenous beliefs were adamantly contested by Christian missionaries (Denis, 2006; Maluleka, 2017),

They invalidated African traditional practices and beliefs by claiming they were founded on superstition and equivalent to evil acts (Maluleka, 2017). Despite attempts to suppress African customs by the government and Christian missionaries, African practices continued (Maluleka, 2017). As a result, the authorities and Christian missionaries showed some tolerance (Maluleka, 2017). According to Denis (2006), traditional African religion and Christianity were eventually turned into a duality with an interconnection. As a result, Africans continued to perform their traditional rituals, consult with traditional healers, and attend Christian services on Sundays (Maluleka, 2017). The fusion of Christianity with African traditions resulted in the establishment of Zionist Churches (Maluleka, 2017). Denis (2006) argues that Zionist churches resemble indigenous religious traditions because they promise their members healing and material benefits; this contrasts with their beliefs inspired by Christian teaching. However, some Africans abandoned their indigenous beliefs and practices in favour of Christianity, while

others rejected Christianity and stuck solely to their traditional African beliefs and customs (Denis, 2006).

The collapse of the apartheid system ushered myriad transformations that significantly affected traditional healing systems (Maluleka, 2017). A person who uses indigenous medicinal plants is recognised by the South African government as an indigenous healer as a result of the end of apartheid (Maluleka and Nkwe, 2022). After years of deliberation, the South African government adopted the Traditional Healers Act (Act No. 22 of 2007).

2.7.1 The Traditional Health Practitioners Act

The Traditional Healers Act (Act No. 22 of 2007) regulates the traditional healing practice and requires traditional healers to be registered and licensed. According to the Act, registered traditional healers have the right to practice for-profit and declare themselves members of the traditional healing profession. A non-registered individual practising for profit is guilty of a crime punishable by a fine/and or year of imprisonment (Government Gazette, 2008). To be eligible for traditional health practice, an apprenticeship for a specific period, usually between 1- 5 years, should be undertaken under the supervision of a registered traditional health practitioner (Maluleka, 2017).

This Act governs South Africa's traditional healing practices and the practitioners and trainees who participate in or are pursuing these practices (Government Gazette, 2008). An individual who desires to register as a traditional healer should send an application to the registrar (Maluleka, 2017). If the registrar determines that the documents provided to support the application for registration are authentic and comply with this Act and after the required registration fee has been received, the registrar will grant a qualification that allows the applicant to practice as a traditional healer in South Africa (Maluleka, 2017).

Nevertheless, this process encounters a variety of challenges. As previously stated, being a traditional healer is a calling granted by ancestors to an individual who is then apprenticed to be a skilled diviner for some time (Van der Watt and Biederman, 2021). Customarily, the senior diviner is the one that grants the authorisation after all the initiation teaching has been fully grasped and the student fees have been paid (Maluleka, 2017). It, therefore, becomes impractical for the government to have all traditional healers registered because even if they are not registered in accordance with the act, communities will still use their services as they have witnessed the graduation ceremony (Maluleka, 2017). Some individuals have taken advantage of the gap in the system and continue to practice as traditional healers despite not

being registered (Maluleka, 2017). There should be strategies that enable the government to oversee the traditional healing practice while simultaneously accommodating the traditional healers.

The Traditional Health Practitioners Act, No. of 2007, also aimed at establishing the Interim Traditional Health Practitioners Council of South Africa.

2.7.2 The Interim Traditional Health Practitioners Council (ITHPC)

An interim traditional health practitioners' council has been founded (Tshehla, 2015) to aid the National Department of Health in facilitating the merging of traditional health medicine into the national health system. The prime focus of the ITHPC is to preserve and address South Africa's concerns about unethical and fraudulent traditional healers' practices. The objectives of the Council are to increase public knowledge of health issues and regulate the standard of health services offered by traditional health practitioners (Government Gazette, 2008).

2.7.3 Traditional Healers' Organisation (THO)

The Traditional Healers' Organization (THO) was founded in 1970 to educate all healers and initiate awareness campaigns to counteract the abuse and discrimination against traditional healers, particularly registered member healers (Maluleka, 2017). Additionally, the organisation trains traditional healers on how to treat various ailments (Maluleka, 2017).

Before establishing the Traditional Healer's Association, traditional healers were primarily accountable to the Department of health through the Traditional Medicines Desk (Hlabano, 2013). However, occasionally there appeared to be disagreements amongst government departments about who should deal directly with traditional healers (Hlabano, 2013).

The Traditional healer's Organisation issues trained and qualified traditional healers with a certificate that recognises them as qualified healers and enable them to practice. This certificate is recognised in Europe, Asia, Australia, and Africa. Additionally, traditional healers are prohibited from using the term 'Medical Practitioner' as well as any other term that suggests that they are trained in biomedicine, modern medicine, evidence-based medicine, and western medicine (Hlabano, 2013; Maluleka, 2017).

2.8 Medicinal plants conservation

As shown above, traditional medicine forms the foundation of healthcare in many rural communities in African countries. The transition from subsistence utilisation to commercial medicinal plant trade has prompted a rise in the number of medicinal plants gathered from wild

populations (Van Wyk *et al.,* 2013; Van Wyk and Prinsloo, 2018). Overharvesting places all plants at risk of extinction; however, medicinal tree species are highly vulnerable because they have slow reproducing and growth rates, and many have habitat specifications that restrict their distribution (Cunningham, 1997; Van Wyk and Prinsloo, 2018). Trees that die from overharvesting are not easily replaced (Van Wyk and Prinsloo, 2018). For centuries the conservation of medicinal plants was fostered by numerous inadvertent and deliberate management approaches (Van Wyk and Prinsloo, 2018). As transitions in traditional healing practices and urbanization occurred, some of these approaches became obsolete (Van Wyk and Prinsloo, 2018). Numerous South African initiatives have attempted to introduce sustainable use and propagation approaches to conserve medicinal plant species (Van Wyk and Prinsloo, 2018). However, limited funding, unified efforts at all governmental levels, and competition for limited resources for basic public needs impede the development and effective implementation of sustainable conservation measures for overharvesting medicinal species (Crouch and Smith, 2011; Van Wyk and Prinsloo, 2018).

2.8.1 Threats to medicinal plants conservation

2.8.1.1 Population growth

The core issues behind biodiversity decline are the growing population, socio-cultural transformation, and expanding resource consumption (Mathibela, 2013). Demand for traditional medicines in Africa will rise along with population growth, placing greater pressure on medicinal plants than ever before, however, wild plant harvesting for traditional medicine utilisation has adverse impacts on some species (Van Wyk and Prinsloo, 2018). As the global population grows, more land is transformed for human settlement and activities, resulting in fewer natural habitats (Hunde, 2007). This will have significant implications, like increased habitat fragmentation, environmental pollution, and climate disturbance (Mathibela, 2013).

2.8.1.2 Habitat fragmentation and loss

Anthropogenic-induced environmental degradation and transformation pose the greatest threat to the destruction of biodiversity (Yaynemsa and Demissew, 2022). The earth's species distribution is becoming increasingly uniform (Millennium Ecosystem Assessment, 2005). Converting natural habitats to grow a limited number of crop species chosen specifically for human consumption is one form of accomplishing this (Yaynemsa and Demissew, 2022). The abundance of other resources, such as medicinal plants, has decreased due to this natural habitat being converted to crop cultivation fields (Loundou, 2008). Half of the earth's habitable surface is covered by cultivated systems (livestock production etc.) (Yaynemsa and Demissew, 2022).

The primary risks to biodiversity in South Africa are illegal hunting, grazing, agriculture, afforestation, urbanization, mining, and invasive species (Leisher *et al.*, 2022). Cultivation is one of the greatest biodiversity loss threats covering 37.9% of South Africa's total land area (StatsSA, 2017). The abundance of medicinal and other economically important plants essential to indigenous communities has been adversely affected by anthropogenic transformations.

2.8.1.3 The transformation of customary regulations

Traditionally, harvesting of medicinal plants in South Africa was limited to traditional health practitioners (Van Andel and Havinga, 2008). Indigenous knowledge of the utilisation of medicinal plants has been primarily exchanged between traditional healing practitioners (Van Wyk and Prinsloo, 2018). Localised indigenous knowledge, such as management approaches and sustainable methods of harvesting medicinal plants are vanishing on an annual basis because of the lack of written records, easy access to modern medicine, urbanisation, and the death of the elderly (Hamilton, 2004; Regassa, 2013; Van Wyk and Prinsloo, 2018).

Traditional healers adhere to strict traditional values such as superstitions, spiritual beliefs, morals, and taboos concerning the harvesting of medicinal plants, and as a result, they have made a significant contribution to the conservation of medicinal plant species (Williams *et al.*, 2000; Kambizi and Afolayan, 2006; Van Wyk and Prinsloo, 2018). Examples of traditional strategies that deterred plant overharvesting included harvesting plant material only when ancestors commanded them to do so and after certain rituals had been conducted (Van Wyk and Prinsloo, 2018). When harvesting the root of a plant for medicinal purposes, traditional customs prohibited harvesting more than two roots of the same plant at once (Van Wyk and Prinsloo, 2018).

These approaches of indirect management were frequently employed unconsciously (Williams *et al.*, 2000; Kambizi and Afolayan, 2006; Van Wyk and Prinsloo, 2018), Others were included on purpose to conserve medicinal plant material and promote sustainable harvesting (Van Wyk and Prinsloo, 2018). Several of these approaches have become obsolete as medicinal plant harvesting, formerly limited to traditional healers, is now undertaken by commercial harvesters (Van Wyk and Prinsloo, 2018). Because of these abandoned traditional practices, species such as *Warburgia salutaris* and *Siphonochilus aethiopicus* are at risk of extinction in South Africa (Van Wyk and Prinsloo, 2018). The transition from subsistence utilisation to commercial

medicinal plant trade has prompted a rise in the number of medicinal plant species gathered from wild populations (Van Wyk and Prinsloo, 2018).

The high rate of unemployment in South Africa's urban and rural areas has pushed untrained and typically uncaring people from impoverished communities toward commercial plant harvesting (Williams *et al.,* 2000; Van Wyk and Prinsloo, 2018). Commercial harvesting methods, in contrast to the approaches of traditional healers outlined above, are destructive to the environment (Van Wyk and Prinsloo, 2018).

For instance, medicinal tree bark harvesting involves removing as much bark as possible (Van Wyk and Prinsloo, 2018). When some tree species, for example, become rare, commercial harvesters would construct ladders to increase the amount of bark gathered from a tree (Cunningham, 1988; Van Wyk and Prinsloo, 2018). In some cases, mature trees are even toppled to harvest the bark from the entire tree (Van Wyk and Prinsloo, 2018). Additionally, when the bark of mature trees is scarce, bark from juvenile trees' bark is harvested (Chungu *et al.,* 2007). Commercial gatherers of medicinal plants are unconcerned about the increasing shortage of certain plant species. The increasing scarcity of medicinal plant species entails increased prices for commercial gatherers, which raises their profit (Van Wyk and Prinsloo, 2018). Commercial harvesters are also forced to increase the amount of harvested plant material to earn a decent income due to the generally low prices paid to them (Monakisi, 2007). It is concerning that fewer traditional healers harvest medicinal plants themselves, as most have opted to buy from commercial harvesters (Van Wyk and Prinsloo, 2018). This is particularly the case for traditional healers whose practises are in urban areas, which are often remote from natural resources (Mander, 1998; Van Wyk and Prinsloo, 2018). There are no incentives provided to commercial harvesters who adhere to sustainable harvesting practices, and plants are viewed as a common property resource by commercial harvesters in both urban and rural areas (Dold and Cocks, 2002; Van Wyk and Prinsloo, 2018).

2.8.1.4 COVID-19 implications on harvesting

The breakout of a new coronavirus, SARS-CoV-2, sparked a COVID-19 pandemic (WHO, 2020). By 23 September 2020, over 31 million infections and 960 000 covid-related deaths had been recorded (WHO, 2020). Since the first case was identified in Wuhan, China, research conducted by physicians and researchers worldwide has helped shed light on the virus (Lim *et al.,* 2021). This new information and evidence from research subsequently initiated policy changes on transmission control strategies, as well as the formulation of medicinal drugs and

preventative vaccines (Lim *et al.,* 2021). These transmission control strategies included social distancing, hand washing, and using personal protective equipment (PPE) such as surgical masks (Chu *et al.,* 2020; Sardar *et al.,* 2020). However, maintaining these extreme measures of imposed social distancing over extended periods has presented adverse socio-economic problems such as loss of income and increased poverty; this is most evident in developing nations such as South Africa (Bonaccorsi *et al.,* 2020; Kidd *et al.,* 2020).

Humanity's reliance on medicinal plants for basic healthcare during the recent COVID-19 pandemic has never been more prominent (Lim *et al.,* 2021). Traffic (2020) has reported that COVID-19 prescriptions have increased the volume of medicinal plant products traded in Thailand, China, India, and some parts of Africa. The number of harvesters is expected to rise around the globe due to the long-term economic downturn caused by COVID-19, especially in regions such as rural areas where medicinal plant harvesting is linked to high poverty and unemployment rates (Traffic, 2020).

2.8.1.5 Unsustainable harvesting

Population growth in developing countries has increased pressure to harvest natural resources that are extensively used, such as medicinal plants (Van Wyk and Prinsloo, 2018). Rukangira (2001) reported that increased medicinal plant demands in developing countries like South Africa have led to unsustainable harvesting practices. For instance, intensive unsustainable harvesting in the Eastern Cape province in South Africa has led to declining quantities of several valued plant species, which presents a severe challenge to the region's biodiversity (Dold and Cocks, 2002). Therefore, medicinal plant harvesting and provision to fulfil both the rural and urban population demands have become environmentally detrimental (Mothibe and Sibanda, 2019). The most common harvesting techniques commercial harvesters employ are uprooting the whole plant and ringbarking (Cunningham, 1993; Van Wyk and Prinsloo, 2018). Commercial harvesters harvest medicinal plants carelessly, and these destructive techniques are adopted to support the expanding muthi trading business and maximise profits (Moeng, 2010).

2.8.1.6 Trading of medicinal plants

South Africa has a large and booming market for traditional medicines. A study by Williams *et al.* (2000) revealed that 511 plant species are being traded on the Witwatersrand muthi markets. Medicinal plant trading has significantly increased due to social factors such as

unemployment, rising living expenses, and population growth (Moeng, 2010; Coopoosamy and Naidoo, 2012).

South Africa has numerous muthi markets; the biggest informal market is the Faraday market, located in the heart of Johannesburg, followed by the Warwick market, which is situated in the heart of Durban (Mbongwa, 2018). Small-scale trading also occurs in other parts of South Africa, such as Limpopo, Mpumalanga, Northwest, and other provinces (Botha *et al.,* 2004; Mahwasane *et al.,* 2013; Mbongwa, 2018). The bulk of these marketplaces are daily operations and require a consistent supply of medicinal plant material (Williams, 2003). Medicinal plant trading is categorised into formal and informal markets (Williams, 2003). The informal markets consist of street vendors operating out of stands on the sides of the road (Williams, 2003; Mander and Le Breton, 2006). In this market, there is no formal regulation and scientific processing of medicinal plant material; the sole processing is sun drying, chopping, and grinding (Williams, 2003). On the contrary, the formal market sells pharmaceutical companies the traded plant material that is scientifically processed (Williams, 2003; Mander and Le Breton, 2006).

A consumer study by Mander and Le Breton (2006) reported that the yearly traded medicinal plant material in South Africa ranged from 35,000 to 70,000 tonnes. Roots, barks, whole plants, leaves, and tubers are among the plant components traded (Van Wyk *et al.,* 1997; Williams *et al.,* 2000; Mahwasane *et al.,* 2013). At least 166 medicinal plant species, totalling 525 tonnes of plant material worth around R27 million, are traded yearly in the Eastern Cape Province (Dold and Cocks, 2002). In Mpumalanga, 176 medicinal plant species are sold (Botha *et al.,* 2004). The annual value of medicinal plants traded in Gauteng was estimated to be ZAR 27 million (Williams, 2003; Mander *et al.,* 2007). Published research on the medicinal plant trade demonstrates that the South African muthi markets are not comparable since species diversity varies between markets (Mander *et al*., 1997; Dold and Cocks, 2002; Williams, 2003; Botha *et al.,* 2004). Since demand is likely to increase in medicinal plants as the human population could potentially pressure the wild plant population, trade markets should be monitored to determine the appropriate conservation and regulation strategies (Williams, 2003).

2.8.1.7 Unemployment

Rural-urban communities are looking for alternative means of sustaining their daily needs due to the worsening economic conditions and low employment opportunities in the formal sector of the South African economy (Monakisi, 2007; Mathibela, 2013). Trading medicinal plants is

the means of making a living for some people. Wild harvesting allows poor communities to generate an income (Schippmann *et al.,* 2002; Tshisikhawe, 2012). Poverty due to unemployment is driving rural and urban communities to generate income by trading valuable medicinal plant species (Van Wyk and Prinsloo, 2018). Many rural communities are compelled by poverty to amass an excessive amount of precious natural resources to facilitate natural restoration (Rasethe *et al*., 2019). Poverty is also a factor in the trade of natural resources that could contribute to the decline in biodiversity if not appropriately handled (Van Wyk and Prinsloo, 2018). Overharvesting of natural resources has significantly reduced quantities of wild plant population, particularly for species that are valuable to rural communities and/or have high commercial value (Van Wyk and Prinsloo, 2018).

2.9 Approaches to Medicinal plants conservation

The government and non-governmental organisations have launched a number of programs to combat the over-exploitation of medicinal plants as a reaction to the decline of medicinal plant populations (Van Wyk and Prinsloo, 2018). It is essential to explain the important features of the legislation through the preparation of workshops and brochure distribution that includes a thorough explanation of the pertinent sections of the legislation relevant to the conservation of natural resources (Mintsa Mi Nzue, 2009; Mutshinyalo and Siebert, 2010). Environmental awareness programs are essential for educating an intended audience regarding the actual current state of affairs and empowering them to effectively manage and conserve medicinal plants (Hadjichambis *et al*., 2020).

Biodiversity conservation has multiple advantages; a significant proportion of the South African population depends directly on natural resources for subsistence uses, such as plant collection and harvesting for building materials, fuel, medicine, food, and trade (Nefhere, 2019). Natural resources are used as safety nets against poverty and provide employment opportunities in rural communities (Mathibela, 2013).

2.9.1 Community-based Natural Resource Management (CBNRM)

Understanding how rural communities utilize and manage their local natural resources before developing and introducing conservation programs is essential (Njoroge, 2016). The community-based Natural Resource Management program is focused on the collaborative management of natural resources to strengthen the livelihoods of rural communities (Mathibela, 2013). It intends to dissolve ecosystem management authority on the community

scale by empowering local communities to make informed decisions about their natural resources without degrading and overexploiting them (Mbaiwa *et al*., 2019).

The exclusion of local community members from using natural resources may drive some to participate in criminal enterprises by trading and exploiting resources in conservation areas, leading to over-harvesting of resources in non-protected areas (Mbaiwa *et al*., 2019).

2.9.2 The South African legislation

While South Africa has many environmental legislations, the poor implementation makes most of them ineffective (Nefhere, 2019). Exacerbating the issue are usually the arbitrary fines levied for violating legislation and the incapability of government departments to track infringements (Mathibela, 2013).

If medicinal plants are regulated properly, they can continue to benefit human livelihoods indefinitely (Hamilton, 2004). According to Qhobela and Moru (2011), refinement and improvement of the regulatory frameworks are a practical approach to preserving the existence of traditional medicine and indigenous knowledge research. South Africa is a floristically rich country with a rich supply of medicinal plants that serve as a foundation for traditional medicine (Mathibela, 2013). However, sound legislation is required to ensure that these natural resources are not lost, that knowledge holders' interest is protected, and that they receive equitable benefits (Qhobela and Moru, 2011). Some laws and legislations concerning protecting South African biodiversity and preventing natural resource overexploitation are outlined below.

South Africa's basic environmental legislation was revised in 1994 with the election of a new government regime (South Africa, 1996). The South African government enacted Acts like the National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA) (South Africa, 2004) to fulfil its pledge as a signatory to the 2015 Convention on Biological Diversity (CBD) (Wynberg, 2002). To promote the preservation and the sustainable use of natural resources, the NEMBA, National Biodiversity Framework (NBF) National Biodiversity Strategy, and the Action Plan (NBSAP) were implemented (Crouch and Smith, 2011). Access to natural resources where they had previously been restricted was made possible and enabled by the National Environmental Management: Protected Areas Act 57 of 2003 (NEMPA) (South Africa, 2003), with an emphasis on the sustainability principle (Vermeulen, 2009).

The National Forests Act 84 of 1998 (NFA) (South Africa, 1998) utilises a licensing model to protect South African forests and trees. The unlawful harvesting and trading of indigenous South African plant material have not been successfully curbed by the environmental legislation enacted before and after the declaration of democracy (Botha *et al.,* 2004). The previous environmental legislation did not protect medicinal plants, resulting in extensive detrimental resource harvesting (Crouch *et al.,* 2008). Both previous and present environmental legislation is falling to halt the overharvesting and selling of protected plants (LeRoux-Kemp, 2010).

Despite all these legislation and policy, South Africa still faces challenges regarding the conservation and sustainable use of medicinal plant species. According to Vermeulen (2009), the challenges are brought on by the socioeconomic situation of many South African communities, impediments in establishing a sustainable harvest system, shortage of expertise and funding to facilitate the effective integration of the legislation and policy, and an increased in the number of commercials. Moreover, there are not enough reliable sources of information and efficient management systems for all available resources (Ngubeni, 2015). Despite extensive social and environmental research on medicinal plant conservation, there has not been much emphasis on making sure that the research conclusions and recommendations are put into practice (Ngubeni, 2015). A comprehensive understanding of current management, the scope of authorized and illicit usage, as well as the degree of resource degradation, is required in order to develop a strategy to tackle the issue (Ngubeni, 2015).

2.8.2 Cultivation of medicinal plants

The overharvesting of medicinal plants necessitates an urgent response to protect declining wild populations (Amujoyegbe *et al.,* 2012). Owing to the unsustainable medicinal plant harvesting in South Africa, several conservation initiatives have concentrated on building medicinal plant nurseries (Mbongwa, 2018; Van Wyk and Prinsloo, 2018).

Cultivation is considered to promote biodiversity conservation while eradicating poverty (Amujoyegbe *et al.,* 2012; Mbongwa, 2018). Some traditional healers have taken the initiative to conserve the wild population of medicinal plants by cultivating medicinal plants in their backyards for consultations (Oladele *et al.,* 2011; Amujoyegbe *et al.,* 2012, Mathibela, 2013).

According to a study by Semenya and Potgieter (2014), most Bapedi traditional healers cultivate medicinal plants in their home gardens. The rarity of some medicinal plants in the wild was reported to be the key driver of their cultivation. A study conducted by Nefhere (2019)

in the Thulamela Municipality in the Limpopo province reported that most of the traditional healers are interested in using and buying cultivated medicinal plants; however, some were reluctant to use cultivated medicinal plants because they believed these to have less healing powers than the wild medicinal plants.

Cultivation is a strategy for reducing the pressure on wild populations, particularly plants harvested in huge quantities (Van Wyk and Prinsloo, 2018). Cultivation is adopted to supply medicinal plants to meet the demand and prevent the over-harvesting of medicinal plants (Monakisi, 2007). There are several challenges related to cultivating medicinal plants. One of the restriction is related to slow-growing medicinal plant species which only offers low yields and are not immediately profitable (Monakisi, 2007). Another constraint is the low pricing imposed by local muthi markets (Van Wyk and Prinsloo, 2018). Cultivators must compete with wild collectors without capital and operating expenses (Monakisi, 2007).

Another constraint is the preference for wild over cultivated medicinal plants, which is related to the belief that cultivated medicinal plants have fewer healing powers than wild-collected plants (Monakisi, 2007). Medicinal plants are believed to be less potent when handled by a ‘polluted’ person (Ndawonde, 2015). For instance, a person is deemed "polluted" if they are menstruating, engaged in sexual intercourse, gave birth, or experienced death in the family; such people are expected to undergo cleansing before they handle any medicinal plants (Ndawonde, 2015). According to a study by Pirbalouti *et al.* (2013), there are physiological and biological variations between cultivated and wild medicinal plants. Moreover, these variations could be the cause of peoples’ perceptions that wild plants are more effective than cultivated plants (Moyo *et al.*, 2015). Pirbalouti *et al.* (2013) compared essential variations between cultivated and wild *Thymus vulgaris* and *Thymus daenensis* plant species, findings from this study indicated no significant difference between the growth of these plant species. However, the quantity and quality of essential oils varied significantly. These results suggested that environmental factors influence a plant's biological characteristics, which in turn alter the plant's medicinal properties (Pirbalouti *et al.*, 2013).

For instance, Asian consumers are willing to spend an additional 30% for *Panax quinquefolius* roots that are collected from the wild than from cultivated sources (Hamilton, 2004). In contrast, Mathibela (2013) showed that most of the traditional healers in the Blouberg Municipality in the Limpopo province use cultivated medicinal plants in their practice and share the sentiment that cultivated and wild collected medicinal plants have similar healing

properties. Inadequate resources, awareness, and method expertise pose additional restrictions. (Monakisi, 2007). Sustainability cannot be accomplished without considering the limitations that influence sustainability, such as the increasing human population and conservation challenges (Attwell and Cotterill, 2000). Medicinal plant cultivation may assist in relieving pressures on wild populations. However, without the proper effective application of conservation plans together with the policies, over-harvesting and disappearing medicinal plants from the wild population will continue (Monakisi, 2007).

2.10 Summary

This chapter presented literature related to ethnobotany, traditional healing systems, the legal framework governing traditional healing practice, medicinal plant conservation, South African legislation, and the utilisation and acceptability of cultivated medicinal plants. The next chapter provides a description of the study's research methods.

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CHAPTER 3
Research Methods

3.1 Introduction

This chapter presents methodological approaches that underpin this study. Research methods are essential as they reveal the broader area of discourse concerning methods and the interplay between methods and concepts (Hennink *et al*., 2020). Research methods are employed to gather and analyse data (Adams and McGuire, 2022).

This chapter is divided into two sections. The first section gives a brief description of the socio-economic as well as the biophysical and geographical background of the study area. The second section represents the research methods used in this study. The advantages and disadvantages of the research design, the instruments, and the research procedure are also discussed. Additionally, this chapter discusses population and sampling approaches, plant identification, data analysis, data quality, ethical consideration, and Covid-19 precautions.

3.2 Study area

3.2.1 The locality

The Nkomazi Local Municipality (Fig.3.1) is located within the eastern parts of the Ehlanzeni administrative district of Mpumalanga province (Nkomazi Local Municipality, 2020). Nkomazi is bordered by Eswatini in the south, Kruger National Park in the north, and Mozambique in the east (Nkomazi Local Municipality, 2020). This local municipality is connected to Mozambique through a railway and the national road (N4) representing the Maputo Corridor, and it is also connected to Eswatini by two provincial roads, R571 and R570 (Nkomazi Local Municipality, 2020). Nkomazi covers 4786.86 km^2, which is approximately 17% land of the Ehlanzeni district (Nkomazi Local Municipality, 2020).

3.2.2 Socio-economic background

Nkomazi Local Municipality consists of 8 traditional authorities (Mawewe, Lomshiyo, Kwa-Lugedlane, Mlambo, Hhoyi, Mhlaba, Matsamo, and Siboshwa tribal authorities) and 43 Villages (Nkomazi Local Municipality, 2020). The area is dominated by Shangaan and Swati ethnic groups due to its proximity to Eswatini and Mozambique (Mkhonto, 2018). The Municipality has a population of 423 358, it makes up 23% of the Ehlanzeni population and is the fourth-largest population in the province, with an annual growth rate of 1.0% (Nkomazi Local Municipality, 2020). High birth rates and a large inflow of immigrants from ESwatini and Mozambique are the main factors contributing to the increasing population (Nkomazi

Local Municipality, 2020). Since the Nkomazi municipality is majorly rural, it is faced with high levels of unemployment (Nkomazi Local Municipality, 2020). Skills shortages and high illiteracy rates also contribute to high levels of unemployment (Nkomazi Local Municipality, 2020). Women and young people in the Nkomazi Local Municipality between the ages of 15 and 35 experience greater rates of unemployment than people in the general population between the ages of 15 and 64, which affects the municipality's overall development (Nkomazi Local Municipality, 2020). Most of the rural inhabitants of Nkomazi are heavily reliant on agriculture and government social grants and frequently relocate to urban regions in search of better opportunities (Ubisi *et al.*, 2019).

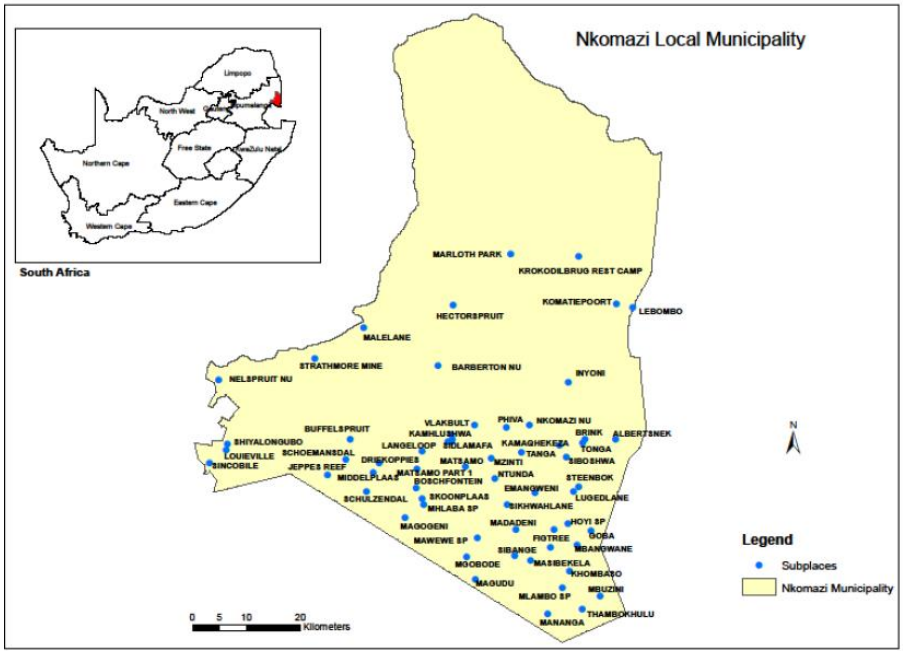

Figure 3.1. Nkomazi Local Municipality map (Ubisi *et al.*, 2019).

3.2.3 Biophysical and geographical characteristics

Nkomazi Local Municipality is a subtropical region characterised by a summer rainfall with a 775 mm mean annual precipitation (Nkomazi Local Municipality, 2020). Additionally, January is the warmest month in the Nkomazi Local, with a mean temperature of 26.2°C, while June is the coldest, with a mean temperature of about 18.4°C (Nkomazi Local Municipality, 2020).

The Nkomazi Local Municipality is situated within the Savanna Biome (Mucina and Rutherford, 2006). According to Mucina and Rutherford (2006), the Savanna Biome makes up over one-third of South Africa's total area and is the biggest biome in Southern Africa. It is distinguished by an upper layer of shrubs and trees and a grassy ground layer.

There are various vegetation types found in the savanna biome. According to Mucina and Rutherford's (2006) national vegetation classification, the study area consists of seven major vegetation types: Tshokwane-Hlane Basalt Lowveld, Granite Lowveld, Delagoa Lowveld, Zululand Lowveld, Malelane Mountain Bushveld, Barberton Serpentine Sourveld, Southern Lebombo Bushveld, and Kaalrug Mountain Bushveld (Fig. 3.2).

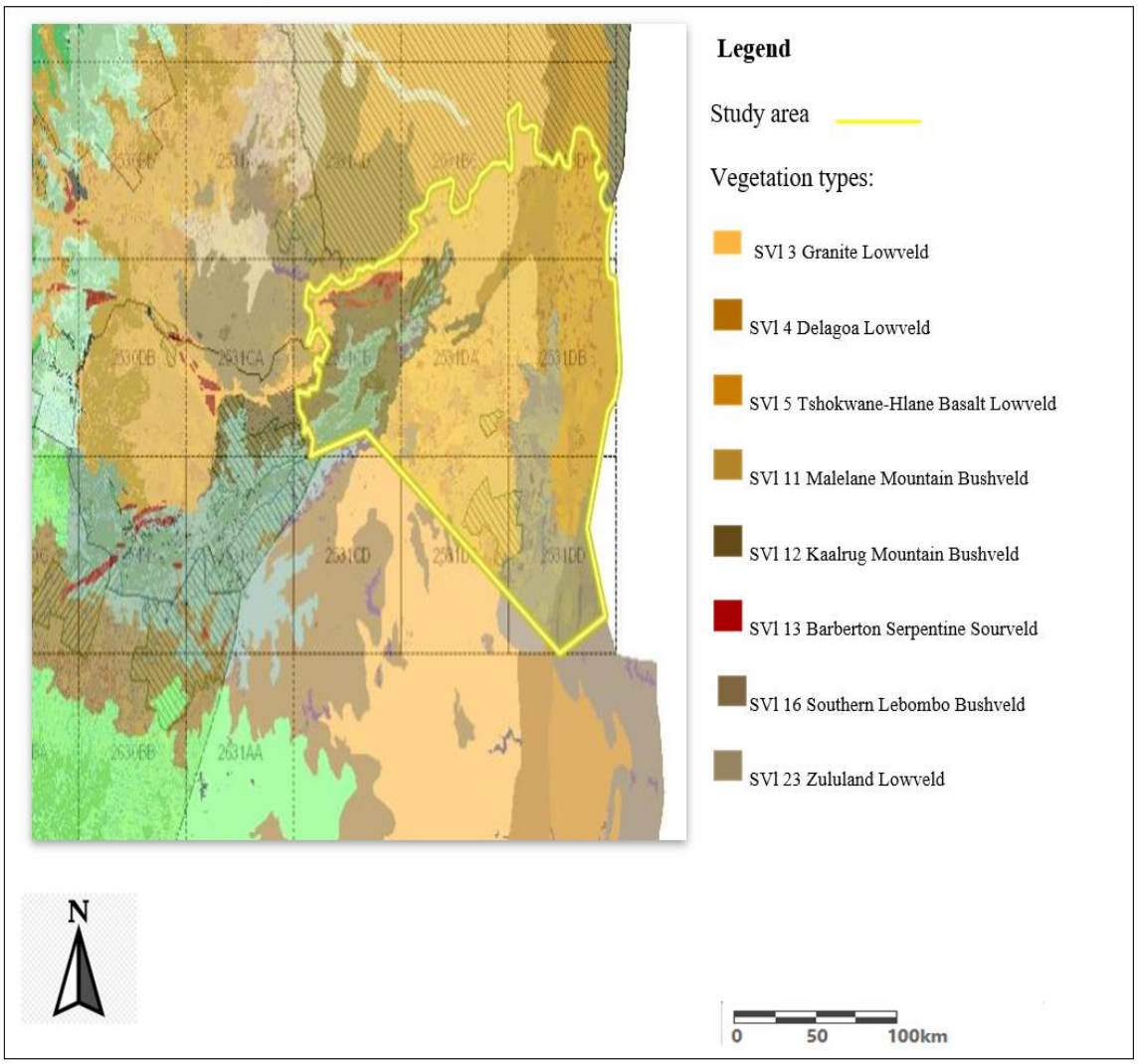

Figure 3.2. Vegetation types found within Nkomazi Local Municipality.

The Tshokwane-Hlane Basalt Lowveld occurs in the Mpumalanga province and stretches to Swaziland with typically quite flat plains with an open woodland savanna that is frequently dominated by *Acacia nigrescens* and *Sclerocarya birrea* species, as well as a dense layer of herbaceous vegetation and a slightly grown shrub layer (Mucina and Rutherford, 2006). This vegetation type consists of clay soils that are red, black, and brown which are formed by the Letaba Formation basalts (Mucina and Rutherford, 2006).

Granite Lowveld is found in the provinces of Limpopo and Mpumalanga and Swaziland, where it is composed of steep sandy highlands, shrubland with sparse trees, and relatively dense low woodland (Mucina and Rutherford, 2006). Dominant species include *Acacia caffra, Combretum apiculatum, Sclerocarya birrea, and Acacia nigrescens* (Mucina and Rutherford, 2006). The region's primary basement geology is composed of the younger Mpuluzi granite. Archaean granite and gneiss weathering results in sandy soils in the upland areas and sodium-rich clay soils in the lowlands (Mucina and Rutherford, 2006).

The Delagoa Lowveld vegetation type, which is primarily restricted to Mpumalanga and Swaziland and slightly stretches into KwaZulu-Natal, comprises a dense layer of trees or shrubs, with *Acacia welwitschii* as its dominant species (Mucina and Rutherford, 2006). The soils are rich in sodium and are very susceptible to erosion, and are dominated by species such as *Euclea divinorum, Spirostachys africana, Acacia senegal* var. *rostrata, Albizia petersiana, Pappea capensis* and *Schotia capitata* (Mucina and Rutherford, 2006).

Zululand Lowveld is located in the provinces of KwaZulu Natal and Mpumalanga as well as ESwatini. It consists of a network of diverse bushveld units, ranging from park-like areas to dense woodland dominated by trees that are supported by plain or slightly undulating terrain (Mucina and Rutherford, 2006). The *A. tortilis, A. nigrescens,* and *Sclerocarya birrea subsp. Caffra* dominate this vegetation type. Consists of duplex and black clay soils that are formed by various types of clastic and volcanic deposits (Mucina and Rutherford, 2006).

The Malelane Mountain Bushveld is only found in Mpumalanga and is made up of low-lying clear to dense slopes, short mountain grasslands and low-lying regions (Mucina and Rutherford, 2006). It consists of large boulder-filled hills formed by granite and gneiss, predominantly from the Nelspruit suite, which is buried in shallow, coarse, sandy lithosols that are mostly made up of Glenrosa or Mispah soils (Mucina and Rutherford, 2006). *Dombeya rotundifolia, Acacia caffra, Combretum molle, Heteropyxis natalensis, Acacia davyi* and *Pterocarpus angolensis,* are some of the dominant trees in the area (Mucina and Rutherford, 2006).

The Barberton Serpentine Sourveld stretches in a triangle pattern from Malelane to the eastern parts of Swaziland. It appears in scattered patches on the bare ultramafic bedrock. It is a highly hilly and varied topography (Mucina and Rutherford, 2006). The ultramafic outcrops in the south are home to herbaceous grassland with more woody plants and stunted trees, the soils are generated from ultramafic lavas (Mucina and Rutherford, 2006). The ultramafic bedrock yields

soils with extremely high magnesium and calcium concentrations (Mucina and Rutherford, 2006).

The Southern Lebombo Bushveld Lowveld is located in the Mpumalanga and KwaZulu Natal provinces as well as Swaziland (Mucina and Rutherford, 2006). It consists of open bushlands that are dominated by *Acacia* and *Combretum* species, with *Themeda triandra* dominating pristine sites and it consists of shallow soils that are formed by the Mispah and Glenrosa soils (Mucina and Rutherford, 2006).

The Kaalrug Mountain Bushveld is distributed to the province of Mpumalanga with some patches covering some parts of Swaziland, and it consists of short mountainous savanna or bushes, that are open to dense, complemented by a denser grassland surface at higher elevations (Mucina and Rutherford, 2006). The Rocky Mountains are made up of shale, quartzite, schists, and gneiss, soils are shallow, primarily Mispah and Glenrosa, with occasional vertic, melanic clays around the lowest margins (Mucina and Rutherford, 2006).

3.3 Research methods

According to Queirós *et al.* (2017), every research study has a systematic methodology that helps the researchers address questions by conducting intensive, comprehensive investigations. The method chosen determines the kind of data that is collected (Adams and McGuire, 2022). When conducting studies, researchers can select three types of methods: mixed, quantitative, and qualitative methods (Creswell and Creswell, 2017).

3.3.1 Quantitative approaches

The quantitative research method is founded on the logical positivism philosophical approach (Punch, 2013). The positivist approach, which forms the basis of the natural scientific method in studying human behaviour, maintains that research must be restricted to what can be observed and measured objectively (Mason, 2017). This positivist paradigm approaches the research process through deductive reasoning. In the context of the social sciences, quantitative research starts with theories and research questions or hypotheses about a specific topic. It then collects data from a real-life setting and statistically analyses it to support or refute the stated research hypothesis (Ormston *et al.*, 2014). A deductive reasoning approach is employed in quantitative research to direct the study's design and the analysis of the findings (Punch, 2013).

A study is considered to use a quantitative research approach when there is a focus on the quantification of concepts because the researcher thinks that quantitative measuring, which is

accomplished by allocating numbers to the perceived attributes of objects, is the only or best approach to measure the characteristics of phenomena (Ormston *et al.*, 2014). A quantitative method may be appropriate if variables are vital in describing and understanding human behaviour, often known as variable or correlation analysis (Babbie and Mouton, 2011). A correlation between two variables does not indicate causation (Punch, 2013). The quantitative approach can also be used in contexts where sources of error can be regulated by statistical measures, such as multivariate analysis (Babbie and Mouton, 2011).

Precision and control are the quantitative approach's key advantages. Control is accomplished using sampling and design approaches and the accurate and trustworthy quantitative measurement of collected data (Mligo, 2016). Another advantage is that experimentation can reveal a causal relationship between variables after controlling or removing other factors; it is possible to demonstrate that one variable's systematic manipulation directly affects another (Babbie and Mouton, 2011). Additionally, hypotheses are validated by a deductive approach, and using quantitative data enables statistical studies to be performed (Ormston *et al.*, 2014). As a result, the quantitative research method offers conclusions with a considerably more solid foundation than emotion, common sense, or personal view (Punch, 2013).

The quantitative scientific approach raises concerns among researchers because it fails to separate social structures and people from the natural sciences (Ormston *et al.*, 2014). As a result, they assert that the quantitative research approach undermines or overlooks human individuality and individuals' capacity for independent thought (Mligo, 2016). For example, investigating relationships between variables constructs a fixed paradigm of social life dissociated from people's lives (Mason, 2017). Correlation analysis excludes the activity of interpretation connected to social groups, such as their behaviour at a given period (Mligo, 2016). A quantitative approach ignores people's unique ability to evaluate their experiences and knowledge and create interpretations (Babbie and Mouton, 2011). The measuring procedure is claimed to convey a fictitious and illusory sense of precision and accuracy, and its measurements are based more on assumptions than on actual data (Punch, 2013).

Furthermore, it is worth noting that not everyone defines and interprets vital terminology in the same way (Mligo, 2016). As a result, a scientific approach cannot be completely objective because subjectivity is involved in investigating an issue and interpreting the research's outcomes (Punch, 2013). Reliance on tools and methodologies can make it challenging to connect research to real-world problems (Ormston *et al.*, 2014).

3.3.2 Qualitative approaches

Qualitative studies seek to investigate human behaviour from the point of view of the participant (Chowdhury, 2015). The primary objective of this approach is to comprehend and characterise human behaviour (Babbie and Mouton, 2011).

A qualitative approach is distinguished by its aims, which are concerned with understanding certain facets of social systems and processes, which yields words instead of numbers as results (Chowdhury, 2015). Qualitative approaches strive to understand perceptions and experiences and to address questions about the 'how,' 'why,' or 'what' of a particular event instead of 'how much' or 'how many' questions addressed by quantitative approaches (Chowdhury, 2015).

The qualitative approach is linked to the interpretive social sciences paradigm, which bases research methods on the importance of the subjective and the experience domain of people (Babbie and Mouton, 2011). Qualitative research documents what individuals say and how they behave as a result of how they perceive and make sense of the complexity of their real-world surroundings (Ormston *et al.*, 2014). Additionally, the qualitative research approach helps the researcher to perceive social events from the viewpoint or comprehension of the participants (Babbie and Mouton, 2011). The qualitative research approach uses focus groups, in-depth interviews with individuals, or participant observations to collect data (Babbie and Mouton, 2011). The qualitative research approach is subjective due to the foundational paradigms it employs; it strongly draws on the texts and narratives of the participant (Punch, 2013). Due to the in-depth data collection necessary for the qualitative study, a qualitative research approach often only involves a small number of respondents in the research process (Mligo, 2016).

The inability to employ large samples representative of the target population is a crucial drawback of qualitative research. Because in-depth surveys can only reach a small number of people, qualitative research does not assume to represent the larger community (Ormston *et al.*, 2014).

3.3.3 Mixed Method

As stated in the introductory chapter, the study aimed to document medicinal plants utilised by the Nkomazi Local Municipality's traditional healers and assess opportunities and constraints for medicinal plant conservation in the Nkomazi Local Municipality. The study employed

qualitative and quantitative approaches to understand traditional healers' perspectives concerning the ethnobotanical significance and medicinal plant conservation in the Nkomazi Local Municipality. This was essential to enhancing the study's depth and validity. A pragmatist paradigm was applied in this case since it enables the integration of quantitative and qualitative approaches within a single and across various phases.

According to Creswell and Poth (2018), A pragmatist researcher leverages numerous sources of data collection, uses multiple methodologies to answer the research question best, and additionally focuses on the practical significance of the research. A ‘mixed methods approach’ is a term commonly used to describe the employment of quantitative and qualitative approaches in the fields of social and behavioural science (Tashakkori and Teddlie, 2008; Grbich, 2013; Kimmons, 2022).

According to Tashakkori and Teddlie (2008), qualitative and quantitative research approaches have historically been perceived as being in rivalry against one another. The disagreements between the constructivist paradigm, which underpins qualitative methods, and the positivist paradigm, which underpins quantitative methods, have led to the "paradigm wars" (Tashakkori and Teddlie, 2008; Kimmons, 2022). The qualitative and quantitative methods were viewed as being incompatible by purist researchers, who are known as such since they only employ one of the two approaches to conduct research (Tashakkori and Teddlie, 2008; Kimmons, 2022). They contend that the paradigms underlying these procedures are incompatible, making their compatibility impossible (Tashakkori and Teddlie, 2008; Kimmons, 2022). Moreover, they believed that any attempts to do so could fail since the two methodologies are intrinsically incompatible (Tashakkori and Teddlie, 2008; Kimmons, 2022). The paradigm wars between quantitative and qualitative approaches were put to rest by the mixed method approach (Tashakkori and Teddlie, 2008; Kimmons, 2022). Using quantitative and qualitative approaches in research has become feasible (Creswell and Poth, 2018).

According to Mertens (2019), the goal of this approach is not to eliminate either the qualitative or quantitative approaches but rather to enhance their respective advantages and mitigate their disadvantages. By doing this, the approach might give more accurate results (Cropley, 2015). Using the mixed approach can improve comprehension of the issue and produce more thorough evidence, giving the researcher both breadth and depth on the topic (Creswell and Creswell, 2017). The mixed approach integrates paradigms, allowing for both deductive and inductive

analysis, permitting the combination of theory production and hypothesis testing within a specific study (Jogulu and Pansiri, 2011).

According to Morse (2008), the combined use of qualitative and quantitative methods may yield complementary outcomes that deepen the research findings. Applying a mixed method approach, often known as "triangulation," has advantages. It improves the results' validity and allows for the collection of a more accurate, comprehensive, and meaningful representation of the component(s) under investigation (Tashakkori and Teddlie, 2008; Kimmons, 2022). Furthermore, it is helpful in ensuring that the most holistic approach is used to address a research problem when one method appears insufficient, which enhances the validity of the study (Tashakkori and Teddlie, 2008; Kimmons, 2022). The fundamental principle of a mixed methods approach is combining qualitative and quantitative approaches generates a more profound comprehension of a social phenomenon than using each approach separately (Creswell, 2011).

In this present study, a mixed methods approach was adopted to complement and expand the scope of the study. Complementing aims to elaborate, enrich, demonstrate, and elucidate the findings of one method with findings from the other method, and expansion intends to broaden the scope of inquiry by using different approaches to various inquiry components (Mona, 2022). The qualitative approach was used to obtain a comprehensive account of the medicinal plants and related traditional knowledge and discuss the findings of the interviews. Textual data from semi-structured questionnaires, field notes, and observations were collected to understand traditional healers' perspectives concerning the ethnobotanical significance of medicinal plant conservation in the Nkomazi Local Municipality. The qualitative approach has advantages in that it allows researchers to search for underlying beliefs and values in people's personal experiences in textual data format (Choy, 2014) while enabling the researcher to ask insightful questions (Creswell and Creswell, 2017).

In this study, the quantitative approach was employed to compare responses among respondents since identical questions were posed to all participants in the same sequence to enable meaningful comparison of responses among respondents (Crossman, 2021). Semi-structured questionnaires were given to individual traditional healers to gain a comprehensive account of the ethnobotanical diversity of medicinal plants and participants' opinions, attitudes, and interpretations of using cultivated medicinal plants.

3.4 Research design

Research design is a form of inquiry that outlines and directs the steps to be taken during the research process (Creswell and Creswell, 2017). Qualitative researchers have a variety of research designs from which they select when conducting their research. The most popular types include case study, phenomenology, grounded theory, ethnography, and narrative (Creswell and Creswell, 2017). The research designs frequently used in qualitative approaches are presented in the following section. The design believed to be most appropriate for this study is also presented.

Narrative research explores the participant's lived experiences so that a story about their lives can be conveyed (Creswell and Creswell, 2017). The primary objective of this study design is to discover occurrences based on subjective paradigms and first-hand experiences (Ataro, 2020). A narrative design, according to Butina (2015), is a method of interpreting an event by establishing a relationship with the participant. Clandinin (2016) cited that sociality, temporality, and place as elements that set this design apart from others because, while employing this design, all three of these elements must be considered concurrently. Sociality is a combination of the participant's feelings and context that combined construct social and language narratives.

In contrast, temporality is when the researcher focuses on the research participants' past, present, and future (Butina, 2015). Finally, place anchors the actual context in which the investigation is conducted (Butina, 2015). Because narrative design is commonly used in biographies and autobiographies (Butina, 2015), it was unsuitable for this study.

The grounded theory is a design inquiry where the researcher constructs theories based on the study participants' perspectives, as evidenced in the data collected (Creswell and Creswell, 2017). Because theories were not constructed from the collected data, this design was inappropriate for this study.

A case study is a design where the researcher investigates certain occasions, initiatives, or procedures (Creswell and Creswell, 2017). These studies focus on a single representative of a group, are carried out in their natural environment, and are time-bound (Hancock and Algozzine, 2021). There are three types of case studies: instrumental, intrinsic, and collective (Hancock and Algozzine, 2021). A collective case study makes an effort to describe a problem

through several case studies (Hancock and Algozzine, 2021). Because the study did not focus on a single group representative, this design was inappropriate for this study.

Ethnography is a design used to comprehensively understand people's beliefs and behaviour, including their environment, by collecting in-depth observations and interviews (De Costa and Kessler, 2022). Ethnographic studies are typically qualitative in approach and attempt to offer an in-depth overview of a community; because these descriptions are woven into the lives and practices of the participants being studied, they provide a distinct insider's viewpoint on the participants and their practices (De Costa and Kessler, 2022). Ethnography studies cultures and indigenous knowledge to comprehend them from the local people's point of view (Sarantakos, 2017).

The advantages of ethnographic research are as follows; ethnographers can become a part of a setting by observing participants, creating a broad understanding of social action in various circumstances (De Costa and Kessler, 2022). It provides ethnographers with chances to acquire empirical data on social activities that are typically kept private and can help them identify, investigate, and relate social phenomena that do not necessarily have a lot of similarities (De Costa and Kessler, 2022).

However, the following disadvantages could emerge during an ethnographic study; in some cases, the researcher might struggle to find participants, where participants fear that the research may negatively reflect on them or their organisation, and it can be challenging to obtain repeated access because much time is spent engaging participants and observing their actions (De Costa and Kessler, 2022).

The research employed an ethnographic design to explore various factors concerning the gathering and usage of medicinal plants among traditional healers in the Nkomazi Local Municipality located in the Mpumalanga province. The ethnographic design employed in the study gathered extensive data from traditional healers by observing their traditional healing techniques and conducting interviews to obtain their indigenous knowledge regarding the utilisation of medicinal plants.

3.5 Research Instruments

Research instruments are tools used by researchers to acquire and collect data and answer their research questions (Sharma and Kumar, 2022). A researcher must read pertinent resources

about similar studies conducted to discover the instruments used by other researchers and to select suitable instruments for their research (Sharma and Kumar, 2022).

The study employed several tools such as interviews, field walks, observations, and a literature review to obtain a comprehensive understanding of the traditional healers' indigenous knowledge of the usage of medicinal plants. These instruments were also used to assess opportunities and constraints for medicinal plant conservation in the Nkomazi Local Municipality.

3.5.1 Observations

Closely observing the research participants is essential for successfully gathering ethnographic data, which can be accomplished through participating in local practices (Barbie and Mouton, 2011). Respondents' observations are conducted by non-participant observers who spend time with the respondents (Barbie and Mouton, 2011). Observational data are valuable in bridging the gap between what participants say and how they actually behave and can also reveal behaviour that the participants are unaware of (Chowdhury, 2015).

The non-participatory observation was employed during the data collection phase to observe traditional healers and gain insights into their traditional healing techniques. The observation focused on the processes and methods used by traditional healers for the collection, preparation, and packaging of medicinal plants. In cases where permission was granted, recordings and pictures were taken to supplement observation.

3.5.2 Field walks

During field walks, the researcher conducts a mobile interview while accompanying local research participants from within the village to the outskirts of the village who are particularly informed about their topic of interest (Madden, 2022). During field walks, the researcher and participants discuss issues of shared interest while jointly observing what occurs in various micro-ecological niches (Madden, 2022). The researcher observed, questioned, and listened to the informants' ethnobotanical knowledge and identification. The objective was to observe the scenario and grasp the opportunity to inquire about the available medicinal plant resources and their utilization.

The field walk method helps concentrate on issues including where resources are situated, how and by whom they are utilised, how much pressure is placed on different resources, seasonal availability, what the access restrictions are, and whether there are conflicts arising amongst

users of these natural resources (Madden, 2022). Field walks were an appropriate way to start the study process as they established the participants as specialists in medical ethnobotany. During the field walk with 10 participants, extensive data on medicinal plants and harvesting methods were collected. This data highlighted the accessibility and the use of various plant species in ethnomedicine.

3.5.3 Literature review

Desktop research was conducted by consulting existing documents and literature on traditional healing, ethnobotanical and ethnopharmacological studies, and the conservation and cultivation status of medicinal plants mentioned by traditional healers within the study area. This information was then compared with data collected from the study.

3.5.4 Semi-structured interviews

An interview is a discussion between two or more people during which the researcher asks the participants specific questions pertinent to the research topic (Bloomberg and Volpe, 2018). The primary objective of interviews is to capture the participant's opinions, explanations, and interpretations (Rabionet, 2011). Depending on the interview format, researchers can draw meanings based on the participants' words (Bloomberg and Volpe, 2018). Three types of interviews can be utilised in research, namely structured, unstructured, and semi-structured interviews, and are selected based on the specific research objectives of the study (Brinkmann, 2014). Unstructured interviews may commence with broad inquiries concerning the study's questions, and later themes from the interview guide may be brought up (Chilisa, 2019). Additionally, interviewers are unrestricted in how they order their questions, and the interview structure is based on the answers they obtain from participants (De Vos *et al.*, 2011). Structured interviews usually employ close-ended questionnaires, typically used in quantitative studies and for participants with hearing and speaking impairments (Brinkmann, 2014). Semi-structured interviews are commonly used by researchers to obtain a detailed and comprehensive understanding of a participant's views, opinions, attitudes, or interpretations of a particular subject (Maluleka, 2017). The semi-structured interview format allows for flexibility and permits the researcher to probe deeper into areas of interest while still maintaining a certain level of structure (De Vos *et al.*, 2011). Semi-structured interviews differ from other types of interviews in that they are interactive and allow study participants to express their opinions and views in their own words, rather than responding to a series of predetermined, hypothesis-based questions (Babbie and Mouton, 2011).

Ethnobotanical data were collected using a semi-structured interview questionnaire (Appendix A) from traditional healers in Nkomazi villages. The questions for the semi-structured interview are adapted from an existing instrument by Nefhere (2019) and Mathibela (2013), which were used to investigate the indigenous knowledge of the use of medicinal plants by traditional healers in Thulamela and Blouberg Mountain in Limpopo.

To overcome the language barrier, the questionnaire was created in English but conducted in Siswati and Shangaan. The researcher is conversant with Swati and Shangaan languages and originates from the municipality. Therefore, the translation of interviews into local languages was not an issue.

In instances where consent was granted, the interviews were audio-recorded, the records were transcribed, and the resulting texts analysed. Extensive field notes were taken when permission for audio recording was not granted.

The semi-structured interview (Appendix A) was divided into the following sections.

- Biogeographical information of the respondents.
- Medicinal plants Knowledge.
- Conservation of medicinal plants.
- Inventory of Medicinal plants: (Appendix B) to record the local and scientific names of medicinal plants utilised.

Ten traditional healers from eight different villages (Mangweni, Hoyi, Mzinti, KaMaqhekeza A, Magudu, Tonga, Mbangwane, and Sibange) in Nkomazi were individually interviewed during field visits Between July 2021 and February 2022.

3.6 Research procedure

This section will discuss the research procedure used to carry out this study. The research procedure features the focus population, sampling methods, methods used to collect and process data, and data analysis (Maluleka, 2017).

3.6.1 Population Sampling

A population is described by Cash *et al*. (2022) as the abstract concept of a population of numerous cases from which a researcher selects a sample for the study. As outlined in the background information, the participants in this research included traditional healers (herbalists

and diviners). In this study, traditional healers in the Nkomazi Local Municipality, Mpumalanga province, were the focus population. The following section describes the sampling method.

3.6.2 Sampling method

According to Cash *et al*. (2022), define sampling as the process of selecting a smaller group (sample) from a larger population to study the sample and draw valid conclusions about the population as a whole. Neuman (2006) emphasises that researchers typically use sampling to save time, cut expenses, and generate reliable data.

In an ethnographic methodological approach, study participants are chosen primarily based on their knowledge of the investigated topic. The respondents should be knowledgeable about the research subject matter and be able to interpret the implications of their influences (Jain, 2010).

The sample for this study was strategically chosen to be made up of individuals with an in-depth understanding of ethnobotany, indigenous knowledge, and traditional healing. Traditional healers were sampled using the snowball sampling method. Snowball sampling is accomplished through identifying a small number of knowledgeable individuals about the focus issue and soliciting them to assist the researcher by referring to other individuals relevant to the study (Sarantakos, 2017). In this sampling method, the researcher selects a few participants from a population that fits the criteria and is closer to them and asks them to recommend and refer other individuals who match the requirements and are willing to be part of the research (Sarantakos, 2017). This procedure is repeated with new participants until no more important information can be gathered from subsequent participants or participants are no longer available (Babbie, 2010; Sarantakos, 2017). This approach is used when the researcher cannot obtain a suitable sample, the target population is undefined, or when it is challenging to reach participants in any other manner due to a lack of sampling frames (Sarantakos, 2017).

According to Maluleka (2017), statistics on the number of traditional South African healers' practitioners are unavailable. Researchers can only make estimates, and a considerable amount of effort and time is required from the government to rectify this (Maluleka, 2017). Due to the stigma associated with traditional healing, most community members likely will not be aware of those practising as traditional healers in their locality, and only those who have previously worked with traditional healers are most likely to know of this (Maluleka 2017). Traditional healers consider their indigenous knowledge related to healing sacred; researchers must rely

on those who already trust them to assure other traditional healers that their intentions are not to harm them, to be trusted and granted access (Maluleka, 2017). The advantage of adopting snowball sampling in this study was ideal as the traditional healing practice is made up of an existing mentor network, as one has to be trained by another healer to practice as a healer (Maluleka, 2017). Accessing one healer gave the researcher access to other traditional healers within the Nkomazi community. The first participants are family friends (of the researcher) who are traditional healers from Mangweni Village (the researcher's home village). These traditional healers were asked to refer their colleagues from various villages within the Nkomazi Local municipality.

3.7 Plant collection and taxonomic identification

All plants were initially identified in the participants' home language during interviews and field walks with the traditional healers. Voucher samples were collected per Jain's recommended standards (2010). The lack of observable plant specimens, due to the fact that some of the plants were purchased in neighbouring countries like Mozambique and Eswatini, compromised the reliable identification of species. As a result, plants were identified by collecting plant specimens from the wild while accompanying traditional healers on harvesting field visits. The taxonomic identification of these plants was later made by consulting the C.E Moss herbarium (Witwatersrand University). For plant species where observable/fresh specimens were not obtainable, ethnobotanical literature compiled by other researchers was consulted (Schmidt *et al*., 2002; Moeng, 2010; Botha *et al.,* 2004; Ribeiro *et al.,* 2010; Mbongwa *et al.,* 2021).

3.8 Classification of medicinal plant uses

The medicinal uses were classified into 20 categories based on Moffett's (2010) classification, derived from Snyman's (2010) classification.

3.9 Conservation status

All species cited were categorised according to their conservation statuses based on the SANBI Red List website (SANBI, 2017) enabling the cited plants to be assessed accordingly.

3.10 Data analysis

To address the research questions, data collected from this study were analysed to establish a holistic understanding of the indigenous knowledge related to the use of medicinal plants by traditional healers in the rural communities of Nkomazi Local Municipality and opportunities and constraints for medicinal plant conservation.

As alluded to previously, data for this study was collected using interviews, field walks, observations, and literature review, with the interviews being recorded and analysed verbatim.

Qualitative and quantitative research usually generates a large amount of data to be summarised, analysed, and interpreted (Smith and Firth, 2011). Data analysis entails arranging and interpreting data collected to generate explicit and implicit statements about structures and dimensions (Smith and Firth, 2011). Meaning-making is created by these structures and dimensions, as well as what is depicted in the data content analysed (Flick, 2014).

The study employed two approaches to analyse and present data. Qualitative data were analysed using content analysis. Quantitative analysis was done through quantitative ethnobotany indices such as use value, informant consensus factor and relative frequency of citations. These indices were employed to quantify medicinal plants use patterns by the Nkomazi Local Municipality's traditional healers.

3.10.1 Qualitative data analysis

Data gathered from semi-structured interviews, observations, and field walks were analysed using content analysis. Content analysis is arranging and summarising textual data and identifying themes that indicate relevant interpretations utilised to address research objectives (Flick, 2014). According to Vaismoradi *et al*. (2013), Coding is the primary categorization method in qualitative research, and it entails reorganising data by categorising it so it can be compared (Chowdhury, 2015). Coding is the method of assigning terms to different parts of the data to facilitate the retrieval of data fragments (Merriam and Tisdell, 2015). Coding links intriguing characteristics from data that may be investigated concerning the research topics (Bloomberg and Volpe, 2018).

The following six steps outlined by Maguire and Delahunt (2017) were taken during data analysis. (1) familiarising yourself with the data by reviewing transcripts and listening to the recorded audio; (2) creating codes; (3) identifying themes in the data; (4) reviewing; (5) characterising the themes; and (6) writing up the thesis.

The first step comprises going through the data several times while making notes of any insights that may emerge. The second step entails the construction of the initial codes substantially. The term "themes" refers to the expression of concepts such as single words, phrases, or paragraphs that display patterns relevant to the study objective (Lochmiller, 2021). The third step is creating themes entails categorising the codes. The fourth step of the review

process involves organizing the themes according to their significance and connection to the research questions. Characterising the themes entails identifying the theme's subjects and relationships to one another (Lochmiller, 2021).

Data triangulation was done by cross-checking data obtained from interviews, field walks and observations, and literature review. This allowed the researcher to assess the accuracy of the emerging results, ensuring the data's reliability, the research's internal validity and rigour. Researcher bias was mitigated by recognizing the perspectives of participants and recording their precise opinions of the participants. These views from participants were analysed during content analysis.

3.10.2 Quantitative analysis

Pearson's chi-squared ($\chi 2$) test was used to test for differences between perceptions and attitudes of herbalists and diviners on using cultivated medicinal plants.

Quantitative ethnobotany began to gain traction in the past twenty years (Leonti, 2022), with its proponents criticising the lack of scientific rigour in the conventional methods used in conducting ethnobotanical studies and analysing the findings (Eldeen *et al*., 2016). The emergence of quantitative ethnobotany was mainly a response to the long-held misconception that ethnobotanical research was not scientific (Martin, 2010). Adu-Tutu *et al.* (1979) proposed an approach that is regarded as one of the first to attempt quantification of plant uses by examining the frequency of citation for plant applications. The method considers the depth of a plant's history in a community (for example, how a species' usage has remained over history) to evaluate the species' level of use (Magwede, 2018). However, this approach was criticised for being lengthy, mainly when applied across various cultures and regions (Magwede, 2018). Trotter and Logan (1986) introduced the "Informant Consensus" method as an extension of the Adu-Tutu *et al*. (1979) approach. This approach is less time-consuming and is appropriate for small communities (Magwede, 2018). The approach relies on informant consensus regarding plant species and their applications, intending to connect a high level of consensus to the usefulness of the plant species (Magwede, 2018). Numerous researchers consider the approach useful (Lozada *et al*., 2006; Trotter and Logan, 2019). This eventually resulted in the emergence of the concept of "Quantitative Ethnobotany", which was introduced by Prance *et al*. (1987) in a study done in the Amazon where he calculated how many Amazonian inhabitants utilize valuable species. Quantitative ethnobotany, as described by Phillips and Gentry (1993), provides rigour and scientific methodologies for data gathering and analysis.

The qualitative ethnobotany analysis applied in this present study is discussed in the following section.

3.10.2.1 Relative Frequency of Citations (RFC)

The relative frequency of citation was constructed by Tardio and Pardo-de-Santayana (2008). In this approach, the frequency of citation of a species is determined by dividing the number of participants who mentioned using a specific species by the total number of study participants. Despite considering species use, the approach does not consider use categories (Magwede, 2018). The formula used to calculate the relative frequency of citation is:

RFCs = FCs /N.

Where FCs = the total number of participants mentioning the use of the species and N the total number of participants who participated in the study.

The calculated value lies between 0 and 1. A lower number closer to 0 suggests that healers disagree with employing the same species. In contrast, values near 1 indicate that many healers utilise a small number of species or taxa (Tardio and Pardo-de-Santayana, 2008).

3.10.2.2 Informant Consensus factor (ICF)

Analysis of the ethnobotanical medicinal value of a given species can be conducted using the frequency of use of the given species (Ankli *et al*., 1999). Species commonly mentioned in a category of traditional applications are more valuable from an ethnobotanical perspective than those only mentioned by a small number of participants (Mophuthing, 2015). The informant consensus (Fic) (Heinrich *et al*., 1998) for the use categories was calculated using the following formula:

Fic=Nur-T/Nur-1

Where Nur= the number of ailments reported for the use category and T= the number of plant species used in treating the reported ailments in the use category.

The homogeneity of the information given by participants was assessed using the consensus factor.

3.10.2.3 Use value (UV)

The use value (UV) represents the relative significance of locally recognised plant species. The use (UV) (Bibi *et al*., 2014) was calculated using the following formula:

UV = ΣU/n

Where UV = the value of the species, U = the number of uses reported by participants, and n = the total number of participants who mentioned the given species (Bibi *et al*., 2014). If there are several reports of plant species being used, the UV level will be high (about 1). If fewer use data for the plant species are available, The UV readings are near zero (Bibi et al., 2014).

3. 11 Data quality

Every study uses a different set of assessment criteria to ensure the integrity of the study. Trustworthiness can be used to evaluate the quality of a qualitative (Bryman, 2012).

3.11.1 Trustworthiness of the study

According to Bryman (2012), a qualitative researcher can include indicators of trustworthiness such as transferability, dependability, credibility, and confirmability.

3.11.1.1Transferability

Transferability, which mirrors external validity, focuses on creating in-depth narratives of the social realm rather than on coverage (Bryman, 2012).

3. 11.1.2 Dependability

Dependability is similar to reliability in that it focuses on documenting all stages of the research process to show how well the appropriate steps have been followed and adhered to (Bryman, 2012).

3.11. 1. 3 Credibility

Credibility is the level of trust placed in a study's findings as an accurate portrayal of the social world institution under investigation (Noble and Smith, 2015). It questions the degree to which study findings and participant interpretations correspond (Anney, 2014). Anney (2014) has developed numerous credibility measures, such as member-checking and triangulation. Triangulation is the process of obtaining study findings by using multiple methodologies (Anney, 2014). There are several ways to triangulate, including investigator triangulation, in which one employs various researchers to investigate the same issue; data triangulation, in which one employs different research instruments to improve the quality of the data; and methods triangulation, in which one employs a variety of research methods (Anney, 2014).

3. 11.1. 4 Confirmability

This relates to objectivity, which entails ensuring the researcher is objective and not allowing personal emotions, perceptions, and values to influence the research findings (Bryman, 2012).

To guarantee trustworthiness, these strategies were considered in this study. The interviews were recorded using a voice recorder, and all the tape recordings were stored with field notes. The responses were recorded exactly as they were provided, and the researcher listened to them to ensure that the transcribed information was accurate and authentic. The researcher used the recording to check any discrepancies in the notes that would have compromised the accuracy of the data. Data triangulation was employed in this study, combining data collected from interviews, observations, literature reviews, and field walks and triangulating them in the data analysis process. Additionally, the primary researcher consulted the supervisors, who further assisted in triangulating the data gathered from interviews, observations, literature reviews, and field walks.

3.12 Ethical considerations

According to Hay (2016), ethical research is distinguished by researchers who conduct themselves with integrity and behave in an unbiased, benevolent, and respectful manner. The two most important ethical considerations are anonymity and confidentiality, and participants must be assured that all the information they supply will be held secure through regulated access (Lobe *et al*., 2020). The foundational ethical principle of social research is that respondents must not be harmed (Cohen *et al*., 2017). The researcher has an ethical responsibility to protect the respondent from any emotional or physical discomfort that might arise because of the study (Thomas *et al*., 2019). Participants should be made aware that participating in the study is entirely optional, and they have a choice to discontinue at any time, for any reason (Dempsey *et al*., 2016). The researcher should summarise the study's results to participants after completing the study (Babbie, 2010). The researcher ensured that all participants signed consent and confidentiality forms (Appendix C).

All the information collected was regarded as confidential and personal. The research project did not mention personal details such as names, addresses, or other identifying information. Raw and transcribed data from the questionnaires were securely stored and were not disclosed to anyone. The confidentiality and anonymity of the study were explicitly disclosed to the participants. (see Appendix D).

The University of Witwatersrand has committed to observing legally binding ethical principles. These principles are put in place to ensure that social research is conducted ethically, that non-harmful research approaches are used, that the research respondent's confidentiality is protected, that reckless behaviour is addressed, that conflict of interest is avoided, and that the

research does not pose any harm to the society or the environment. The researcher is a registered student at the University of Witwatersrand, and this study is therefore obligated to follow these principles. Adherence was achieved by following the specifications for obtaining ethical clearance from the Wits Human Research Ethics Committee. Appropriate permits and approvals from Nkomazi Local Municipality (Appendix E) were acquired to conduct the study authority before data collection occurred. A permit was obtained from the Nkomazi Local Municipality authority (Appendix F). The University of the Witwatersrand's human research ethics committee granted ethical approval for this study (H21/06/14) (Appendix G). The principle of informed prior consent in particular was observed and adhered to as part of the International Society of Ethnobiology's (ISE, 2006) ethical guidelines. The first author originated from the municipality and was familiar with the cultural practices and protocols.

3.13 Covid-19 precautions

The global Coronavirus outbreak has forced the scientific community to explore alternative ways to conduct research and minimize the rates of infections. The study observed all the covid-19 precaution guidelines as provided by the world health organization (WHO) and the National Institute for Communicable Diseases (NICD). Before visiting participants, the researcher underwent a Covid- 19 test and isolated themselves for ten days. During the data collection phase, the researcher conducted daily self-screening using the patient box app. The researcher wore a face mask, maintained a social/physical distance of 1.5m from participants, all interactions were conducted outdoors, and hands and equipment were regularly sanitised (alcohol-based 70%). The researcher provided face masks and hand sanitisers to participants. A detailed record of whom the researcher encountered or the data collection locations were kept so that tracing possible contact would be made accessible in case the researcher was diagnosed with Covid-19.

3.14 Summary

The chapter presented background information about the study areas, research design and methods, the rationale behind the method, and the sampling method. Additionally, the chapter reviewed the concept of data quality, how data analyses were undertaken, the ethical considerations, and Covid-19 precautions. Data collection was primarily based on traditional healers' responses and was collected through the following instruments: interviews, field walks, observations, and a literature review. These instruments enabled the researcher the chance to unearth nuanced and detailed data that could not be easily obtained using

questionnaire approaches. Chapter 4 focuses on presentations and discussion of the results obtained from traditional healers.

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CHAPTER 4
Inventory of Nkomazi Local Municipality Medicinal plants

4.1 Introduction

Ethnobotany is a field of study that explores how humans interact with plants, and it commonly concentrates on traditional medicine for its potential application in modern medicine (Sobiecki, 2004; Nair *et al*., 2023). Ethnobotany focuses mainly on the cultural significance of the interactions between people and plants (Gaoue *et al*., 2017). The discipline is founded on indigenous knowledge accumulated by a community over many generations of constant interaction with the natural environment. Consequently, various cultures have different perceptions of plants and their application (Panigrahi *et al*., 2022). Indigenous knowledge serves as the foundation for local decision-making concerning many essential aspects of day-to-day tasks in a community, such as food production, maintaining health, veterinary care, and adapting to societal and environmental changes (Whyte, 2017).

Ethnobotanical studies are essential for preserving indigenous knowledge, as they provide a record-keeping system that documents this knowledge for future generations (Stoianoff, 2023). Additionally, Ethnomedical and ethnobotany research are the most powerful tools for discovering novel medicinal plants or to re-investigate plants documented in previous research to examine their bioactive compounds (Thirumalai *et al*., 2009). Traditional medicine continues to significantly impact many people's lives amid all the advancements in modern medicine (Mbongwa, 2018). Many rural communities in Mpumalanga (Nkomazi Local Municipality) province use traditional treatments available locally to treat a variety of illnesses (Shabangu, 2021). However, the available research on the traditional use of medicinal plants by the rural communities of Mpumalanga is highly fragmented and under-researched, encompassing only the Jongilanga tribal council, which falls under the Bushbuckridge Local Municipality (Tshikalange *et al.,* 2016). There is no comprehensive account of the indigenous knowledge of the Nkomazi Local municipality's medicinal plants and their associated applications. Consequently, this chapter makes an effort to investigate and document (i) medicinal plants utilised by traditional healers and the various ailments treated, (ii) medicinal plant species that are most popular in the Nkomazi Local Municipality, (iii) conservation statuses of the medicinal plants cited by traditional healers, (iv) parts of the plants that are used,

(v) how medicinal plants are prepared and administered, and (vi) how medicinal plants are harvested, stored, and packaged.

4.2 Methods

Details on data collection and analysis are outlined in Chapter 3. Information on medicinal plants utilised by the Nkomazi Local Municipality's traditional healers was collected using data sheets (Appendix B) during field walks. Additionally, traditional healers were observed during the data collection phase through non-participation observation to understand traditional healing practices such as methods and processes of harvesting, preparation, and packaging of medicinal plants.

Plants were identified by collecting plant specimens from the wild while accompanying traditional healers on harvesting field visits. The taxonomic identification of these plants was later made by consulting the C.E Moss herbarium (Witwatersrand University). For plant species where observable/fresh specimens were not obtainable, ethnobotanical literature compiled by other researchers was consulted (Schmidt *et al*., 2002; Moeng, 2010; Botha *et al.,* 2001; Ribeiro *et al.,* 2010; Mbongwa *et al.,* 2021).

Moffett's (2010) classification, which was adapted from Snyman's (2010) classification, was used to categorise medicinal uses into 20 categories.

All species cited were categorised according to their conservation statuses based on the SANBI Red List website (SANBI, 2017), enabling the cited plants to be assessed accordingly.

The study employed two approaches to analyse and present data. Qualitative data were analysed using content analysis. Quantitative analysis was done through quantitative ethnobotany indices such as use value, informant consensus factor and relative frequency of citations. These indices were employed to quantify medicinal plants use patterns by the Nkomazi Local Municipality's traditional healers.

4.3 Results and Discussion

4.3.1 Demographic characteristics of traditional healers

The chosen traditional healers are licensed practitioners who treat locals with medicines derived from indigenous plants and animal products. They included both females and males and the two categories of healers, namely diviners (*Sangoma*) and herbalists (*Lugedla*). Some of the herbalists sold Medicinal plants to diviners and the general public (Table 4.1).

Table 4.1. The demographic structure of participants.

Parameter	**Specification**	**Number of participants**
Gender	Female Male	7 3
Age group (years)	26-35 36-45 >45	3 2 5
Level of education	No Schooling Primary School Secondary School Tertiary	5 2 2 1
Cultural group	Swati Tsonga	6 4
Traditional healing category	Herbalist Diviners	5 5
Years of Experience in traditional healing	<10 11-20 21-30 >30	4 1 4 1

Participants also had a range of levels of informal and formal education. The ages of participants were between the ages of 24-60, and the majority (n=7) were female. Women have been reported to be more active participants in numerous ethnobotanical studies than men (Ndawonde *et al*., 2007; Khumalo, 2018), and the results from this current study reflect this pattern. The majority of the traditional male healers were not willing to share their ancestral knowledge with the researcher. As a result, just 30% of the participants were males in this present study. Masevhe *et al*. (2015) conducted a study which found similar results, indicating that males were generally hesitant to participate in ethnobotanical surveys, even when they were assured that the information collected was solely for research purposes. Six of the participants were Siswati-speaking, while four spoke Tsonga. Four of the participants had less than ten years of experience in traditional healing; one had from 11-20 years, four had from 21-30 years, and one had more than 30 years of experience. Most of the traditional healers

interviewed were over 45 years old. This age group's dominance could be ascribed to the reality that they have a financial obligation to look after their households (Ndawonde *et al*., 2007). Given the short life expectancy for South African females (64.6 years) and males (59.3 years) (Stats SA, 2021) and the fact that traditional healers are often reluctant to share their knowledge with outsiders, the opportunity to preserve indigenous knowledge may be threatened. This mandates an urgent need to document and thus preserve cultural and indigenous knowledge (Semenya and Potgieter, 2014).

4.3.2 Taxonomic diversity of Nkomazi Local Municipality medicinal plants

The ethnobotanical study has provided insight into the traditional medicine used by traditional healers in the rural communities of Nkomazi Local Municipality. A total of 111 plant species (Table 4.2) from 59 families that are commonly used for medicinal purposes were recorded.

Table 4.2. Medicinal plant nomenclature and use in the Nkomazi Local Municipality.

* = Exotic species.

** = No voucher number, as traditional healers did not have fresh observable specimens.

Scientific name Index values: [RFC] [UV]	**Family**	**Local name (Sw)= Siswati (X)= Xitsonga**	**Life Form**	**Voucher no**	**Parts used**	**Method of Preparation**	**Method of administration**	**Diseases treated**
Acorus calamus L. * [0.6] [0.8]	Acoraceae	Ikalamuzi (Sw)	Herb	**	Roots	Decoction	Taken orally	Coughs Colds Fever Loss of appetite Intestinal worms
Tulbaghia violacea Harv. [0,7] [0.1]	Alliaceae	Lisela (Sw)	Herb	NK28	Whole Plant		Planted in the yard	Snake repellent
Boophone disticha (L.f.) Herb. [0.5] [0.2]	Amaryllidaceae	Siphahluka (Sw) Rihemana (X)	Herb	NK45	Bulb	Decoction	Taken orally	Luck charm
Sclerocarya birrea (A. Rich.) Hochst. [0.8] [0.1]	Anacardiaceae	Mganu (Sw) Nkanyi (X)	Tree	NK15	Bark	Decoction	Taken orally	Diarrhoea
Lannea schweinfurthii var. stuhlmannii Engl. [0.6] [0.2]	Anacardiaceae	Umganunkomo (Sw) Ximbombokanyi (X)	Shrub	NK44	Leaves	Decoction	Hot leaves placed on boils	Boils
Annona senegalensis Pers. [0.6] [0.3]	Annonaceae	Mtelemba (Sw) Muyembe (X)	Shrub	NK14	Bark	Decoction	Taken orally gargled/mouthwash	Mental illness Toothache
Artabotrys brachypetalus Benth. [0.5] [0.2]	Annonaceae	Ntita (X)	Shrub	**	Roots	Infusion	The whole body is bathed with the infusion	Cleansing after a funeral in the family
Heteromorpha arborescens (Spreng.) Cham. & Schltdl. [0.4] [0.3]	Apiaceae	Umbangadlala (Sw)	Tree	**	Roots	Decoction	Taken orally	Appetite stimulant
Alepidea amatymbica Eckl. & Zeyh. [0.3] [0.7]	Apiaceae	Likhatsato (Sw)	Herb	NK54	Roots	Powdered	Smoked Snuff Topically	Communicate with the ancestors Snakes bites

Foeniculum vulgare Mill.* [0,6] [0.2]	Apiaceae	Imbozisa (Sw)	Herb	NK46	Roots	Infusion	Emetic	Poisoning (*sidliso*)
Secamone gerrardii Harv. ex Benth. [0.5] [0,2]	Apocynacea e	Mgobandlovu (Sw)	Climber	**	Roots	Infusion	The whole body is bathed with the infusion	Cleansing for bad luck
Carissa bisponosa (L.) Desf. ex Brenan [0,8] [0,1]	Apocynacea e	Umvusankunzi (Sw)	Shrub	NK23	Roots	Decoction	Taken orally mixed with milk	Erectile dysfunction
Tabernaemontana elegans Stapf [0.7] [0.1]	Apocynacea e	Mkhahlu (Sw) Nkahlwane (X)	Shrub	**	Roots	Infusion	Taken orally	Erectile dysfunction
Acokanthera oppositifolia (Lam.) Codd [0.5] [0.6]	Apocynacea e	Mutsimulisa (Sw)	Tree	**	Leaves	Powdered Infusion	Snuff Taken orally	Mental illness Headache Epilepsy
Adenium multiflorum Klotzsch [0.6] [0.2]	Apocynacea e	Sisila-Semphala (Sw)	Shrub	**	whole plant	Planted in the yard		Prevents bad luck witchcraft lightning
Cussonia spicata Thunb. [0.6] [0.3]	Araliaceae	Umsenge (Sw) Musenje (X)	Tree	NK25	Leaves	Infusion	Taken orally	Biliousness (inyongo) Laxative
Asparagus aethiopicus L. [0.6] [0,2]	Asparagacea e	Kwangulatilo (X)	Climber	NK01	Roots	Decoction	Taken orally	Body pains
Aloe ferox Mill. [0.8] [0,5]	Asphodelace ae	Inhlaba (Sw) Mhangana (X)	Succule nt	NK07	Leaves	Infusion	Taken orally	Skin irritations Hypertension Sexually transmitted Toothache
Aloe maculata All. [0.8] [0.1]	Asphodelace ae	Inhlaba (Sw)	Succule nt	NK32	Leaves	Infusion	The whole body is bathed with the infusion	Cleansing after a funeral in the family
Brachylaena discolor DC. [0.5] [0.6]	Asteraceae	Phahla (Sw)	Shrub	NK30	Roots	Decoction	Taken orally	Labour pains Fertility Threatened miscarriage
Artemisia afra Jacq. ex Willd. [0.6] [0.2]	Asteraceae	Umhlonyane (Sw)	Shrub	NK33	Leaves	Decoction	Taken orally steaming	Colds
Callilepis laureola DC. [0.5] [0.2]	Asteraceae	Ihlamvu (Sw)	Herb	**	Roots	Infusion	Sprinkled around the yard	Protection against evil spirits

Linzia glabra Steetz sens.lat. [0.5] [0.2]	Asteraceae	Linyatselo (Sw)	Herb	NK55	Roots	Decoction	Taken orally	Diabetes
Helichrysum pallidum DC. [0.5] [0,2]	Asteraceae	Mphepho (Sw) Mpetso (X)	Herb	**	Whole plant	Burned	Incense	Used to connect with ancestors
Berkheya bipinnatifida (Harv.) Roessler subsp. Bipinnatifida [0.6] [0,3]	Asteraceae	Likhakhasi (Sw)	Herb	**	Roots	Infusion	The whole body is bathed with infusion	Cleansing to connect with ancestors. Protects against harmful spirits.
Bidens pilosa L.* [0.7] [0.1]	Asteraceae	Chuchuza (Sw)	Herb	NK03	Leaves	Decoction	Taken orally	Headaches
Kigelia africana (Lam.) Benth. [0.6] [0.2]	Bignoniaceae	Umvongotsi (Sw) Mpfungurhu (X)	Tree	NK36	Bark	Infusion	Taken orally	STI's
Ehretia rigida (Thunb.) Druce [0.8] [0.3]	Boraginaceae	Sihlehle (Sw) Muhambe (X)	Shrub	**	Roots	Decoction	Taken orally	STI's Haemorrhoids
Cladostemon kirkii (Oliv.) Pax & Gilg [0.6] [0.7]	Brassicaceae	Uphanda (Sw)	Tree	**	Roots	Decoction	Taken orally	Arthritis Boils STI's High blood pressure
Warburgia salutaris (Bertol.f.) Chiov. [0.6] [0.5]	Canellaceae	Sibhaha (Sw) Xibaha (X)	Tree	**	Bark	Infusion	Taken orally	Tonsils Flu Colds
Trema orientalis (L.) Blume [0.6] [0.3]	Cannabaceae	UmBalalaqane (Sw) Mpuka (X)	Tree	**	Bark	Infusion	Taken orally	Colds Chest pains
Capparis tomentosa Lam. [0.8] [0.4]	Capparaceae	Inkunzi-ebomvu (Sw) Nkawa (X)	Shrub	NK39	Roots	Decoction	Taken orally	Ulcers Labour pains STI's
Elaeodendron croceum (Thunb.) DC. [0.5] [0.4]	Celastraceae	Sithundu (Sw)	Tree	**	Roots	Infusion	The whole body is bathed with infusion Sprinkled in the yard	Protection against evil spirits/ witchcraft
Gymnosporia buxifolia (L.) Szyszyl. [0.3] [0.7]	Celastraceae	Sihlangu lesimnyama (Swa)	Shrub	**	Bark	Decoction	Taken orally	Poisoning (sidliso) STI's

Elaeodendron transvaalense (Burtt Davy) R.H. Archer [0.4] [1.5]	Celastraceae	Ngcotfo (Sw) Shimapana (X)	Tree	NK56	Bark	Decoction	Taken orally	Blood purification Heartburn STI's Stroke(Sifulane) Skin irritations Improves fertility
Pterocelastrus rostratus (Thunb.) Walp. [0.5] [0.2]	Celastraceae	Usehlulamanye (Sw)	Tree	**	Bark	decoction	Taken orally	To remove bad luck
Argyrolobium tomentosum (Andrew) Druce [0.5] [0.8]	Fabaceae	Umlomomnandzi (Sw)	Shrub	**	Roots	Infusion	The whole body is bathed with infusion	A charm to win court cases and disciplinary hearing Gain dignity Love charm. Used to convince people to agree to whatever you are saying
Combretum apiculatum Sond. subsp. Apiculatum [0.7] [0.1]	Combretacea e	Imbondvo (Sw) Xikukutsi (X)	Tree	NK56	Roots	Dried up and powered	Smoked	Used by traditional healers (sangoma's) to awaken/activate spirits
Combretum imberbe Wawra [0.6] [0.7]	Combretacea e	Mpondvondlovu (Sw) Mondzo (X)	Tree	NK17	Roots	Decoction	Taken orally	Headaches Sinuses Colds diarrhoea
Ipomoea oblongata E. Mey. ex Choisy [0.5] [0.2]	Convolvulaceae	Ubhoqo (Sw) Dema (X)	Climber	**	Roots	Decoction	Taken orally	Drop (STI)
Momordica balsamica L. [1] [0.1]	Cucurbitacea e	Nkaka (X)	Climber	NK12	Leaves	Decoction	Taken orally	High blood pressure
Coccinia rehmannii Cogn. [0.6] [0.2]	Cucurbitacea e	Hawulane (Sw)	Climber	**	Roots	Infusion	The whole body is bathed with infusion	Lucky charm
Scabiosa columbaria L. [0.7] [0.4]	Dipsacaceae	Bheka-Mina (Sw)	Herb	**	Roots	Decoction	Taken orally	Heartburn Period pains Colic

Cephalaria humilus (Thunb.) Roem. & Schult. [0.6] [0.5]	Dipsacaceae	Umpikayiboni (Sw)	Herb	**	Roots	Infusion	The whole body is bathed with infusion	Luck charm for business dignity Protection against enemies
Diospyros galpinii (Hiern) De Winter *[*0.6] [0.2]	Ebenaceae	Indodemnyama (Swa)	Tree	NK57	Roots	Infusion	Taken orally	Tindzaka, TB
Euclea natalensis A. DC. [0.5] [0.4]	Ebenaceae	Indlelayenyamatane-Lemnyama (Sw) Nhalngula (X)	Shrub	NK42	Roots	Decoction	Taken orally	Poisoning (Sidliso) High blood pressure
Euclea divinorum Hiern [0.7] [0.4]	Ebenaceae	Indlelanyamatane-libovu (Sw) Nhlangula (X)	Shrub	NK21	Roots	Decoction	Taken orally	Laxative STI's Blood purification
Diospyros mespiliformis Hochst. ex A. DC. [0.6] [0.2]	Ebenaceae	umTomo (Sw) Ntoma (X)	Tree	NK59	Bark	Decoction	Taken orally	Blood purification
Diospyros lycioides Desf. [0.6] [0.2]	Ebenaceae	Umcafutane (Sw) Xintomane (X)	Shrub	**	Roots	Decoction	Taken orally	Epilepsy
Ricinus communis L.* [0.9] [0.2]	Euphorbiaceae	Mhlafusha (Sw) Nhlamfura Ya Valungu (X)	Shrub	NK02	Seeds	Seed oil extracted through grinding	Topically	Skin irritations Stretch marks
Macaranga capensis (Baill.) Benth.ex Sim [0.5] [0.2]	Euphorbiaceae	Nompumelelo (Sw)	Tree	**	Bark	Infusion	The whole body is bathed with infusion	Lucky charm for success
Jatropha zeyheri Sond. [0.5] [0.6]	Euphorbiaceae	Mfelo (Sw) Xidomeja (X)	Herb	**	Roots	Powdered	Taken orally (mixed with porridge)	Menstrual pains Painful womb Maintains pregnancy
Spirostachys africana Sond. [0.7] [0.1]	Euphorbiaceae	Likhambi lebantfwana (Sw) Xilangamahlo (X)	Tree	NK20	Roots	Decoction	Taken orally	Constipation

Albizia anthelmintica (A. Rich.) Brongn. [0.5] [0.4]	Fabaceae	Umgadankawu (Sw)	Shrub	**	Bark	Decoction	Taken orally	Biliousness Menstrual pains
Neorautanenia ficifolia Benth. ex Harv.) C.A.Sm.[0.4] [0.3]	Fabaceae	Sikhundla (Sw)	Climber	NK60	Whole plant	Infusion	The whole body is bathed with infusion	The charm used for promotion at work /organisations
Abrus laevigatus E. Mey. [0.4] [0.8]	Fabaceae	Umehlebatsakate (Sw)	Shrub	NK21	Whole plant	Decoction	Taken orally	Stomach complaints Diarrhoea Kidney infections
Schotia brachypetala Sond. [0.6] [0.3]	Fabaceae	Uvhovhovho (Sw) Nwavilombe-Chochelamandleni (X)	Tree	NK18	Bark	Infusion	Taken orally	Diarrhoea Blood purification
Mimosa pudica L. var. hispida Brenan* [0.5] [0.2]	Fabaceae	Indabulaluvalo (Sw)	Shrub	**	Bark	Powdered	Taken orally/ sprinkled on food and drinks	Love charm/ reverses it
Peltophorum africanum Sond. [0.4] [0.5]	Fabaceae	Umkhabamkhombe (Sw) Ndzedze (X)	Tree	**	Bark	Decoction	Taken orally	Stomach complaints Blood purification
Albizia versicolor Welw. ex Oliv. [0.7] [0.3]	Fabaceae	Sivangatane (Sw) Mbhesu (X)	Tree	NK09	Bark	Infusion	Taken orally	Contraceptive Stomach complaints
Dalbergia melanoxylon Guill. & Perr. [0.5] [0.6]	Fabaceae	Isparati (Sw) Xipalatsi (X)	Tree	**	Roots	Decoction	Taken orally	STI's Stomach complaint Given to women with a history of miscarriage
Mundulea sericea (Willd.) A. Chev. [0.5] [0.4]	Fabaceae	Umsindandlovana (Sw) Ntsandzandlopfu (X)	Shrub	**	Roots	Infusion	Taken orally	Fertility Poisoning (sidliso)
Vachellia robusta *(Burch.) Kyalangalilwa & Boatwright subsp. robusta* [0.5] [0.4]	Fabaceae	Umngamanzi (Sw) Mvumbangwenya (X)	Tree	NK29	Bark	Decoction	Taken orally	STD's Menstrual pains
Erythrina lysistemon Hutch. [0.6] [0.3]	Fabaceae	Umsinsi (Sw) Nsisimbana (X)	Tree	NK26	Roots	Infusion	Taken orally	Labour pains Toothache

Elephantorrhiza elephantina (Burch.) Skeels [0.5] [0.4]	Fabaceae	Intfolwane (Sw) Xivurayi (X)	Shrub	NK61	Roots	Infusion	Taken orally	diarrhoea Haemorrhoids
Acacia xanthophloea (Benth.) P.J.H. Hurter [0.6] [0.5]	Fabaceae	UmKhanyakudze (Sw) Nkelenga (X)	Tree	NK43	Bark	Decoction	Taken orally	Lucky charm Kidney infections Improves libido in men
Merwilla plumbea (Lindl.) Speta [0.5] [1.4]	Hyacinthaceae	Inguduza (Sw)	Herb	**	Herb	Decoction Powdered	Taken orally Topically	Fertility Laxative Boils wounds fractures labour pains and delivery
Urginea altissima (L.f.) Baker [0.4] [0.5]	Hyacinthaceae	Silulwane (Sw)	Herb	**	Leaves	Infusion	The whole body is bathed with the infusion	Cleansing against evil spirits
Ledebouria apertiflora (Baker) Jessop [0.6] [0.7]	Hyacinthaceae	Siganama (Sw)	Herb	NK31	Bulb	Crushed Decoction	Topically Taken orally	Skin irritations Boils Stroke(Sifulane) Biliousness (inyongo)
Bowiea volubilis Harv. Ex Hook. f. subsp. Volubilis [0.7] [0.4]	Hyacinthaceae	Gibizisila (Sw)	Climber	**	Herb	Decoction	Taken orally	STI's Labour pains Infertility
Schizocarphus nervosus (Burch.) Van der Merwe [0.7] [0.4]	Hyacinthaceae	Imbita-yebantwana (Sw)	Herb	NK34	Bulbs	Decoction	Taken orally	Used in babies to treat a reddish spot at the back of the head (Libala) stomach complaints peptic ulcers
Eucomis autumnalis (Mill.) Chitt [0.6] [0.5]	Hyacinthaceae	Umathunga (Sw)	Herb	NK48	Bulb	Decoction	Taken orally	Healing after operation Improves libido Blood purification (HIV)
Hydnora africana Thunb. [0.5] [0.4]	Hydnoraceae	Mavumbuka (Sw)	Epiphyte	**	whole plant	Decoction	Taken orally	Labour pains Fertility

Hypoxis hemerocallidea Fisch., C.A. Mey. & Avé-Lall. [0.7] [0.4]	Hypoxidaceae	Isifozonke (Sw)	Herb	**	Roots	Decoction	Taken orally	Panacea (all-purpose) HIV (boosts Immune system) Ulcers
Pyrenacantha grandiflora Baill. [0.6] [0.2]	Icacinaceae	Velabahleke (Sw)	Climber	**	Bark	Infusion	The whole body is bathed with infusion	A charm to win court cases disciplinary hearing dignity
Aristea capitata (L.) Ker Gawler [0.7] [0.1]	Iridaceae	Phalabashimane (Sw)	Herb	**	Roots	Infusion	The whole body is bathed with infusion	Protection against evil spirits
Leonotis leonurus (L.) R.Br. [0.8] [0.1]	Lamiaceae	Umfincafincane (Sw) Mabangi ya nhova (X)	Herb	NK06	Roots	Decoction	Taken orally	High blood pressure
Clerodendron glabrum E.Mey. var. glabrum [0.6] [0.2]	Lamiaceae	Mphehlacwatsi (Sw) Xinhun'welambeva (X)	Tree	**	Leaves	Decoction	Sprinkled around the yard/house	Snake repellent
Ocotea bullata (Burch.) Baill. [0.7] [0.1]	Lauraceae	Umnukani (Sw)	Tree	**	Bark	Decoction	Taken orally	Acne (isicitho)
Cinnamomum camphora (L.) * Siebold [0.5] [0.2]	Lauraceae	Uroselina (Sw)	Tree	NK04	Bark	Infusion	Emetic	Used as an emetic against evil spirits/bad luck
Strychnos henningsii Gilg [0.4] [0.5]	Loganiaceae	Umnono (Sw)	Shrub	**	Bark	Powdered	Taken orally (licked)	Anthelmintic Sharp pains (mahlaba)
Grewia monticola Sond. [0.8] [0.4]	Malvaceae	Umsiphane (Sw) Nsihane (X)	Tree	NK49	Roots	Decoction	Taken orally	Maintains pregnancy Infertility Period pains
Hibiscus pusillus Thunb. [0.6] [0.2]	Malvaceae	Uvuma (Sw)	Climber	**	Bark	Decoction	Taken orally	Helps to facilitate the closing of the fontanelles in infants (Sikhala)
Dombeya rotundifolia Hochst. [0.4] [0.3]	Malvaceae	Nhlitiyo (Sw)	Tree	NK24	Bark	Decoction	Taken orally	Heart diseases

Ekebergia capensis Sparrm. [0.5] [0.2]	Meliaceae	Umnyamatsi (Sw) Nyamaru (X)	Tree	**	Bark	Infusions	Taken orally	Stomach complaints
Trichilia emetica Vahl [0.8] [0.1]	Meliaceae	Umkuhlu (Sw) Nkuhlu (X)	Tree	NK13	Bark	Powdered	Topically (mixed with petroleum gel)	Burns wounds
Ficus sur Forssk. [0.5] [0.6]	Moraceae	Umkhiwane (Sw)	Tree	NK27	Bark	Powdered	Topically	Boils Wounds Burns
Moringa oleifera Lam. [0.8] [0.5]	Moringaceae	Moringa (Sw and X)	Tree	NK35	Leaves	Leaves dried and powdered	Taken orally mixed with porridge	High blood pressure Diabetes Cancer Stomach Complaints
Psidium guajava L.* [0.9] [0.1]	Myrtaceae	Umgwava (Sw)	Tree	NK11	Leaves	Infusion	Taken orally	High blood pressure
Rapanea melanophloeos (L.) Mez [0.5] [0.4]	Myrsinaceae	Ligcolo (Sw) Shitsuvane (X)	Tree	NK50	Bark	Decoction	Taken orally	Poisoning (sidliso) Blood purification
Eucalyptus tereticornis Sm.* [0.7] [0.4]	Myrtaceae	Indlulamitsi (Sw)	Tree	NK37	Bark	Decoction	Taken orally Steaming	Menstrual pains Colds and Coughs Sinusitis
Ximenia caffra Sond. [0.8] [0.4]	Olacaceae	Umtfundvuluka (Sw) Ntsengele-lowu kulu (X)	Tree	NK16	Roots	Infusion	Taken orally	Diarrhoea Fertility Maintains pregnancy
Adenia gummifera (Harv.) Harms var. gummifera [0.6] [0.5]	Passifloraceae	Upindakumshaye (Sw) Dovosha (X)	Climber	NK10	Roots	Infusion	Taken orally	Period pains Infertility Biliousness (Inyongo)
Antidesma venosum E. Mey. ex Tul. [0.5] [0.6]	Phyllanthaceae	Umhlalamuhuhulu (Sw) Mpfalambati (X)	Shrub	**	Roots	Infusion	Taken orally	Stomach complaints Period pains coughs
Cymbopogon citratus (DC.) Stapf* [0.4] [0.8]	Poaceae	Litiye lase Mozambique (Sw) Ntepu (X)	Grass	**	Roots	Infusion	Taken orally (served as a hot beverage)	High blood pressure Colds Stomach complaint

Coix lacryma-jobi L.* [0.5] [0.2]	Poaceae	Ilozisi (Sw)	Grass	**	Seeds	Seeds are used to make necklace/waist beads	Worn on the neck or waist	Seeds are used to create a necklace, waist beads (amulet) for children as a protection charm and aids with teething (kuhabula)
Faurea saligna Harv. [0.6] [0.5]	Proteaceae	Sefo (Sw) N'wamidzumba (X)	Tree	**	Leaves	Decoction	Taken orally	STI's diarrhoea Epilepsy
Clematis brachiata Thunb. [0.5] [0.6]	Ranunculaceae	Zinyolemamba (Sw)	Climber	**	Roots	Infusion	Taken orally	Asthma Stomach complaints colds
Berchemia discolor (Klotzsch) Hemsl. [0.6] [0.2]	Rhamnaceae	Umhlungulo (Sw) Nyiri (X)	Tree	NK40	Roots	Powdered and combined with petroleum jelly	Topically	Treatment of wounds
Prunus africana (Hook.f.) Kalkman [0.4] [0.5]	Rosaceae	Umdumezulu (Sw)	Tree	NK38	Bark	Decoction	Taken orally	Chest pains UTI's
Gardenia volkensii K. Schum. [0.4] [0.3]	Rubiaceae	Sivalasangwane (Sw) Ntsalala (X)	Shrub	NK19	whole plant	Planted in the yard		Protects the households against enemies/ evil spirits
Vangueria infausta Burch. [0.6] [0.3]	Rubiaceae	UmNtuli (Sw) Mpfilwa (X)	Tree	NK22	Roots	Decoction	Taken orally	Injuries (broken bones) headaches
Dracaena aletriformis (Haw.) Bos [0.5] [0.2]	Ruscaceae	SiKhonkhwane (Sw)	Shrub	**	Roots	Infusion	The whole body is bathed with infusion	Protection against evil spirits cleansing for bad luck
Zanthoxylum leprieurii Guill. & Perr. [0.7] [0.4]	Rutaceae	Umnungwane (Sw) Manhungwana (X)	Tree	**	Roots	Decoction	Taken orally	Laxative Panacea (usually used to treat unidentifiable diseases) Arthritis
Vepris reflexa I. Verd. [0.6] [0.2]	Rutaceae	Lifembo (Sw) Nkuhuma (X)	Tree	**	Roots	Decoction	Steaming	Symptoms of covid

Zanthoxylum capense (Thunb.) Harv. [0.3] [0.3]	Rutaceae	Umnungamabele (Sw)	Tree	**	Roots	Infusion	Taken orally	Epilepsy
Dovyalis caffra (Hook. f. & Harv.) Hook. f. [0.4] [0.3]	Salicaceae	Intapane (Sw) N'wabula (X)	Shrub	NK20	Bark	Decoction	Taken orally	Arthritis
Hippobromus pauciflorus (L.f.) Radlk. [0.4] [0.5]	Sapindaceae	Isiphahluka (Sw)	Tree	NK52	Bark	Infusion	The whole body is bathed with infusion	Love Charm Protection against enemies
Pappea capensis Eckl. & Zeyh. [0.5] [0.6]	Sapindaceae	Liletsa (Sw) Xikwakwaxu (X)	Tree	**	Bark	Decoction	Taken orally	Poisoning (sidliso) Tuberculosis (Tindzaka)
Talinum caffrum (Thunb.) Eckl. & Zeyh. [0.5] [0.2]	Talinaceae	Punyuka Bamphethe (Sw)	Succulent	**	Bark	Infusion	The whole body is bathed with infusion	A charm to win court cases disciplinary hearing
Balanites maughamii Sprague [0.6] [0.5]	Zygophyllaceae	Liphambo (Sw) Nulu (X)	Tree	NK51	Bark	Decoction	Taken orally	Poisoning (sidliso) Laxative Blood purification

Fabaceae was the widely used plant family, accounting for 12 of all medicinal plant species in this study, followed by Asteraceae (6), Euphorbiaceae (6), and Hyacinthaceae (6) (Fig. 4.1). Several ethnobotanical studies in South Africa (such as Mahwasane *et al*., 2013; Mongalo and Makhafola, 2018; Semenya and Maroyi, 2019; Magwede *et al*., 2019; Mhlongo and Van Wyk, 2019) and other regions around the world as reported by (Aumeeruddy and Mahomoodally, 2020; Lawal *et al*., 2020; Enebeli-Ekwutoziam *et al*., 2021) have similarly documented species in the Fabaceae family as the most predominantly used plant species for medicinal purposes. The Fabaceae family's dominance could be attributed to their adaptation to various environmental conditions (Semenya and Maroyi, 2019) and their effectiveness in treating a diverse array of conditions (Van Wyk *et al*., 1997).

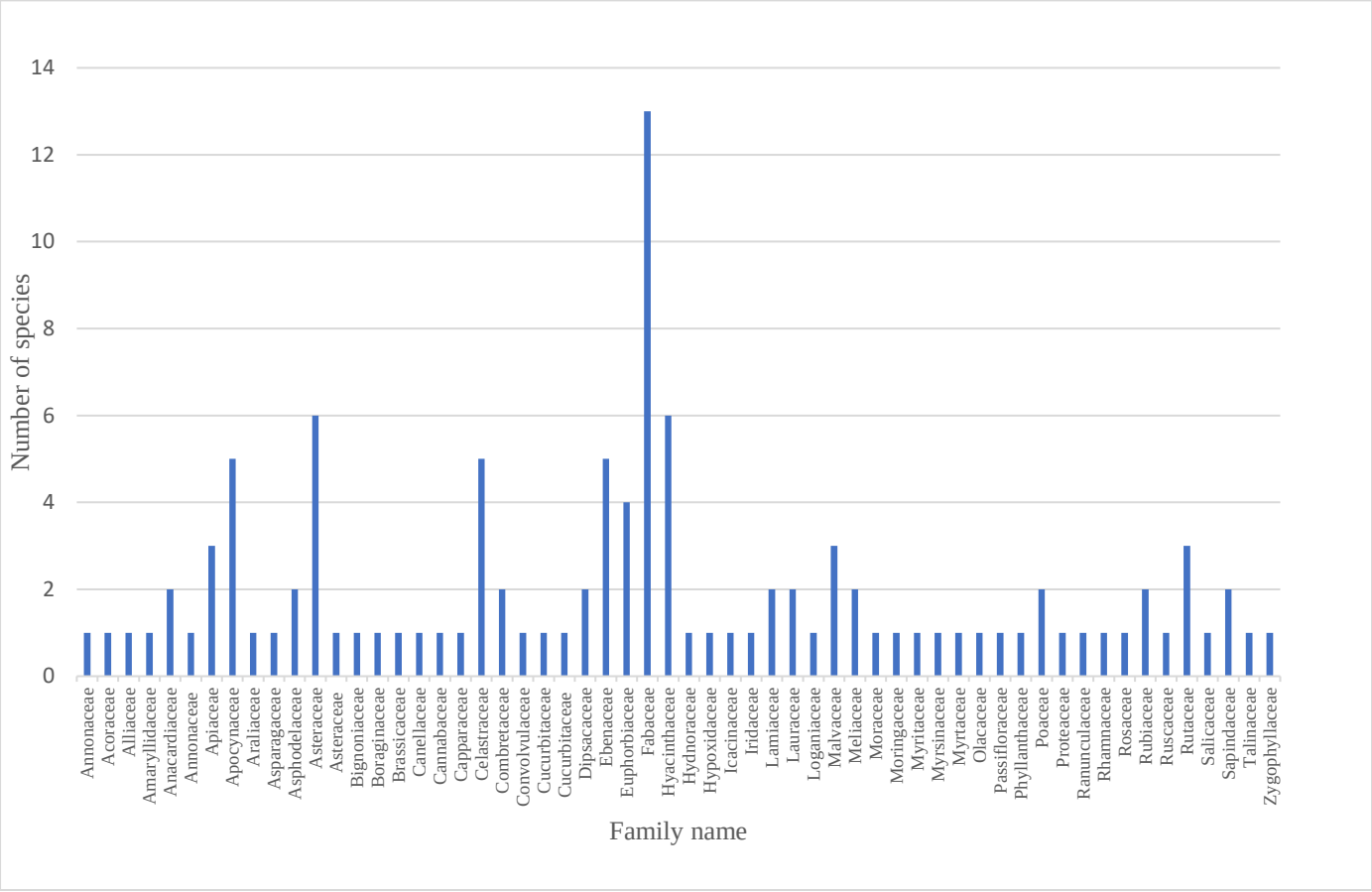

Figure 4.1. Family representation of plant used by traditional healers in Nkomazi Local Municipality, Mpumalanga province of South Africa.

4.3.3 Main use categories

Sixty-five different medicinal uses were grouped into the following major categories: analgesic, paediatric, anthelmintic, anti-microbial, cardio-vascular cytological dermatological, nose and throat, endocrine system, gastrointestinal, gynaecological and obstetrics,

musculoskeletal, nervous system, respiratory system, tonics, trauma, urinary system, ethnoveterinary, traditional uses (spiritual) and reproductive system were recorded in this study (Fig. 4.2). The majority of plant species found in Nkomazi Local Municipality are utilised for treating gastro-intestinal disorders, followed by traditional (spiritual) purposes and cardiovascular-related conditions. Most medicinal plants (68 plants) are reported to be used for treating multiple ailments, causing a single species to be placed multiple times on the 20 categories of use. For example, *Cladostemon kirkii* is traditionally employed to alleviate arthritis, boils, sexually transmitted infections, and high blood pressure. Additionally, *Jatropha zeyheri* is utilised to relieve menstrual cramps and alleviate pain in the uterus, as well as to help maintain pregnancy.

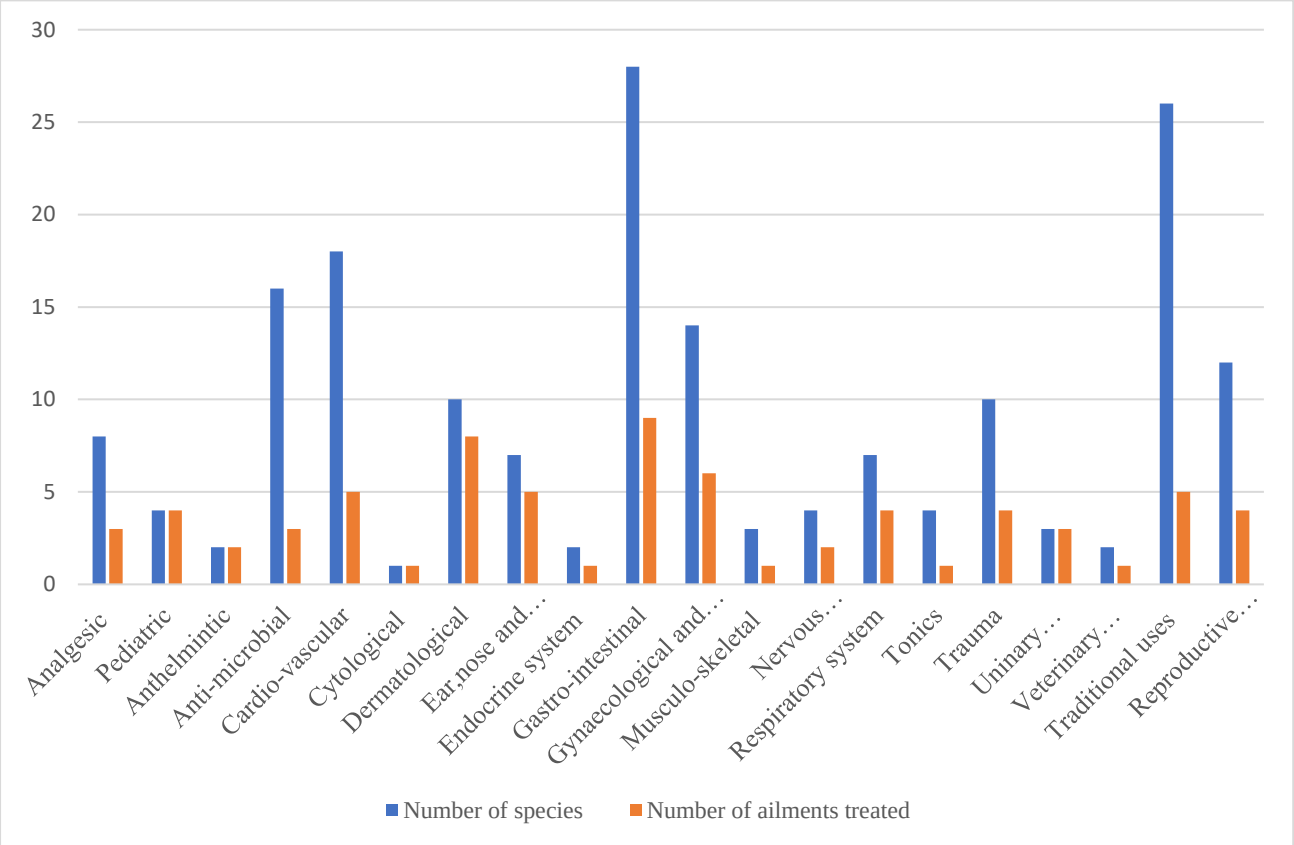

Figure 4.2. Medicinal plant use identified in Nkomazi Local Municipality, along with the total number of species associated with each category and the total number of ailments treated within each category

Each main category comprises various ailments (Table 4.3). Below is a more comprehensive description of the main use categories of medicinal plants.

4.3.4 Analyses of the main use category

Table 4.3. Main use category of the Nkomazi Local Municipality, with the specific ailments treated and the number of plant species used for each ailment

Main use categories	Ailment treated	Number of species per ailment
Analgesic uses	Headache	3
	Toothache	4
	Body Pains	1
Paediatric uses	Colic	1
	Sunken Fontanelles	1
	Protection charm	1
	Diarrhoea	1
Anthelmintic uses	Vermifuge	2
Anti-microbial uses	venereal diseases (STIs)	12
	Tuberculosis (*Tindzaka*)	2
Cardio-vascular system uses	High blood pressure	8
	Blood purification	8
	Stroke (*Sifulane*)	2
	Heart diseases	1
Cytological uses	Cancer	1
Dermatological uses	Boils	5
	Skin irritations	4
	wounds	4
	Burns	2
	Stretch marks	1

Nose and throat use	Colds and flu	9
	Sinusitis	2
	Tonsils	1
Endocrine system uses	Diabetes	2
Gastro-intestinal uses	Stomach complains	12
	Diarrhoea	7
	Biliousness (*inyongo*)	4
	Laxative	5
	Ulcers	3
	Heartburn	2
	Haemorrhoids	2
	Constipation	1
Gynaecological and obstetrics uses	Dysmenorrhea	8
	easing of labour pains	5
	Prenatal care	3
	Threatened miscarriage	1
	contraceptive	1
	Painful womb	1
Musculoskeletal uses	Arthritis	3
Nervous system uses	Epilepsy	4
	Mental illness	1
Respiratory system uses	Coughs	3
	Chest pains	2
	Asthma	1
	Symptoms of covid	1
Tonics uses	Panacea	2

	Appetite Stimulant	2
	Immune system booster	1
Trauma uses	Poisoning *(sidliso)*	7
	Snake bites	1
	Injuries (broken bones)	1
	Healing after an operation	1
Urinary system uses	Kidney infections	2
	Urinary tract infections	1
Veterinary uses	Snake repellent	2
Traditional uses	Luck charms	12
	Protection charm	10
	Ward of bad luck	4
	Love charms	3
	Divination charms	3
	Burial cleansing	2
	Charm to prevent lightning	1
Reproductive uses	Fertility enhancers	8
	Erectile dysfunction	2
	Libido enhancers	2

4.3.4.1 Analgesic uses

Analgesics are medications that act to relieve pain without making a person unconscious (Anekar, 2021). Eight plant species were reportedly to treat three types of pain linked to various ailments (Table 4.3). The traditional healers mentioned that only the symptoms of ailments, such as pain, are often treated instead of the underlying ailment. Below are specific ailments and the commonly utilised medicinal plant species used in treating them: toothache- *Annona senegalensis* and *Aloe ferox*; headache- *Bidens Pilosa* and *Acokanthera oppositifolia*; and body pains - *Asparagus aethiopicus.* Numerous studies have reported the use of *Annona*

senegalensis, Aloe ferox, Bidens Pilosa, Acokanthera oppositifolia and *Asparagus aethiopicus* for analgesic purposes such as back pain, general pains, earache (Watt and Breyer-Brandwijk, 1962; Bhat and Jacobs, 1995; Hutchings *et al*., 1996; De Beer and Van Wyk, 2011; Bhat, 2014; Maroyi, 2017; Hulley and Van Wyk, 2019; Mhlongo and Van Wyk, 2019; Mokganya and Tshisikhawe; 2019; Mbanjwa, 2020). Additionally, pharmacological studies have demonstrated that all these plant species utilised for analgesic purposes in this present study exhibit anti-inflammatory activities (Horiuchi and Seyama, 2008; Mwale and Masika, 2010; Ondua, 2015; Mashele, 2019), which justifies their use for analgesic purposes.

4.3.4.2 Paediatric uses

Paediatrics describes the medical treatment provided to newborns, young children, and teenagers. The age restriction varies across countries, but it is generally applied from birth until 18 (Rudolf and Levene, 2011). Adult medicine is distinct from paediatric medicine in terms of congenital anomalies, physiological body size, and developmental difficulties (Mountcastle *et al*., 2023). The indigenous knowledge of traditional medicine acquired by mothers plays a significant role in mitigating the effects of infections in children and ultimately improving their health. (Mashile et al., 2019). Four different types of paediatric ailments were reported to be treated by four plant species (Table 4.3). This category is said to be challenging to those who lack specialised indigenous knowledge or are unfamiliar with South African traditional health concepts (Mhlongo, 2019). However, some effort was made to at least describe the primary symptoms of *Sikhala*, *Libala,* and *Kuhabula* as they occur in infants.

Sunken fontanelle is one of the paediatric ailments treated by the Nkomazi Local Municipality's traditional healers. The term "sunken fontanelles" refers to the protrusion of the soft areas on infants' heads, a condition known as *sikhala* (Siswati), and it is treated within the first year of the child's development (Mashile, 2019). Sunken fontanelles are seen to be the entry for bad spirits; hence they need to be cured immediately (Cocks and Moller, 2002). A child with a sunken fontanelle experiences loss of appetite, persistent vomiting, sunken eyes, weight loss, and passing stools green in colour (Tembane, 2019). The Western medicine system does not have a term for the *sikhala* condition, as it is not recognised as an illness but rather a gap between the infant's cranium bones that naturally closes within two months postnatal (Tembane, 2019). In the Siswati and Xitsonga cultures, the fontanelle is routinely examined for any abnormalities, such as pounding, because it is believed that if it is not treated, the condition can be fatal for infants (Ramaube, 2018; Thwala *et al*., 2012). Traditional healers at Nkomazi Local Municipality treat sunken fontanelle with *Hibiscus pusillus*.

Infants with *libala* typically display a visible red patch on the back of their neck, though it can also manifest in other ways, such as mouth inflammation (Thwala *et al*., 2012). This condition is said to force the affected child's head backwards, causing the neck to bend backwards when sleeping and sitting (Tembane, 2019; Thwala *et al*., 2012). *Libala* is treated with *Schizocarphus nervous* (*Imbita-yebantfwana*). Our Findings supported that of Zukulu *et al*. (2012), who reported the use of *Schizocarphus nervous* in treating *inyoni/libala* in the Pondoland.

Kuhabula is when infants contract evil spirits from their environment (Thwala *et al*., 2012). Evil spirits have been identified as an additional issue that has an adverse impact on infants' health. It is perceived that infants may pick up evil spirits from their surroundings, which can make them susceptible to illnesses (Ramaube, 2018). If a child has not been adequately protected and is exposed to evil spirits, they may struggle to fall asleep, constantly startled, agitated, and crying during their sleep (Mhlongo, 2019). *Coix lacryma-jobi* seeds are worn as an amulet around the neck and waist as a protection charm against evil spirits. Roberts (1990) has recorded *Coix lacryma-jobi L.* as a protective charm against evil spirits in infants.

This study has recorded *Scabiosa columbaria* as a plant species used to treat colic. Colic is known as *inkaba* in Siswati, a condition where the weak intestines develop because of the slow healing process of the umbilical cord wound (Mashile, 2019). The Zulu and Sotho tribes have reported the use of Scabiosa columbaria for treating colic (Watt and Brandwijk, 1927; Hutchings *et al*., 1996; Van Wyk and Gericke, 2000).

4.3.4.3 Anthelmintic uses

Acorus calamus and *Strychnos henningsii* were reportedly used by the Nkomazi Local Municipality traditional healers as vermifuges. Similarly, Motley (1994); Grace *et al.* (2003); and Mhlongo and Van Wyk (2019) have reported these plants to be used as vermifuges.

4.3.4.4 Anti-microbial uses

Microbial infections are a worldwide health concern (Kareru *et al*., 2008). Medicinal plants contain bioactive compounds that can be utilised as an affordable and effective treatment for common bacterial ailments (Tran and Pham, 2020). Fourteen medicinal plant species were reported to treat microbial ailments, with venereal diseases (n=12) accounting for most uses (Table 4.3). Some examples of medicinal plants used to treat sexually transmitted infections (STIs) include *Ehretia rigida*, *Euclea divinorum*, *Cladostemon kirkii*, and *Spirostachys Africana.* To the best of my knowledge, *Ehretia rigida* is reported for the first time in the treatment of venereal diseases, and no reports for similar use have been documented. *Euclea*

divinorum, *Cladostemon kirkii*, and *Spirostachys Africana* were also reported to treat venereal diseases in other studies (Geyid *et al*., 2005; De Wet, 2011; Maroyi, 2013). The interviewed traditional healers did not specify the types of STI ailments they treat. STIs are still considered a significant health issue in developing nations (Leferela *et al*., 2013). These infections are associated with significant mortality, morbidity, and as well as social stigma (Choudhry *et al*., 2010). Numerous ethnobotanical research has shown that rural communities tend to favour traditional remedies over Western medicine for treating sexually transmitted infections (Chinsembu, 2016; Maroyi, 2011; Mulaudzi *et al*., 2011; Mathibela *et al*., 2019). Due to the stigmas associated with disclosing sexual behaviour, many people, particularly those living in rural areas, decide against seeking western medical care when they contract sexually transmitted infections infected (Mulaudzi *et al*., 2016).

Pappea capensis and *Diospyros galpinii* were reportedly used in treating *tindzaka* by the Nkomazi Local Municipality traditional healers, an African affliction commonly conflated with tuberculosis. To the best of my knowledge, this is the first report *of Pappea capensis* and *Diospyros galpinii* in the treatment of *tindzaka*/TB. *Tindzaka* illness relates to the ideas of morality.

"*During funerals in the family, family members are expected to abstain from sexual activities until cultural cleansing rituals are performed. If they go against these moral standards, ancestors will be angered and can cause that person to become ill, either emotionally or physically*" (N. Mathabela, pers. comm., 2021).

This ailment reportedly develops because of moral misconduct, especially when sexual restrictions are disobeyed during birth, at family members' funerals, and after having an abortion (Ngobe, 2015). According to traditional healers, the symptoms of *tindzaka* include weight loss, continuous coughing, fatigue, and disrupted sleep; hence it often gets confused with tuberculosis.

4.3.4.5 Cardio-vascular uses

Various Cardio-vascular related ailments were reported to be treated by a total of 19 medicinal plant species (Table 4.3). High blood pressure has been reported as the most common cardiovascular disorder (Baradaran *et al*., 2014), and this appears to be the case for the Nkomazi Local municipality. Among the cardiovascular-related ailments treated by medicinal plants, high blood pressure and blood purification were the most frequently addressed, with eight medicinal plant species reportedly used in treating these conditions. Below are specific

ailments and the commonly utilised medicinal plant species used in treating them: blood pressure - *Cladostemon kirkii, Momordica balsamica*, and *Moringa oleifera*. Numerous studies on medicinal plants used to treat hypertension cited *Cladostemon kirkii, Momordica balsamica*, and *Moringa oleifera* (Thakur *et al*., 2009; De wet *et al*., 2016; Ludidi, 2018; Mudau *et al*., 2020).

According to Takyi (2013), blood is a sacred component in many cultural traditions throughout Africa. According to the African belief systems, illness is not only caused by random events but also by spiritual or social disharmony, and blood purification is perceived to provide holistic healing (van Vuuren, 2020). In this present study, *Euclea divinorum*, *Schotia brachypetala*, and *Balanites maughamii* were used for blood purification purposes. Similarly, ethnobotanical studies by Miller and Morris (2004); Mhlongo and Van Wyk (2019) reported the use of *Euclea divinorum*, *Schotia brachypetala*, and *Balanites maughamii* as blood purifiers.

The Nkomazi traditional healers indicated that they use *Dombeya rotundifolia* to treat heart diseases. This is consistent with numerous studies that have also documented the use of Dombeya rotundifolia in treating heart-related ailments (Roberts, 1990; Venter and Venter, 1996; Reid *et al*., 2000; Van Wyk *et al*., 2013). Additionally, pharmacological studies have demonstrated that *Dombeya rotundifolia* contains cardiac glycoside, which is a component of drugs used to treat heart-related ailments (Reid *et al*., 2000), which justifies its use for cardiac-related ailments purposes.

Elaeodendron transvaalense and *Ledebouria apertiflora* were reportedly used in the treatment of Stroke (*Sifulane*). Similarly, *Ledebouria apertiflora* was recorded as being used in the treatment of stroke by the Bapedi Traditional in the Central Sekhukhune land (Mogale *et al*., 2018). To the best of my knowledge, *Elaeodendron transvaalense* is reported for the first time in the treatment of Stroke (*Sifulane)*. No reports for similar use have been documented in the literature.

4.3.4.6 Cytological uses

Cancer was reported to be treated with *Moringa oleifera* in the present study. The use of *Moringa oleifera's* potential to treat cancer is owed to the plants' ability to interfere with the signalling pathway that encourages cell growth and development (Berkovich *et al*., 2013). Chemicals such as phenolics and eugenol are primarily responsible for the prevention of the proliferation of cancer cells (Berkovich *et al*., 2013).

4.3.4.7 Dermatological uses

Dermatological-related ailments are a primary concern worldwide, accounting for 34% of all occupational illnesses (Abbasi *et al*., 2010). In the present study, Nkomazi Local Municipality healers use ten medicinal plant species to treat six dermatological ailments (Table 4.3). The specific ailments and the commonly utilised medicinal plant species used in treating these ailments include skin irritations - *Ricinus communis* and *Ledebouria apertiflora*; stretch marks- *Ricinus communis*. The use of *Ricinus communis* for skin-related ailments has been reported by numerous studies (Watt and Breyer-Brandwijk, 1962; Hutchings, 1996; Van Wyk *et al*., 2000; Mabona and Vuuren, 2013).

In the present study, *Merwilla plumbea, Lannea schweinfurthii*, and *Cladostemon kirkii* are reportedly used in the treatment of boils. Numerous studies have documented the use of *Merwilla plumbea, Lannea schweinfurthii*, and *Cladostemon kirkii* in the treatment of boils (Chhabra *et al*., 1987; Fowler, 2002; Ncube *et al*., 2011; Maroyi, 2019). Additionally, pharmacological studies have demonstrated *Merwilla plumbea, Lannea schweinfurthii*, and *Cladostemon kirkii* to exhibit anti-bacterial activity against *Staphylococcus aureus* which causes boils (Okoth, 2014, De Wet and Van Wyk, 2008; Emamzadeh-Yazdi, 2013; Pereira *et al*., 2015). Wounds and burns were reportedly treated with *Trichilia emetica* and *Ficus sur*. Similarly, Palmer and Pitman (1972); Hutchings *et al*. (1996); Germanò *et al*. (2005); and Van Wyk *et al*. (2011) have reported the use of *Trichilia emetica* and *Ficus sur* in the treatment of dermatological related ailments.

Ocotea bullata was reportedly used in the treatment of acne **(***isicitho***)**. As shown by a comment from an interview with a traditional healer/diviner, *Isicitho* is "*a curse imposed by jealous individuals to make the victim unappealing or despised by their partners or the general public Isichito is commonly suspected when lovers part ways without any apparent cause*" (T. Khoza, pers. comm., 2021). The physical manifestation of *isicitho* is shown by the sudden appearance of acne, unpleasant body odour and body lice (Mhlongo, 2019).

4.3.4.8 Nose and throat uses

A total of seven medicinal plant species were reported to treat nose and throat, related ailments (Table 4.3). Colds and flu were treated by all medicinal plant species mentioned under this category and had the highest number of medicinal plants used. Similar findings have been reported by Njoroge and Bussmann (2006) and Mhlongo (2019), who reported colds and fever

as the most treated ailments through traditional healing in the Kenya and KwaCele region in the Kwazulu Natal Province. Below are specific ailments and the commonly utilised medicinal plant species used in treating them: colds and flu -*Artemisia afra*, *Warburgia salutaris,* and *Acorus calamus*; sinusitis -*Combretum imberbe and Eucalyptus tereticornis*; tonsils-*Warburgia salutaris*. Numerous studies have documented the use of *Artemisia afra, Warburgia salutaris, Acorus calamus, Combretum imberbe and Eucalyptus tereticornis* in the treatment of nose and throat-related ailments such as colds and flu, sinusitis, and tonsils (Maroyi, 2013; du Tuit *et al*., 2019; Sitoe, 2020; Navia, 2022; Leonard *et al*., 2023).

4.3.4.9 Endocrine system uses

Diabetes was the only endocrine disorder that participants in the current study reported. There are two medicinal plant species recorded for the treatment of diabetes in this study which are: *Linzia glabra* and *Moringa oleifera.* Amusan *et al*. (2007) reported the use of *Linzia glabra* for treating diabetes by Swazi traditional healers. There is overwhelming evidence for the use of *Moringa oleifera* as a treatment for diabetes (Anthanont *et al*., 2016; Leone *et al*., 2018; Mashile, 2019; Hamata *et al*., 2020; and Mthiyane *et al*., 2022).

4.3.4.10 Gastrointestinal uses

Gastrointestinal-related ailments are often caused by inadequate sanitation and lack of access to clean drinking water (De Wet *et al*., 2010). Twenty-eight medicinal plant species were reported in this present study to be used to treat nine ailments related to Gastrointestinal complaints. Gastrointestinal-related ailments which accounted for the highest number of medicinal species are stomach complaints (n=10) and diarrhoea (n=7), followed by biliousness (*Inyongo*) and laxative, both with four species (Table 3). i*Nyongo* is a Swati word for bile or gall bladder (Ochan, 2020). At Nkomazi Local Municipality, the term refers to extreme gall bladder discomfort most likely caused by excessive gall production (biliousness). The symptoms of biliousness include a temporary loss of vision following a sudden head lift and dizziness, and excessive gall is believed to lead to various ailments, hence it needs to be expelled through purging or emetic (Mhlongo, 2019). *Inyongo* is reportedly treated by *Cussonia spicata* and *Adenia gummifera* in the Nkomazi Local Municipality. *Abrus laevigatus, Ekebergia capensis,* and *Albizia versicolor* were reportedly used to treat stomach complaints. *Abrus laevigatus*, *Schotia brachypetala*, and *Faurea saligna* were used in the treatment of diarrhoea. *Euclea divinorum, Zanthoxylum leprieurii*, *Merwilla plumbea* and *Cussonia spicata* were reportedly used as laxatives. Ulcers were reportedly treated with *Capparis tomentosa* and *Schizocarphus nervous*. *Scabiosa columbaria* and *Elaeodendron transvaalense* were

reportedly used to treat heartburn. Haemorrhoids were reportedly treated with *Ehretia rigida* and *Elephantorrhiza elephantina*, and constipation with *Spirostachys Africana.*

Numerous studies have documented the use of *Abrus laevigatus, Adenia gummifera, Albizia versicolor, Cussonia spicata, Ehretia rigida, Ekebergia capensis, Elaeodendron transvaalense, Elephantorrhiza elephantina, Euclea divinorum, Faurea saligna, Merwilla plumbea, Scabiosa columbaria, Schotia brachypetala, Spirostachys Africana, and Zanthoxylum leprieurii* in the treatment of Gastrointestinal related ailments such as stomach complains, diarrhoea, biliousness (inyongo), laxative, ulcers, heartburn, haemorrhoids, and constipation (Hutchings *et al*., 1996; Okhale and Nwanosike, 2016; Mabogo, 2012; Maroyi, 2016, 2017, 2019; Guetchueng *et al*., 2017; Mhlongo and Van Wyk, 2019; Khumalo, 2021). To the best of my knowledge *Capparis tomentosa* and *Schizocarphus nervous* are reported for the first time in the treatment of ulcers. No reports for similar use have been documented in the literature.

4.3.4.11 Gynaecological and obstetrics uses

Fourteen species were recorded to treat six gynaecological and obstetrics-related ailments (Table 4.3). The two most prominent uses are dysmenorrhea (n=8) and easing of labour pains (n=5). A considerable percentage of women of reproductive age worldwide suffer from painful menstrual cramps, known as dysmenorrhea, which negatively influences their quality of life (Sanogo, 2011). According to the interviewed traditional healers' women with dysmenorrhea are most likely to struggle with conceiving.

"Women with period pains usually struggle to fall pregnant because their wombs are tied up" (N. Mathabela, pers. comm., 2021).

A similar phenomenon was reported by Mashile *et al*. (2019), where participants perceived that dysmenorrhea-affected women have tied wombs which prevents them from conceiving. The medicinal plant species reported for the treatment of dysmenorrhea in the current study are as follows: *Grewia monticola, Adenia gummifera, Antidesma venosum, Scabiosa columbaria, Jatropha zeyheri, Albizia anthelmintica, Vachellia robusta*, and *Eucalyptus tereticornis*. *Adenia gummifera, Antidesma venosum* and *Scabiosa columbaria* were also reported to treat dysmenorrhea by Arnold and Gulumian (1984); Hutchings *et al*. (1996); Pooley (1998); and Mbanjwa (2020).

Brachylaena discolor, *Capparis tomentosa*, *Erythrina lysistemon*, *Bowiea volubili*, and *Merwilla plumbea* were reportedly used to ease labour pains in the Nkomazi Local Municipality. Similar results have been reported by Gerstner (1941); Ndawonde *et al*. (2007); Chinsembu (2016); and Mhlongo and Van Wyk (2019), where *Erythrina lysistemon, Capparis tomentosa, and Merwilla plumbea* were used to easy and facilitate the birthing process.

Ximenia caffra, Jatropha zeyheri, and *Grewia monticola* are used as prenatal care to support and maintain pregnancy. Hulme (1954); Bhat and Jacobs (1995); and Mashile *et al*. (2019) have reported *Ximenia caffra and Jatropha zeyheri* as prenatal care supplements in Nigeria and South Africa. It is noteworthy that *Jatropha zeyheri*, *Brachylaena discolor*, and *Grewia monticola* species were reported to be used under this category for more than one use.

Brachylaena discolor was reportedly used to arrest threatened miscarriage, and *Dalbergia melanoxylon* was used to prevent miscarriage by women with a history of miscarrying. Similar results were reported by Van Wyk and Van Wyk (1997) and Mhlongo and Van Wyk (2019), where *Brachylaena discolor* are used by the Zulu ethnic group to prevent pregnant women from miscarrying. *Albizia versicolor* is recorded as a contraceptive. Similar results have been observed by Nefhere (2019), where Thulamela traditional healers reported the use of *Albizia versicolor* to prevent pregnancy.

4.3.4.12 Musculoskeletal uses

Musculoskeletal system disorders are the second-leading cause of disability, and their effects typically worsen as people age (Oakman *et al*., 2016). Arthritis was the only ailment reported under this use category, and only three medicinal plant species were used for its treatment (Table 4.3). Medicinal plants mentioned to treat this ailment were *Dovyalis caffra*, *Zanthoxylum leprieurii*, and *Cladostemon kirkii*. Pharmacological studies have demonstrated *Zanthoxylum leprieurii* and *Dovyalis caffra* to exhibit antioxidant and anti-inflammatory activities (Tatsadjieu *et al*., 2003; Loots *et al*., 2006; Fogang *et al*., 2012; Waweru, 2022). These pharmacological properties justify the use of *Zanthoxylum leprieurii* and *Dovyalis caffra* for the treatment of arthritis. Similarly, Guetchueng *et al*. (2017) and Okagu (2021) reported the use of *Zanthoxylum leprieurii* and *Dovyalis caffra* to treat arthritis. To the best of my knowledge, *Cladostemon kirkii* is reported for the first time in the treatment of musculoskeletal-related ailments. No reports for similar use have been documented in the literature.

4.3.4.13 Nervous system uses

Four medicinal plant species were reported to be used to treat two conditions affecting the nervous system. (Table 4.3). In the present study, *Diospyros lycioides*, *Faurea saligna*, *Zanthoxylum capense,* and *Acokanthera oppositifolia* were used in treating epilepsy. Several studies have reported that different South African ethnic groups use *Diospyros lycioides, Faurea saligna, Zanthoxylum capense, and Acokanthera oppositifolia* in treating epilepsy (Van Wyk *et al*., 2002; Bodede *et al*., 2015; Tshikalange *et al*., 2016; Maroyi, 2018).

Acokanthera oppositifolia was additionally reported to treat mental illness (*Kuhlanya)* According to Ngobe (2015), common definitions of mental illness include cognitive and behavioural distortions that cause a person to lose a sense of reality. However, traditional healers' understanding of this condition appears to be influenced by cultural beliefs. Nkomazi traditional healers revealed that mental illness could signal ancestral calling or witchcraft, where the individual soul is captured by evil spirits inflicted by jealous family or community members. *Acokanthera oppositifolia* has been reported by Sharma and Chaurasia (2014) to treat convulsions.

4.3.4.14 Respiratory system uses

Four respiratory system-related ailments were reported to be treated by seven medicinal plant species (Table 4.3). Below are specific ailments and the commonly utilised medicinal plant species used in treating them:

Coughs were reportedly treated with *Acorus calamus* and *Eucalyptus tereticornis*. Similarly, Imam (2013) and Zhang *et al*. (2022) reported the use of *Acorus calamus* and *Eucalyptus tereticornis* to treat coughs. Sharma *et al*. (2022) extracts derived from *Acorus calamus* exhibited antibacterial effects against *Klebsiella pneumonia* and *Staphylococcus aureus*. *Eucalyptus tereticornis* has been reported to have a variety of chemical components such as steroids, flavonoids, tannins, digitalis and saponins (de Castro *et al*., 2022), which may account for its broad spectrum anti-bacterial activity against a variety of microbes like bacterial pathogens linked to respiratory illnesses like *Pseudomonas aeruginosa* and *Staphylococcus aureus* (Alma *et al*., 2004; Rakotonirainy and Lavédrine, 2005; Bachheti *et al*., 2011). Chest pains were reportedly treated with *Prunus Africana* and *Trema orientalis*. Similarly, numerous studies have reported the use of *Prunus Africana* and *Trema orientalis* to treat chest-related ailments (Van Wyk *et al*., 1997; Bii, 2010; Bodeker, 2014). Asthma was reportedly treated with *Clematis brachiate*. Numerous studies have documented the use of *Clematis brachiate* in

the treatment of respiratory system related ailments such as colds, fever, and asthma (Roberts, 1990; Chhabra *et al*., 1991; Pendota *et al*., 2008). Additionally, Pharmacological studies have demonstrated *Prunus Africana* and *Trema orientalis,* and *Clematis brachiate* to exhibit anti-inflammatory activities (Mostafa, 2010; Mutuma *et al*., 2020; Parvez *et al*., 2019), therefore, the use of these plants to treat chest pains and asthma is justified. *Vepris reflexa* was reportedly used to treat symptoms of Covid**.** To the best of my knowledge *Vepris reflexa* is reported for the first time in the treatment of Covid Symptoms. No reports for similar use have been documented in the literature.

4.3.4.15 Tonic uses

Van Wyk and Gericke (2000) initially noted the importance of tonic plants in Southern Africa, and Olivier and Van Wyk (2013) later provided a more detailed explanation. Tonics perfectly illustrates how difficult it is to translate traditional healthcare concepts into modern medical counterparts (Mhlongo, 2019). *Imbita* is a general tonic used by Swati to treat various nonspecific ailments. Tonics are commonly utilised when a person feels unwell but does not present any overt symptoms that would make the ailment easy to diagnose. Most tonics are prepared as mixtures known as *Uzifozonke* (panacea), which directly translates as "all ailments", which denotes the plant's capacity to treat a wide range of ailments (Mhlongo, 2019). *Hypoxis hemerocallidea* and *Zanthoxylum leprieurii* were reportedly used as a panacea in the Nkomazi Local Municipality. *Hypoxis hemerocallidea* was additionally used as an immune system booster. Similarly, *Hypoxis hemerocallidea* has been used by the Zulu ethnic group to treat unspecified ailments and as an immune system booster (Mhlongo, 2019; Mbanjwa, 2020). *Acorus calamus* and *Heteromorpha arborescens* were reportedly used as appetite stimulants. To the best of my knowledge, *Zanthoxylum leprieurii* and *Acorus calamus* are reported for the first time for the use of aforementioned ailments. No reports for similar use have been documented in the literature. Our Findings supported that of Palmer and Pitman (1972) and Maroyi (2018), who reported the use of *Heteromorpha arborescens* to stimulate appetite in Lesotho, South West Africa, and Swaziland.

4.3.4.16 Trauma uses

Trauma related ailments were reported to be treated by ten medicinal plant species (Table 4.3). Poisoning *(sidliso)* was reportedly treated with *Balanites maughamii*, *Foeniculum vulgare*, and *Mundulea sericea*. *Sidliso* is a form of poisoning through which witchcraft is used to poison the victim spiritually. *Sidliso* is often administered through a dream (eating or drinking food in a dream) or by secretly poisoning the victim's food. *Sidliso* is used to inflict bad luck or sickness

or as a love charm (Ngobe, 2015). Similarly, the use of *Balanites maughamii, Foeniculum vulgare*, and *Mundulea sericea* to treat poisoning has been reported in the Zulu ethnic group (Grace *et al*., 2003; Mhlongo, 2019). Broken bones were reportedly treated with *Vangueria infausta*. No reports of *Vangueria infausta* have been documented for the treatment of broken bones. However, it has been reportedly used for other purposes in this category, such as snake bites (Tshikalange *et al*., 2018). *Eucomis autumnalis* was reportedly used in post-operation healing. Similarly, Ndhlala *et al*. (2012) and Mkhumbeni *et al*. (2021) have reported the use of *Eucomis autumnalis* bulbs decoction to aid in post-operative healing. *Alepidea amatymbica* was reportedly used to treat snake bites. To the best of my knowledge, no phytochemical analysis has been done to verify the antivenin activity of *Alepidea amatymbica.*

4.3.4.17 Urinary system uses

Two urinary system disorders were reported to be treated with three medicinal plant species (Table 4.3). Urinary tract infection was reportedly treated with *Prunus Africana.* While kidney related ailments were treated with *Acacia xanthophloea* and *Abrus laevigatus.* Similarly, studies by Bhatia *et al*. (2013); Bodeker *et al*. (2014); and Gobind (2016) have documented the use of *Prunus Africana, Acacia xanthophloea,* and *Abrus laevigatus* in the treatment of urinary system related ailments. Additionally, the biochemical properties of *Prunus Africana* and *Abrus laevigatus* add credence to their traditional uses. For instance, it has been reported that they exhibit antimicrobial activity against *Proteus vulgaris, Staphylococcus aureus,* and *Bacillus cereus,* which colonise and cause infections in the urinary tract (Bhatia *et al*., 2013; Ngule *et al*., 2014).

4.3.4.18 Veterinary uses

Tulbaghia violacea and *Clerodendron glabrum* are utilised to repel snakes in the current study. *Tulbaghia violacea* appears to be frequently cultivated in the homes of Zulu and Xhosa ethnic groups to keep snakes away (Watt and Breyer-Brandwijk, 1962; Hutchings *et al*., 1996; Pooley, 1998; van Wyk and Gericke, 2000; Pooley, 2005).

4.3.4.19 Traditional uses

A total of twenty-six medicinal plant species are used by Nkomazi Local Municipality for traditional uses (Table 4.3). The plants are used for traditional rituals, such as divination, warding off bad luck, protective charms, and burial cleansing. Below are specific traditional uses and the commonly utilised medicinal plant species:

Seven plants are used as good luck charms, which include an accused who wants to win a court case, businesspeople requiring their businesses to boom, individuals seeking favours from other people or promotions at work. *Argyrolobium tomentosum, Pyrenacantha grandiflora,* and *Talinum caffrum* decoctions are used as a bathing solution by accused individuals seeking court and disciplinary hearings to favour them. *Argyrolobium tomentosum, known as Umlomomnandzi (*silver tongue*)* in Swati, enables one to speak eloquently and persuade people. According to Sobiecki (2014), plants that are used as a luck charm function by allowing the consumer to achieve a positive mental state that results from the sensation of clear thinking and well-being that emerge from consuming the psychoactive chemicals contained by the utilised plants. *Cephalaria humilus, Macaranga capensis,* and *Neorautanenia ficifolia* are reportedly used as luck charms for businesses to boom and obtain promoted at work.

Eight plants are used as protective charms. The majority serve as protection against evil spirits and witchcraft, according to participants. Protection charms are used in different ways, such as bathing the whole body with the infusion, sprinkling the decoction in the yard, or planting the plant in the homestead. These charms can be used to protect an individual or their whole family. *Callilepis laureola, Berkheya bipinnatifida,* and *Gardenia volkensii* were reportedly used as protective charms in the present study. It appears that there are some similarities between the Pondoland and Nkomazi Local Municipality traditional healer's methods of practice in administering protection charms. Traditional healers in the Pondoland follow the same procedure applied when administering protection charms, for example, *the Encephalartos natalensis* tree is planted in the homestead to ward off evil spirits, and *Bersama swinnyi* decoction is sprinkled in the yard to ward off evil spirits (Zukulu *et al.*, 2012).

Charm to ward off bad luck

Secamone gerrardii, Adenium multiflorum, Pterocelastrus rostratus, Cinnamomum camphora, and *Dracaena aletriformis* are reportedly used to ward off bad luck. Bad luck is known as "*Sinyama"* in Swati. According to the interviewed traditional healers, *"Kulahla emasiko",* which refers to neglecting tradition, can result in bad luck. An individual is usually regarded as having bad luck when all aspects of their life (work, family, finances, and social) do not go well. When someone has bad luck, nothing goes as planned, and they may have problems with everything they desire to accomplish regardless of their best efforts. An individual with bad luck may be tied to evil spirits, and traditional healers might be required to chase the spirit away (Mashile, 2019). According to Cocks and Moller (2002), bad luck emanates from

witchcraft or other supernatural forces since nothing occurs by coincidence. Furthermore, Moteetee and Van Wyk (2011) assert that ancestors may punish a person for disobeying or neglecting them by bestowing bad luck.

Three medicinal plant species are reportedly used in the Nkomazi Local Municipality as love charms. These plants are used in two different ways (i) the whole body is bathed with the infusion while calling out the name of your desired person (e.g., *Argyrolobium tomentosum* and *Hippobromus pauciflorus*), (ii) it can be secretly sprinkled onto the food and drink of the desired person (e.g., *Mimosa pudica*). It appears that some medicinal plants used as love charms can also reverse the effects of love charms (e.g., *Mimosa pudica*). It appears that there are some similarities between the Basotho and Nkomazi Local Municipality traditional healer's methods of practice in administering love charms. For example, Basotho traditional healers add *Cymbopogon marginatus* powder to bathing water and call out the name of the desired person and secretly sprinkled *Linum africanum* onto the food and drink of the desired person (Moteetee, 2017).

Alepidea amatymbica, Combretum apiculatum, Helichrysum pallidum, and Berkheya bipinnatifida are reportedly burned, smoked, and snuffed to "invoke the goodwill of ancestors", facilitate communication with the ancestors and allow traditional healers enter into a trance. *Alepidea amatymbica* has been reported to induce "altered states of consciousness (ASC)," which are essential components in divination (Van Wyk and Gericke, 2000; Moteetee, 2017). The ingestion of these plants causes a gentle stimulating ASC that traditional healers use to divine (Moteetee, 2017). Traditional healers from various ethnic groups commonly use *helichrysum pallidum* for its psychoactive properties. It is believed that it induces dreams and produces real visions that stimulate intuitive abilities that ordinarily appear only when sleeping (Hutchings *et al*., 1996; Van Wyk and Gericke, 2000; Sobiecki, 2008; Moteetee, 2017).

Burial cleansing

In the Tsonga and Swati traditions, death is considered to bring defilement. The cleansing ritual is commonly carried out thirty days following the burial, and the timeframe usually differs between families (Dlamini, 2020). In these cultures, a burial in the family concludes with a cleansing ceremony known as "*Kugeza emanti*" to allow the family to interact freely with other people (Dlamini, 2020). It is believed that the bereaved family members are surrounded by bad luck and dark cloud before being cleaned, referred to as "sinyama" in Swati (Dlamini, 2020). *Sinyama* can only be lifted after the cleansing ritual has been completed; thus, this ceremony

is essential to the Swazi culture (Dlamini, 2020). During this ceremony, family members bathe in a herbal decoction prescribed by a herbalist (*Lugedla*) to dispel the dark cloud, which might result in another death within the family (Dlamini, 2020). After the burial, the community and family members are given a herbal decoction to wash their hands and dispel bad luck (Dlamini, 2020). The Zulu culture also holds similar beliefs that death brings misfortune to the family if the cleansing ceremony is not undertaken (Hutchings, 2007). If this ceremony is not performed, one is at risk of contracting *Tindzaka*, previously discussed under the anti-microbial uses. In this study, *Aloe maculate* and *Artabotrys brachypetalus* were decoctions reportedly used for burial cleansing ceremonies.

Charms to divert lightning

According to the interviewed traditional healer's sorcerers possess the ability to manipulate and direct lightning towards a chosen target. Lightning is commonly perceived as a sign of witchcraft, due to the widespread perception that lightning is an evil spirit manifested (Zukulu *et al.*, 2012). *Adenium multiflorum* is reportedly planted in the yard by Nkomazi Traditional healers to divert lightning. It appears that there are some similarities between the Pondoland and Nkomazi Local Municipality traditional healer's methods of practice in diverting lightning. For example, traditional healers in the Pondoland follow the same procedure applied where the *Encephalartos natalensis* tree is planted in the homestead to ward off evil spirits and lightning (Zukulu *et al.*, 2012).

4.3.4.20 Reproductive system uses

A total of twelve medicinal species are reportedly used in treating reproductive system-related ailments. Most plants in this use category are used to improve fertility. Black South Africans strongly emphasise fertility since it assures the survival and growth of the tribe (Veale *et al*., 1992). It is believed that having a big family in black families will protect against old age hunger (de Wet and Ngubane, 2014). Since marriage is intended to be followed by procreation, being barren is seen as a disgrace (Tabong and Adongo, 2013). The specific ailments and medicinal plant species used to treat them as indicated by the study's participants: fertility- *Grewia monticola, Brachylaena discolor,* and *Mundulea sericea;* erectile dysfunction- *Carissa bisponosa* and *Tabernaemontana elegans;* libido enhancers- *Eucomis autumnalis* and *Acacia xanthophloea.* Numerous studies have documented the use of *Grewia monticola, Brachylaena discolor, Mundulea sericea, Carissa bisponosa, Tabernaemontana elegans* and *Acacia xanthophloea* for the treatment of reproductive-related ailments such as fertility, erectile

dysfunction, and libido enhancers (Gelfand *et al*., 1985, Steenkamp 2003; Attah *et al*., 2012; Semenya *et al*., 2013; de Wet and Ngubane, 2014). To the best of my knowledge, *Eucomis autumnalis* is reported for the first time as a libido enhancer. No reports for similar use have been documented in the literature.

4.4 Sources of used medicinal plants

All of the interviewed traditional healers reported that they collect medicinal plants from communal land around Nkomazi Local Municipality and buy some of the plants from muthi shops, street vendors, and commercial collectors. The choice to purchase is influenced by the lengthy travel times required to collect some medicinal plant species, travel expenses and the difficulty in locating certain medicinal plant species. Medicinal plants sold by commercial harvesters are reportedly sourced from neighbouring provinces such as Gauteng, KwaZulu-Natal and Limpopo and neighbouring countries such as Eswatini and Mozambique. Similarly, William *et al*. (2000) and Mbongwa (2018) reported that the majority of species harvested for trade came from Gauteng, Mpumalanga, Limpopo, KZN, Swaziland, and Mozambique. These findings demonstrate the strong connection between harvesters from South Africa and neighbouring nations.

4.5 Plant parts and growth forms used

The most commonly used part of medicinal plants in the Nkomazi Local Municipality is the roots, accounting for 44% of usage, followed by the bark (31%), leaves (12%), whole plant (6%), and bulbs (5%) (Fig. 4.3). Similar findings were reported by Mathabe *et al*. (2006), Mudau *et al.* (2022), Mahwasane *et al.* (2013) where roots were the most used plant parts for medicinal purposes. In this study, interviews with the Nkomazi Local Municipality's traditional healers revealed that “roots possess the most healing powers” than any other parts of the plant. Similar findings were reported by Semenya and Maroyi (2012); Masevhe *et al.* (2015); Neelo *et al.* (2015); and Bhandari *et al*. (2021), where traditional healers preferred roots as they believe that underground plant parts such as roots have the highest concentration of potent medicinal properties. According to Kunwar *et al.* (2006) and Chinsembu (2016), roots and other underground parts are favoured because they contain high concentrations of bioactive compounds. Additionally, the root's preference is their year-round availability (Neelo *et al*., 2015). The collection of roots and whole plants for medicinal purposes is unsustainable as it compromises the survival of many medicinal plants, potentially leading to the plants' extinction (Mudau *et al*., 2022).

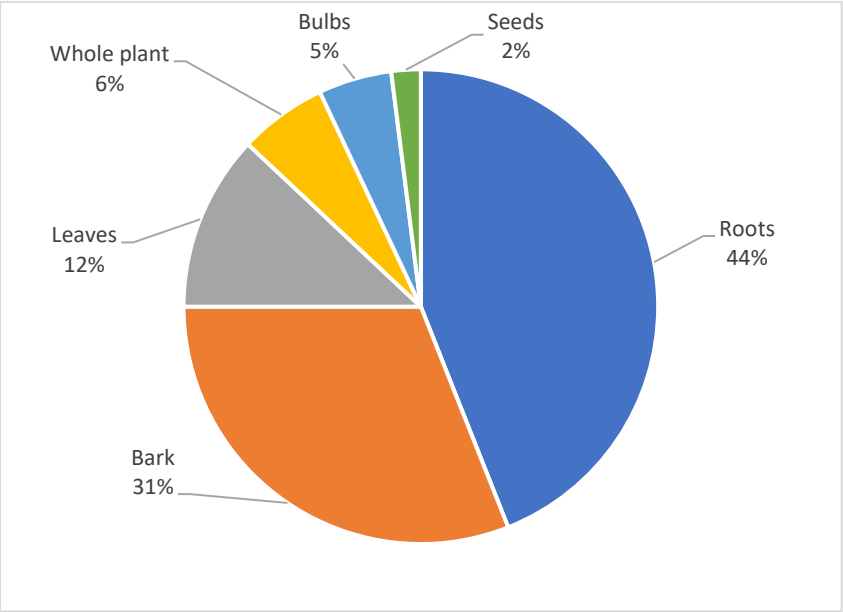

Figure 4.3. Plant Parts that are used to treat various ailments by traditional in the Nkomazi Local Municipality.

Figure 4.4 presents the growth forms of medicinal plants utilised by traditional healers in Nkomazi Local Municipality. According to Magwede *et al*. (2018), in biomes where trees dominate, it is anticipated that trees will have the highest usage frequency. The usage of medicinal plant species by traditional healers in the Nkomazi Local Municipality seems to confirm this expectation, as illustrated in Fig. 4.4. trees (n=47) are the predominantly used life forms followed by shrubs (n=26), herbs (n=21), climbers (n= 11), succulents (n=3), grasses (n=2) and epiphyte (n=1), displaying the Savanna biome in which the study area is situated. According to Masevhe *et al.* (2015), the high utilization of tree species can be attributed to their availability all year round. Additionally, traditional healer's preference for tree species over other growth forms can be linked to the higher concentrations of phytochemicals such as alkaloids, phenols, quinones, tannins, and triterpenes found in trees (Cartaxo and Souza, 2010).

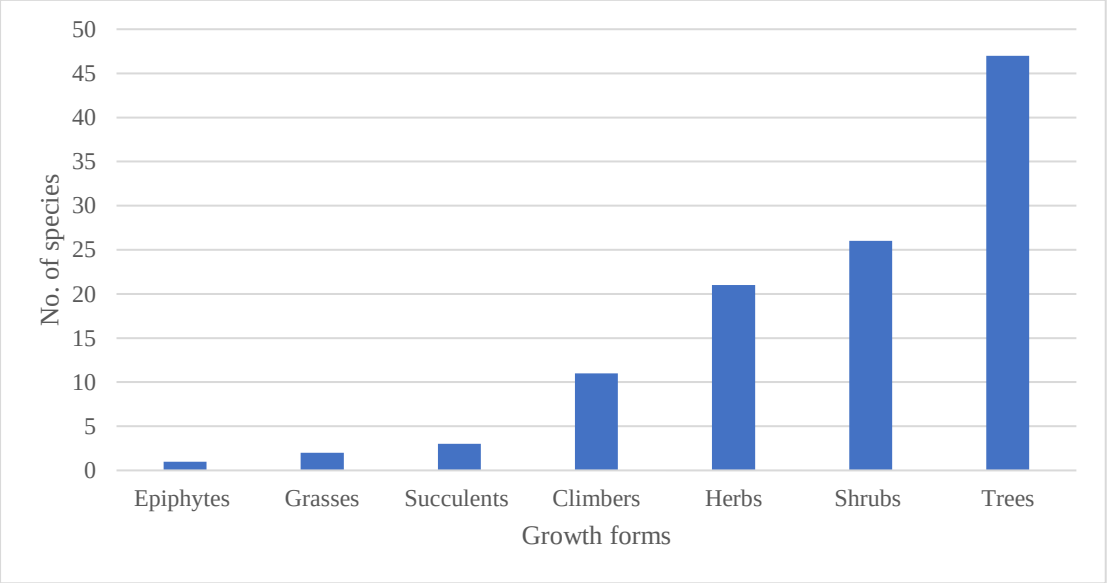

Figure 4.4. The different growth forms for the medicinal plants used by Nkomazi Local Municipality's traditional healers.

4.6 The conservation status

The medicinal plant species utilised by the Nkomazi Local Municipality traditional healers were categorised based on their South African IUCN Red List status, ninety-three are Least Concern, eleven are Not Evaluated, three are Endangered and Vulnerable, and one is Near Threatened (Fig. 4.5). Information about each species IUCN Red List status is provided in Appendix (H).

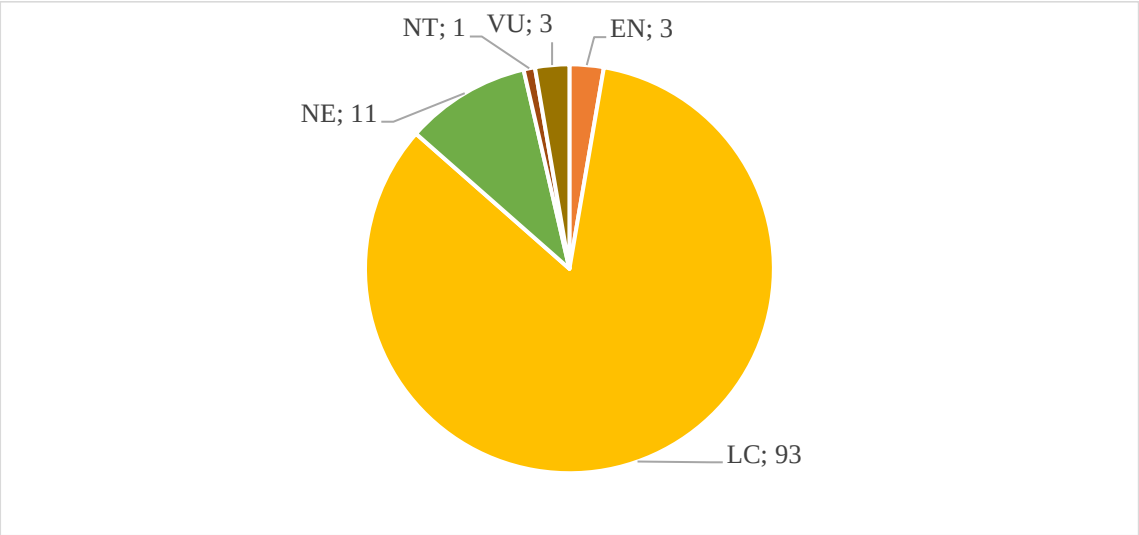

Figure 4.5. Red list categories of medicinal plant species utilised by the Nkomazi Local Municipality's traditional healers. LC=Least Concern, NE=Not Evaluated, EN=Endangered, NT=Near Threatened, VU=Vulnerable.

Categories on the IUCN Red List demonstrate the degree to which a particular species is threatened on a national scale (Mbongwa, 2018). Most of the 111 reported medicinal plants for this present study are of Least Concern, while only three are Endangered and Vulnerable. The findings in the present study support Mbongwa's (2018) argument that resource users' and conservationists' conservation priorities are not entirely compatible. *Alepidea amatymbica*, *Ocotea bullata and Warburgia salutaris* were the only mentioned medicinal plant species that are endangered. *Ocotea bullata* is almost extinct in the wild due to its extensive use in traditional medicine over many years and the increased demand caused by the expanding population (Ogundajo *et al*., 2018). *Alepidea amatymbica* is a highly sought-after medicinal plant used primarily for gastrointestinal and respiratory-related disorders (Olivier and Van Wyk, 2013). The rhizomes of *Alepidea amatymbica* have been excessively harvested for trade at muthi markets throughout Southern Africa, leading to a steady decline in its wild populations. (Maroyi, 2008). *Ocotea bullata* and *Warburgia salutaris* are endangered because they are extensively utilised and highly valued by traditional healers (Mbongwa, 2018). In addition to extensive harvesting, the furniture manufacturing industry and deforestation also have an adverse effect on *Ocotea bullata* wild population (Williams *et al*., 2000). The use of Endangered, Near Threatened, and Vulnerable species such as *Alepidea amatymbica*, *Ocotea bullata and Warburgia salutaris* by the Nkomazi Local Municipality is concerning since some of these species are still highly valuable and in demand in the informal market, suggesting that we can anticipate further population declines in the upcoming years.

Eleven Medicinal plant species utilised by the interviewed traditional healers are exotic species, with two being non-naturalised cultivated species and nine naturalised as common crops in the Nkomazi Local Municipality homesteads (Appendix H). Exotic plant species are primarily introduced as ornamental plants, fruits, and vegetables (Raghuteja *et al.*, 2022). For instance, *Psidium guajava* was introduced from Madeira in 1890 by Faan Retief and was commonly cultivated for the fruit canning industry (Schoeman *et al*., 2012), eventually becoming naturalised. Traditional healers in the Nkomazi Local Municipality now use *Psidium guajava* for medicinal purposes to treat high blood pressure. Similar findings on this phenomenon have been reported by Dold and Cocks (2000), Semenya *et al*. (2012) and Magwede *et al.* (2019), where exotic plants are assimilated into the local traditional healing systems.

4.7 Quantitative Ethnobotany

4.7.1 Relative frequency of citation (RFC)

Relative frequency of citation (RFC) describes the status and significance of a specific medicinal plant within a particular community (Umair *et al*., 2017), and the calculation has been explained in section 3.10.2.1. Higher RFC values suggest that locals preserve and successfully transmit their traditional knowledge (Tounekti *et al*., 2019). In this current study, the RFC values ranged from 1.0-0.3. The highest RFC calculated was for *Momordica balsamica* (1.0), followed by *Ricinus communis* (0.9), *Psidium guajava* (0.9), and *Sclerocarya birrea, Carissa bisponosa, Aloe ferox, Aloe maculata, Ehretia rigida, Capparis tomentosa, Leonotis leonurus, Grewia monticola, Trichilia emetica, Moringa oleifera, and Ximenia caffra* with an RFC value of 0.8 (see Appendix I). High RFC values for medicinal plant species reflect their extensive use and knowledge homogeneity among the participants (Umair *et al*., 2017). Likewise, plants with the highest RFC, *Momordica balsamica*, *Ricinus communis,* and *Psidium guajava,* are abundantly distributed in the study area. These species are reportedly used in other parts of the country (Omokhua-Uyi and Van Staden, 2020; Sagbo and Hussein, 2022; Ruwanza and Thondhlana, 2022). It is challenging to identify any common characteristics among the most widely used medicinal plant species from a botanical viewpoint, as they represent different morphologies, life forms, and categories of bioactive compounds and families. Even though there was no official evaluation of the species abundance, it is generally believed that most species with a high relative frequency citation are abundant in the study areas, and they are not threatened or rare (Mhlongo, 2019).

4.7.2 Use value (UV)

Use value was employed to evaluate the reported plants' relative importance for various uses, and the calculation for this aspect is shown in section 3.10.2.3. Use value (UV) is an evaluation metric frequently employed to assess the relative importance of plants reported (Zenderland *et al*., 2019). In the current study, UV ranged between 1.5-0.1 (Appendix J). *Elaeodendron transvaalense* (1.5) and *Merwilla plumbea* (1.4) had the highest use value. They were used in multiple ailments such as fertility, boils, wounds, and heartburn, followed by *Acorus calamus, Argyrolobium tomentosum, Abrus laevigatus*, and *Cymbopogon citratus* with a use value of 0.8. A high use value demonstrates a species' significance in a community (Ngarivhume *et al*., 2015). A total of 18 plants included species such as *Tulbaghia violacea, Tabernaemontana elegans, Bidens Pilosa, Combretum apiculatum, Spirostachys Africana, and Aristea capitata* had a use value of 0.1. According to Albuquerque *et al.* (2006), high use value is defined by

the number of participants instead of the number of uses reported for each plant species. This was evident in *Moringa oleifera*, reportedly used in treating four ailments but has a low use value (0.5). According to Ong and Kim (2014), the low UV of some species is a result of their inaccessibility, scarcity, and reported side effects.

4.7.3 Informant consensus factor (ICF)

The ailments reported were classified into main use categories to assess the informant consensus factor (Fic). In the present study, the Fic values ranged from 1.0-0.0. Cytological uses (1.0), the respiratory system uses (0.80), veterinary uses (0.80), trauma (0.7), and paediatric (0.7) received the highest informant consensus factor, indicating a high homogeneity among traditional healers (Table 4.4).

Table 4.4. Informant consensus factor for medicinal plants use categories reported by Nkomazi Local municipality traditional healers.

Use Category	Number of reports (Nur)	Number of species (N_t)	Informant consensus (F_{ic})
Analgesic	15	8	0,5
Paediatric	10	4	0,7
Anthelmintic	2	2	0,0
Anti-microbial	25	16	0,4
Cardio-vascular	19	18	0,1
Cytological	2	1	1,0
Dermatological	20	10	0,5
Nose and throat	12	7	0,5
Endocrine system	3	2	0,5
Gastro-intestinal	60	28	0,5
Gynaecological and obstetrics	25	14	0,5
Musculoskeletal	6	3	0,6
Nervous system	10	4	0,7
Respiratory system	25	7	0,8
Tonics	5	4	0,3
Trauma	27	10	0,7
Urinary system	3	3	0,0
Veterinary uses	5	2	0,8
Traditional uses	60	26	0,6
Reproductive system	30	12	0,6

From an ethnobotanical perspective, a high consensus factor denotes the significance of the plant species utilised for a particular use category. This establishes a foundation for further

investigation into the phytochemical and pharmacological activity of the commonly used plant species. (Kayani *et al.*, 2015). The least consensus among the informant was observed in use categories such as anti-microbial uses (0.4), tonics (0.3), cardio-vascular uses (0.1), urinary system (0.0), and anthelmintic uses (0.0). The low informant consensus factor suggests that there is little consensus among the participants regarding the use of the plant species (Tugume *et al.*, 2016). According to Tangjang *et al.* (2011), low ICF results when several plant species have relatively similar high-use citations. The informant consensus factor is low when there is minimal sharing of indigenous knowledge on using a specific plant among traditional healers and high when indigenous knowledge is shared on how a particular plant is used (Mugisha *et al.*, 2014). Findings from this study suggest that there might be a lack of communication among Nkomazi Local Municipality's traditional healers on some use categories with the lowest informant consensus factor or the mentioned category that are less common within the municipality.

4.8 Method of preparation and administration

Traditional healers reported that medicinal plant preparation and administration methods vary based on the medical and spiritual condition being treated. The most common method of preparation was decoction (57%), followed by infusion (33%) and powdered forms (9%) (Fig. 4.6). Decoction has been reported in the published literature to be the most common method of preparation in traditional healing as it is perceived that boiling medicinal plants is the most effective way of extracting the plant's bioactive compounds (Ahmad *et al.*, 2014, Umair *et al.*, 2017).

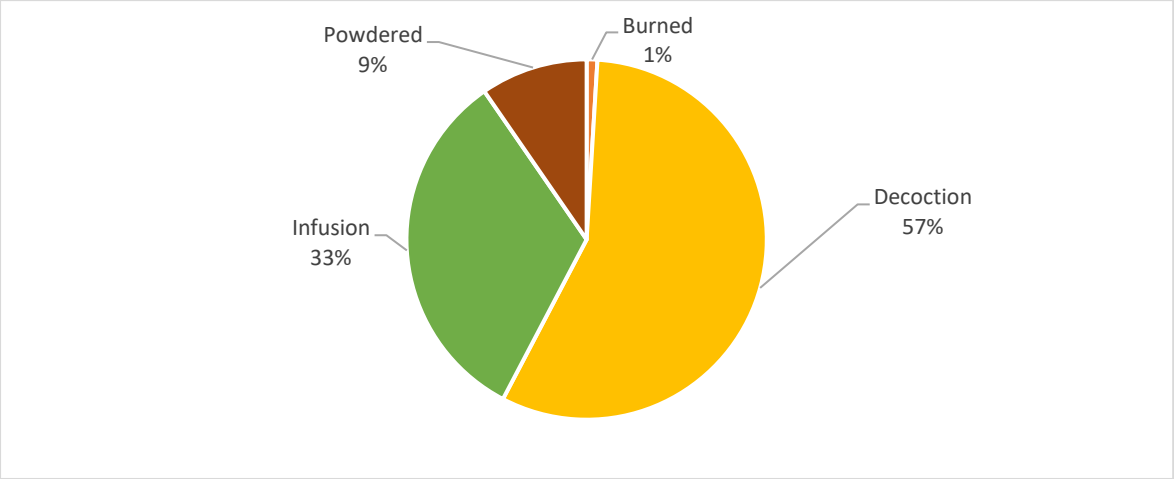

Figure 4.6. Method of preparation of reported medicinal plants used by Nkomazi Local Municipality traditional healers.

Most of the medicinal plants used by traditional healers from the Nkomazi Local Municipality are consumed orally in a liquid or sprinkled and licked in powdered form (Fig. 4.7). Similar findings were reported by Grace *et al.* (2003), Mukazayire *et al*. (2011), Wambugu *et al*. (2011), Khumalo (2018) who observed that the oral administering mostly treated internal ailments of medicinal plants. The predominant use of oral administration was expected since it is consistent with orthodox medicine, where oral administration is commonly used (Khumalo, 2018).

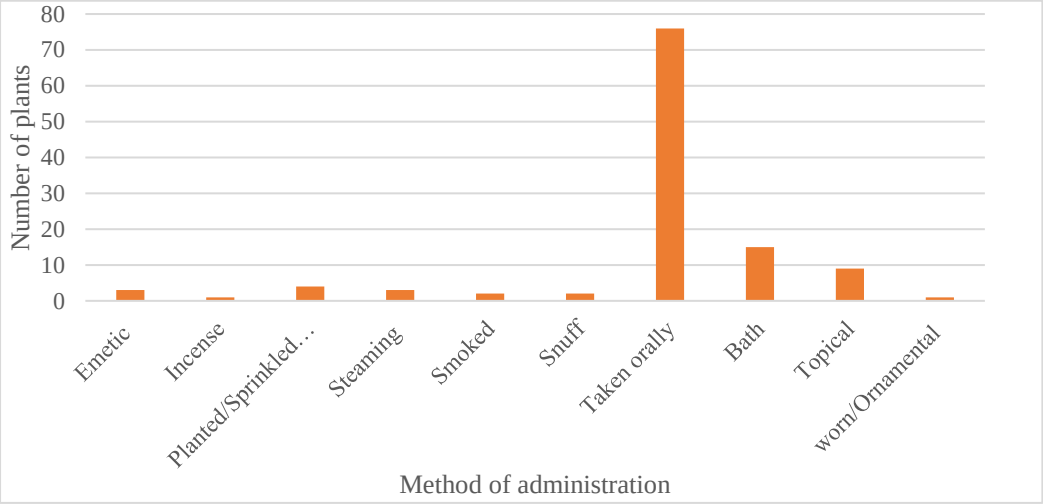

Figure 4.7. Method of administration of reported medicinal plants used by Nkomazi Local Municipality traditional healers.

It was noted that the most common way to administer medication for most dermatological-related ailments is through topical application. Numerous ethnobotanical studies have reported similar findings that topical application is the most common administration method for treating dermatological-related ailments (Watt and Breyer-Brandwijk, 1962; Hutchings *et al*., 1996; Felhaber, 1997; Rabe and Van Staden, 1997; Van Wyk *et al*., 2000; Mabona and Van Vuuren, 2013). Direct or topical applications are preferred over other administration routes because they ensure immediate and direct interaction of the plant biochemical compounds to the target area (Mabona and Van Vuuren, 2013).

The most common way to administer medication for most respiratory system-related ailments in this present study was through steaming inhalation. Steam inhalation is an eminent administration approach in traditional African health, and numerous ethnobotanical studies have reported this approach in treating respiratory system related ailments (Ngwenya *et al*., 2003; Van Wyk, 2008; Maroyi, 2013; Khumalo, 2018; Braünlich, 2018; Mhlongo, 2019;

Nefhere, 2019; Mbanjwa, 2020; Cock, 2020). Steam inhalation has previously demonstrated significant effectiveness in the treatment of respiratory related ailments such as influenza and coronavirus infections (Swain and Sahu, 2021). However, there have been reports of incidental scald burns in children who were taking steam without adult supervision (Wallis *et al*., 2008; Mathew, 2010; Belmonte *et al*., 2015). Additionally, breathing the vapour of extremely hot steam (above 130°C) can result in serious harm to the respiratory system (Scarborough *et al*., 2021). Thus, the steam inhalation administration approach is only safe if careful precaution and close supervision are maintained.

Using body ornaments such as wearing a necklace is one of the least common administration methods. *Coix lacryma-jobi L.* seeds are used to create a necklace and waist beads worn by babies to aid teething and protect against evil spirits (Table 4.2). Additionally, snuff was also noted as one of the least common methods of administration, which are treatments made from dried and finely ground medicinal plants that can be sucked up into the nose by inhalation (Van Wyk *et al*., 1997). Some of the powdered medicinal plants, such as *Alepidea amatymbica* and *Acokanthera oppositifolia*, are administered as snuff to treat mental illness, headaches, and epilepsy and to communicate with ancestors (Table 4.2). In this study, bathing and emetic were mainly used for spiritual or magical charm purposes (to ward off evil spirits or win court cases). Enemas are liquid solutions prepared for rectal injection and administered for Laxative and anthelmintic purposes (Van Wyk *et al.*, 1997). Similar findings have been reported by Khumalo (2018), where most spiritual and magical charm medicinal plants were administered by bathing and enemas. Medicinal plants used to defend against misfortune, love spells, and evil spirits were reportedly administered as emetics, bathing, yard sprinkling solutions, and ointments. *Callilepis laureola* bark decoction was said to be sprinkled around the yard during the process called "*Kubetsela likhaya/kucinisa likhaya*" (homestead protection against witches/enemies). *Cussonia natalensis* bark infusion was reportedly used as a bathing solution as a charm to win court cases, disciplinary hearings, and protection against enemies. *Balanites maughamii* bark decoction was administered as an emetic for food poisoning (sidliso). The interviewed traditional healers indicated that in some instances, cuts are made around various parts of the patient's body using a sharp object, such as a double-edged razor blade. This process is then followed by combining one or more medicinal plants with petroleum jelly or body lotion. This is a widespread practice during a ritual called '*kucinisa muntfu*' (personal protection against enemies and misfortunes and to help gain dignity and attract luck).

4.9 Plant collection and harvesting

Traditional healers harvest medicinal plants using a variety of tools. Hoes (Fig. 4.8a) are typically used to harvest roots. The bark is commonly harvested using a machete (Fig. 4.8b). The leaves are harvested by handpicking (Fig. 4.8c). Root harvesting is dependent on the type of soil and plant, where small shrubs and herbs roots are uprooted (Fig. 4.8d).

Figure 4.8. The different methods used to harvest medicinal plants in the Nkomazi Local Municipality: (a) the roots of a plant harvested using a hoe, (b) a tree bark harvested using a machete, (c) hand picking of leaves (d) uprooting of a herb.

Traditional healers emphasised that they employed sustainable harvesting practices. In cases where the bulbs were harvested, not all plants were collected, they left behind some plants. The uprooting of the entire plants was observed for herbs such as *Helichrysum pallidum, Hydnora Africana, and Neorautanenia ficifolia.* The interviewed traditional healers indicated that they harvested the whole plant because they intended to use all the parts simultaneously. According to Sharma and Kala (2022), uprooting the entire plant during harvesting is highly destructive and could lead to species extinction. Therefore, traditional healers should be advised to avoid harvesting the whole plant but rather collect fewer parts of the plant. Although this procedure

might be time-consuming, mainly when collecting ground-spreading herbs plants such as *Neorautanenia ficifolia*, it will mitigate unsustainable harvesting. In cases where the roots are harvested, the traditional healers indicated that they avoid the tap root and target the adventitious roots and cover the remaining roots with the soil.

Kigelia Africana, *Trichilia emetica*, and *Balanites maughamii* are some of the trees harvested for their bark. Additionally, these trees are also harvested for their bark in other regions of South Africa (Komane *et al*., 2011; Mabogo, 2012; Nabatanzi *et al.*, 2020). The unsustainable harvesting of the bark could lead to the extinction of tree species due to their poor wound recovery and slow growth (Geldenhuys and Williams, 2005). However, the Nkomazi Local Municipality traditional healers indicated that during bark harvesting, they avoid ring barking and only harvest on the eastern side of the tree. The cut is then covered by soil to hasten recovery. Traditional healers believe that harvesting the bark from the sun facing the eastern side is crucial for the plant's healing. This practice has been observed in other parts of the country (Semenya *et al*., 2013; Mathibela, 2013). According to the VhaVenda and Zulu traditional healers, bark harvested on the eastern side has more healing powers than the ones collected on the other sides (Ndawonde, 2006; Semenya *et al*., 2013). This harvesting practice eliminates ring barking and facilitates quick recovery of the tree (Kambizi and Afolayan, 2001).

During field walks in the present study, the researcher observed that before some traditional healers commenced harvesting, they performed rituals to appease the ancestors and ensure that the harvested medicinal plant worked effectively and was of high potency. Performing rituals before harvesting was previously the primary method of conserving medicinal plants, and maintaining rituals were feasible since only the trained healers gathered plants (Ndawonde, 2006). This study observed rituals like sprinkling snuff on the ground and using coins to ask ancestors for guidance before harvesting the plant.

"*Harvesting rituals vary from one traditional healer to traditional healer as well as from plant to plant. Some plants require you to abstain from sexual activities, sprinkle snuff on the ground, or slaughter a chicken next to the plant before harvesting. In some plants, rituals are not required*" (N. Mathabela, pers. comm., 2021).

Traditional healers in this study have emphasised that these rituals must be adhered to so that the specific medicinal plant can work effectively. Traditional healers still widely practised these rituals during medicinal plant harvesting, which are perceived to ensure that the plant survives after harvesting and works effectively (Van Wyk *et al*., 2018). According to traditional

healers, medicinal plants that require rituals before harvesting are *Adenia gummifera*, *Acacia xanthophloea*, and *Capparis tomentosa*. Mbongwa (2018) reported that traditional healers perform rituals that include placing a silver coin and praying to the ancestors before the medicinal plant they intend to harvest.

4.10 Storage and Packaging of medicinal plants

The interviewed traditional healers indicated that medicinal plants can be stored raw or processed (Fig. 4.9). Medicinal plants are chopped into small pieces or ground during processing. After being processed, plant materials are dried in the sun before getting stored in the consultation rooms. Drying plants is perceived as an effective way to preserve and maintain their potency. Fresh plants are said to be susceptible to contamination by fungi and rotting. However, leaving plant material in the sun is inappropriate as it risks exposure to unwanted substances that can poison patients (Van Wyk and Prinsloo, 2020).

Figure 4.9. (a) Processed plant material in consulting rooms (b) unprocessed plant material.

Traditional healers use various materials, such as bottles, buckets, newspapers, and plastic, to package medicinal plants (Fig. 4.10).

Figure 4.10. Plants material storage containers in consulting rooms at Nkomazi Local Municipality.

Packaging of medicinal plants bought from traditional healers is commonly packaged in old newspapers, a variety of recycled liquor bottles, and plastic bags (Mathibela, 2013). The size of the recycled bottles used to sell liquid products depends on the desired volume. Liquid products such as infusions and decoctions are sold in recycled bottles. According to traditional healers, they preferred newspapers for packing their plant material because they aid in keeping the plant material dry and preventing it from rotting. Traditional healers asserted that plant material could be stored for over a year without compromising their therapeutic properties. How plant material is stored and packaged is crucial, especially for customers who need a high-quality product (Mathibela, 2013). A study of South African patients in rural clinics by Street *et al.* (2008) found that most patients prefer buying medicinal plants that are packed hygienically and securely. According to Mathibela (2013), the storage procedure should incorporate thorough identification and labelling of medicinal plants to prevent confusion and erroneous dispensation. Storage of medicinal plants is a crucial element of the traditional healing practice. If done inappropriately, they can be exposed to microorganisms that can harm patients (Street *et al.*, 2008). Plant material should be kept in a hygienic environment, as incorrect storage might cause plant material to spoil (Street *et al.*, 2008). Storage can affect the chemical composition and physical appearance of medicinal plants; thus, it is essential to maintain the proper storage conditions to prolong the plant material shelf life (Birdi *et al.*, 2006).

4.11 Conclusion

One significant finding of the current study is that Traditional healers in the Nkomazi Local Municipality have a comprehensive understanding of plants and their relevance in treating a variety of ailments. The indigenous knowledge of medicinal plants in the Nkomazi Local Municipality is diverse, encompassing 111 species from 59 different families. The most used families in Nkomazi Local Municipality were Fabaceae, Asteraceae, Euphorbiaceae, and Hyacinthaceae. The study documented a total of 65 ailments, which were grouped into main categories such as analgesic, paediatric, and anthelmintic, among others. Most plant species are used in the treatment of gastrointestinal ailments, followed by traditional (spiritual) and cardiovascular-related ailments. In the Nkomazi Local Municipality, communal lands serve as the primary supply of plants for traditional healers since they typically provide convenient access to medicinal plants. Medicinal plants that have become challenging to find in Mpumalanga Province, are imported from neighbouring countries like Eswatini, and Mozambique, well as other provinces like Gauteng and Kwazulu Natal.

Most of the reported medicinal plants for this present study are of Least Concern, while only three are Endangered and Vulnerable. Additionally, the top fourteen most reported species in the Nkomazi Local Municipality for traditional medicine included well-known species, some of which are valuable commercial plants, like *Psidium guajava, Ricinus communis, Sclerocarya birrea, Aloe ferox, Aloe maculata, Leonotis leonurus,* and *Moringa oleifera*. The roots predominantly used plant parts, followed by the bark and leaves. Methods of preparation and administration of traditional medicines varied depending on the medical and spiritual condition being treated. Traditional healers employed various methods to ensure the sustainable harvesting of medicinal plants. Medicinal plants are stored in their raw form or processed. Processed plant materials are dried out in the sun before getting stored in the consultation rooms. Traditional healers used various materials for storage, such as bottles, buckets, newspapers, and plastic, to store medicinal plants.

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CHAPTER 5
Opportunities and Constraints for Medicinal Plant Conservation in the Nkomazi Local Municipality

5.1 Introduction

Many South African ethnic groups still rely on traditional medicine as an integral component of primary healthcare, despite western medicine accessibility and availability (Zondi and Ehaine, 2022). Approximately 3400 plant species accounting for 10 % of the South African flora, are utilised as traditional medicine by about 200 000 traditional healers (Louw and Duvenhage, 2016). Many plant species are displaying signs of unsustainable harvesting, while some have become locally scarce (Van Wyk and Prinsloo, 2018). Additionally, there is documentation of local extirpation for species like *Siphonochilus aethiopicus* (Viljoen *et al*., 2023) and *Warburgia salutaris* (Leonard *et al*., 2023). The unsustainable use of medicinal plants has been a persistent issue in South Africa. Zululand missionary Jacob Gerstner predicted the extinction of "doomed" plant species utilised in traditional medicine as early as 1946 (William *et al*., 2013). As a result, he suggested that they be cultivated in state nurseries, however, the government of that time did not act on this recommendation (William *et al*., 2013).

In response to the decline of medicinal plant populations, stakeholders such as the government and non-governmental organisations have taken various initiatives to counteract medicinal plant over-exploitation (Loundou, 2008). The South African government has made significant progress in enforcing environmental legislation (Xaba *et al*., 2022). The legislation places a major responsibility on environmental organisations and institutions to ensure that the trade of medicinal plants and animal products is permittable based on sustainable practices (Xaba *et al*., 2022). However, some traditional medicine harvesters are non-compliant because they are primarily motivated by financial gain and thus exploit the system (Xaba *et al*., 2022). Therefore, it is difficult to find a middle ground between the dilemma of livelihood sustenance and environmental preservation. Education and awareness have the power to transform people's perspectives, which could assist in reducing and even eliminating environmental threats (Xaba *et al*., 2022).

Traditional healers are the custodians of invaluable knowledge valuable to their immediate and global communities (Mathibela, 2013). South Africa has two distinctive categories of traditional healers: the diviner (Swati: *Sangoma/inyanga; Tsonga: mungoma/nyamusora* and

the herbalist (Swati: *lugedla/ inyanga yemitsi; Tsonga: n'anga*) (Hammond-Tooke, 1998; Shilubane, 2008; Ngobe, 2015). The ancestors guide diviners' healing and diagnosing practices, while herbalist healing practices are not guided by ancestors (Mbongwa, 2018). Diviner's ability to identify illnesses and the cause of misfortune and 'bad luck' is guided by ancestors (Santos and Shale, 2022). Diviners and herbalists use and trade medicinal plants for livelihood sustenance and to generate income (Mbongwa, 2018). Diviners learn how to utilise and administer medicinal plants during their training (Santos and Shale, 2022). On the contrary, herbalist knowledge about the utilisation of medicinal plants is not influenced by ancestors, instead, they rely on information gathered from family and community members or friends who are knowledgeable about medicinal plants (Mbongwa, 2018). Diviners conform to spiritual traditions associated with the belief that ancestors exist (Ngobe, 2015). Additionally, it is believed that ancestors influence the medicinal properties and potency of medicinal plants, as a result, diviners use plants in accordance with the preferences of their ancestors (Wiersum *et al.*, 2006). According to Mbongwa (2018), there are certain methods diviners use to handle medicinal plants, generally, they are prohibited from handling medicinal plants after having sexual intercourse, after attending a funeral and during the menstrual period. Diviner's knowledge and experience of medicinal plant usage are connected to supernatural forces that transcend the scope of purely empirical scientific inquiry, and they are honoured by rituals like animal sacrifice and ancestor worship (Bhat, 2014).

Cultivation is considered a viable conservation strategy that could mitigate pressures on wild plant populations from the increasing demand (Schippman *et al.*, 2002). A study by Kelatwang and Abbot (2002) reported that diviners and some herbalists saw cultivation as an unfeasible approach to conserve medicinal plants, with some diviners indicating that they would only participate in cultivation if they had a personal garden or an isolated site. However, considering the scarcity of wild medicinal plants, some traditional healers are now open to accepting cultivated medicinal plants (Mbongwa, 2018).

Considering that traditional healers receive training in different methods, it is essential to assess how they view cultivation because they may differ from or resemble one another. Some diviners claim that cultivated medicinal plants are less efficient and of low potency than wild-collected medicinal plants, however, these historical standards about perceptions of cultivated medicinal have altered over time due to cultural transformations (Mbongwa, 2018). Given the disparities in how diviners and herbalists acquire traditional healing knowledge and the impact

of ancestors in acquiring this knowledge, there should be an understanding of the influence of ancestral belief on the acceptability of cultivated medicinal plants.

Limited research has been done to investigate and comprehend the cultural beliefs and practices related to the use of medicinal plants (Mbongwa, 2018). Despite the appearance of uniformity within the traditional healing practice, traditions vary among ethnic groups, and these variations may impact the acceptance of cultivated medicinal plants (Mbongwa, 2018). According to Botha (2001), people's perceptions, attitudes, and values toward natural resources differ from region to region and significantly impact the effectiveness of conservation strategies. Understanding these value systems will help to ensure that cultivated plants are more acceptable to traditional healers and could even benefit nurseries that are now struggling to draw traditional healers. Therefore, this chapter investigates the level of knowledge that exists amongst traditional healers regarding environmental management regulations relating to the conservation of indigenous medicinal plants, the awareness of traditional healers on declining medicinal plants and the difference between herbalists' and diviners' perceptions of the use of cultivated medicinal plants. Findings from this study will help policymakers formulate policies that take resource users' views and perceptions into account.

5.2 Methods

Details on data collection and analysis are outlined in Chapter 3. To achieve the objective of this chapter, traditional healers were asked about the protected plant species and the National Environmental Management Act (NEMA), which regulates all activities relating to plant species collection, transportation, and translocation in South Africa, to assess the level of knowledge that exists amongst traditional healers regarding environmental management regulations (South Africa, 2004). And list plant species they perceived as declining from the wild/markets. Participants' responses were recorded and then summarised. A comparison between diviners and herbalists on the acceptability of using cultivated medicinal plants was performed using Pearson's chi-squared ($\chi 2$) test. Additionally, participants who were not in favour of cultivated medicinal plants were asked to share their sentiments on why cultivated plants were not ideal for their practice. All species cited as declining were categorised according to their conservation statuses based on the SANBI Red List website (SANBI, 2017).

5.3 Results and discussion

5.3.1 Demographic characteristics of healers

Ten traditional healers (five herbalists and five diviners) were interviewed in this study, whose ages ranged from 24-60 years, and the majority (n=7) were female. Four of the participants had less than ten years of experience in traditional healing; one had from 11-20 years, four had from 21-30 years, and one had more than 30 years of experience. Four participants were Tsonga speaking, while six were SiSwati speaking.

Table 5.1 The demographic structure of participants.

Parameter	**Specification**	**Number of participants**
Gender	Female Male	6 4
Age group (years)	26-35 36-45 >45	3 2 5
Level of education	No Schooling Primary School Secondary School Tertiary	5 2 2 1
Cultural group	Swati Tsonga	6 4
Traditional healing category	Herbalist Diviners	5 5
Years of Experience in traditional healing	<10 11-20 21-30 >30	4 1 4 1

It has been observed that women participate more actively in several ethnobotanical studies than men (Ndawonde *et al*., 2007; Khumalo, 2018). These findings are similar to a study by Williams (2004), who reported that the majority of the traders at Johannesburg's Faraday Muthi Market were a woman (70%). And a study by Mander *et al*. (2007) reported that women make up 74% of traditional healers and commercial harvesters.

5.3.2 The level of knowledge exists amongst traditional healers regarding environmental management regulations relating to the harvesting and sustainability of indigenous medicinal plants

The majority of the interviewed traditional healers (80%) were affiliated with the Traditional Healers Association in the Nkomazi Local Municipality. This membership has a permit system that allows traditional healers to collect wild medicinal plants from communal land and nature reserves. When questions were posed to the traditional healers, it emerged majority (80%) of them were unaware of the protected plant species and the National Environmental Management Act (NEMA). These findings concede with studies by Mathibela (2013); and Semenya, and Potgieter (2014), where most traditional healers did not know about the National Environmental Management Act. The inadequate knowledge about environmental legislation and conservation impedes medicinal plant conservation efforts (Semenya and Potgieter, 2014). These findings are expected when viewed against the educational background of participants. In this study, about 70% of the participants had no formal schooling to primary schooling. This impedes people's ability to comprehend legislative documents, thus undermining any conservation measures (Mathibela, 2013). The lack of knowledge of the protected plant species and the National Environmental Management Act (NEMA) by the interviewed traditional healers strongly suggests that the medicinal plant species collection by the Nkomazi Local Municipality traditional healers is operating in violation of the South African environmental legislation framework.

According to Moeng (2010), numerous medicinal plant regulatory measures exist, such as restrictions on the collection of certain plant species without a permit and the designation of protected areas where valuable plants grow. Cunningham (1993) nonetheless argued that regulating the collection and use of medicinal plants by the South African government legislation is generally ineffective. The ineffectiveness of environmental legislation related to the conservation of medicinal plants in South Africa is attributed to several factors, such as not having adequately trained environmental officials (Moeng, 2010; Mathibela, 2013). Additionally, it was reported that some of the environmental officials in Limpopo were not clear on how to apply the different legislation related to medicinal plants (Moeng, 2010; Mathibela, 2013). Responsibilities pertaining to maintaining and preserving the environment are shared across the department of Water Affairs, Environmental Affairs, and Forestry and Agriculture. This overlapping of responsibilities renders the legislation ineffective as it prevents relevant departments from taking their obligations (Moeng, 2010). Registering with

the Traditional Healers Association shows no influence on the dissemination of the content of the legislation related to the collection of medicinal plants in the Nkomazi Local Municipality. This is because the Traditional Healers Association regulates traditional medical healing practices and does not oversee legislation or conservation issues (Mathibela, 2013). Given the apparent lack of awareness of the environmental legislation related to medicinal plants in the Nkomazi Local Municipality, awareness education should be coupled with implementing plant conservation regulations. Traditional healers could be informed about legislation governing the conservation of medicinal plants through workshops addressing conservation concerns and legislation. According to Mathibela (2013), the lack of awareness of the legislation related to medicinal plants could be addressed by encouraging traditional healers to participate in initiatives like Adult Basic Education and Training (ABET). This will enrich their comprehension of environmental regulations and enable them to understand sustainable resource management. It will further ensure that ecologically sound activities are carried out at all levels, thus preventing biodiversity loss (Mathibela, 2013).

5.3.3 Medicinal plants species perceived as declining

Medicinal plant demand has resulted in increased pressure on wild populations, particularly in rural communities (Van Wyk and Prinsloo, 2018). According to Shackleton (2005), socioeconomic factors are at the foundation of the issue. Poverty pushes many rural communities to overexploit valuable natural resources, making it difficult for them to recover naturally (Rasethe *et al*., 2019). Overharvesting of natural resources has contributed to significant reductions in quantities of wild plant population, particularly for species that are valuable to rural communities and/or have high commercial value (Van Wyk and Prinsloo, 2018). Resource users and local communities are integral collaborators in the conservation of medicinal plants that are vulnerable to overexploitation (Loundou, 2008). They are the first to experience and notice any changes in the condition of their resources before conservationists because they are intimately familiar with their natural environment (Loundou, 2008). In line with this view, all the interviewed traditional healers acknowledged that 21 medicinal plant species are in decline (Table 5.2). Some of these medicinal plants consist of those that the traditional healers have reported in Chapter 4 (Table 4.2.). Traditional healers speculated that this might be because of habitat transformation, unsustainable harvesting methods, incorrect harvesting techniques and commercial harvesters. Furthermore, traditional healers have indicated that this has adverse impacts on their practice since the rarity of some medicinal

species leads commercial harvesters to increase their prices, and they are forced to travel to neighbouring countries to purchase some plants.

Table 5.2. List of medicinal plant species that are perceived as declining by the Nkomazi Local Municipality traditional healers.

Scientific name	Family name	Local name (Sw)= Siswati (X)= Xitsonga	Conservation status according to SANBI Red data list
Boophone disticha	Amaryllidaceae	Siphahluka (Sw) Rihemana (X)	Least Concern
Adenium multiflorum	Apocynaceae	Sisila-Semphala (Sw)	Least Concern
Aloe arborescens	Asphodelaceae	Inhlaba (X)	Least Concern
Cladostemon kirkii	Brassicaceae	Uphanda (Sw)	Least Concern
Warburgia salutaris	Canellaceae	Sibhaha (Sw) Xibaha (X)	Endangered
Capparis tomentosa	Capparaceae	Inkunzi-ebomvu (Sw) Nkawa (X)	Least Concern
Pleurostylia capensis	Celastraceae	Ubovane (Sw)	Least Concern
Elaeodendron transvaalense	Celastraceae	Ngcotfo (Sw) Shimapana (X)	Near Threatened
Garcinia gerrardii	Clusiaceae	Sikhwelamkhala (Sw)	Least Concern
Cephalaria humilus	Dipsacaceae	Umpikayiboni (Sw)	Least Concern
Bauhinia bowkeri	Fabaceae	Mdladlovu (Sw)	Near Threatened
Merwilla plumbea	Hyacinthaceae	Inguduza (Sw)	Vulnerable
Bowiea volubilis	Hyacinthaceae	Gibizisila (Sw)	Vulnerable
Drimia elata	Hyacinthaceae	Umqumba (Sw)	Data Deficient
Eucomis autumnalis	Hyacinthaceae	Umathunga (Sw)	Least Concern
Schizocarphus nervosus	Hyacinthaceae	Imbita-yebantwana (Sw)	Least Concern
Strychnos henningsii	Loganiaceae	Umnono (Sw)	Least Concern
Acridocarpus natalitus	Malpighiaceae	Mabophe (Sw)	Least Concern
Adenia gummifera	Passifloraceae	Upindakumshaye (Sw) Dovosha (X)	Least Concern
Dracaena aletriformis	Ruscaceae	SiKhonkhwane (Sw)	Least Concern
Zanthoxylum capense	Rutaceae	Umnungamabele (Sw)	Least Concern

Incorrect harvesting techniques and over-harvesting of medicinal plants have frequently been identified as contributing factors to their depletion, for instance, one-third of traders at the Johannesburg Faraday muthi market indicated that overharvesting was the primary cause of the shortage of medicinal plants (Williams *et al*., 2000). Medicinal plant traders in the Amatola region of the Eastern Cape Province cited poor harvesting practices (15%) and overharvesting

(80%) as the main causes of the extinction of medicinal plants (Wiersum *et al*., 2006). Additionally, traditional healers and traders in the Southern Cape have acknowledged the declining number of the wild population of some medicinal plant species and have attributed it to unsustainable and destructive harvesting methods as well as the increase in demand (Ngubeni, 2015). It is encouraging that Nkomazi traditional healers and participants from previous research conducted in the Southern Cape, Eastern Cape, Limpopo, Gauteng, and Western Cape demonstrated a diversity of awareness of the depletion of medicinal plant species and the causative factors (Williams *et al*., 2000; Wiersum *et al*., 2006; Loundou, 2008; Mathibela, 2013; Ngubeni, 2015; Nefhere, 2019). If communities are aware of the decline, they might be more inclined to collaborate with conservation organisations to conserve their natural resources (Ngubeni, 2015).

Ocotea bullata requires special attention as it has a conservation status of ENA2bd (Endangered) (SANBI, 2017). Furthermore, Ocotea bullata is listed on the DAFF list of indigenous tree species in South Africa Notice 734 of 2011 (South Africa, 2011) that are protected under the National Forestry Act (NFA) Act 84 of 1998 (South Africa, 1998). Nevertheless, the Nkomazi traditional healers did not cite or perceive it to be declining even though this species is widely used in the study area (Table 2.1). In contrast, most species cited by traditional healers as declining have the least concern conservation status. Medicinal plants that are recognized as vulnerable by resource users but are not red listed should have their conservation status re-evaluated (Williams, 2007).

5.3.4 The difference between herbalist's and diviners' perceptions of the use of cultivated medicinal plants

Diviner's and herbalist perception of using cultivated plants did not differ significantly (χ2=0.4762, df=1, P= 0. 490). Seventy percent of the interviewed diviners and eighty percent of the herbalist indicated that they would consider using cultivated medicinal plants (Fig. 5.1). The minority of the diviners who indicated that they would not use cultivated medicinal plants are of the view that cultivated plants are less effective than wild harvested plants and that they are certain harvesting rituals that must be performed to appease ancestors so that the plant works effectively. These opposing views among diviners might be because some practices have been altered because of gradual changes in training practices, and some practices or rituals are no longer observed (Mbongwa, 2018). These practices might be lost during initiation because of the instructor's financial interests and neglecting ancestors' guidance (Mbongwa, 2018). Therefore, a diviners initiation approach and the area where they were initiated might influence

their perception of the use of cultivated medicinal plants (Dold and Cocks, 2002). Thus, differences between the cultural and practical applications of wild medicinal plants are relative rather than absolute (Cocks and Wiersum, 2003).

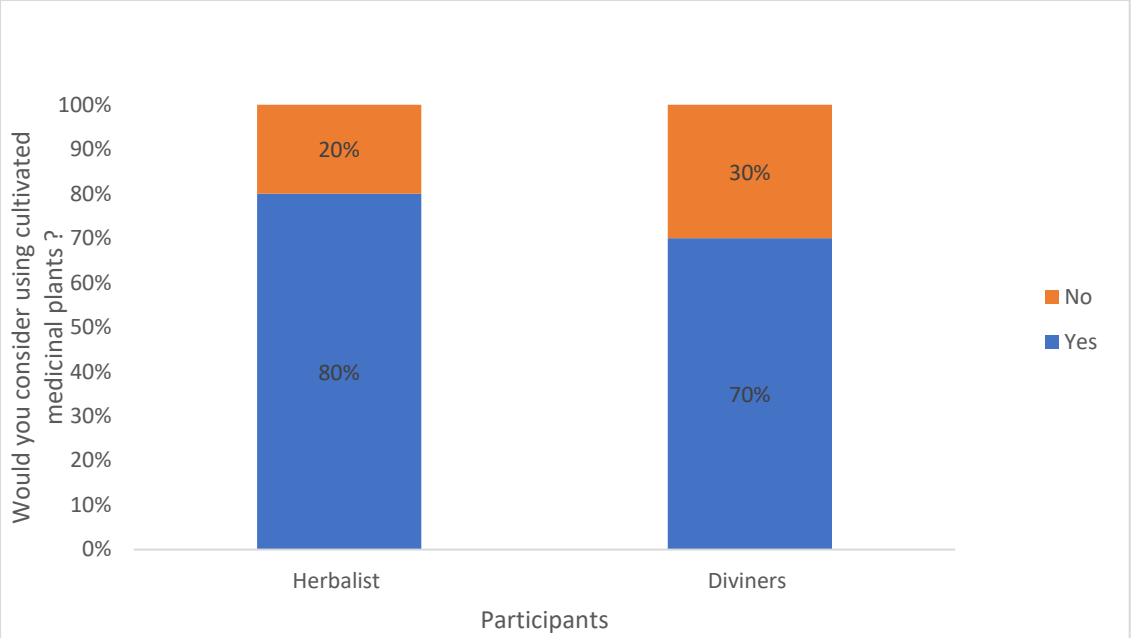

Figure 5.1. Comparison between diviners' and herbalists' perceptions of using cultivated medicinal plants.

The herbalist who indicated they would not use cultivated medicinal plants indicated that they do not have nurseries within their communities and would need to travel to other parts of the municipality to access these facilities. The present study demonstrated that although there are some commonalities between diviners and healers, there are also notable dissimilarities in how they perceive cultivated medicinal plants. However, the results indicate that the spiritual dimension of using medicinal plants is the sole reason some diviners would not consider using cultivated medicinal plants. In contrast, herbalist unwillingness is related to not having access to nurseries.

It is noteworthy that none of the herbalists mentioned the cultural limitations related to the use of cultivated medicinal plants. These findings indicate that herbalists only use the medicinal plant to generate an income and are unaware of the cultural restrictions. Additionally, an individual's ethnicity impacts cultural beliefs, frequently leading to opposing beliefs and understanding about the cultural restrictions of using cultivated medicinal plants (Mbongwa, 2018). According to Mbongwa (2018), the cultural norms of using cultivated medicinal plants are typically taught during the initiation process, and herbalists generally do not get exposure

to this knowledge unless their family members have undergone the initiation process. The various arguments for unwillingness to use cultivated medicinal plants demonstrate that perceptions and knowledge are not homogeneous and are sometimes influenced by belief systems, experience, and personal circumstances.

The belief that cultivated medicinal plants are inferior in potency to wild-harvested plants appears to be gradually eroding in the Nkomazi Local Municipality. This concedes with Mathibela (2013), who reported that 92% of the Blouberg traditional healers in Limpopo would utilise cultivated medicinal plants and that having a nursery nearby would benefit their practice. Similarly, Cunningham (1993) reported that traditional Swazi healers in the Malolotja region are of the view that cultivation is a viable solution to the declining wild population of medicinal plants. Dold and Cocks (2002) also reported that 82% of the Eastern Cape, traditional healers were willing to use cultivated medicinal plants in their practices. Mbongwa (2018) reported that 83% and 74% of traders and healers, respectively, viewed cultivated medicinal plants as a viable alternative to curb overharvesting.

According to (Mbongwa, 2018), limited research has been done on the spiritual aspect of using cultivated medicinal plants. Some healers have never encountered medicinal plants until heeding the call and undergoing initiations to be traditional healers. Thus, their understanding of medicinal plants is primarily based on their instructor's knowledge, perceptions, and ancestral spirits (Mbongwa, 2018). Furthermore, Mishra *et al.* (2009) stated that an individual's traditional knowledge level is influenced by age, sociocultural background, and relationships with their local communities.

The fact that Nkomazi Local Municipality's traditional healers are willing to purchase cultivated medicinal plants is encouraging. Formerly, traditional healers were unwilling to buy and utilize cultivated medicinal plants (Cunningham, 1993; Mavi and Shava, 1997). Therefore, the willingness of traditional healers to use cultivated medicinal plants suggests that there has been a change in attitudes and perceptions.

5.4 Conclusion

The majority of the Nkomazi Local Municipality's traditional healers did not know the protected plant species and the National Environmental Management Act (NEMA. Nkomazi Local Municipality resource users are aware of the local changes in the wild population of medicinal plants and attributed this decline to habitat transformation, unsustainable harvesting methods, incorrect harvesting techniques and commercial harvesters. Overall traditional

healers in this study expressed their willingness to utilise cultivated medicinal plants in their practices and felt that they were equally as beneficial as wild-harvested medicinal plants. Although most traditional healers were optimistic, some diviners were less receptive to the idea of using cultivated medicinal plants because they perceived cultivated plants as less efficient than wild harvested plants and that they are certain harvesting rituals that must be performed to appease ancestors so that the plant works effectively.

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CHAPTER 6
Summary, Conclusion, and Recommendations

6.1 Introduction

This chapter summarises the study's findings, conclusions, and recommendations based on the findings presented, analysed, and discussed in Chapters 4 and 5. According to Kalusopa (2011), the following aspects should be considered when formulating conclusions and recommendations: conclusions and recommendations must be directly connected to findings, the researcher must avoid drawing premature or unjustified findings or generalisations to prevent over-concluding, and all research questions must be addressed.

of the research findings, conclusions, recommendations, and suggestions for future research.

6.2 Summary of the findings

The findings are summarised in accordance with the study's research questions.

6.2.1 Which medicinal plants are utilised by traditional healers, and what are the various ailments treated in the Nkomazi Local Municipality?

The Nkomazi Local Municipality's medicinal plants utilisation is characterised by a wide diversity, as demonstrated by the 111 species belonging to 59 families to treat various ailments. The most used families in Nkomazi Local Municipality are Fabaceae, Asteraceae, Euphorbiaceae, and Hyacinthaceae. The study documented a total of 65 ailments, which were grouped into main categories such as analgesic, paediatric, and anthelmintic uses, among others.

6.2.2 Which medicinal plant species are most popular in the Nkomazi Local Municipality?

This crucial question has been addressed by adopting a rigorous and quantitative method. Though improvements could be made in the future, the Relative Frequency of Citations produced by an ethnobotanical survey with ten traditional healers from eight villages gave a comprehensive insight into the most common and frequently utilised medicinal plants in the Nkomazi Local Municipality. A detailed analysis of the 14 most popular species is presented in Chapter 4 (Appendix H). The most popular medicinal plant species in the Nkomazi Local municipality were *Momordica balsamica*, *Ricinus communis*, *Psidium guajava, Sclerocarya*

birrea, Carissa bisponosa, Aloe ferox, Aloe maculata, Ehretia rigida, Capparis tomentosa, Leonotis leonurus, Grewia monticola, Trichilia emetica, Moringa oleifera, and Ximenia caffra.

6.2.3 What are the conservation statuses of the medicinal plants cited by traditional healers?

Ninety-three of the medicinal plant species utilised by the Nkomazi Local Municipality traditional healers were of Least Concern, eleven were Not Evaluated, three were Endangered and Vulnerable and were Near Threatened (Fig. 4.5). Information about each species' IUCN Red List status is provided in Appendix (H).

6.2.4 Which parts of the plants are used the most?

In the Nkomazi Local Municipality, the roots were predominantly used plant parts for medicinal purposes, followed by the bark and leaves. Nkomazi traditional healers believed roots possess more healing powers than other plant parts.

6.2.5 How are medicinal plants prepared and administered?

The most common method of preparation was decoction, followed by infusion and powdered forms. Traditional healers reported that medicinal plant preparation and administration methods vary based on the medical and spiritual condition being treated. For instance, *Vachellia robusta* and *Antidesma venosum* are boiled to make an infusion or decoction for the treatment of Menstrual pains, stomach complaints, and sexually transmitted infections (STIs). *Artemisia Afra* is administered through steam inhalation for the treatment of colds, coughs, and fever-related illnesses. Dried and powdered *Berchemia discolor* roots are combined with petroleum jelly and administered topically to treat wounds. Medicinal plants used to defend against misfortune, love spells, and evil spirits are administered as emetics, bathing, yard sprinkling solutions, and ointments.

6.2.6 How are medicinal plants harvested, stored, and packaged?

Traditional healers employ various methods to ensure the sustainable harvesting of medicinal plants. When bulbs are harvested, not all plants are collected, they leave behind some plants. In cases where the roots are harvested, the traditional healers indicated that they avoid the tap root, target the adventitious roots, and cover the remaining roots with the soil. The Nkomazi Local Municipality traditional healers indicated that during bark harvesting, they avoid ring barking and only harvest on the eastern side of the tree, and then proceed to cover the cut with the soil to hasten recovery.

The interviewed traditional healers indicated that medicinal plants can be stored raw or processed. Processed plant material is dried out in the sun before getting stored in the consultation rooms. Traditional healers use various materials for storage, such as bottles, buckets, newspapers, and plastic, to store medicinal plants.

6.2.7 What level of knowledge exists amongst traditional healers regarding environmental management regulations relating to the harvesting and sustainability of indigenous medicinal plants in the Nkomazi Local Municipality?

The majority (80%) of the Nkomazi Local Municipality's traditional healers did not know about the protected plant species and the National Environmental Management Act (NEMA). The lack of knowledge of the protected plant species and the National Environmental Management Act (NEMA) by the interviewed traditional healers strongly suggests that medicinal plant collection by the Nkomazi Local Municipality traditional healers is operating in violation of the South African environmental legislation framework.

6.2.8 Are traditional healers in the Nkomazi Local Municipality aware of the decline of some medicinal plant species?

All the interviewed traditional healers acknowledged that 21 medicinal plant species are in decline (Table 5.1). Furthermore, traditional healers have indicated that this has adverse impacts on their practice since the rarity of some medicinal species leads commercial harvesters to increase their prices, and they are forced to travel to neighbouring countries to purchase some plants.

6.2.7 How do diviners' and herbalists' attitudes and perceptions of using cultivated medicinal plants differ?

Diviner's and herbalist perception of using cultivated plants did not differ significantly ($\chi 2$=0.4762, df=1, P= 0. 490). Most of the interviewed traditional healers (80%) and herbalists (70%) in this study used cultivated medicinal plants in their practices. They felt that they are equally as beneficial as wild-harvested medicinal plants. The minority of the diviners who expressed their reluctance to utilise cultivated medicinal plants hold the view that these plants are not as potent as those gathered from the wild and that certain harvesting rituals must be performed to appease ancestors so that the plant works effectively. The herbalist who indicated they would not use cultivated medicinal plants believed they do not have nurseries within their communities and would need to travel to other parts of the municipality to access these facilities.

6.3 Conclusion

This study presents the first detailed and comprehensive inventory of valuable medicinal plants employed by traditional healers in Nkomazi. The fundamental guidelines applied when conducting ethnobotanical research were implemented in this study, as suggested by Heinrich *et al.* (2009), which emphasised the importance of scientific rigour. Formerly ethnobotanical studies were frequently just descriptive and did not consider the relative value of species. Quantitative ethnobotany makes it possible to perform multi-directional statistical analysis (Heinrich *et al*., 2009). This study investigated and quantified the relative value of medicinal plant species.

The findings and summary provided in this study provides insight into the Swazi and Tsonga cultural heritage and demonstrate the diversity of medicinal plant application within the Nkomazi Local Municipality. One of the main objectives of this study was to provide an inventory of medicinal plants collected and employed by traditional healers in the Nkomazi Local Municipality. This objective has been fulfilled with 111 medicinal plant species documented, along with their common names and primary applications.

The possible practical application of this inventory includes the following: the preservation of invaluable indigenous knowledge that may be lost as western lifestyles are embraced; a source of knowledge for intergovernmental organizations, which they can utilize to improve the existing biodiversity legislation; the documented applications from this inventory provide numerous suggestions that can be evaluated scientifically for the verification of their efficacy and lastly, future comparative research between ethnicities and locations can make use of this inventory and information.

People's traditions and cultural norms continue to shape their worldviews, which in turn affects the type of health care they prefer (Gyasi *et al*., 2016). Health-seeking behaviour is influenced by culture, which explains why Africans rely upon their traditional healing systems (Ndlovu, 2016). In addition to being used for healing, medicinal plants can support interactions between a patient's spiritual and physical well-being (Shirungu, 2016).

The use of medicinal plants for traditional or magic-related applications has always been a significant aspect of the South African traditional healing systems (Magwede, 2018, Khumalo, 2018). The continued use of over 20 medicinal species for traditional and magical purposes demonstrates that the traditional and magical rituals are still relevant to the South African

traditional healing systems. There is a need for further research into the Nkomazi Local Municipality documented traditional and magical plants.

The use of plants for magical applications is sometimes disregarded by scientists as illogical and unscientific, which can result in the potential loss of valuable traditional knowledge if the underlying beliefs and principles are not comprehensively understood. (Magwede, 2018). Some expressions, such as “evil spirits in the house”, could refer to a fatal infection ailment, the source of which would require a microscope for locals to identify (Magwede, 2018). The magical properties attributed to some medicinal plants may be explained by their psychoactive and mind-altering properties (Van Wyk and Gericke, 2000; Moteetee, 2017). It is possible that a portion of what seems magical may have entirely logical justifications.

Resource users and local communities are the first to experience and notice any changes in the condition of their resources before conservationists because they are intimately familiar with their natural environment (Loundou, 2008). This statement has been demonstrated to be valid in the present study. Likewise, all the interviewed traditional healers acknowledged a reduction in the population of some plant species in the wild. Traditional healers have attributed the depletion of medicinal plants to overharvesting and improper harvesting techniques, even though mining, agricultural and land development have posed the greatest biodiversity threats in the Mpumalanga Province (Lötter, 2015).

Overall traditional healers were open to using cultivated medicinal plants in their practices. However, some diviners believed that cultivated medicinal plants were less effective than those gathered from the wild and that they were certain harvesting rituals must be performed to appease ancestors so that the plant worked effectively in healing. None of the herbalists mentioned the spiritual limitation, the resistance towards using cultivated medicinal plants was primarily that they do not have nurseries within their communities and would need to travel to other parts of the municipality to access these facilities. These discrepancies may be attributed to the fact that diviners receive formal training in the use of medicinal plants, while herbalists learn about these plants through hearsay or family and community members or friends (Mbongwa, 2018). Age, sociocultural background, experience, culture, and relationships with their local communities influence an individual’s attitudes, views, and understanding (Ngubeni, 2015). As a result, there was a lack of consensus regarding the spiritual limitations imposed on using cultivated medicinal plants among traditional healers practising as diviners.

Several of the challenges that traditional healers are currently experiencing would need to be addressed for the principle of sustainable use to be successfully implemented (Monakisi, 2007; Groner *et al*., 2020). It is essential to encourage enhanced knowledge and skill development among traditional healers. Basic education on cultivation, legislation, plant dynamics and sustainable use should be included in the training and awareness programs. The establishment of local nurseries in the rural communities within Nkomazi Local Municipality, both small and large scale, will greatly reduce pressures from the wild. This, combined with improved cooperation between the government, local municipality and tribal authorities and legislation framework, would aid in promoting the sustainable utilisation of valuable plant species (Monakisi, 2007; Moshi and Mhame, 2013). Without adequate training and awareness among local resource users, these attempts may be futile. Conservation strategies cannot be successfully implemented unless resource users come to comprehend the plant dynamics related to the variety of species they deal with on a daily basis (Monakisi, 2007; Mathibela, 2013). The traditional medicinal plants of South Africa will remain at risk unless the challenges affecting the traditional healers are resolved, and many of these plants may become extinct if these concerns are not addressed (Monakisi, 2007; Van Wyk and Prinsloo, 2018).

This study provides the necessary foundation data for quantitative assessments of future changes in the use of indigenous medicinal plants.

6.4 Study limitations

The following limitations were experienced during the data collection period of this study. Due to the limited time frame, not all the Nkomazi Local Municipality traditional healers could be interviewed. Some of the traditional healers were unwilling or uninterested in partaking in the study. Therefore, their opinions were not recorded. Some traditional healers alluded to the fact that traditional healing knowledge is sacred and that they are uncomfortable exchanging it with a stranger as one of their justifications for declining to participate in the study. Due to the initial rapport between the researcher and certain traditional healers, which was characterised by a lack of trust between the researcher and the traditional healers, many of the interviews lasted longer than initially planned. This resulted from the healers' perception that the researcher would exploit the data collected from their interviews for monetary benefit. They also mentioned that they had previously taken part in studies conducted by other researchers without receiving any rewards and that they had never received feedback on the study's findings. This obstacle was overcome by giving traditional healers additional time to ask questions and voice

out their concerns. To establish trust between the researcher and the participants, a letter from the Nkomazi Local Municipality was also presented.

6.5 Recommendations

This section provides recommendations to resolve concerns discovered during the study.

6.5.1 Public Awareness

In order to ensure that resource users are informed about the significance of medicinal plant conservation, the legislation concerning their harvesting as well as the ramifications of violating the regulation. The South African government should implement more awareness and education programs at a local scale. An awareness program is essential to informing resource users about their present condition and empowering them to use and manage their resources sustainably (Motaleb, 2010). By spreading awareness about the legislation and sustainable management of medicinal plants, it may be conceivable to curb the unsustainable harvesting of medicinal plants in the Nkomazi Local Municipality.

5.5.2 Plant part substitution

Substitution of plant parts provides an alternative to harvesting plant parts (Zschocke and van Staden, 2000). When harvesting, plant part selection is crucial and could affect whether a plant survives or dies (Zschocke and van Staden, 2000). In cases where roots are extensively harvested, stems and leaves could be alternatively used. More research on plant parts substitution is required to determine how medicinal properties vary within different parts of a plant. Traditional healers need to be brought to the attention of this information. Harvesting leaves and stems instead of the roots and bark could help mitigate the destructive, unsustainable harvesting of roots observed in the Nkomazi Local Municipality.

5.5.3 Storage and packaging

There should be more research done on plant material packaging and storage. Given the lack of comprehensive information on this element of traditional healing, this would guide how long plants are kept in consultation rooms. Patients' health may be seriously impacted by improper packaging and storage.

5.5.4 Plant cultivation

Because it is becoming more essential to cultivate medicinal plants, there is now a chance to compare and track medicinal plant supply and demand and document the acceptability of cultivated medicinal plants among traditional healers. The following significant studies may be considered in the future: Basic propagation skills that are required for traditional healers to

cultivate medicinal plants successfully. More traditional healers should be surveyed to document medicinal plants that are extensively used and in high demand so they can be cultivated within their local communities. The government must therefore fund community projects that will provide traditional healers with training in the fundamentals of plant propagation. The government can further provide materials for cultivation and encourage traditional healers to start their local nurseries since some traditional healers stated that the lack of nurseries within their proximity as the reason for not using cultivated medicinal plants.

5.6 Future research recommendations

This study was restricted to traditional healers in eight out of forty-three villages in the Nkomazi Local Municipality (Mangweni, Hoyi, Mzinti, KaMaqhekeza A, Magudu, Tonga, Mbangwane, and Sibange). As a result, the current study raises various issues that necessitate more research. Because it is impractical to explore everything in a research study, the following recommendations for future research are proposed.

- This study primarily used traditional healers to collect data. Leaders and representatives from the Traditional Healers Association (THO) were not included. Considering this, it is recommended that future research looking into the acceptability of cultivated medicinal plants should consist of these influential stakeholders. This will provide a comprehensive overview of the situation concerning the acceptability of cultivated medicinal plants in traditional healing systems. Therefore, enabling the researcher to conclude the issue from all sides of the equation.
- Research on medicinal plants was the main emphasis of this present study. One can only speculate about how much novelty there is for other categories of use (such as construction, food, fuel, and ethnoveterinary) that have not yet been formally documented. Therefore, a comprehensive analysis of all plant use categories is recommended to understand the traditional plant use at Nkomazi Local Municipality. Such a study might be broadened to include other regions of Mpumalanga. To provide a thorough analysis of Swati and Tsonga ethnobotany, publications resulting from this type of study could be very valuable in terms of adding to the cultural legacy of South Africa.

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APPENDICES

Appendix A: Questions for traditional healers

Questionnaire number

Personal basic information

Name									
Gender	Female		Male						
Home language	SiSwati		Shangaan/Tsonga		Other (specify				
Village									
Age group	<18		18-25		26-35		36-45		>45
Level of Education	No Schooling			Primary Education					
	Secondary Education			Tertiary Education					
Years of experience in traditional healing	<10		11-20		21-30		>30		

Medicinal plants knowledge

1. How did you become a traditional healer?

Ancestral gift (went through initiation)		Knowledge acquired from a family member (Parents, grandparents, etc..)	
Knowledge acquired from a friend		Trained	
Other			

If other specify:
……
……
……

2. Who is responsible for collecting medicinal plants for you?

You		Someone else	

If not you, who collects?
……
……

If other specify:
……
…….

1. Where do you harvest your medicinal plants? (Specify the name of the place)

Communal	Private	Other

If other specify:
……
…….

2. Do you have permission from the traditional authority or the private landowner?

Yes		No	

Conservation of medicinal plants

1. Do you have any techniques you use when collecting medicinal plants, to ensure that they survive during and after harvesting?

Yes		No	

If yes, explain
……
……
……

2. Have you experienced challenges in finding certain medicinal plants?

Yes		No	

If yes, name them

3. Does this have an impact on your practice?

Yes		No	

If yes explain

Expensive to buy plant materials from other places		No plant material means no patients		Decline will result in loss of knowledge		Other (specify)	

1. Would you consider medicinal plants from nurseries?

Yes		No	

If no, explain.

……
……
……
……..

2. As a traditional healer, how do ensure that medicinal plants are available for future use?

Use correct harvesting. techniques	Grow medicinal plants in my yard	Reduce my harvest quantities	Other (specify)

3. Do you have ideas on ensuring that medicinal plants are effectively conserved and protected in the future?

Yes		No	

If yes specify
……
……
……
……..

4. Do you buy medicinal plants not found within the Nkomazi Local Municipality?

Yes		No	

If yes, where?
……
……
……

Why?
……
……
……

1. Are you familiar with the National Environmental Act (NEMA) and what it provides for?

Yes	No

2. Have the officials from the department of environmental affairs visited you?

Yes	No

If yes, how often?

Monthly	Half-yearly	Annually	Other (specify)

What were the reasons for the visit?
……
……
……

3. Do you have a permit to harvest and protect medicinal plant species?

Yes	No

If not, why?

Do not collect in restricted areas		It is expensive	
Do not know how to apply		Do not know that it is required	

4. Are you registered with the Traditional Healing Association?

Yes	No

If not, why?
……
……
……
……..

5. Are you aware of red list data/protect species?

Yes		No	

If yes, give examples
……
……
……
……

Appendix B: Data Collection Sheets

Name and contact of the healer:

Village:

Plant name (Scientific and Vernacular names)	Part of the plant used 1= bark 2= stem 3= leaves 4= roots 5= fruits 6= bulb 7=other (specify)	Method of preparation	Method of administrating	Disease Treated	Method of harvesting 1= uproot 2=cut leaves 3=strip bark 4=ring bark 5=other (shift)	Method of storage

Thank you for your valuable input

Appendix C: Consent and confidentiality form

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Research Participants Consent Form

Title of project: An Ethnobotanical study of indigenous knowledge on medicinal plants used by traditional healers in the rural communities of Nkomazi Local Municipality, Mpumalanga province

Name of researcher: Nompendulo Khoza

I, ..., agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following: (Please circle the relevant options below).

I agree that my participation will remain anonymous	YES	NO
I agree that the researcher may use anonymous quotes in his / her research report	YES	NO
I agree that the interview may be audio recorded	YES	NO
I agree to have my samples, methods of plant harvesting and consultation room to be photographed	YES	NO
I agree to that ethnographic observation of how I collect and store my samples may be conducted	YES	NO
I agree that the information I provide may be used in an anonymized format after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained	YES	NO

..... (signature)
..... (name of participant)
..... (date)

..... (signature)
..... (name of person seeking consent)
..... (date)

Appendix D: Participant Information sheet

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Research Participant Information Sheet

Dear Sir / Madam

My name is Nompendulo Khoza, and I am a master's student in the school of Animal, Plants and Environmental Sciences (APES) at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and I am conducting an ethnobotanical study of indigenous knowledge on medicinal plants used by traditional healers in the rural communities of Nkomazi Local Municipality, Mpumalanga province under the supervision of Dr Ida Risenga, Dr. Shalini Dukhan and Mr Phillemon Ramalepe. The aim of this research project is to investigate aspects related to the collection and utilisation of medicinal plants by traditional healers at Nkomazi Local Municipality, Mpumalanga province, with the intention to contribute to a conservation strategy of medicinal plants used in the area and document indigenous knowledge on medicinal plants

As part of this project, I would like to invite you to take part in an interview. This activity will involve answering questions on the use of medicinal plants and traditional healing and will take around 20-30 minutes. With your permission, I would also like to audio record the interview using a digital device, ethnographic observation and photograph traditional healing practices (harvesting and storage of plants). This recording will be stored in a password protected personal device and only the researcher will have access to this recording. It will be deleted after 8 years (2029).

There will be no personal costs to you if you participate in this project, you will not receive any direct benefits from participation but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any question if you do not want to. The interview will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will be using a pseudonym (false name) to represent your participation in my final research report. If you experience any distress or discomfort at any point in this process, we will stop the interview or resume another time. In terms of my ethnographic field observations, with your permission, I would like to gain insight into how you collect and store the plant samples for your medicinal practice. I would also like to take photographs of plant samples and harvesting procedures with your permission.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you (optional). The data collected from this research project will be stored securely in a password protected personal device and will be kept for 8 years. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours

sincerely,

Nompendulo

Khoza

Researcher: Nompendulo Khoza, 1162598@students.wits.ac.za, 0608541538

Supervisor: Dr. Ida Risenga, Ida.Risenga@wits.ac.za, 0117176436 Supervisors: Dr. Ida Risenga, Ida.Risenga@wits.ac.za, 011717643; Dr. Shalini Dukhan, Shalini.dukhan@wits.ac.za, 0117176497; Mr Phillemon Ramalepe, Phillemon.Ramalepe@wits.ac.za, 0117176436

Appendix E: Letter of permission

School of Animal, Plant & Environmental Sciences

Private Bag 3, Wits 2050, South Africa ·Enquiries: Tel.: +27 (0) 11 717-6403 | Fax: +27 (0) 11 717-6494

Nkomazi Local Municipality

9 Park street, Malelane

Private Bag X101 Malelane

1320

13/04/2021

Dear Sir/Madam,

Re: Permission to conduct research at Nkomazi Local Municipality

Ms Nompendulo Khoza is my MSc postgraduate student and under my supervision. She is registered for a Masters in Animal Plants and Environmental Sciences in the school of Animal Plants and Environmental sciences at the University of the Witwatersrand, Johannesburg. I would like to request that you grant her permission to do research at Nkomazi Local Municipality.

She is conducting research on the indigenous knowledge on medicinal plants used by traditional healers in the rural communities of Nkomazi Local Municipality. The aim of her study is to investigate aspects related to the collection and utilisation of medicinal plants by traditional healers at Nkomazi Local Municipality, Mpumalanga province, with the intention to contribute to a conservation strategy of medicinal plants used in the area and document indigenous knowledge on medicinal plants. This study will be based on the perceptions and indigenous knowledge of traditional healers from various rural communities within the Nkomazi Local Municipality.

The research will entail collecting data from traditional healers from various villages across the municipality. Participants will be asked to give their written or verbal consent before the research begins. Their responses will be treated confidentially, and identities (their names and the name of the organisation) will be anonymous unless otherwise expressly indicated. Individual privacy will be maintained in all published and written data resulting from the study. The results of the project will be communicated through a Masters dissertation.

The research participants will not be disadvantaged in any way. They will be reassured that they can withdraw their permission at any time during this project without any penalty. There are no foreseeable risks in participating in this study. The participants will not be paid for this study.

All research data will be preserved anonymously for possible continuation of similar research towards the researchers' doctorate degree or reuse by other researchers.

School of Animal, Plant & Environmental Sciences

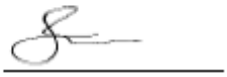
Private Bag 3, Wits 2050, South Africa ·Enquiries: Tel.: +27 (0) 11 717-6403 | Fax: +27 (0) 11 717-6494

I therefore request in writing that you grant her permission to conduct her research at your municipality. The permission letter should be on your organisation's headed paper, signed and dated, and specifically referring to Ms Nompendulo Khoza and the title of her study.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely,

Dr Ida Risenga



The University of the Witwatersrand, Johannesburg

School of Animal, Plant and Environmental Sciences

Oppenheimer Life Sciences Building, Room 2009

Private Bag 3, WITS, 2050

Phone: +27 (0) 11 717 6436 or 0613232346

E-mail:Ida.Risenga@wits.ac.za

Appendix F: Nkomazi Local Municipality approval to Conduct Study

PRIVATE BAG X101
MALELANE
1320
Tel: 013 7900245/6/7
Fax: 013 7900886
E-mail: gabby.nkosi@nkomazi.gov.za

Nkomazi Municipality

OFFICE OF THE MUNICIPAL MANAGER

Enquiries: Mr Vincent Bhiya
Tel: 013 790 0245 & 072 014 7640

The University of the Witwatersrand
School of Animal, Plant and Environmental Sciences
Oppenheimer Life Sciences Building, Room 2009
Private Bag 3
WITS
2050

Attention: Dr I Risenga
Supervisor

RE: APPROVAL FOR PERMISSION TO CONDUCT A RESEARCH STUDY: THE INDIGENOUS KNOWLEDGE ON MEDICAL PLANTS USED BY TRADITIONAL HEALERS IN THE RURAL COMMUNITIES OF NKOMAZI LOCAL MUNICIPALITY, IN MPUMALANGA, SOUTH AFRICA

The above matter bears reference:

I hereby respond on your letter dated 04 April 2021 of **Ms Nompendulo Khoza** a registered Msc postgraduate student at the School of Animal, Plant and Environmental Sciences requesting permission to conduct a research study as mentioned above and the request is granted.

The office of the Municipal Manager hereby commits to assist with any information that she may request during the research study. We hope after completing her situation analysis with regards to findings and recommendations will be shared with the municipality to improve in strengthening our municipality in coming up with programmes that will be beneficial to the communities of Nkomazi.

Hope this letter will serve the purpose and do not hesitate to contact my office should any further information may be required by your good-self.

I wish her all the best during her research endeavours.

Yours faithfully,

Mr MD Ngwenya
Municipal Manager
Date: 14 / 05 / 2021

NKOMAZI MUNICIPALITY
PRIVATE BAG X101 MALELANE 1320
14 -05- 2021
OFFICE OF THE MUNICIPAL MANAGER
MALELANE CIVIC CENTRE

"ALL CORRESPONDENCES SHOULD BE DIRECTED TO THE OFFICE OF THE MUNICIPAL MANAGER"

Appendix G: Ethics clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Khoza

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H21/06/14**
PROJECT TITLE	Ethnobotanical study of indigenous knowledge on medicinal used by traditional healers in the rural communities of Nkomazi Local Municipality, Mpumalanga province
INVESTIGATOR(S)	Ms N Khoza
SCHOOL/DEPARTMENT	Animal Plants and Environmental Sciences/
DATE CONSIDERED	18 June 2021
DECISION OF THE COMMITTEE	Approved Risk Level: Minimal
EXPIRY DATE	18 August 2024
DATE 19 August 2021	**CHAIRPERSON** (Professor J Knight)

cc: Supervisor : Dr I Risenga, Dr S Dukhan and Mr P Ramalepe

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to submit an amendment of the protocol to the Committee. **I agree to completion of a regular progress report. For Minimal and Low studies, this is due annually on 31 December. For Medium and High Risk studies, this is due twice annually on 30 June and 31 December.**

N. Khoza
Signature

19 / 08 / 2021
Date

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

Appendix H: Conservation status of medicinal plants cited by Nkomazi Local Municipality traditional healers. [LC=Least Concern, EN=Endangered, NE=Not Evaluated VU=Vulnerable, NT=Near Threatened, DDT=Data Deficient Taxonomically, CR=Critically Rare (SANBI, 2017)]. * = Exotic species.

Scientific name	Family	Local name (Sw)= Siswati (X)= Xitsonga	Conservation status
Acorus calamus L. *	Acoraceae	Ikalamuzi (Sw)	NE
Tulbaghia violacea Harv.	Alliaceae	Lisela (Sw)	LC
Boophone disticha (L.f.) Herb.	Amaryllidaceae	Siphahluka (Sw) Rihemana (X)	LC
Sclerocarya birrea (A. Rich.) Hochst.	Anacardiaceae	Mganu (Sw) Nkanyi (X)	LC
Lannea schweinfurthii var. stuhlmannii Engl.	Anacardiaceae	Umganunkomo (Sw) Ximbombokanyi (X)	LC
Annona senegalensis Pers.	Annonaceae	Mtelemba (Sw) Muyembe (X)	LC
Artabotrys brachypetalus Benth.	Annonaceae	Ntita (X)	LC
Heteromorpha arborescens (Spreng.) Cham. & Schltdl.	Apiaceae	Umbangadlala (Sw)	LC
Alepidea amatymbica Eckl. & Zeyh.	Apiaceae	Likhatsato (Sw)	EN
Foeniculum vulgare Mill. *	Apiaceae	Imbozisa (Sw)	NE
Secamone gerrardii Harv. ex Benth.	Apocynaceae	Mgobandlovu (Sw)	LC
Carissa bisponosa (L.) Desf. ex Brenan	Apocynaceae	Umvusankunzi (Sw)	LC
Tabernaemontana elegans Stapf	Apocynaceae	Mkhahlu (Sw) Nkahlwane (X)	LC
Acokanthera oppositifolia (Lam.) Codd	Apocynaceae	Mutsimulisa (Sw)	LC
Adenium multiflorum Klotzsch	Apocynaceae	Sisila-Semphala (Sw)	LC
Cussonia spicata Thunb.	Araliaceae	Umsenge (Sw) Musenje (X)	LC
Asparagus aethiopicus L.	Asparagaceae	Kwangulatilo (X)	LC
Aloe ferox Mill.	Asphodelaceae	Inhlaba (Sw) Mhangana (X)	LC
Aloe maculata All.	Asphodelaceae	Inhlaba (Sw)	LC
Brachylaena discolor DC.	Asteraceae	Phahla (Sw)	LC
Artemisia afra Jacq. ex Willd.	Asteraceae	Umhlonyane (Sw)	LC

Callilepis laureola DC.	Asteraceae	Ihlamvu (Sw)	LC
Linzia glabra Steetz sens.lat.	Asteraceae	Linyatselo (Sw)	LC
Helichrysum pallidum DC.	Asteraceae	Mphepho (Sw) Mpetso (X)	LC
Berkheya bipinnatifida (Harv.) Roessler subsp. Bipinnatifida	Asteraceae	Likhakhasi (Sw)	LC
Bidens pilosa L. *	Asteraceae	Chuchuza (Sw)	NE
Kigelia africana (Lam.) Benth.	Bignoniaceae	Umvongotsi (Sw) Mpfungurhu (X)	LC
Ehretia rigida (Thunb.) Druce	Boraginaceae	Sihlehle (Sw) Muhambe (X)	LC
Cladostemon kirkii (Oliv.) Pax & Gilg	Brassicaceae	Uphanda (Sw)	LC
Warburgia salutaris (Bertol.f.) Chiov.	Canellaceae	Sibhaha (Sw) Xibaha (X)	EN
Trema orientalis (L.) Blume	Cannabaceae	UmBalalaqane (Sw) Mpuka (X)	LC
Capparis tomentosa Lam.	Capparaceae	Inkunzi-ebomvu (Sw) Nkawa (X)	LC
Elaeodendron croceum (Thunb.) DC.	Celastraceae	Sithundu (Sw)	LC
Gymnosporia buxifolia (L.) Szyszyl.	Celastraceae	Sihlangu lesimnyama (Swa)	LC
Elaeodendron transvaalense (Burtt Davy) R.H. Archer	Celastraceae	Ngcotfo (Sw) Shimapana (X)	NT
Pterocelastrus rostratus (Thunb.) Walp.	Celastraceae	Usehlulamanye (Sw)	LC
Argyrolobium tomentosum (Andrew) Druce	Fabaceae	Umlomomnandzi (Sw)	LC
Combretum apiculatum Sond. subsp. Apiculatum	Combretaceae	Imbondvo (Sw) Xikukutsi (X)	LC
Combretum imberbe Wawra	Combretaceae	Mpondvondlovu (Sw) Mondzo (X)	LC
Ipomoea oblongata E. Mey. ex Choisy	Convolvulaceae	Ubhoqo (Sw) Dema (X)	LC
Momordica balsamica L.	Cucurbitaceae	Nkaka (X)	LC
Coccinia rehmannii Cogn.	Cucurbitaceae	Hawulane (Sw)	LC
Scabiosa columbaria L.	Dipsacaceae	Bheka-Mina (Sw)	LC
Cephalaria humilus (Thunb.) Roem. & Schult.	Dipsacaceae	Umpikayiboni (Sw)	LC
Diospyros galpinii (Hiern) De Winter	Ebenaceae	Indodemnyama (Swa)	LC
Euclea natalensis A. DC.	Ebenaceae	Indlelayenyamatane-Lemnyama (Sw) Nhalngula (X)	LC

Euclea divinorum Hiern	Ebenaceae	Indlelanyamatane-lebovu (Sw) Nhlangula (X)	LC
Diospyros mespiliformis Hochst. ex A. DC.	Ebenaceae	umTomo (Sw) Ntoma (X)	LC
Diospyros lycioides Desf.	Ebenaceae	Umcafutane (Sw) Xintomane (X)	LC
Ricinis communis L. *	Euphorbiaceae	Mhlafusha (Sw) Nhlamfura Ya Valungu (X)	NE
Macaranga capensis (Baill.) Benth. ex Sim	Euphorbiaceae	Nompumelelo (Sw)	LC
Jatropha zeyheri Sond.	Euphorbiaceae	Mfelo (Sw) Xidomeja (X)	LC
Spirostachys africana Sond.	Euphorbiaceae	Likhambi lebantfwana (Sw) Xilangamahlo (X)	LC
Albizia anthelmintica (A. Rich.) Brongn.	Fabaceae	Umgadankawu (Sw)	LC
Neorautanenia ficifolia Benth. ex Harv.) C.A.Sm.	Fabaceae	Sikhundla (Sw)	LC
Abrus laevigatus E. Mey.	Fabaceae	Umehlebatsakate (Sw)	LC
Schotia brachypetala Sond.	Fabaceae	Uvhovhovho (Sw) Nwavilombe-Chochelamandleni (X)	LC
Mimosa pudica L. var. hispida* Brenan	Fabaceae	Indabulaluvalo (Sw)	NE
Peltophorum africanum Sond.	Fabaceae	Umkhabamkhombe (Sw) Ndzedze (X)	LC
Albizia versicolor Welw. ex Oliv.	Fabaceae	Sivangatane (Sw) Mbhesu (X)	LC
Dalbergia melanoxylon Guill. & Perr.	Fabaceae	Isparati (Sw) Xipalatsi (X)	LC
Mundulea sericea (Willd.) A. Chev.	Fabaceae	Umsindandlovana (Sw) Ntsandzandlopfu (X)	LC
Vachellia robusta (Burch.) Kyal. & Boatwr.	Fabaceae	Umngamanzi (Sw) Mvumbangwenya (X)	LC
Erythrina lysistemon Hutch.	Fabaceae	Umsinsi (Sw) Nsisimbana (X)	LC
Elephantorrhiza elephantina (Burch.) Skeels.	Fabaceae	Intfolwane (Sw) Xivurayi (X)	LC
Acacia xanthophloea (Benth.) P.J.H. Hurter	Fabaceae	UmKhanyakudze (Sw) Nkelenga (X)	LC
Merwilla plumbea (Lindl.) Speta	Hyacinthaceae	Inguduza (Sw)	VU

Urginea altissima (L.f.) Baker	Hyacinthaceae	Silulwane (Sw)	LC
Ledebouria apertiflora (Baker) Jessop	Hyacinthaceae	Siganama (Sw)	LC
Bowiea volubilis Harv. Ex Hook. f. subsp. Volubilis	Hyacinthaceae	Gibizisila (Sw)	VU
Schizocarphus nervosus (Burch.) Van der Merwe	Hyacinthaceae	Imbita-yebantwana (Sw)	LC
Eucomis autumnalis (Mill.) Chitt	Hyacinthaceae	Umathunga (Sw)	LC
Hydnora africana Thunb.	Hydnoraceae	Mavumbuka (Sw)	LC
Hypoxis hemerocallidea Fisch., C.A. Mey. & Avé-Lall.	Hypoxidaceae	Isifozonke (Sw)	LC
Pyrenacantha grandiflora Baill.	Icacinaceae	Velabahleke (Sw)	LC
Aristea capitata (L.) Ker Gawler	Iridaceae	Phalabashimane (Sw)	LC
Leonotis leonurus (L.) R.Br.	Lamiaceae	Umfincafincane (Sw) Mabangi ya nhova (X)	LC
Clerodendron glabrum E. Mey. var. glabrum.	Lamiaceae	Mphehlacwatsi (Sw) Xinhun'welambeva (X)	LC
Ocotea bullata (Burch.) Baill.	Lauraceae	Umnukani (Sw)	EN
Cinnamomum camphora (L.) * Siebold	Lauraceae	Uroselina (Sw)	NE
Strychnos henningsii Gilg	Loganiaceae	Umnono (Sw)	LC
Grewia monticola Sond.	Malvaceae	Umsiphane (Sw) Nsihane (X)	LC
Hibiscus pusillus Thunb.	Malvaceae	Uvuma (Sw)	LC
Dombeya rotundifolia Hochst.	Malvaceae	Nhlitiyo (Sw)	LC
Ekebergia capensis Sparrm.	Meliaceae	Umnyamatsi (Sw) Nyamaru (X)	LC
Trichilia emetica Vahl	Meliaceae	Umkuhlu (Sw) Nkuhlu (X)	LC
Ficus sur Forssk.	Moraceae	Umkhiwane (Sw)	LC
Moringa oleifera Lam. *	Moringaceae	Moringa (Sw and X)	NE
Psidium guajava L.	Myritaceae	Umgwava (Sw)	NE
Rapanea melanophloeos (L.) Mez	Myrsinaceae	Ligcolo (Sw) Shitsuvane (X)	LC
Eucalyptus tereticornis Sm. *	Myrtaceae	Indlulamitsi (Sw)	NE
Ximenia caffra Sond.	Olacaceae	Umtfundvuluka (Sw) Ntsengele-lowu kulu (X)	LC

Adenia gummifera (Harv.) Harms var. gummifera	Passifloraceae	Upindakumshaye (Sw) Dovosha (X)	LC
Antidesma venosum E. Mey. ex Tul.	Phyllanthaceae	Umhlalamuhuhulu (Sw) Mpfalambati (X)	LC
Cymbopogon citratus (DC.) Stapf *	Poaceae	Litiye lase Mozambique (Sw) Ntepu (X)	NE
Coix lacryma-jobi L. *	Poaceae	Ilozisi (Sw)	NE
Faurea saligna Harv.	Proteaceae	SiSefo (Sw) N'wamidzumba (X)	LC
Clematis brachiata Thunb.	Ranunculaceae	Zinyolemamba (Sw)	LC
Berchemia discolor (Klotzsch) Hemsl.	Rhamnaceae	Umhlungulo (Sw) Nyiri (X)	LC
Prunus africana (Hook.f.) Kalkman	Rosaceae	Umdumezulu (Sw)	VU
Gardenia volkensii K. Schum.	Rubiaceae	Sivalasangwane (Sw) Ntsalala (X)	LC
Vangueria infausta Burch.	Rubiaceae	UmNtuli (Sw) Mpfilwa (X)	LC
Dracaena aletriformis (Haw.) Bos	Ruscaceae	SiKhonkhwane (Sw)	LC
Zanthoxylum leprieurii Guill. & Perr.	Rutaceae	Umnungwane (Sw) Manhungwana (X)	LC
Vepris reflexa I. Verd.	Rutaceae	Lifembo (Sw) Nkuhuma (X)	LC
Zanthoxylum capense (Thunb.) Harv.	Rutaceae	Umnungamabele (Sw)	LC
Dovyalis caffra (Hook.f. & Harv.) Hook.f.	Salicaceae	Intapane (Sw) N'wabula (X)	LC
Hippobromus pauciflorus (L.f.) Radlk.	Sapindaceae	Isiphahluka (Sw)	LC
Pappea capensis Eckl. & Zeyh.	Sapindaceae	Liletsa (Sw) Xikwakwaxu (X)	LC
Talinum caffrum (Thunb.) Eckl. & Zeyh.	Talinaceae	Punyuka Bamphethe (Sw)	LC
Balanites maughamii Sprague	Zygophyllaceae	Liphambo (Sw) Nulu (X)	LC

Appendix I: List of 111 Nkomazi Local Municipality medicinal plants with scores showing the Relative frequency of citations. * = Exotic species.

Scientific name	RFC
Momordica balsamica L.	1
Ricinis communis L.*	0,9
Psidium guajava L.*	0,9
Sclerocarya birrea (A. Rich.) Hochst.	0,8
Carissa Bisponosa (L.) Desf. ex Brenan	0,8
Aloe ferox Mill.	0,8
Aloe maculata All.	0,8
Ehretia rigida (Thunb.) Druce	0,8
Capparis tomentosa Lam.	0,8
Leonotis leonurus (L.) R.Br.	0,8
Grewia monticola Sond.	0,8
Trichilia emetica Vahl	0,8
Moringa oleifera Lam.*	0,8
Ximenia caffra Sond.	0,8
Tulbaghia violacea Harv.	0,7
Tabernaemontana elegans Stapf	0,7
Bidens pilosa L.*	0,7
Combretum apiculatum Sond. subsp. apiculatum	0,7
Scabiosa columbaria L.	0,7
Euclea divinorum Hiern	0,7
Spirostachys africana Sond.	0,7
Albizia versicolor Welw. ex Oliv.	0,7
Bowiea volubilis Harv. Ex Hook. f. subsp. volubilis	0,7
Schizocarphus nervosus (Burch.) Van der Merwe	0,7
Hypoxis hemerocallidea Fisch., C.A. Mey. & Avé-Lall.	0,7
Aristea capitata (L.) Ker Gawler	0,7
Ocotea bullata (Burch.) Baill.	0,7
Eucalyptus tereticornis Sm.*	0,7
Zanthoxylum leprieurii Guill. & Perr.	0,7
Acorus calamus L.*	0,6
Lannea schweinfurthii var. stuhlmannii Engl.	0,6
Annona senegalensis Pers.	0,6
Foeniculum vulgare Mill. *	0,6
Adenium multiflorum Klotzsch	0,6
Cussonia spicata Thunb.	0,6
Asparagus aethiopicus L.	0,6
Artemisia afra Jacq. ex Willd.	0,6
Berkheya bipinnatifida (Harv.) Roessler subsp. Bipinnatifida	0,6
Kigelia africana (Lam.) Benth.	0,6
Cladostemon kirkii (Oliv.) Pax & Gilg	0,6
Warburgia salutaris (Bertol.f.) Chiov.	0,6
Trema orientalis (L.) Blume	0,6

Combretum imberbe Wawra	0,6
Coccinia rehmannii Cogn.	0,6
Cephalaria humilus (Thunb.) Roem. & Schult.	0,6
Diospyros galpinii (Hiern) De Winter	0,6
Diospyros mespiliformis Hochst. ex A.DC.	0,6
Diospyros lycioides Desf.	0,6
Schotia brachypetala Sond.	0,6
Erythrina lysistemon Hutch.	0,6
Acacia xanthophloea (Benth.) P.J.H. Hurter	0,6
Ledebouria apertiflora (Baker) Jessop	0,6
Eucomis autumnalis (Mill.) Chitt	0,6
Pyrenacantha grandiflora Baill.	0,6
Clerodendron glabrum E. Mey. var. glabrum	0,6
Hibiscus pusillus Thunb.	0,6
Adenia gummifera (Harv.) Harms var. gummifera	0,6
Faurea saligna Harv.	0,6
Berchemia discolor (Klotzsch) Hemsl.	0,6
Vangueria infausta Burch.	0,6
Vepris reflexa I. Verd.	0,6
Balanites maughamii Sprague	0,6
Boophone disticha (L.f.) Herb.	0,5
Artabotrys brachypetalus Benth.	0,5
Secamone gerrardii Harv. ex Benth.	0,5
Acokanthera oppositifolia (Lam.) Codd	0,5
Brachylaena discolor DC.	0,5
Callilepis laureola DC.	0,5
Linzia glabra Steetz sens.lat.	0,5
Helichrysum pallidum DC.	0,5
Elaeodendron croceum (Thunb.) DC.	0,5
Pterocelastrus rostratus (Thunb.) Walp.	0,5
Argyrolobium tomentosum (Andrew) Druce	0,5
Ipomoea oblongata E. Mey. ex Choisy	0,5
Euclea natalensis A.DC.	0,5
Macaranga capensis (Baill.) Benth.ex Sim	0,5
Jatropha zeyheri Sond.	0,5
Albizia anthelmintica (A. Rich.) Brongn.	0,5
Mimosa pudicaa L. var. hispida Brenan*	0,5
Dalbergia melanoxylon Guill. & Perr.	0,5
Mundulea sericea (Willd.) A. Chev.	0,5
Vachellia robusta (Burch.) Kyal. & Boatwr.	0,5
Elephantorrhiza elephantina (Burch.) Skeels	0,5
Merwilla plumbea (Lindl.) Speta	0,5
Hydnora africana Thunb.	0,5
Cinnamomum camphora (L.) Siebold*	0,5
Ekebergia capensis Sparrm.	0,5
Ficus sur Forssk.	0,5

Rapanea melanophloeos (L.) Mez	0,5
Antidesma venosum E. Mey. ex Tul.	0,5
Coix lacryma-jobi L.*	0,5
Clematis brachiata Thunb.	0,5
Dracaena aletriformis (Haw.) Bos	0,5
Pappea capensis Eckl. & Zeyh.	0,5
Talinum caffrum (Thunb.) Eckl. & Zeyh.	0,5
Heteromorpha arborescens (Spreng.) Cham. & Schltdl.	0,4
Elaeodendron transvaalense (Burtt Davy) R.H. Archer	0,4
Neorautanenia ficifolia Benth. ex Harv.) C.A.Sm.	0,4
Abrus laevigatus E. Mey.	0,4
Peltophorum africanum Sond.	0,4
Urginea altissima (L.f.) Baker	0,4
Strychnos henningsii Gilg	0,4
Dombeya rotundifolia Hochst.	0,4
Cymbopogon citratus (DC.) Stapf*	0,4
Prunus africana (Hook.f.) Kalkman	0,4
Gardenia volkensii K. Schum.	0,4
Dovyalis caffra (Hook. f. & Harv.) Hook. f.	0,4
Hippobromus pauciflorus (L.f.) Radlk.	0,4
Alepidea amatymbica Eckl. & Zeyh.	0,3
Gymnosporia buxifolia (L.) Szyszyl.	0,3
Zanthoxylum capense (Thunb.) Harv.	0,3

Appendix J: List of 111 Nkomazi Local Municipality medicinal plants with scores showing the Use Value. * = Exotic species.

Scientific name	UV
Elaeodendron transvaalense (Burtt Davy) R.H. Archer	1,5
Merwilla plumbea (Lindl.) Speta	1,4
Acorus calamus L. *	0,8
Argyrolobium tomentosum (Andrew) Druce	0,8
Abrus laevigatus E. Mey.	0,8
Cymbopogon citratus (DC.) Stapf*	0,8
Alepidea amatymbica Eckl. & Zeyh.	0,7
Cladostemon kirkii (Oliv.) Pax & Gilg	0,7
Gymnosporia buxifolia (L.) Szyszyl.	0,7
Combretum imberbe Wawra	0,7
Ledebouria apertiflora (Baker) Jessop	0,7
Acokanthera oppositifolia (Lam.) Codd	0,6
Brachylaena discolor DC.	0,6
Jatropha zeyheri Sond.	0,6
Dalbergia melanoxylon Guill. & Perr.	0,6
Ficus sur Forssk.	0,6
Antidesma venosum E. Mey. ex Tul.	0,6
Clematis brachiata Thunb.	0,6
Pappea capensis Eckl. & Zeyh.	0,6
Aloe ferox Mill.	0,5
Warburgia salutaris (Bertol.f.) Chiov.	0,5
Cephalaria humilus (Thunb.) Roem. & Schult.	0,5
Peltophorum africanum Sond.	0,5
Acacia xanthophloea (Benth.) P.J.H. Hurter	0,5
Urginea altissima (L.f.) Baker	0,5
Eucomis autumnalis (Mill.) Chitt	0,5
Strychnos henningsii Gilg	0,5
Moringa oleifera Lam.*	0,5
*Adenia gummifera (*Harv.) Harms var. gummifera	0,5
Faurea saligna Harv.	0,5
Prunus africana (Hook.f.) Kalkman	0,5
Hippobromus pauciflorus (L.f.) Radlk.	0,5
Balanites maughamii Sprague	0,5
Scabiosa columbaria L.	0,4
Euclea divinorum Hiern	0,4
Bowiea volubilis Harv. Ex Hook. f. subsp. volubilis	0,4
Schizocarphus nervosus (Burch.) Van der Merwe	0,4
Hypoxis hemerocallidea Fisch., C.A. Mey. & Avé-Lall.	0,4
Eucalyptus tereticornis Sm.*	0,4
Zanthoxylum leprieurii Guill. & Perr.	0,4
Elaeodendron croceum (Thunb.) DC.	0,4

Euclea natalensis A.DC.	0,4
Albizia anthelmintica (A. Rich.) Brongn.	0,4
Mundulea sericea (Willd.) A. Chev.	0,4
Vachellia robusta (Burch.) Kyal. & Boatwr.	0,4
Elephantorrhiza elephantina (Burch.) Skeels	0,4
Hydnora africana Thunb.	0,4
Rapanea melanophloeos (L.) Mez	0,4
Capparis tomentosa Lam.	0,4
Grewia monticola Sond.	0,4
Ximenia caffra Sond.	0,4
Annona senegalensis Pers.	0,3
Cussonia spicata Thunb.	0,3
Berkheya bipinnatifida (Harv.) Roessler subsp.Bipinnatifida	0,3
Trema orientalis (L.) Blume	0,3
Schotia brachypetala Sond.	0,3
Erythrina lysistemon Hutch.	0,3
Vangueria infausta Burch.	0,3
Zanthoxylum capense (Thunb.) Harv.	0,3
Albizia versicolor Welw. ex Oliv.	0,3
Heteromorpha arborescens (Spreng.) Cham. & Schltdl.	0,3
Ehretia rigida (Thunb.) Druce	0,3
Neorautanenia ficifolia Benth. ex Harv.) C.A.Sm.	0,3
Dombeya rotundifolia Hochst.	0,3
Gardenia volkensii K. Schum.	0,3
Dovyalis caffra (Hook. f. & Harv.) Hook. f.	0,3
Ricinis communis L.*	0,2
Boophone disticha (L.f.) Herb.	0,2
Artabotrys brachypetalus Benth.	0,2
Secamone gerrardii Harv. ex Benth.	0,2
Callilepis laureola DC.	0,2
Linzia glabra Steetz sens.lat.	0,2
Helichrysum pallidum DC.	0,2
Pterocelastrus rostratus (Thunb.) Walp.	0,2
Ipomoea oblongata E. Mey. ex Choisy	0,2
Macaranga capensis (Baill.) Benth.ex Sim	0,2
Mimosa pudicaa L. var. hispida Brenan*	0,2
Cinnamomum camphora (L.) Siebold*	0,2
Ekebergia capensis Sparrm.	0,2
Coix lacryma-jobi L.*	0,2
Dracaena aletriformis (Haw.) Bos	0,2
Talinum caffrum (Thunb.) Eckl. & Zeyh.	0,2
Lannea schweinfurthii var. stuhlmannii Engl.	0,2
Foeniculum vulgare Mill. *	0,2
Adenium multiflorum Klotzsch	0,2

Asparagus aethiopicus L.	0,2
Artemisia afra Jacq. ex Willd.	0,2
Kigelia africana (Lam.) Benth.	0,2
Coccinia rehmannii Cogn.	0,2
Diospyros galpinii (Hiern) De Winter	0,2
Diospyros mespiliformis Hochst. ex A.DC.	0,2
Diospyros lycioides Desf.	0,2
Pyrenacantha grandiflora Baill.	0,2
Clerodendron glabrum E. Mey. var. glabrum	0,2
Hibiscus pusillus Thunb.	0,2
Berchemia discolor (Klotzsch) Hemsl.	0,2
Vepris reflexa I. Verd.	0,2
Tulbaghia violacea Harv.	0,1
Tabernaemontana elegans Stapf	0,1
Bidens pilosa L.*	0,1
Combretum apiculatum Sond. subsp. apiculatum	0,1
Spirostachys africana Sond.	0,1
Aristea capitata (L.) Ker Gawler	0,1
Ocotea bullata (Burch.) Baill.	0,1
Sclerocarya birrea (A. Rich.) Hochst.	0,1
Carissa Bisponosa (L.) Desf. ex Brenan	0,1
Aloe maculata All.	0,1
Leonotis leonurus (L.) R.Br.	0,1
Trichilia emetica Vahl	0,1
Psidium guajava L.*	0,1
Momordica balsamica L.	0,1