PERCEPTIONS OF TRADITIONAL HEALERS REGARDING ETHNOBOTANICAL IMPORTANCE AND CONSERVATION STATUS OF INDIGENOUS MEDICINAL PLANTS OF THULAMELA, LIMPOPO

by

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DECLARATION

I, Khamusi Victor Nefhere, hereby declare that the dissertation which I hereby submit for the degree of Master of Science in ornamental horticulture, at the University of South Africa, is my own work, and has not previously been submitted by me for a degree at this or any other institution.

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DEDICATION

This project is dedicated to my late father (Nkhelebeni Wilson), mother (Tshinakaho) and brother, Phalanndwa Nefhere. “Edelani nga mulalo dzi Ndou” (Rest in peace).

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ABSTRACT

Medicinal plants of Thulamela municipality are experiencing challenges due to human activities, resulting in some of the medicinal plants becoming difficult to find, declining, endangered or even extinct. Unsustainable harvesting is threatening the survival of certain medicinal plant species used as a source of primary healthcare in the area.

This study investigates aspects related to traditional healers' perceptions with regard to collection, ethnobotanical importance and conservation status of indigenous medicinal plants used by traditional healers around Thulamela municipality. Information on medicinal plants was gathered by means of semi-structured interviews, field walks, personal observation and a literature review.

A total of 90 medicinal plant species, which belong to 47 families, from a total of 82 genera commonly used by traditional healers to treat different ailments, were recorded.

About 87% of traditional healers indicated that some medicinal plants are difficult to find; only 13% of healers did not experience difficulties in finding some medicinal plants.

KEYWORDS: conservation, declining, ethnobotany, indigenous medicinal plants, medicinal plants cultivation, primary healthcare, traditional healers, traditional healing, traditional medicine, unsustainable harvesting.

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GLOSSARY OF TERMS

Active ingredients: Ingredients of herbal medicines with therapeutic activity (WHO, 2001:4).

Bulb: A fleshy underground structure made up of numerous layers of fleshy scales which are actually leaf bases (Van Wyk, Van Oudshoorn & Gericke, 2013:12).

Complementary/alternative medicine: Healthcare that is considered supplementary to allopathic medicine (WHO, 2001:1).

Conservation: The **s**upport of sustainable development, by protecting and using biological resources in a way that do not diminish the world's variety of species or genes, or destroy important habitats and ecosystems (Kasagana & Karumuri, 2011:1378).

Critically endangered species: The species is facing an extremely high risk of extinction (SANBI: 2012).

Cuttings: The most widely used type of vegetative propagation of plants, in which a portion of a stem, petiole, leaf lamina or bud is removed by cutting with a sharp knife, and inserted into a suitable growing medium and maintained in a suitable environment, to induce the formation of adventitious roots and eventually develop into a new plant (Bird, 2014:426).

Decoction: Plant material is boiled to extract the active ingredient (Nzira, 2008:73).

Ethnobotany: The global research field of exploring the relationship between plants and humans, and very often focusing on traditional medicines for their uses and potential applications in Western medicine (Sobiecki, 2004)**.**

Endangered plant species: This is when the best available evidence indicates that the species meets at least one of the five ICUN criteria for being endangered, indicating that the species is facing a high risk of extinction (SANBI:2012).

Extinct: When there is no reasonable doubt that that the last individual has died (SANBI:2012).

Indigenous knowledge: A wide range of subject areas, from art to agriculture, as well as medicinal uses of plants and traditional systems of medical diagnosis, that have been passed down over generations (Abbott, 2014).

Infusion: When wet or dry plant material is placed in boiling water that is removed from the heat source (hot infusion) or when the plant material is left in cold water (cold infusion), usually overnight, to allow water-soluble chemicals to dissolve into the water (Nzira, 2008:73).

Lotion: A liquid preparation intended for application to the skin. It may be an aqueous or alcoholic solution, or a suspension in an aqueous vehicle (Van Wyk *et al.*, 2013:16).

Medicinal plants: Any plants which, in one or more of their organs, contain substances that can be used for therapeutic purposes, or which are precursors for the synthesis of useful drugs (Sofowora, Ogunbodede & Onayade, 2013:210).

Muthi *see* **Medicinal plants** *and* **Traditional medicin**e

Native/indigenous plants: Plants occurring naturally in an area, and not introduced from elsewhere (Van Wyk, 2000:138).

Ointment: A semi-solid preparation consisting of a medicament, or mixture of medicaments, dissolved or dispensed in a suitable basis of animal, vegetable, mineral or synthetic origin, used as an emollient, a protective preparation on the skin, or as a vehicle for topical application of medicaments (Van Wyk *et al.*, 2013:16).

Propagation: A process of multiplication of a plant by sexual or asexual means, to ensure the continuation of its progeny (Oommen, 2002:18).

Protected species: Any of the protected areas referred to in Section 9 of NEMA: PAA Act 57 of 2003, such as special nature reserves (including wildness areas) and protected environments, World Heritage sites, specially protected forest areas, forest nature reserves and forest wildness areas declared in terms of the National Forests Act 84 of 1998, and mountain catchment areas declared in terms of the Mountain Catchment Areas Act 63 of 1970 (South Africa, 2003b).

Rare species: When the species meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat, and does not qualify for category of threat according to one of five ICUN criteria (SANBI, 2012).

Rhizome: A woody, or fleshy, elongated stem that usually grows horizontally below the ground (Van Wyk *et al.*, 2013:12).

Rooting hormone: A plant hormone used to promote rooting of cuttings (Joffe, 2003:29).

Scarification: Chemical or mechanical treatment to reduce or break the testa of a seed, in order to improve imbibition and germination (Bird, 2014:438).

Sexual propagation: The production of new individuals by the fusion of a nucleus from the male (in pollen) and one in the female (in the ovule) to form a zygote (Adams, Bamford & Early, 2012:136).

Sustainability: The creation and maintenance of conditions under which humans and nature can exist in productive harmony (Bird, 2014:440).

Sustainable: A method of growing and/or using resources, so that the resource is not permanently damaged and can be re-used again in the future (Bird, 2014:440).

Traditional healing system: The sum total of knowledge, skills and practices, based on theories, beliefs and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness (WHO, 2001:1).

Traditional medicine: This includes a diversity of health practices, approaches, knowledge and beliefs incorporating plant, animal, and/or mineral-based medicines, spiritual therapies, manual techniques and exercises, applied singly or in combination, to maintain well-being, as well as to treat, diagnose or prevent illness (WHO, 2001:1).

Transplanting: The transferring of seedlings to individual containers to prevent them from becoming leggy due to overcrowding (Joffe, 2003:29).

Truncheon: A giant cutting or a section of a branch (Joffe, 2003:29).

Vegetative propagation: The propagation of plants by non-sexual means, such as by division, cuttings, bulbs, corms, or tubers (Bird, 2014:441).

Western medicine: A broad category of medical practice that is sometimes called allopathic medicine, biomedicine, scientific medicine or modern medicine (WHO, 2001:1).

ACRONYMS

AIDS = Acquired Immunodeficiency Syndrome

Ca = Calcium

CBD = Central Business District

CBD = Convention on Biological Diversity

CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora

Cu = Copper

DEAT = Department of Environmental Affairs and Tourism

DWAF = Department of Water Affairs and Forestry

HIV = Human Immunodeficiency Virus

ICUN = International Union for Conservation of Nature

K = Potassium

LEMA = Limpopo Environmental Management Act

Mg = Magnesium

Na = Sodium

NEM: BA = National Environmental Management: Biodiversity Act

NEM: PAA = National Environmental Management: Protected areas Act

NEMA = National Environmental Management Act

NFA = National Forest Act

SANBI = South African National Biodiversity Institute

TB = Tuberculosis

WHO = World Health Organisation

Zn = Zinc

APPENDICES

CHAPTER 1: INTRODUCTION AND BACKGROUND

1. Introduction and background

Ethnobotany is the global research field of exploring the relationship between plants and humans, and very often focuses on traditional medicines for their uses and potential applications in Western medicine (Sobiecki, 2004). Ethnobotany is the use of plants by local people. (Van Wyk & Gericke, 2000:7).

During the past decade, traditional systems of medicine have become a topic of global importance (WHO, 1999:1). All cultures from ancient times to the present day have used plants as a source of medicine. As many as 80% of the world's population depend on traditional medicine for their primary healthcare. In the United States, 25% of all prescriptions from community pharmacies between 1959 and 1980 depended on traditional medicine for primary healthcare (WHO, 1993:4).

Vandebroek *et al*. (2008:1) in Bolivia recorded 181 medicinal plant species used to treat 67 different health conditions. Mustafa *et al.* (2012:1) in the Albanian Alps in Kosovo recorded 98 species belonging to 39 families used in folk-medicinal preparations. An ethnobotanical survey of medicinal plants used by traditional healers and indigenous people in different districts of the Chittagong division in Bangladesh, conducted by Dey, Rashid and Millat (2014:1) indicated that a total of 40 plant species from 20 families were listed for the treatment of gastrointestinal disorders, skin diseases and sexual dysfunction.

Ethnobotanical studies conducted throughout Africa confirmed that native plants are the main constituent of traditional African medicines (Cunningham, 1993:3)**.** d'Advigdor, Wohlmuth, Asfaw and Awas (2014:1) recorded 73 medicinal plants used locally in Ethiopia. Herbal anti-typhoid preparations are highly patronised and have been found to be efficacious (Koffuor *et al*., 2016:001). An ethnobotanical survey carried out in Tanzania recorded a total of 99 medicinal plant species used to treat various human diseases (Augustino & Gillah, 2005:44).

An ethnobotanical study on indigenous knowledge of medicinal plant use by traditional healers in the Oshikoto region in Namibia, conducted by Cheikhyoussef, Shapi, Matengu, and Ashekele (2011:1) recorded 61 species that belong to 25 families, for the treatment of various diseases and disorders. Medicinal plants in South Africa contribute to both the health and livelihood of many South African populations, approximately 70% of the population use medicinal plants for their healthcare (Van Wyk, Van Oudshoorn & Gericke 2009**:**250).

A medical ethnobotanical survey of the Kamiesberg in the Northern Cape, conducted by Nortje (2011:145) indicated that ethnobotanical information for Namaqualand is incomplete, and that a broad systematic survey of all useful plants of the region needs to be done as a matter of urgency. A total number of 101 plant species used to treat every day human ailments were recorded.

De Wet, Nzama and Van Vuuren (2012:12) indicated that 33 plant species were recorded as being used for treatment of sexually transmitted infections in the northern Maputaland of KwaZulu-Natal. Mathibela (2013) investigated the aspects of medicinal plant use by traditional healers from the Blouberg Mountains in Limpopo.

Samie, Obi, Bessong and Namrita (2005:1443) recorded 14 plants used in traditional medicine in the Venda region of South Africa. Tshisikhawe (2002) recorded 58 medicinal plant species commonly harvested for the medicinal properties of their bark in the Venda region. An ethnobotanical study of Vhavenda conducted by Mabogo (1990:207) concluded that, apart from the significance of indigenous plants as sources of food, medicine, firewood and materials for art and building, they are also considered useful for shade, fencing, shelter against wind, as sources of oils and dyes, and as ornamentals. Higher plants are therefore treasure houses for a repertoire of phytochemicals which serve as valuable drugs that have helped combat several fatal diseases the world over (Drewes *et al*., 2001:93).

Traditional healers are found in most societies, and they are often part of the local community, culture and tradition. Their knowledge of medicinal plants and their use is not only important for the conservation of cultural traditions and biodiversity, but also for community healthcare and drug development in the present and the future (Cheikhyoussef *et al.,* 2011:7). Traditional healers play a crucial role in providing healthcare; therefore, the existence of traditional healers and the influence they have

on the day-to-day lives of both rural and urban communities cannot be overlooked (Masupha, Thamae & Phaqane, 2012:30). It is estimated that 70-80% of people worldwide rely chiefly on traditional, largely herbal, medicine to meet their primary healthcare (Hamilton, 2004:13).

Medicinal plants still provide hope for discovery of new drugs for resistant diseases and those that were not treated by conventional prescribed drugs (Kayombo, Mahunnah & Uiso, 2013:1). Buchu is one of three South African medicinal plants that is used in international medicine (Coetzee, 1999:1). Despite all the advances in modern orthodox medicine, traditional medicine still plays a significant role in the lives of many people (Mabogo, 1990:2). Despite this, traditional African medicine often carries with it a perception and stigma of being irrational and ungrounded in scientific method, in academia (Sobiecki, 2004:1).

African medicinal plant species may be doomed to extinction by over-exploitation resulting from excessive commercialisation, habitat destruction and other natural and man-made destructive influences, unless energetic conservation measures are taken to ensure their continued availability (Chen *et al*., 2016:1) This can be done through the establishment of medicinal plant gardens and farms (Rukangira, 2001:180). *Warburgia salutaris* (Canellaceae) is an important, over-exploited African ethno-medicinal plant threatened with extinction in the wild (George, Laing & Drewes, 2001:383). Demand is one of the root causes of over-exploitation, whereby the most popular and effective species are the most vulnerable (Xego, Kambizi & Nchu, 2016:169).

Plant propagation is a natural phenomenon in all plants. It is a process of multiplication of a plant, by sexual or asexual means, to ensure the continuation of its progeny. This is achieved artificially in the field by adopting techniques suitable to the specific plant and its growth cycle (Oommen, 2002:18); however, traditional healers do not have professional knowledge and skills in production practices of medicinal plants. Training is therefore crucial, to ensure that they develop skills in the basic practice of growing medicinal plants (Manzini, 2005:49).

Encouragement of cultivation is often likely to be useful in taking pressure off the wild stock, thus helping to conserve genetic diversity, and perhaps more reliable sources of income for village people (Verma, 2013:174).

For threatened medicinal plant species, cultivation is a conservation option, because the constant drain of material from their population is higher than the annual sustained yield. If the demand for these species can be met from cultivated sources, the pressure on the wild populations, improved security of germplasm *ex-situ,* and *in-situ* investment in selection and improvement programmes, makes this an urgent venture (Schippman, Leaman & Cunningham, 2002:8). Documenting the trade and use of medicinal plants, understanding the socio-economic conditions of resource users, and their perceptions of cultivated medicinal plants, is believed to be the starting point for the sustainable management of medicinal plants (Loundou, 2008:30).

1.1. Study area

Thulamela municipality forms part of the Vhembe district of Limpopo, and it forms part of the former Venda homeland (Figure1.1). Thulamela municipality is located within the latitudes 22º 57º S 30º 29º E (Thulamela Local Municipality, 2015:3).

The native residents of this area are Venda- and Tsonga-speaking people. Thulamela municipality was established in terms of the Local Government: Municipal Structures Act No. 117 of 1998 (South Africa, 1998a). It is one of four local municipalities comprising the Vhembe district municipality, and it is the eastern-most local municipality in the district. The Kruger National Park forms the boundary in the east, Mutale municipality forms the border in the north- east, and Makhado municipality in the south-west. Forty-seven percent (47%) of the entire Vhembe district's population live in Thulamela municipality, and more than 85% of the people in this municipality live in tribal areas. Thulamela municipality has a population size of 618 462, with a population growth of 0, 62% in 2011 (Statistics South Africa, 2016).

The geographical location of Thulamela is as follows:

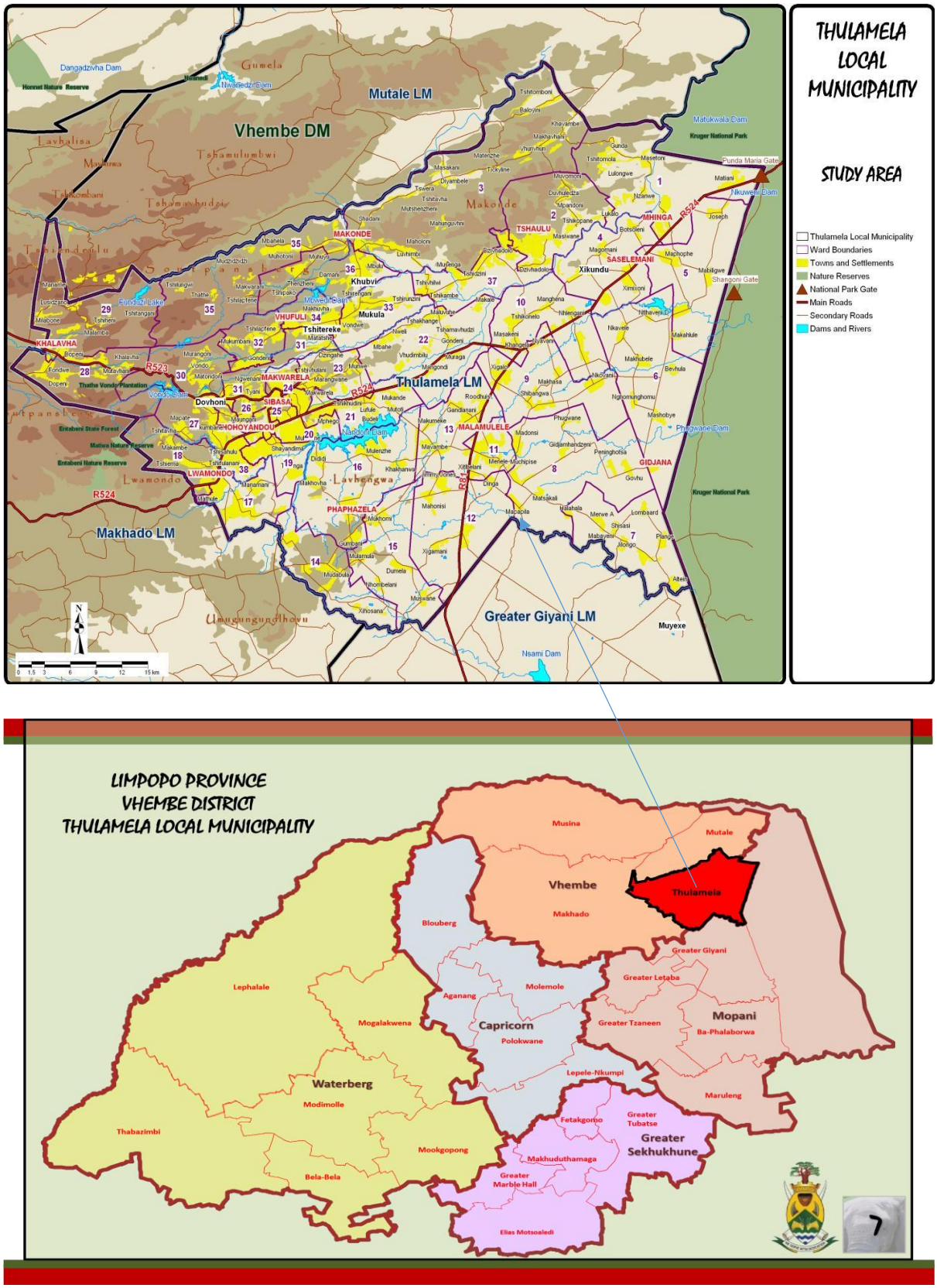

Figure 1.1: Thulamela municipality. (**Source**: Thulamela Local Municipality, 2013/14).

1.1.1. Topography

Thathe Vondo Mountains (1439 metres above sea level) on the eastern side of Nzhelele slopes gently into the Sibasa region. The eastern side of this mountainous region also undulates into the hilly areas of Thohoyandou/Mphaphuli districts (Mabogo, 1990:8). The Maniini area has a gentle terrain, and is located in a floodplain, making it vulnerable to flooding, compared with Tshilugwi village, which is characterised by gently rolling plains, as well as mountainous and hilly terrain (Musyoki, Thifhulufhelwi & Murungweni, 2016).

The area falls within the eastern part of the lowveld which forms part of the greater Limpopo basin, and is characterised by 8% gently undulating slopes running in a north-south direction (Mzezewa & Van Rensburg, 2011:166-167).

1.1.2. Geology and soil type

The area is underlain by Precambrian basalts of the Sibasa formation of the Soutpansberg group to the north and leucocratic biotite gneiss, leucocratic granite and pegmatite, grey biotite gneiss, and migmatite of the sand river gneiss of the central zone of the Limpopo belt, to the south. The area is characterised by Precambrian igneous and metamorphic rocks (Hutten, 2015:6-7).

In the Lambani area the dominant soils are Hutton, Dresden, Tukulu, Sepane and Vaalsrivier (Petja *et al*., 2010:4). The geology and soil in Thulamela consists of fertile clay soil, sandy soil and clay loam soil (Musyoki *et al.,* 2016).

1.1.3. Climate

The temperature is associated with seasonal conditions and topography, with warm wet summers (16-40 degrees Celsius) and cool dry winters (12-22 degrees Celsius). Annual rainfall varies from as high as 2000mm in the east, and reaching as low as 340mm in the west (Kabanda, 2003:10-11**).** The highest rainfall is in summer, and Venda hardly experiences frost (Mabogo, 1990:8).

The Thulamela climate is typically subtropical, with mild, moist winters and warm summers characterised by lowveld (arid and semi-arid). The area experiences an

annual rainfall of approximately 500mm per annum, out of which 87, 1% falls between October and March. The rainfall pattern is largely influenced by the orographic rain effect of the Drakensberg Mountains joining the Soutpansberg perpendicularly, hence decreasing from east to west (Thulamela Local Municipality, 2017:34).

1.1.4. Vegetation

This area represents a montane forest vegetation type, which is least protected among the different forest types of South Africa. The area is characterised by a subtropical climate, with a mist belt, montane forest and woodland dominating the Tshivhase region (Tshiguvho, 2008:36).

The Thulamela area has a surprising biological diversity of flora and fauna. This rich biodiversity can be attributed to its geographical location and diverse topography. The district falls within the greater Savanna biome (Figure 1.2), commonly known as the bushveld, with some small pockets of grassland and forest biomes. These and other factors have produced a unique assortment of ecological niches which in turn are occupied by a wide variety of plant and animal diversity. The area also comprises a number of sacred forests (Thulamela Local Municipality, 2017:35).

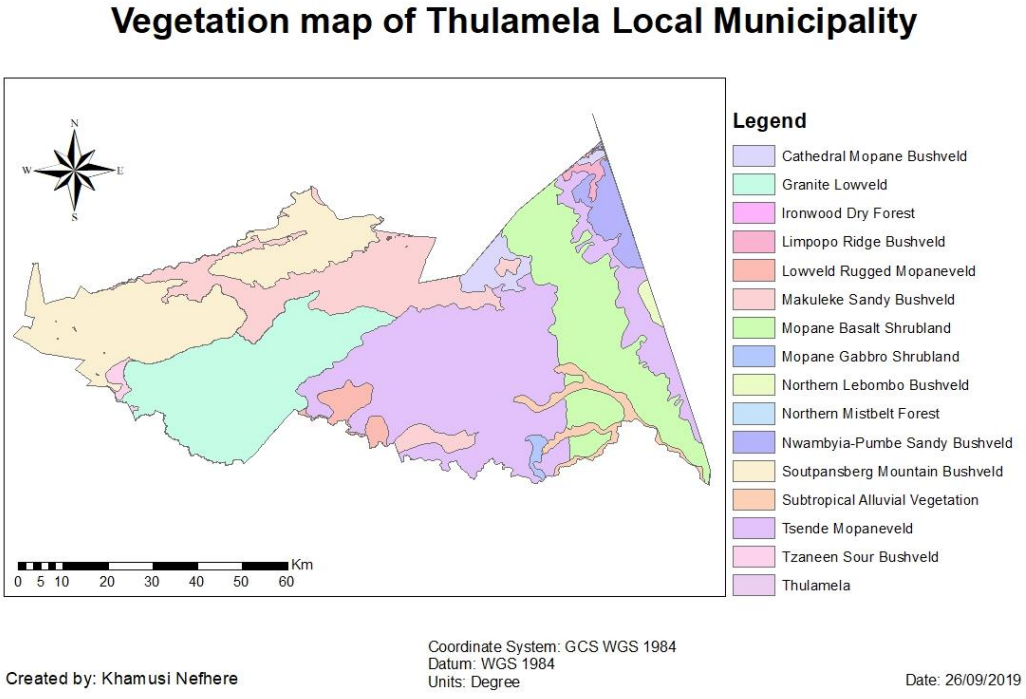

Figure 1.2. Vegetation map of Thulamela (**Source**: Mucina *et al*., 2014).

The rampant use of muthi contributes greatly to the unsustainable harvesting of indigenous plant species. Overgrazing, bush encroachment, poor settlement planning and highly densified rural areas are placing severe stress on the vegetation and soil (Thulamela Local Municipality, 2017:59).

Thathe Vondo forest has a variety of floral species among which the following are locally endemic species: Mutango (*Faurea saligna*), Mutondo (*Pterocarpus angolensis*), Mutuhu (*Trichilia dracaena*), Mulathoho (*Croton sylvaticus*), Tshikwatule (*Sapium integerriumum*), Tshiphophamadi (*Apodytes dimidiata*) and Phiriphiri (*Piper capense*) (Sikhitha, 1999:24). Of the 38 known endemic plant taxa in the Soutpansberg, approximately 52% occur within the mist belt region, and no fewer than 26% are restricted to it (Hahn, 2002:27).

1.2. Problem statement and rationale

Indigenous medicinal plant resources are increasingly under threat from habitat destruction because of agricultural, industrial and housing development. The activities of professional herb gatherers and traditional healers have also exaggerated the impact on the remaining stock of wild plants (Van Wyk *et al.*, 2013:14; Mabogo, 1990:2). The high demand for some plants in the popular *muthi* (traditional medicine) trade (which in many cases exceeds the supply) makes them objects of extinction in the wild (Chen *et al.,* 2016:1). Together with the increase in Africa's population, and a higher demand for traditional medicine, depletion of natural resources due to loss of habitat is becoming imminent; this results in many medicinal plants becoming extinct before they are even documented (Van Wyk & Prinsloo, 2018:340, Xego *et al*., 2016: 169).

Limpopo is one of the poorest provinces in South Africa, with a large rural population growth rate, resulting in prestine habitat being eradicated at an unprecedented rate (Hahn, 2002:27). The traditional medicine trade in South Africa is a growing industry, with around 27 million consumers of traditional medicine, constituting an estimated contribution of R2,9 million to the national economy (Mander, Ntuli, Diederichs & Mavundla, 2012:190). Despite this, traditional African medicine often carries with it a

perception and stigma of being irrational and ungrounded in scientific academia (Sobiecki, 2004:1).

If collecting a medicinal plant reduces the wild population, continuing to do so will inevitably impair the rights of future generations (WHO, 1993:20, Van Wyk & Prinsloo, 2018:340). To use and conserve medicinal plants effectively, it is vital to know precisely which are the species concerned, what their correct names are, and how they grow (Williams, Victor & Crouch, 2013:29).

The indigenous medicinal plant industry is fully based on harvesting from the wild. This is not sustainable, and will have to be supplemented by propagation. For threatened medicinal plant species, cultivation is a conservation option because the constant drain of material from their population is higher than the annual sustained yield (Coetzee, Jefthas & Reintein, 1999:162; Van Wyk & Prinsloo, 2018:335). Therefore, the need to develop the tradition of cultivating the plants is imperative (Xego *et al.,* 2016: 177, Petersen *et al*., 2017:4).

If the demand for these species can be met from cultivated sources, the pressure on the wild populations will become less. (Mathibela, 2013:74). Improved security of germplasm, and *ex-situ* and *in-situ* investment in selection and improvement programmes is very urgent (Larkin, Jacobi, Hipp & Kramer, 2016: 1). Regrettably, unsustainable harvesting is an increasingly common occurrence that threatens not only these species, but also the livelihoods and health status of people around the world (Verma, 2013:116). Documenting the trade and use of medicinal plants, as well as understanding the socio-economic conditions of resource users and their perceptions of cultivated medicinal plants, is believed to be the starting point for sustainable management of medicinal plants (Loundou, 2008:30).

Considering the sustainable use of medicinal plants which includes formulation of good harvesting practices must be practiced (Chen *et al*. 2016:7). If the increasing demand for medicinal plants needs to be met, it is very crucial to conserve these plant species by cultivation or other conservation measures such as in-situ and ex-situ conservation measures, to ensure a continuous sustainable supply of raw materials for the industry for their sustainable utilisation (Xego *et al*., 2016:176).

1.3. Research questions

1.3.1. What are the most-harvested plant parts, and what is being done to ensure the species' survival during and after harvesting?

1.3.2. Is there any potential role that medicinal plants can play as an alternative to biomedicine in the provision of primary healthcare?

1.3.3. Is there sufficient awareness regarding environmental regulations concerning collection/harvesting of medicinal plants among traditional healers?

1.3.4. What is the current conservation status regarding indigenous medicinal plants?

1.4. Aim and objectives

1.4.1. Research aim

The main aim of this research project was to investigate aspects relating to traditional healers' perceptions with regard to collection, ethnobotanical importance and conservation of indigenous medicinal plants used by traditional healers around Thulamela municipality. This will help to identify medicinal plants used by local people, for future planting in their households, community gardens and nurseries.

The information gained from this study will inform further studies and projects aimed at documenting medicinal plant knowledge, and support continued practice and sustainability of indigenous medicinal plants.

1.4.2. Research objectives

The main objectives of this study are the following:

- To document medicinal plants collected and utilised by traditional healers, and identify their conservation status.
- To determine the most-harvested plant parts, harvesting procedures and processes.
- To determine whether there is a potential role that medicinal plants can play as an alternative care to biomedicine in the provision of primary healthcare.

- To determine whether there is sufficient awareness regarding environmental management regulations among traditional healers concerning harvesting and sustainability of indigenous medicinal plants of Thulamela municipality.

Sustainable management of traditional medicinal plant resources is important, not only because of their value as a potential source of new drugs, but also due to reliance on traditional medicinal plants for health (Xego *et al*., 2016:169).

Through an improved understanding of the application of information and technologies and the traditional ethno-botanical research model, tomorrow's scientists may better record and compare traditional botanical knowledge. This integration would greatly assist in stemming the tide of unprecedented loss of global biocultural diversity in the twentieth century (Thomas, 2003:65).

1.5. Hypotheses

H_0 = Medicinal plants are not collected and utilised by traditional healers of Thulamela municipality.

H_1 = Medicinal plants are collected and utilised by traditional healers of Thulamela municipality.

H_0 = Harvesting procedures, processes and parts harvested do not have an impact on the survival of the species being harvested by traditional healers of Thulamela municipality.

H_2 = Harvesting procedures, processes and parts harvested have an impact on the survival of the species being harvested by traditional healers of Thulamela municipality.

H_0 = There is insufficient awareness regarding environmental management regulations concerning harvesting/collection of medicinal plants among traditional healers of Thulamela municipality.

H_3 = There is sufficient awareness regarding environmental management regulations concerning harvesting/collection of medicinal plants among traditional healers of Thulamela municipality.

H_0 = Medicinal plants of Thulamela municipality are irrational and ungrounded in scientific method in academia.

H_4 = Medicinal plants of Thulamela municipality are rational and grounded in scientific method in academia.

H_0 = Medicinal plants of Thulamela municipality cannot play a role as an alternative source of primary healthcare to biomedicine.

H_5 = Medicinal plants of Thulamela municipality can play a role as an alternative source of primary healthcare to biomedicine.

H_0 = There is no decline in the availability of some medicinal plants of Thulamela municipality.

H_6 = There is a decline in the availability of some medicinal plants of Thulamela municipality.

1.6. Motivation for the study

This study will benefit communities by doing the following:

- Explaining basic propagation methods that can be used to encourage ordinary citizens and traditional healers to grow medicinal plants in their own backyards for medicinal purposes, and for their aesthetic beauty as garden subjects.
- Providing a better understanding of traditional medicine and the traditional healing process, as well as the role played by traditional medicine as a source of primary healthcare to rural and urban communities.
- Informing the communities about the status of indigenous medicinal plants that need special attention, the consequences of unsustainable behaviour towards medicinal plants, and approaches that can be followed to conserve medicinal plants.

CHAPTER 2: LITERATURE REVIEW

2.1. Ethnobotany

Ethnobotany is the use of plants by local people (Van Wyk & Gericke, 2000:7). Around the world, indigenous groups have traditionally used leaves, bark and roots containing tannins to treat diarrhea and intestinal parasites in humans and livestock. Traditional practices could be a means to better health and economy for traditional societies (Aas, 2003:32). Ethnobotanical survey conducted in rural Alpine communities in Europe indicated that 98 species belonging to 39 families were recorded. The most quoted families were Rosaceae, Asteraceae and Lamiaceae (Mustafa *et al*., 2012:1)

The use of medicinal plants as a fundamental component of the African traditional healthcare system is perhaps the oldest and the most assorted of all therapeutic systems (Mahomoodally, 2013:2). Local traditional medicine and the practice of plant-based medicine are still widespread in rural areas such as the Chipinge district in Zimbabwe, and traditional healers play an important role in primary healthcare (Ngarivhume, Van't Klooster, De Jong & Van der Westuizen, 2015:225). Plants are used as an important source of medicinal agents to treat and cure various diseases, and economically important drugs are derived from plant sources. Many of these plants have antimicrobial properties (Obi *et al.*, 2002:25).

In this dual role as a source of healthcare and income, medicinal plants make an important contribution to the larger development process. Unfortunately, some plant species of medicinal value are already in short supply, which poses a threat to human welfare and the wild species themselves. Immediate action is therefore required to ensure that harvest and trade of medicinal plant species are conducted sustainably (Verma, 2013:113). If the useful information of traditional peoples is to be documented before it is too late, ethnobotanical activities must be broadened and accelerated (WHO, 1993:10).

2.2. Traditional healing system

There are an estimated 200 000 indigenous traditional healers in South Africa, and up to 60% of South Africans consult these healers, usually in addition to modern biomedical services (Van Wyk & Van Wyk, 1997:10). It is estimated that there are between 250 000 and 400 000 traditional healers in South Africa, and 28 000 medical doctors (Ross, 2010:46). Eight out of every ten black South Africans rely on traditional medicine alone, or in combination with Western medicine. This concurrent use of allopathic and traditional medicine is referred to as medical pluralism or medical syncretism (Ross, 2010:46). The Northern Province (Limpopo, currently) has one doctor for every 20 000 people, yet there is one traditional healer for every 200 inhabitants. Africa has a rich tradition of plant use, and an immense range of climates, cultures and species, as well as human and natural resources, to become an even greater producer of natural plant products (Potgieter, Madzibane, Mashabane & Wessels, 2001:78).

2.3. Traditional medicine

The WHO (2002:1) estimates that up to 80% of the population of Africa make use of traditional medicine. Medicinal plants are the main source of medication for 80% of the sub-Saharan population. The use of medicinal plants as a fundamental component of the African traditional healthcare system is perhaps the oldest and most assorted of all therapeutic systems (Mahomoodally, 2013:2).

The rich heritage of indigenous knowledge associated with herbal medicine is considered as the basis of all systems of traditional remedies in Bangladesh, and most medicinal plants are extensively used in the preparation of Ayurvedic and homeopathic medicines (Dey *et al*., 2014:1). Local traditional medicine and the practice of plant-based medicine are still widespread in rural areas such as the Chipinge district in Zimbabwe, and traditional healers play an important role in primary healthcare (Ngarivhume *et al*., 2015:225). In South Africa, a large part of day-to-day medicine is still derived from plants, and large volumes of plants or their extracts are sold in the informal and commercial sectors of the economy (Van Wyk *et al*., 2013:8).

2.3.1. Knowledge acquisition

African traditional healers' skills are acquired by apprenticeship to an older healer, experienced of certain techniques or conditions, or calling by the spirits or the ancestors. The calling can take the form of a dream, a passion or a feeling. Sometimes the calling makes a person feel sick or brings them ill-fortune so that they consult a traditional healer, who tells them that they have been "called" (Ross, 2010:46). Training and practice are organised within and around a framework of rituals which typically involve the slaughter of an animal, and brewing of sorghum-based beer at the gathering of sangoma, thwasa and others. Drumming, dancing and declamation are powerful features of such events – which may last for several days (Wreford, 2005:93-94).

Knowledge on traditional healing originates from the ancestors with whom sangomas are in constant contact. To become a sangoma and acquire the special contact from ancestors requires a special "call" in a dream, which all sangomas told that they had had. Whether it is locations of collecting plants, what to collect, or how to mix and prepare a cure for illness, sangomas ask the ancestors for advice (Stoffersen, Winstrup, Nieminen & Allerton, 2011:22)

During this time, the trainee learns how to throw the bones and to control the trance-like states where communication with spirits takes place. After completion of the training process, a culturally accepted form of ancestral spirit possession follows, when called to become a diviner (Truter, 2007:57, Mabogo, 1990:32).

2.3.2. Knowledge transfer

The transfer of knowledge is important, in order to sustain the local knowledge and for the tradition of medicinal plant use to survive. Knowledge in the use of medicinal plants and traditional healing is an oral tradition transferred from generation to generation (Stoffersen *et al.*, 2011:21; Van Wyk *et al.*, 2013:7). The chain of knowledge may break if none of the family members becomes interested (Tshisikhawe, 2012: 60).

Indigenous medical knowledge and traditional medicine (TRM) practice was in danger, because some the potential youths to practice TRM were moving to urban areas, boarding schools and higher training institutions, and some of these youths were not interested in the practice (Kayombo *et al.*, 2013:4).

2.3.3. Species utilisation

Mathibela (2013:47) recorded 64 medicinal plant species as being used by Blouberg traditional healers. Nzue (2009:100) recorded 183 plant species reported to be customarily used for medicinal purposes. Chinsembu (2016:1) recorded 52 plant species in 25 families and 43 genera which were used to treat gonorrhea, syphilis, chancroid, chlamydia, genital herpes and ano-genital warts. Sexually transmitted infections were frequently managed using the following plants: *Terminalia sericea, Strychnos cocculiodes, Ximenia caffra, Cassia abbreviata, Cassia occidentalis, Combretum hereroense, Combretum imberbe, Dichrostachys cinerea, Boscia albitrunca*, *Momordica balsamin*a and *Peltophorum africanum*. Many of these plants have putative antimicrobial activities which may justify their role as natural remedies for sexually transmitted infections. De Wet *et al. (*2012:4) recorded 47 plant species used for the treatment of different skin disorders, including abscesses, acne, burns, boils, ringworm, rashes, shingles, sores, wounds and warts. Semenya and Potgieter (2014:128) recoded 43 species used by Bapedi traditional healers to treat 12 different human diseases. Rankoana (2016:226) recorded 44 indigenous medicinal plant species belonging to 28 families.

2.3.4. Sources of traditional medicine

The majority of the volumes of medicinal plants for informal markets are harvested from wild populations (Moeng, 2010:68). Medicinal plants are being traded mainly in an informal, provincial market. The vast majority of medicinal plants used in traditional medical systems are natural products which are collected in the wild (Verma, 2013:116). Nzue (2009:80) also confirmed that collection from the wild has been the most widespread practice.

2.3.5. Demand and availability

Popular species which are no longer available in these communal areas may be harvested on forestry estates (exotic plantations with natural areas), commercial farms and protected areas. Harvesting takes place with or without the consent of the landowners or local authority (Mander, 1998:37).

The current demand for numerous plant species used for indigenous medicines exceeds supply. To date, several plant species, such as wild ginger (*Siphonochilus aethiopicus*) and the pepper bark tree (*Warburgia salutaris*) have become extinct outside the protected areas in KwaZulu-Natal (Mander, 1998:1). Drewes *et al.* (2001:383) confirm that *Warburgia salutaris* (canellaceae) is an important over-exploited ethnomedicinal plant threatened with extinction in the wild.

The biological diversity of the planet is rapidly depleting as both a direct and indirect consequence of human activity. An unknown but large number of species are already extinct, while many others have reduced population sizes that put them at risk. Many species now require human intervention to ensure their survival (Frankham, Ballou & Briscoe, 2004:2). Climatic changes, that include global warming, have an effect on the distribution of medicinal plants. The changes have contributed to a loss of genetic resources in areas where they used to be found (Kayombo *et al*., 2013:3). Medicinal plants are important for the villagers' healthcare and culture, so it is important to investigate the pressure on medicinal plants within villages (Stoffersen *et al.*, 2011:24).

2.3.6. Harvesting procedures

Traditional healers still practice rituals of collecting medicinal plants while in the field. These rituals possibly ensure that the plant from which plant parts are collected should not die, and to ensure that the medicine should work effectively (Tshisikhawe, 2002:36). Rituals that relate to specific trees such as *Brakenregia zanguebarica* and *Milletia stuhlmanii* require that a traditional healer be naked when they collect material from them. It is believed that anyone who tries to collect *M. stuhlmanii* without being naked will become insane or mentally disturbed (Khorommbi 2001:ixx).

Moeng (2010:70) confirmed that traditional healers perform rituals before harvesting, in order to secure a good quality medicinal plant, and, further, that medicinal plants with magic properties are only harvested by traditional healers who are trained in harvesting rituals.

2.3.7. Harvested plant parts

In South Africa, bark, leaves, rhizomes (roots), bulbs, fruits and seeds are used as medicine. All the various parts of plants carry different chemicals, or active ingredients, so it is essential to make sure one is using the right part of the plant (Nzira, 2008:72). Plant parts most preferred in medicinal plants are roots. Of the medicinal plants found in shops visited, 61% were roots, 22% were in the form of a whole plant, 15% in the form of bark, 1% in the form of fruits, and the remaining 1% in the form of leaves (Tshisikhawe, 2002:36). The plant parts most sensitive to harvest are the ones that are most exploited; therefore, collectors must collect such parts with extreme care to ensure plant survival and conservation (Tshisikhawe, 2002:36). Among the different plant parts, roots are the most frequently used for the treatment of diseases, followed by leaves, whole plant parts, bark, tubers, seeds, fruits, pods and stems (Cheikhyoussef *et al*., 2011:21).

2.3.8. Preparation and administration

Plants are either used fresh, or dried for later storage (Nzira, 1998:73). The method of preparation is critical, as it includes the amount of fresh or dry material to be used, the addition of appropriate volumes of solvents such as water or alcohol, and additional activities such as boiling water for a specified length of time, or partial burning to achieve a desired colour. These activities can serve to neutralise certain toxins (Van Wyk *et al.*, 2013:18).

2.3.9. Packaging and storage

While some whole plants, or parts of plants, can only be used in a fresh state, many can be dried and stored. Plant material may be dried in the sun or shade, or cut into slices and left to dry. Once dry, the plant material may be stored as is, or reduced to powder. Dry plant material is stored in paper bags, newspaper, glass jars or tin cans (Van Wyk *et al.*, 2013:14). Once medicinal plants have been dried, they should not be exposed to light or heat for long, as this will degrade them. They should be stored in a cool dark place (Nzira, 1998:73).

2.4. Medicinal plant conservation

Declining biodiversity is a major environmental problem. Even without climate change, extinction, or the disappearance of whole species, is now occurring at the highest rate recorded in human history (Myers & Spoolman, 2014:368). Despite the supply of electricity to households, people still illegally cut down trees for firewood, in turn driving away the fauna and other related ecosystem networks. The socio-economic makeup of the community is making it difficult for people to afford electricity. This puts direct pressure on natural trees as the cheapest alternative form of energy (Mutshinyalo & Siebert, 2010:167). Rural people, who constitute the bulk of the population, are heavily dependent on the vegetation around them for fuel wood, and for medicine. They are mainly subsistence farmers, and cannot afford alternative fuels, let alone the high prices of modern medicines. As a result, vegetation is lost, and environmental degradation takes place (Kasagana & Karumuri, 2011:1378).

The vegetation of the world is being changed or destroyed at an alarming rate (WHO, 1993:24). Tshisikhawe (2012:22) indicated that *Adansonia digitata*, *Adenia spinosa*, *Albizia adiathifolia*, *Albizia versicolor, Brackenridgea zanguebarica*, *Warburgia salutaris* and *Croton megalobotrys* are the most vulnerable species. According to the Limpopo Environmental Management Act No. 7 of 2003 (South Africa, 2003a), *Brackenridgea zanguebarica*, *Warburgia salutaris*, *Encerphalartos villosus*, *Pterocarpus angolensis* and *Adansonia digitata* are among plants classified as specially protected plants.

Elaeodendron transvaalense population sampled shows that it is not abundant, and may become increasingly rare in the near future (Tshisikhawe, 2002:104).

Two of the many threats to medicinal plants are the loss of local knowledge about their usage and the loss of species from the wild due to overharvesting. In order to aid the discovery of new drugs, and to find the best application of traditional medicine, it is therefore essential to formally record and thus preserve the traditional knowledge on medicinal plants (Delvaux, Sinsin, Darchambe & Van Damme, 2009:704).

De Wet *et al.* (2012:7) indicate that the use of leaves in traditional medicine encourages sustainable development, as traditional use favours plant parts that can be regrown with ease. The study also noted that lay people are using their medicinal plants conservatively, as it is a valuable free source in their primary healthcare system.

The impact of uncontrolled harvesting on medicinal plants is of serious concern to environmentalists and the community as a whole. Medicinal plants are being harvested at an alarming rate, despite the enactment of the National Environmental Management Amendment Act No. 62 of 2009 (Masupha *et al.,* 2012:30). Many traders are only interested in profit, and do not collect according to the time-honoured ethics and principles of traditional healers; for instance, if the plant is killed, the medicine will not work – and could even harm the harvester, medicine should not be collected from a plant previously harvested by another healer, and roots should not be left exposed (Cumes, Loon & Bester, 2009:6).

Warburgia salutaris has been severely over-harvested throughout its distribution range, due to its popularity as a source of ethnomedicine (Maroyi, 2013:2). As a result of the threatened status of *Warburgia salutaris*, and an increase in illegal harvesting of the population within the Kruger National Park, an active research, management and monitoring strategy was needed to promote long-term survival of the species (Scheepers, Swemmer & Vermeulen, 2011:8).

2.4.1. Threats to medicinal plant conservation

2.4.1.1. Population growth

Human population growth, along with increasing and wasteful resource consumption, are key factors that underlie rapidly growing ecological footprints. This problem can be addressed by improving economic conditions and reducing poverty, educating and empowering women, and promoting family planning (Myers & Spoolman, 2014:378).

There is a worldwide concern that human activities such as pollution, habitat destruction, over-exploitation and foreign plant and animal invasion, are resulting in an ever-increasing loss of the earth's biological wealth. If continued unabated, one stands to lose crucial life-support systems through the loss of important habitats, to undermine rural livelihoods, with the degradation of the natural resource base on which people depend, and to diminish economic opportunities, as options for developing medicines and foods are reduced and the natural resource base for tourism is damaged (DEAT, 1997:11).

Human activity has been changing South Africa's ecosystems for thousands of years, but the pace and extent of change has increased rapidly with agricultural and industrial development. Present estimates suggest that a substantial proportion of natural habitat has been transformed largely by agriculture, urban development, afforestation, mining and dams (DEAT, 1997:13). Due to population pressure, deforestation and changes in land use patterns, many species of flora and fauna have become extinct, and many more are threatened and endangered (Motaleb, 2010:2).

Population growth throughout the KwaZulu-Natal region was 2,4% per year, leading to an increase in the potential number of people who make use of indigenous medicine. Coupled with this increase is an accelerated urbanisation rate, which increases the competition for resources and services, especially where economic growth lags behind population growth (Mander, 1998:25). The expansion of settlements as a result of intrinsic human population growth, is posing a challenge to the *Brackenridgea zanguebarica* population growth, since clearing for such development does not take cognisance of the importance of the plants, in most cases (Tshisikhawe, 2012:195).

As Africa's population grows, the demand for traditional medicines will increase, and pressure on indigenous medicinal plants will become greater than ever; however, the collection of wild plants for traditional medical use is detrimental to certain species (Rukangira, 2001:179). The more people, the more impact and unsustainable use and disrespect there is for biodiversity; therefore, the ever-increasing human population is contributing significantly to the change in behaviour of the existing generation (Mutshinyalo & Siebert, 2010:157).

Rapid urbanisation and importance of herbal medicine in African healthcare systems has stimulated a growing national and regional trade in Africa (Schippman *et al.,* 2002:82). Foreign rule and influence, population growth, the shift to a cash economy, as well as other factors, have combined to weaken the conservation ethic. This has resulted in a rapid decline in biodiversity health, which in turn has led to a decrease in quality of life (Raynor & Kostka, 2003:56). The human population has grown exponentially, and this will worsen the impact on indigenous animals and plants in the near future (Frankham *et al*., 2004:6).

2.4.1.2. Unsustainable harvesting

Sustainability is crucial for any community-based programme (Motaleb, 2010:22). Sustainable management of traditional medicinal plant resources is important, not only because of their value as a potential source of new drugs, but due to reliance on indigenous medicinal plants for health (Cunningham, 1993:1).

Ring-barking or uprooting of plants is the most common method used by commercial gatherers (Cunningham, 1993:3). Presently, there is a tendency for traders to harvest irresponsibly in order to satisfy a growing muthi industry (Cumes *et al*., 2009:6). The current harvesting techniques are destructive, and are aimed at maximising the harvest in order to maintain a high level of income (Moeng, 2010:90).

The essence of over-exploitation is that populations are harvested at a rate that is unsustainable, given their natural rate of mortality and capacity for reproduction (Begon, Howarth & Townsend, 2014:378). If collecting medicinal plants reduces the wild population, continuing to do so will inevitably impair the rights of future generations (WHO, 1993:20).

2.4.1.3. Commercialisation

The traditional medicine trade in South Africa is a large and growing industry. There are 27 million consumers of traditional medicines, and the trade in these medicines contributes to an estimated R2,9 million to the national economy (Mander *et al.*, 2012:190). Williams, Blackwill and Witkowski (1997:72), recorded 511 species from 328 genera and 119 families were identified as being traded on the Witwatersrand. The growing interest in medicinal plants from both the international industry and local markets requires management of tree harvesting from natural forests, to prevent inappropriate exploitation of target species (Delvaux *et al.*, 2009:703). The analysis pattern of trade in medicinal plants by local markets in South Africa is posing a threat to the conservation of many plant species (Tshisikhawe, 2002:52).

Commercialisation of natural resources such as medicinal plants, is a method that is increasingly being used by poor people in developing countries as a means of generating income (Ah Goo & De Wit, 2015:69). Despite the modest income generated from trade, most traders indicated that they preferred to remain in the medicinal plant industry, rather than to pursue other income-generating opportunities (Ah Goo & De Wit, 2015:77). The emergence of commercial medicinal plant gatherers in response to the urban demand for medicines and the rural unemployment rate, has resulted in indigenous medicinal plants being considered as an open access or common property resource, instead of a resource used by specialists.

Ring-barking or uprooting is the most common method of collection used by commercial gatherers (Cunningham, 1993:13). Several pharmaceutical companies are currently developing products for the African market in South Africa. There are reports that some companies are even buying raw materials from plant harvesters in rural areas (Mander, 1998:36).

2.4.1.4. Unemployment

South Africa is experiencing economic growth, but without an increase in jobs, with worsening poverty, and with declining biodiversity. To ensure sustainable livelihoods, it is important to ensure that economic opportunities are expanded in local areas, in a way that takes both humans and biodiversity into account (DEAT, 1997:51-52). Poverty also fuels the demand for medicinal plants, as households are forced to make use of affordable medicine, while consulting a healer may be more expensive than visiting a clinic. Medicine bought directly from street traders is much cheaper than any form of healthcare, and, consequently, an important healthcare option (Mander, 1998:25). Increasing economic hardship and lack of employment opportunities in the formal sector of the South African economy have led many urban dwellers to seek alternative ways of meeting their everyday livelihood needs (Ah Goo & De Wit, 2015:69). Apart from pharmaceutical companies, trade in medicinal plants has become a way of making a living for some people (Tshisikhawe, 2012). Wild harvesting of medicinal plants is a chance for the poorest to make at least some cash income (Schippmann *et al*., 2002:82).

It is worth noting that although the medicinal plant industry plays an important role in empowering many people, the increase in the number of role-players and quantities harvested may result in in the depletion of natural assets, as well as subsequent problems for primary healthcare (Loundou, 2008:26). Medicinal plants represent an important asset, not only in providing primary healthcare, but also in providing an income for rural and urban communities (Loundou, 2008:30).

2.4.1.5. Urbanisation

Urbanisation or urban sprawl is the conversion of large natural areas and croplands to housing and commercial developments, parking lots, streets and highways. Undisturbed natural areas and crop fields also provide food resources and wildlife habitats, but when these natural areas are paved over, the ecological services they provide are degraded or lost (Myers & Spoolman, 2014:61). Urbanisation is a rapidly growing phenomenon worldwide, and, since 2008, urban populations have exceeded rural populations (Mutanga, Simelane & Pophiwa, 2013:163).

Forests are extremely important for the ecological and economic services they provide; for example, they generate oxygen through photosynthesis while removing carbon dioxide from the atmosphere. By performing this service, forests help to stabilise the earth's atmospheric temperature and regulate climate change as part of the carbon circle (Myers & Spoolman, 2014:231).

2.5. Approaches to medicinal plant conservation

In response to the decline in medicinal plant resources, governments, non-governmental organisations (NGOs) and other stakeholders worldwide took some initiatives to overturn the over-exploitation of medicinal plants resources (Loundou, 2008:26). It is recommended that environmental education campaigns be conducted on sustainable harvesting methods (Nzue, 2009:83). There is a need for a concrete environmental education programme, including an explanation of the relevant sections of legislation dealing with the protection of natural resources, through the organisation of workshops and the distribution of brochures, explaining the important aspects of the law (Nzue, 2009:96; Mutshinyalo & Siebert, 2010:167). An awareness campaign is an integral part of educating a target group about the existing situation, and mobilising them to effectively manage and conserve medicinal plants and traditional practices (Motaleb, 2010:8).

Establishment and maintenance of scientific programmes and technical education and training in measures for the identification, conservation and sustainable use of biological diversity and its components, is essential – also to provide support for such education and training for the specific needs of developing countries, and promote and encourage research, which contributes to the conservation and sustainable use of biological diversity.

It is important to promote and encourage understanding of the importance of, and the measures required for, the conservation of biological diversity, as well as its propagation through media, and the inclusion of these topics in educational programmes, as well as cooperation with other states and international organisations in developing educational public awareness programmes, with respect to conservation and sustainable use of biological diversity (DEAT, 1997:112).

The benefits of conserving biodiversity are numerous. A large proportion of South Africa's population are directly dependent upon biological resources for subsistence purposes, including the gathering and harvesting of plants for food, medicine, shelter, fuel, building material and trade. The use of biological resources thus provides an important buffer against poverty, as well as opportunities for self-employment in the informal sector (DEAT, 1997:14).

2.6. Legislation

Although a substantial amount of environmental legislation is in place in South Africa, poor enforcement renders much of it ineffectual. Compounding the problem are the often inappropriate penalties imposed for infringing legislation, and the lack of capacity within government agencies to monitor infringements (DEAT, 1997:93).

2.6.1. Constitution

The South African Constitution (South Africa, 1996) is the supreme law of the country, and any law or conduct inconsistent with the Constitution is invalid. Through the inclusion of environmental rights in the Constitution, environmental law has found a firm entrenchment into South African legal system, with a sound basis and constitutional mandate for further development and improvement.

The Convention on Biological Diversity (CBD) recognises that the conservation of biological diversity is a common concern of humankind, and it emphasises the fact that natural resources are the property of individual countries. It ties this right to a national responsibility for environmental conservation at national level (DEAT, 1997:11).

2.6.2. National Environmental Management Act (NEMA)

This Act is regarded as the framework for legislation relating to biodiversity and conservation, and its objectives are further defined and supported by the National Environmental Management: Protected Areas Act No. 57 of 2003 (NEM:PAA) and the National Environmental Management: Biodiversity Act No. 10 of 2004 (NEMBA) (DEAT, 1997:43). NEMBA provides for the management and protection of the country's biodiversity within the framework established by the Act. It provides for the

protection of species and ecosystems in need of protection, sustainable use of indigenous biological resources, equity in bioprospecting, and the establishment of a regulatory body on biodiversity (Van der Linde & Feris, 2010:119). It implements the White Paper on the conservation and sustainable use of South Africa's biological diversity and multilateral agreements like the CBD (DEAT, 1997:43).

NEM:PAA (South Africa, 2003b) provides for the protection and conservation of ecologically viable areas representative of the country's biological diversity, its natural landscapes and seascapes (Van der Linde & Feris, 2010:87). There is also the National Forests Act No. 84 of 1998 (NFA) (South Africa, 1998c) and the Limpopo Environmental Management Act No. 7 of 2003 (LEMA), which deal with the protection of forests and trees (Van der Linde & Feris, 2010:306).

2.7. Medicinal plant propagation

Plant propagation is a natural phenomenon in all plants. It is a process of multiplication of a plant by sexual or asexual means to ensure the continuation of its progeny. This is achieved artificially, in the field, by adopting techniques suitable to the specific plant and its growth cycle (Oommen, 2002:18).

The sexual propagation method uses seed – which is a reproductive part that carries both sexes of the parents (Oommen, 2002:19). Sexual propagation is the production of new individuals by the fusion of a nucleus from the male (in pollen) and one in female (in the ovule) to form a zygote (Adams *et al.*, 2012:136).

Vegetative propagation involves the use of non-sexual plant organs such as leaves, stems and roots (Rice & Rice, 1997:54). Vegetative propagation is based on using parts of existing stock to generate new plants. These daughter plants will have traits identical to those of the plants from which they were derived (Rice & Rice, 1997:47; Hartmann, Kester, Davies & Geneve, 1990:165).

CHAPTER 3: METHODOLOGY

3.1. Methodology and design

The study was conducted within a qualitative paradigm. Qualitative research attempts always to study human action from the perspective of the social actors themselves. The primary goal of using this approach is defined as describing and understanding, rather than explaining, human behaviour (Babbie & Mouton, 2001:270).

Individual interviews were conducted with 30 traditional healers from 16 villages around Thulamela municipality. Semi-structured questionnaires (Appendix A) was designed to take between 20 to 30 minutes. The ages of traditional healers interviewed ranged from 35 years old and above. The semi-structured questionnaires was supplemented by observation and field walks, as well as extensive literature review.

The qualitative research method was chosen to get the better understanding of traditional healer's perspectives, regarding the ethnobotanical importance, and conservation status of medicinal plants around Thulamela municipality.

Qualitative research is characterised by its aims, which relate to understanding some aspects of social life, and its methods, which (in general) generate words, rather than numbers, as data analysis (Patton & Cochran, 2002:2). Qualitative methods generally aim to understand experiences and attitudes, and aim to answer questions about the 'what', 'how' or 'why' of a phenomenon, rather than 'how many' or 'how much' which are answered by quantitative methods (Patton & Cochran, 2002:3).

Unlike experiments and surveys, in which the elements of research design, hypothesis formulation, measurement and sampling are specified prior to data collection, design elements in qualitative research are usually worked out during the course of the study (Mouton, 2001:195). Qualitative research is especially appropriate to study those attitude and behaviours best understood within a natural setting, as opposed to the somewhat artificial setting of experiments and surveys (Babbie & Mouton, 2001:271).

Qualitative data analysis provides depth and detail, creates openness by encouraging people to expand on their responses, stimulates people's individual experiences, and attempts to avoid pre-judgements. Qualitative data analysis has the following disadvantages, however: fewer people are usually studied, it is less easy to generalise, it is difficult to make systematic comparisons, and it is dependent on the skills of the researcher ("Analyse This!!!" 2008).

Ethnographic research (participant observation studies) was conducted around the Thulamela municipality of the Vhembe district of Limpopo, South Africa.

The aim of ethnography is to provide holistic insights into people's views and actions, including the nature of location they inhabit through the collection of detailed observations and interviews (Reeves, Kuper & Hodges, 1998:4).

Ethnography can be described as the data of cultural anthropology that is derived from the direct observation of behaviour in a particular society (Babbie & Mouton, 2001:279). Ethnographic research does not differ from field research – which is considered to be particularistic in its approach, while ethnographic research is one form of field research (Sarantakos, 2013:218).

Participant observation studies (ethnography) are usually qualitative in nature, and aim to provide an in-depth description of a group of people or community, such descriptions are embedded in the life works of the actors under study, and produce an insider perspective of the actors and their practices Mouton (2001:148). Ethnography is the science of cultural description, a description and interpretation of a cultural or social group or system, and the study of cultures, with the purpose of understanding them from a native point of view (understanding of indigenous knowledge from local people) (Sarantakos, 2013:218).

Ethnographic research offers the following advantages:

Participant observation enables ethnographers to form part in a setting, there by generating a rich understanding of social action in different contexts, it gives ethnographers opportunities to gather empirical insights into social practices that are normally hidden from the public gaze, it can identify, explore, and link social phenomena which have little connection with each other (Reeves *et a*l,. 2008:4).

However, the following disadvantages may occur during ethnographic research:

Long time is spent talking to participants and observing action, it can be difficult to secure repeated access, in case where the participants are concerned that the research may cast them or their organisation in a poor light (Reeves *et al*,. 2008:4).

3.2. Data collection

3.2.1. Semi-structured interviews

Information on medicinal plants was gathered by means of semi-structured interviews, field walks and personal observation. Semi-structured questionnaires (Appendix A) were designed in English, translated into, and asked in, *Tshivenda*, in order to overcome the language barrier. The interviewees were *Vhavenda*- and *Vatsonga*-speaking traditional healers who speak and understand *Tshivenda* fluently.

In cases where permission had been granted, interviews were audiotaped, and the resulting text recordings transcribed, and the resulting texts analysed. In cases where permission for tape recording was not granted, extensive field notes were taken.

The semi-structured questionnaires was divided into the following various aspects of traditional healers and medicinal plants:

- Medicinal plants knowledge and collection
- Medicinal plants conservation
- Medicinal plants propagation
- List of useful medicinal plants collected and used by traditional healers (Data collection sheet).

The data collection sheet was used to record scientific and vernacular names, Parts used, Method of preparation and administration as well as diseases treated (Table 4.1).

A basic individual interview is one of the most frequently used methods of data gathering in qualitative approach. It differs from most other types of interviews in that it is an open interview, which allows the subjects under study to speak for themselves, rather than to provide the respondent with a battery of one's own predetermined hypothesis-based questions (Babbie & Mouton 2001:289).

Researchers use semi-structured interviews in order to gain a detailed picture of a participant's beliefs, perceptions or accounts of a particular picture of a topic. The method gives the researcher and participant much more flexibility, while the researcher is able to follow up particular interesting events that emerge in the interview, while the participant is able to give a fuller picture (De Vos, Strydom, Fouche & Delport, 2011:351).

3.2.2. Observation and field walks

A period of time was spent with traditional healers, in order to gain experience with regard to traditional healing practices. These included harvesting methods and processes, preparation and packaging. Comprehensive field notes were documented throughout the period by asking questions and keeping a field notebook. Apart from taking field notes, observation was supplemented by recording and taking pictures in cases were permission had been granted. It is a good idea to take notes either during observation or as soon afterward as possible. If one takes notes during observation, it should be done unobtrusively, since people are likely to behave differently if they see one taking down everything they say or do (Babbie & Mouton (2001:294).

Undertaking fieldwork is an important component of grounded theory studies, given the attraction that this approach to research has to those investigating the phenomena with social human elements (Birks & Mills, 2015:75). Observational data and field walks conducted are very useful in overcoming the discrepancies between what people say and what they actually do, and might help to uncover behaviour of which the participants themselves are not aware (Patton & Cochran, 2002:20). Observation is the method of data collection that employs vision as the only technique of collection (Sarantakos, 2013:247).

Conservation areas such as Thohoyandou Botanical Gardens, Brackenridge Reserve and Mphaphuli Cycad Reserve were visited, and informal interviews were conducted with staff members of the conservation areas visited, in order to gain an understanding and identification of species conserved, as well as challenges with regard to species conservation.

3.2.3. Literature review

Information regarding medicinal plants propagation/cultivation and conservation status was gathered through a desktop survey. A literature search was conducted by consulting published journal articles and books, and also the Internet, for material containing ethno-botanical and ethno-pharmacological studies of medicinal plants, as well as for information on the traditional healing system. This information was then compared with the gathered information.

3.3. Sampling method

Traditional healers were selected through the snowball sampling method. This is done by finding a few people relevant to the topic (traditional healers) and asking them to refer the researcher to more of them. In snowball sampling, the researcher chooses a few respondents using accidental sampling (taking sample from population that meet the requirements and is closer to the researcher) or any other method, and asks them to refer or recommend other people who meets the criteria of the research and who are willing to participate in the project. This process is continued with new respondents until saturation (that is, until no more substantial information can be acquired through additional respondents, or until no more respondents are available) (Sarantakos, 2013:179, Babbie 2010:193).

This method is employed when the lack of sampling frames makes it impossible for the researcher to achieve a probable sample, when the target population is unknown, or when it is difficult to approach the respondents in any other way. In many cases, snowball sampling is the only way of securing a sample for a study (Sarantakos, 2013:179).

3.4. Data analysis

The grounded theory approach was applied as a method to conceptualise data and identify themes. The grounded theory approach is an inductive approach to research, introduced by Barney Glaser and Anselm Strauss, in which theories are generated solely from an examination of data, rather than being derived deductively (Babbie & Mouton, 2001:511).

This is done by looking at the document, such as field notes for indicators of categories in events and behaviour, naming and coding them on the document, and comparing codes. In grounded theory, data is collected and analysed. The process of analysis takes place from the first time data begins to be collected, and continues until the research study is completed (Leedy & Ormrod, 2010:108).

Grounded theory employs the method of constant comparison where new data gathered, actions observed and perceptions recorded of the subjects, are constantly compared with those of new subjects, in order to generate theory. The aim of constant comparison is to look for similarities and differences in the data. From this process, the researcher identifies underlying uniformities in the indicators or incidents (actions, events and perspectives), and produces a code category or concept. Categories are then clustered to form themes (De Vos *et al*., 2011:318).

The following steps, as described by Eelderink (2015), were followed during data analysis:

- Becoming familiar with data by listening to recordings, and reading notes and transcripts.
- Identifying codes and themes by looking for regularities in data, dividing transcripts into small segments to make themes, seeing if they are overlapping themes, putting them together under new themes, then checking whether this set of codes captures what is going on, and developing the final list that can be used to code the rest of the data.
- Data coding is then developed using a coding scheme, and putting segments about the same matter on the same pile.
- Organising one's codes and themes by putting them together under each code that one wrote. These codes are placed in a spreadsheet.

3.4.1. Data coding

The information in the questionnaires (Appendix A) were coded, all the variable for the answers were listed and number coded, and these codes were then placed in a spread sheet.

When one begins to code, one is involved in taking a segment of text and labelling it according to a meaningful category (Babbie & Mouton, 2001:499).

3.4.2. Validity and reliability

Precautions were taken to ensure that the research findings are the results of the experiences and ideas of the informants, rather than the characteristics and preferences of the researcher (Shenton (2004:72).

To increase the validity of the results, findings from a wide range of sources were collected and compared (triangulation), as described by Flick (2014:183). In addition to generating data through interviews, focus groups, field notes and memoing, the grounded theorist can collect data from other sources (Birks & Mills, 2015:77).

Site triangulation may be achieved by participation of informants within several organisations, to reduce the effect on the study of particular local factors peculiar to one institution. Where similar results emerge at different sites, findings may have greater credibility in the eyes of the reader (Shenton 2004:66). Triangulation helps to promote conformability, and reduce the effect of investigator bias (Shenton, 2004:72).

To widen the spectrum of conceptualisation of reliability and revealing the congruence of reliability and validity in qualitative research, Lincoln and Guba (1985:316), as quoted by Golafshani (2003:601), state that "*since there can be no validity without reliability, a demonstration of validity is sufficient to establish reliability*."

Triangulation refers to the combination of different methods, study groups, local and temporal settings and different theoretical perspectives, in dealing with a phenomenon, to strengthen the quality of qualitative research (Flick 2014:183).

Validity is the research instrument that measures its relevance and accuracy (Sarantakos, 2013:99).

A study is validated if its findings are supported by other studies (cumulative validation) (Sarantakos, 2013:102). Reliability refers to the capacity of measurement to produce consistent results, and the method is reliable if it produces the same results whenever repeated (Sarantakos, 2013:104).

3.5. Consent

Formal written consent was obtained from each individual healer who participated in the study, before conducting interviews, including permission to take and use photographs, digital recordings and personal details. The participants were well informed about what participation entailed, before the interviews were conducted.

During the interviews, some traditional healers were concerned and suspicious, due to the fact that people might come and take their knowledge to make money, whereas some traditional healers refused to be interviewed because traditional healing knowledge is sacred, and therefore they were not allowed to share such information. Only those participants who freely consented to participate were interviewed.

All the participants were informed about the purpose of the study, and a letter from the traditional healers' organisations and the local headmen, was also used to ensure that trust was built between the researcher and the participants. Participants were also given the chance to ask clarity-seeking questions, before the commencement of interviews. In some instances, participants refused to give written consent, the reason being that their signatures might be used for criminal activities; therefore, in cases where participants refused to give written consent, verbal consent was obtained.

The study was formally approved by the College of Agricultural and Environmental Sciences Ethics Committee (Ref: 2015/CAES/109) of the University of South Africa.

CHAPTER 4: RESULTS AND DISCUSSION

4. 1. Demographics

The traditional healers interviewed were a diverse group from a wide range, which included males, females, highly educated, educated, poorly educated, herbalists, traditional surgeons and street traders from both urban and rural areas. The majority of healers interviewed were located in rural areas, compared to those residing in urban areas.

4.1.1. Age group of respondents

The age distribution (Figure 4.1) of all participants interviewed were above 35 years old.

Twenty-seven percent (27%) of interviewees were between the ages of 35-45, 33% were between the ages of 46-55, 10% were between the ages of 56 and 65, and 30% were at the age of 66 and above:

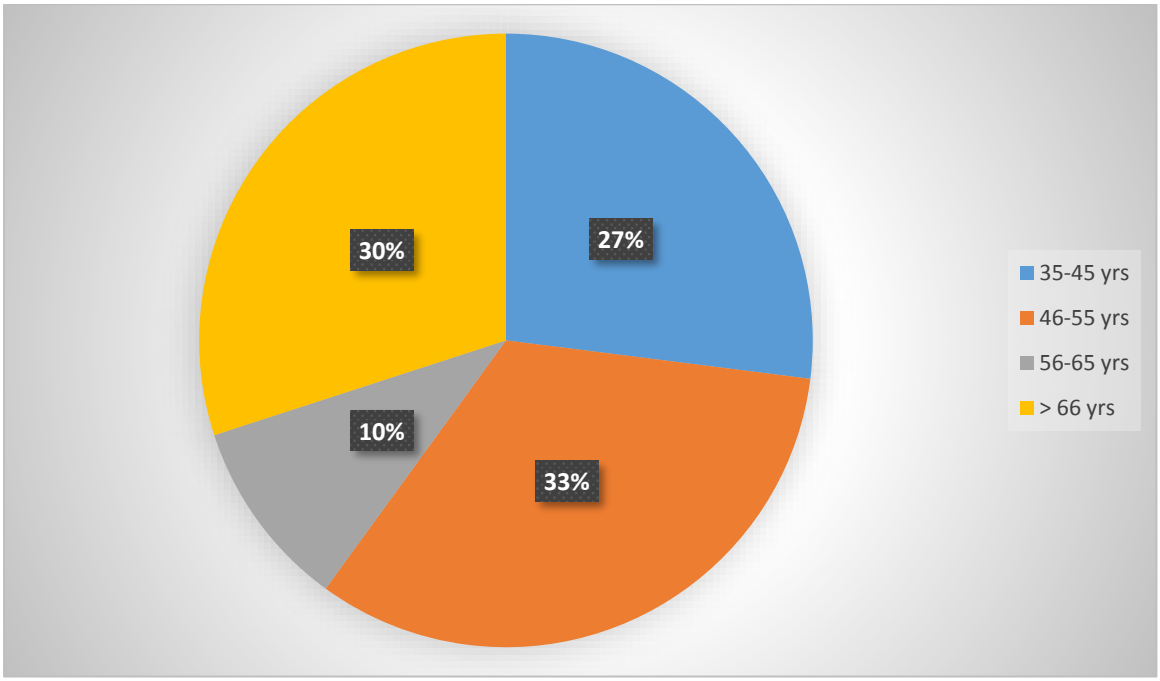

Figure 4.1: Age distribution of respondents. (**Source**: Own).

4.1.2. Gender

Fifty-three percent (53%) of traditional healers interviewed were females, whereas 47% were males.

4.1.3. Age by gender of respondents

The respondents were both males and females of different ages. The majority of respondents (27%) were males ranging from 35-45 years. As opposed to males, the majority of females (23%) ranged from 66 years and above (Figure 4.2):

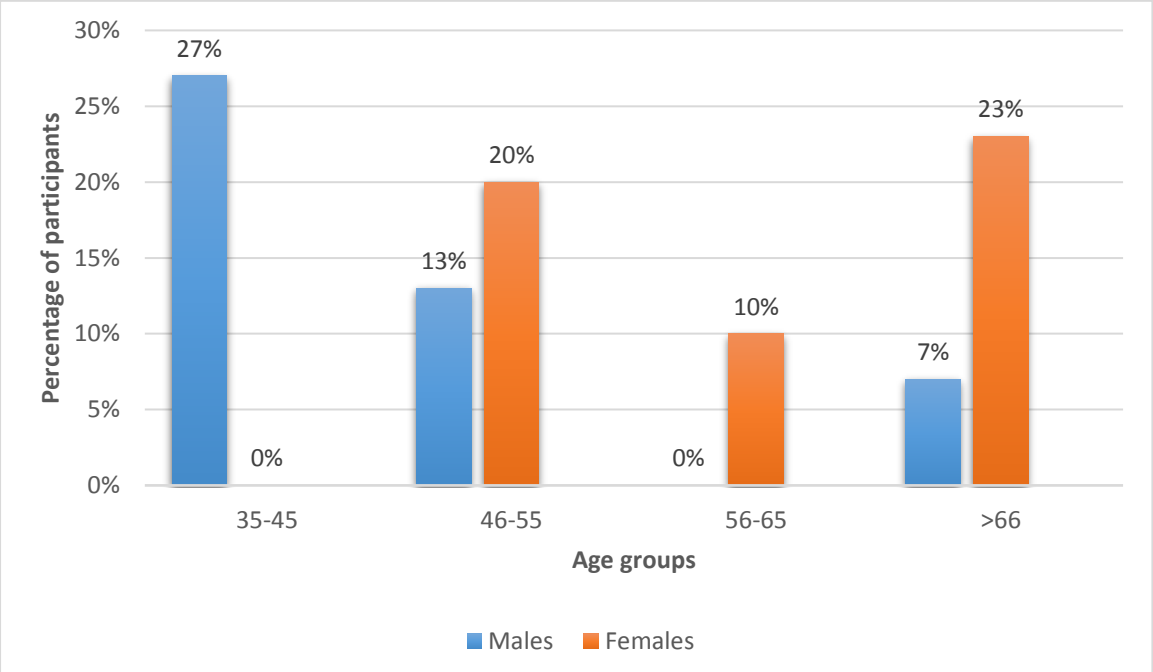

Figure 4.2: Age by gender of respondents. (**Source**: Own).

4.1.4. Cultural group

Ninety percent (90%) of interviewees were Venda speaking, compared to 10% being Tsonga speaking.

4.1.5. Residence

Eighty-three percent (83%) of participants were staying in rural areas, compared to 17% staying in urban areas.

4.1.6. Level of education

Thirteen percent (13%) of traditional healers interviewed had no formal education, 37% had primary education, 47% had secondary education, and approximately 3% had tertiary education (Figure 4.3):

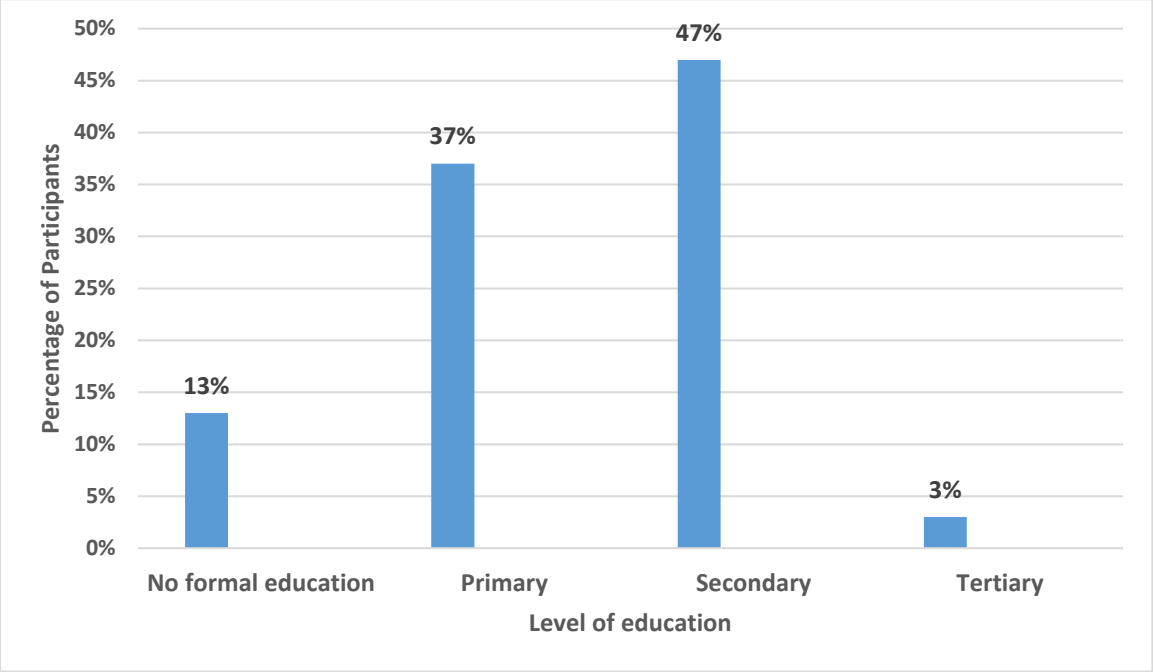

Figure 4.3: Level of education. (**Source**: Own).

4.2. Medicinal plant species used

A total of 90 medicinal plant species, which belong to 47 families, from a total of 82 genera commonly used by traditional healers, were recorded (Table 4.1). The species comprise different forms, such as trees, shrubs, climbers, bulbs and herbs that are used to treat different ailments.

Table 4.1: List of medicinal plants used by traditional healers. (**Source**: Own).

Family	Botanical Name	Common names (V)= Venda (E)= English	Parts used	Method of preparation, administration and uses
Anacardiaceae	*Lannea schweinfurthii* (Engl) Engl. Kokwaro 1980.	Mulivhadza (V) Baster Maroela (E)	Roots (fungus)	Infusion from the root fungus is used to help a person to forget unpleasant things and also to induce weaning in children.
Anacardiaceae	*Sclerocarya birrea* Sond. 1980	Mufula (V) Maroela (E)	Roots/bark	Infusion is taken for diarrhoea.
Anacardiaceae	*Searsia lancea* L.f. 1782.	Mushakaladza (V*)* Karee (E)	Leaves	Infusion is taken orally for the treatment of flu and respiratory tract infections.
Annonaceae	*Artabotrys monteiroae* Olive. 1888.	Mudzidzi (V) Red hook berry (E)	Roots	Infusion is taken orally for infertility in men.

Annonaceae	*Xylopia odoratissima* Welw. ex Olive. 1960	Muvhulavhusiku (V) Kalahari red fingers (E)	Roots	Infusion is taken for painful menstruation, stomach problems and diarrhoea.
Annonaceae	*Annona senegalensis Thonn*. 1979	Muembe (V) Wild custard apple (E)	Roots	Infusion is taken for stomach pains.
Apiaceae	*Heteromorpha trifoliata* H.L. wendl. 1862	Muthathavhanna (V) Parsley tree (E)	Roots	Infusion is taken orally for infertility in men.
Apocynaceae	*Carrisa edulis* (Forssk.) Vahl. 1790	Murungulu (V) Climbing num-num (E)	Roots	Infusion is used to make soft porridge to treat stomach problems/ease digestion
Apocynaceae	*Tabernaemontana Elegans* Stapf. 1894	Muhatu (V) Toad tree (E)	Root	Infusion is taken orally for stomach pains, as well as for the treatment of painful menstruation.
Apocynaceae	*Rauvolfia caffra* Sond. 1850	Munadzi (V) Quinine tree (E)	Bark	Grounded bark is used as a wound dressing.

Apocynaceae	*Holarrhena pubescence (*Buch-Ham.) Wall.ex G.don, 1829	Makhulu-wa Muhatu (V) Feverpod (E)	Roots	Infusion is taken for stomach problems, and infertility.
Araliaceae	*Cussonia spicata* Thunb.1780	Musenzhe (V) Cabbage tree (E)	Bark	Infusion is used as a laxative.
Asparagaceae	*Protasparagus falcatus* (L).1996	Govhakhanga (V) Large forest asparagus (E)	Aerial parts	Infusion is taken orally to stop vomiting in children.
Asteraceae	*Athrixia phylicoides* DC. 1838	Mutshatshaila Bushman's tea	Stems, leaves & roots	Infusion is taken for the treatment of infertility and heart problems.
Asteraceae	*Vernonia colorata* Willd. Drake. 1900	Phathane (V) Star flowered bitter tea (E)	Roots/ leaves	Infusion is taken orally for the treatment/expulsion of worms.

Bignoniaceae	*Kigelia Africana* Lam. 1849	Muvevha (V) Sausage tree (E)	Bark	Infusion is taken for sexually transmitted diseases.
Brassicaceae	*Capparis tomentosa* Lam. 1785	Gwambadzi (V) Cape bush (E)	Roots	Mixed with other ingredients for the protection of homesteads against witchcraft. Decoction is taken for stomach ulcers.
Burceraceae	*Commiphora mollis* Engl. 1883	Muukhuthu (V) Corkwood (E)	Stem Bark	Infusion is taken orally for the treatment of infertility in men.
Burseraceae	*Commiphora merkeri* Engl. 1910	Mutonyombidi (V) Zebra bark-Cammiphora (E)	Roots	Infusion is taken orally for infertility in men.
Canellaceae	*Warburgia salutaris* (G.Bertol.) Chiov. 1937	Mulanga (V) Pepper- bark (E)	Roots, stem bark & leaves	Infusion is taken for flu/colds, ulcers and stomach complaints.

Capparaceae	*Boscia albitrunca* Gilg-Ben. 1915	Muthobi (V) Shepherd's tree(E)	Bark	Infusion is taken as a vitamin supplement.
Celastraceae	*Mondia whitei* Bull.Bur.Pl. 1911	Muungulawe (V) Mondia (E)	Roots	Infusion is taken against infertility in men.
Celastraceae	*Salacia rhemanii* Schinz, Bull. Herb. 1894	Phathatshimima (V)	Root	Chewed for use as a love charm, or to gain more respect.
Celastraceae	*Elaeodendron transvaalense* Butt Davy. 1898	Mukuvhazwivhi (V) Bushveld saffron (E)	Bark	Decoction/infusion is taken for blood purification, stomach problems and infertility. Also used for bathing to get rid of bad luck.
Chrysobalanaceae	*Parinari curatelifolia* Planch.ex Beth. 1849	Muvhula (V) Mobola plum(E)	Bark	Infusion is used for stomach pains.
Cluciaceae	*Garcinia livingstonei* T. Aderson, J. linn. 1886	Mupimbi (V) African mangosteen (E)	Root	Infusion/decoction is used as contraceptive.

Combretaceae	*Combretum microphyllum* Klotzsch. 1861	Mukopokopo (V) Flame creeper (E)	Leaves	Infusion is taken for stomach pains.
Combretaceae	*Terminalia sericea* Burch. Ex Dc. 1860	Mususu (V) Silver leaf (E)	Roots/bark/ leaves	A paste is applied to promote healing in wounds. Infusion/decoction from the roots is also used for stomach problems.
Combretaceae	*Combretum imberbe* Wawra. 1860	Muhiri (V) Leadwood (E)	Root	Infusion is used for female infertility.
Combretaceae	*Combretum molle* R.Br.ex G.Don. 1827	Mugwiti (V) Velvet bush willow (E)	Roots/Bark/ leaves	Root/bark infusion is taken and mixed with soft porridge for the treatment of a disease called “ngoma” in children. Leaves infusion are used for the treatment of diarrhoea.

Ebenaceae	*Diospyros mespiliformis* Hochst.ex A.Dc. 1844	Musuma (A) Jackal berry (E)	Bark	Infusion is taken to expel worms.
Ebenaceae	*Euclea crispa* Burch. 1980	Mutangule (V) Blue guarri (E)	Roots	Infusion is taken for stomach pains associated with bloating and indigestion. Also used to expel worms.
Ebenaceae	*Diospyros lycioides* Desf. 1805	Muthala (V) Transvaal blue bush (E)	Leaves	Ground into fine pulp, paste applied to wounds to facilitate healing.
Euphobiaceae	*Pseudolachnostylis Maprouneifolia* Pax. 1899	Mutondowa (V) Kudu berry (E)	Bark	Infusion/ decoction is taken for cramps and body pains.
Euphobiaceae	*Euphorbia cooperi* N.E.Br.ex A Berger. 1907	Tshikondengala (V) Bushveld candelabra (E)	Root	Infusion is taken for diarrhoea.

Fabaceae	*Bauhinia galpinii* N.E.Br. 1891	Mutswiriri (V) Pride of De Kaap (E)	Roots	Infusion is used to make soft porridge to expel worms and ease digestion.
Fabaceae	*Indigofera arrecta* Hochst. ex. A.Rich. 1847	Muswiswa (V) African indigo (E)	Roots/ leaves	Infusion is used to make soft porridge for the treatment of disease called “ngoma” as well as to ease digestion in children.
Fabaceae	*Peltophorum africanum* Sond. Linnaea. 1850	Musese (V) Weeping wattle (E)	Bark	Infusion is taken orally for sore throat and heavy menstruation.
Fabaceae	*Albizia versicolor* Welw.ex Oliv. 1871	*Muvhamba-ngoma* (V) Poison pod Albizia (E)	Stem bark	Infusion/decoction is taken for family planning.

Fabaceae	*Cassia pitersiana* (Bolle) Lock. 1861	Munembenembe (V) Monkey pod (E)	Roots	Boiled, and the remaining water sprinkled around the yard as a snake repellent.
Fabaceae	*Cassia abbreviata* Oliv. 1871	Mulumanama (V) Sjambok pod (E)	Stem Bark	Infusion is taken orally for infertility.
Fabaceae	*Dichrostachys cinerea* (L.) Wight & Arn. 1834	Murenzhe (V) Sickle bush (E)	Fruit	Is burned, ground, and then applied to wounds to facilitate healing. Also inserted inside the vagina for gynaecological condition known as “gokhonya”.
Fabaceae	*Elephantorrhiza elephantina* (Burch.) Skeels.1910	Gumululo (V) Elands bean (E)	Roots/ rhizomes	Infusion/decoction is taken orally for infertility. Also used for bathing to ward off bad luck.
Fabaceae	*Erythrina lysistemon* Huch.1933	Muvhale (V) Common coral tree (E)	Root	Decoction/ infusion is used for toothache.

Fabaceae	*Mundulea sericea* (Wild.) A. chev. 1925	Mukundandou (V) Cork bush (E)	Roots	Infusion is taken for infertility.
Fabaceae	*Milletia stuhlmanii* Taub. 1893	Muangaila (V) Panga-panga (E)	Roots	Used for protection of homestead against witchcraft.
Fabaceae	*Piliostigma thonningii* (Schumach).milne-Redh.1947	Mukolokote ((V) Camel's foot (E)	Roots/bark	Used in the preparation of baby food for taste, and to ease digestion.
Fabaceae	*Schotia brachypetala* Sond. Linnaea. 1850	Mulubi (V) Weeping boer bean (E)	Bark	Infusion is taken for heartburn.
Fabaceae	*Bolusanthus speciosus* (Bolus) Harms. 1906	Mukambana (V) Tree wisteria (E)	Bark/roots	Infusion is taken for stomach pains.
Fabaceae	*Tylosema esculentum* (Burch.) A schreib. 1960	Mutama(V) Marama bean (E)	Tuber	Infusion is used for the treatment of diarrhoea.

Fabaceae	*Pterocarpus rotundifolius* Druce. 1917	Mushusha-phongwe (V) Round -leaved kiaat (E)	Bark	Infusion is taken for heavy/painful menstrual flow and abdominal pain.
Fabaceae	*Albizia adianthifolia* W.Wight. 1909	Muelela (V) Flat crown (E)	Bark	Infusion is used for the treatment of worms.
Fabaceae	*Dalbergia melanoxylon* Gwill. & Perr. 1958	Muuluri (V) Zebrawood (E)	Bark /roots	Infusion is taken for stomach pains.
Fabaceae	*Colophospermum mopane* (J .kirk ex Benth.) J.L Leonard. 1949	Black iron wood/ mopane (E) Mutanari(V)	Bark/roots	Infusion/decoction is taken for menstrual pain associated with infertility in women.
Hyacithaceae	*Drimia elata* R.A. Dyer. 1943	*Tshiganame* (V) Brandui (E)	Bulb	Infusion taken orally for the treatment of sexually transmitted diseases.
Hypoxidaceae	*Hypoxis hemerocallidea* Fisch. C.A.mey. & Ave-Lall. 1841	Mpupununu (V) African potato (E)	Bulb	Infusion is taken orally for the treatment of cancer, blood purifying, and general wellness.

Icacinaceae	*Pyrenacantha grandiflora* Baill. 1872	Gwere (V)	Roots	Grounded into fine powder and mixed with food as a love charm.
Lauraceae	*Cassytha filiformis* L. 1753	Luangalala (V) Love vine (E)	Aerial parts	Infusion is taken for sexually transmitted diseases.
Leguminosae (mimosoideae)	*Burkea africana* Hook. 1843	Wild seringa (E) Mufhulu(V)	Bark	Infusion/decoction is taken orally for stomach pains/indigestion/sexually transmitted infections.
Malpighiaceae	*Acridocarpus natalitius* A. Juss. 1843	Mavhofhe(V) Month fruit (E)	Roots	Chewed to hinder court proceedings, or mixed with other ingredients as an ointment for protection against bad luck.
Malvaceae	*Adansonia digitata* L. 1753	Muvhuyu (V) Baobab tree (E	Stem bark	Infusion from the bark is mixed with other ingredients as an energy booster.
Malvaceae	*Dombeya rotundifolia* (Hochst.) Planch. 1850-51	Tshiluvhari (V) Wild pear (E)	Bark	Infusion is used for flu.

Meliaceae	*Ekebergia capensis* Sparrm.1979	Mutobvuma (V) Cape ash (E)	Bark	Infusion is used for stomach pains.
Moraceae	*Ficus Sansibarica* Warb. 1894	Mutamvu (V) Knobbly fig (E)	Latex	Applied as a lotion to get rid of body rash.
Moraceae	*Ficus natalensis* Hochst. 1845	Muumo (V) Common wild fig (E)	Latex	Is used as an ointment/lotion for the treatment of rash
Myrtaceae	*Heteropyxis natalensis* Harv. 1863	Mudedede (V) Lavender tree (E)	Bark/ leaves	Is boiled, vapour inhaled for the treatment of colds/flu.
Myrtaceae	*Syzigium cordatum* Steud. 1841	Mutu (V) Water berry (E)	Bark	Decoction is taken for body pains.
Ochnaceae	*Brackenregia zanguebarica* Oliv. 1871	Yellow peeling plane (E)	Roots/bark	Protection of homesteads against witchcraft.

Olacaceae	*Ximenia caffra Sond. 1850*	Mutanzwa (V) Sour plum (E)	Root	Root decoction is taken for female infertility and stomach pains.
Oxalidaceae	*Oxalis corniculata* L. 1753	Mukulungwane (V) Creeping wood sorrel (E)	Whole plant	Paste made from ground parts is inserted inside the vagina to treat the disease called “gokhonya”.
Passifloraceae	*Adenia spinosa* Burtt. 1926	Tshivhuyudumbu (V) Elephant foot	Bulb	Infusion is taken for weight gain.
Passifloraceae	*Adenia gummifera* Burtt. 1912	Bopha (V) Snake climber(E)	Stem/ aerial parts	Infusion is taken for infertility in men.
Phyllanthaceae	*Antidesma venosum* E.Mey. ex Tul. 1851	Mukwalikwali (V) Tassel berry (E)	Roots	Infusion is used to treat stomach and menstrual pain in women.
Phyllanthaceae	*Bridellia micrantha* Baill. 1863	Munzere (V) Mitseeri (E)	Roots	Infusion is taken to expel worms.

Polygalaceae	*Securidaca longepedunculata* Fresen. 1837	Mupesu (V) Violet tree (E)	Roots	Infusion is taken for flu, infertility in men (mixed with mageu). The powder is also rubbed on the incisions made on the forehead for headache.
Proteaceae	*Protea caffra* Meisn. 1856	Tshidzungu (V) Common sugar bush	Flowers	Are burned and inhaled for the treatment of dizziness.
Ranunculaceae	*Clematis brachiata* Thunb. 1800	Tshiumbeumbe (V) Traveller's joy (E)	Stems/ leaves	Boiled, vapour inhaled for the treatment of colds/flu; infusion is also taken orally for the treatment of sore throat.
Rhamnaceae	*Ziziphus mucronata* Wild. 1809	Mukhalu (V) Buffalo thorn (E)	Roots	Infusion is taken for body pains.
Rhamnaceae	*Berchemia zeyheri* Sond. 1949	Munianiane (V) Red ivory (E)	Bark	Infusion is taken for infertility in men.

Rubiaceae	*Conostomium natalense* Hochst. 1952	Ndilela (V) Wild pentas (E)	Stems/ leaves	Lucky/love charm
Rutaceae	*Clausena anisata* Willd. 1849	Murandela (V) False horse wood (E)	Leaves /stems	Infusion taken for sore throat, cold and flue
Rutaceae	*Zanthoxylum capense* Harv. 1860	Mununguu (V) Small-knob wood (E)	Roots	Infusion is taken for sore throat.
Santalaceae	*Osyris lanceolata* Hochst.1832	Mpeta (V) Rock tannin bush(E)	Roots	Mixed with food as a love charm.
Sapindaceae	*Pappea capensis* Sond. 1862	Tshikavhavhe (V) Jacket plum (E)	Roots	Infusion is used for infertility.
Sapotaceae	*Englerophytum Megalismontanum* Sond. 1969	Munombelo (V) Transvaal milk plum	Leaves	Infusion is administered through the ear for toothache.

Sapotaceae	*Mimusops zeyheri* Sond. 1850	Mubululu (V) Red milkwood (E)	Roots	Infusion is taken for stomach pains.
Verbenaceae	*Lippia javanica* Spreng. 1825	Musudzungwane (V) Fever tea(E)	Stem/leaves	Infusion is taken for colds/flu.
Vitaceae	*Cissus quadrangularis* L. 1767	Malongekanye (V) Devil's backbone (E)	Stem	Infusion is taken orally for stomach ulcers, general wellness. Also applied to sores to kill maggots in cows.
Vitaceae	*Rhoicissus tridentata* (L.f.) Wild & R.B Drumm. 1963	Mutumbula mbudzana (V) Bitter grape (E)	Bulb	Infusion is taken as vitamin supplement and for infertility.
Zamiaceae	*Encephalartos transvernosus* Lem. *1868*	Tshifhanga (V) Modjaji cycad (E)	Bark	Infusion is taken orally for the treatment of mental illness, stroke and stress.

4.2.1. Sources of traditional medicine

All the respondents interviewed indicated that they harvest medicinal plants from wild populations on communal land; however they do purchase some of the medicinal plants from street traders, medicinal plant shops and collectors. The reasons for purchasing some medicinal plants are transport costs, long distances they have to travel to obtain some medicinal plant species, and that certain medicinal plant species are difficult to find.

Fifty-three percent (53%) of traditional healers interviewed indicated that they obtain permission from the chief in areas where medicinal plants are collected from other villages, and a certain amount as fee is paid in order to get access to the land. The council will then send someone to accompany the harvesters to show them where to harvest, and to ensure that they practise sustainable harvesting, an example of a traditional council mentioned includes Makuya traditional council, Thengwe traditional council, Tshitavha traditional council and Masisi traditional council. Only 47**%** of healers indicated that they do not need permission from the landowner in order to collect medicinal plants.

In case where harvesting is not controlled, unsustainable harvesting took place as opposed to controlled area.

During field walks continuous harvesting from the same species of *Elaeodendron transvaalense* with its bark completely removed from the stem (Figure 4.5). These results in the decrease in the availability of some medicinal plant species and also results in some medicinal plants facing extinction.

The vast majority of volumes of medicinal plants, which were traded mainly in provincial informal markets, are harvested from wild populations (Moeng, 2010:68; Verma, 2013:116). Collection from the wild was the most widespread practice (Nzue, 2009:80). Harvesting takes place with or without the consent of the landowners or local authority (Mander, 1998:37). This results in the need for alternative supply of medicinal plants material such as cultivation since wild populations are struggling under pressure from unsustainable harvesting practices due to high demand (Van Wyk & Prinsloo, 2018:340).

Medicinal plants with low growth and limited abundance, destructive harvesting results in resource exhaustion and species extinction (Chen *et al*., 2016:7). This pose a challenge to availability and sustainably of these medicinal plants which are culturally and economically important resources for a large proportion of South Africa's population (Williams *et al*., 2013:29). Increasing population numbers, reliance on medicinal plants for primary health care by large number of South Africans for their primary health care, increasing competition for land are barricading the survival of medicinal plants for use by future generations (Van Wyk & Prinsloo, 2018:340).

4.2.2. Demand and availability

Seventy-seven percent (77%) of traditional healers indicated that there is a decline in some medicinal plant species, and some medicinal plants are reported to be found in more distant areas. According to traditional healers, this may be due to commercial collectors, unsustainable harvesting, firewood collectors and urbanisation. They further indicated that this negatively impacts their practice as traditional healers, since the cost of travelling a distance to harvest certain medicinal plants, or the cost of purchase, will affected the price that the patient will pay. Only 23% of traditional healers did not notice a decline in medicinal species (Figure 4.4).

Eighty-seven percent (87%) of traditional healers indicated that some medicinal plant species are difficult to find (Table 4.2), whereas 13% indicated that they do not experience difficulties in finding some medicinal plant species (Figure 4.4, below):

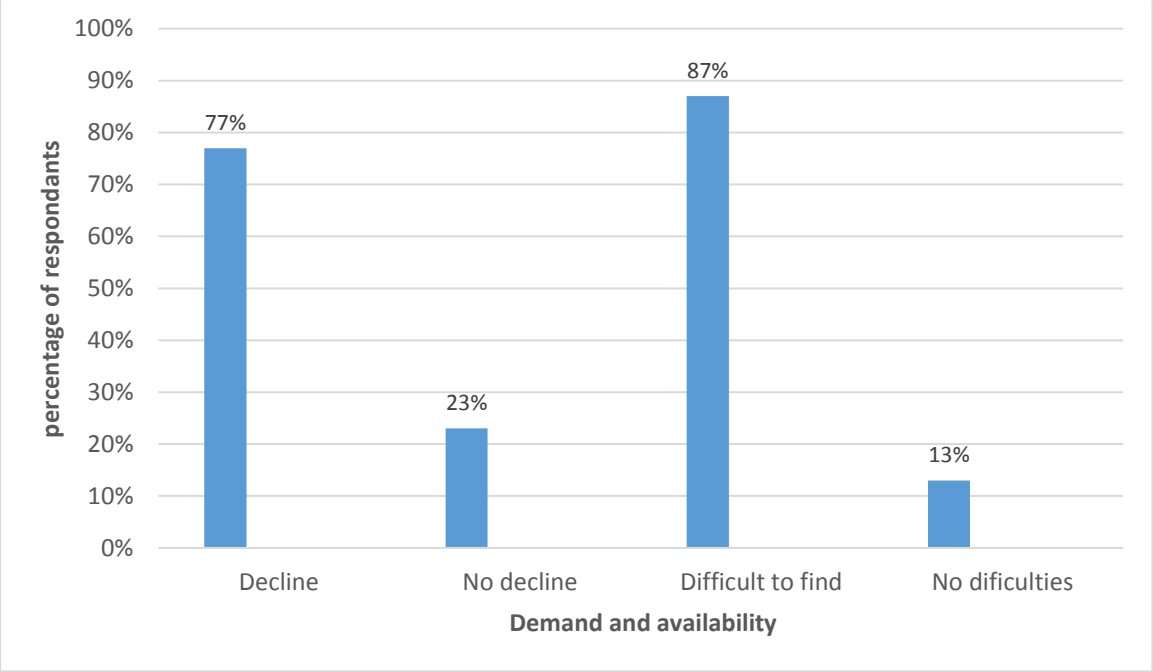

Figure 4.4: Demand and availability. (**Source**: Own).

Table 4.2: List of medicinal plants that are difficult to find according to traditional healers. (**Source**: Own).

Botanical name	Vernacular name	Conservation status according to SANBI Red data list (version 2015.1)
Brackenridgea zanguebarica	Mutavhatsindi	Critically endangered
Milletia stuhlmanii	Muangaila	Least concern
Warburgia salutaris	Mulanga	Endangered
Mondia whitei	Muungulawe	Endangered
Pleurostylia capensis	Murumelelwa	Least concern
Capparis tomentosa	Muobadali	Least concern
Strychnos henningsii	Manono	Least concern
Cassia abbreviata	Mulumanama	Least concern
Securidaca longepedunculata	Mupesu	Least concern
Maerua juncea	Mukundulela	Least concern
Bauhinia petersiana	Mushakula	Least concern
Elaeodendron transvaalense	Mukuvhazwivhi	Near threatened
Artabotrys monterioae	Munnamutswu	Least concern
Adenia gummifera	Bophavhafu	Declining
Wrigtia natalensis	Musunzi	Least concern

Viscum combreticola	Nzunzu ya muhiri	Least concern
Acridocarpus natalitius	Mavhofhe	Declining

The excessive and continuous harvesting of same species was observed during field walks (Figure 4.5). This indicates that the species is declining due to high demand, and this threatens the survival and availability of this commonly used medicinal plant.

Figure. 4.5: *Elaeodendron transvaalense* with its bark completely removed from the stem. (**Source**: Own).

Elaeodendron transvaalense (bushveld saffron/Mukuvhazwivhi) is one of the medicinal plant species used very often by people around Venda, and one of the medicinal plants facing various threats of extirpation through over-harvesting of bark from stems (Tshisikhawe 2002:95). The combination of high demand and lack of any significant resource management and plant production have resulted in the decline in the supply of medicinal plant resources (Mander, 1998:2).

A wide range of plant species is showing indications of unsustainable use, with the size of the plant parts decreasing, and collection distances of stocks increasing. An unknown but large number of species are already extinct, while many others have reduced population sizes that put them at risk (Moeng 2010:90). Many species now require human intervention to ensure their survival (Frankham *et al*., 2004:2).

The majority of patients of traditional healers (77%) felt that the demand for medicinal plants would be higher in future (Manzini, 2005:48).

4.2.3. Harvesting procedure

Harvesting rituals are performed to ensure that the medicine harvested is of good quality and high potency. This includes sprinkling of snuff on the ground before harvesting commences or even before embarking on a harvesting trip; it is done to communicate with the ancestors for guidance and protection. In some instances, sprinkling of snuff is also accompanied with some coins next to the stem of the tree to be harvested. This is also done to cause the medicine to work effectively (Ramawa, 2016). According to Mr M Nefale (2016), traditional healer, rituals before harvesting differ from one healer to the other, or even from one tree to another. In most cases, rituals before harvesting include abstinence from sexual activities, and sprinkling of snuff next to the stem of the tree to be harvested, accompanied by the slaughtering of a hen next to the stem of the plant to be harvested. This is also done to ensure that the medicine works effectively.

According to traditional healers, not all medicinal plants requires rituals to be performed before harvesting. Most plants mentioned by healers, that require rituals to be perfomed before harvesting, are *Brackenregia zanguebarica (*Mutavhatsindi/yellow peeling plane), *Capparis tomentosa* (Muobadali/Cape bush) and *Milletia stuhlmanii* (Muangaila/Panga panga).

Rituals that relate to specific trees, such as *Brakenregia zanguebarica* and *Milletia stuhlmanii,* require that a traditional healer be naked when they collect material from them. It is believed that anyone who tries to collect *M. stuhlmanii* without being naked will become insane or mentally disturbed (Khorommbi, 2001).

Traditional healers still practise rituals of collecting medicinal plants, while in the field. These rituals possibly ensure that the plant from which the medicinal part is collected should not die, to ensure that the medicine will work effectively (Tshisikhawe 2002:36).

4.2.4. Harvesting process

Traditional healers use different objects for harvesting medicinal plants. Among others, this includes picks (Figure 4.6a), spades (Figure 4.6b), axes, stones (Figure 4.6c) and machetes (Figure 4.6d).

Figure 4.6a: Harvesting bulb using a pick. (**Source**: Own).

Figure 4.6b: Traditional healer harvesting bark of corkwood (*Commiphora mollis*) using a spade. (**Source**: Own).

Figure 4.6c: Traditional healer harvesting bark of *Elaeodendron transvaalense* (bushveld saffron) using a stone. (**Source**: Own).

Traditional healers indicated that they practise sustainable harvesting methods. In a case where the whole plant is harvested, some plants are left behind, and not every plant is harvested. In a case where bark is harvested, harvesting only takes place on the eastern and western side of the tree, and ring-barking is avoided at all times. In the case of bark harvesting, the wound is covered with soil or cow dung to facilitate healing. The same applies to the roots; during harvesting, some roots are left behind in order for the tree to survive.

A **B**

Figure 4.6d: *Adenia spinosa* bulb before (A) and during harvesting (B) using knife and spade. (**Source**: Own).

After harvesting roots, the soil is returned into the hole to cover the remaining roots. According to traditional healers, when harvesting roots, only the side roots (adventitious roots) are targeted, while avoiding the tap root (Figure 4.7):

Figure 4.7: Harvesting side roots (rhizomes) of *Elephantorrhiza elephantina*. (**Source**: Own).

The poor harvesting techniques emphasise the need for more training and education for all herbalists and other medicinal plants users, in sustainable ways of harvesting. These include encouraging the removal of bark from opposite quarters of the trunk, avoiding girdling, collection of few roots per plant, as well as covering the soil after digging. Such actions could help to minimise future loss of valuable medicinal plant species (Augustino & Gillah, 2005:51). Intense harvesting of bark from species with a high market demand often results in ring-barking of trees, which subsequently die, and the species becomes rare over time (Tshisikhawe, 2002:96).

4.2.5. Harvested plant parts

The majority of traditional healers (73%) interviewed indicated that roots are the most-harvested plant parts, compared to 27% who indicated that bark is the most commonly harvested part. Although most of the medicinal plants found in consultation rooms visited were processed and stored inside containers, most plant parts found in street traders' shops visited around Thohoyandou were roots, followed by bark.

Harvested plant parts (Figure 4.8) observed from street traders visited around the Thohoyandou area, were roots (68%), followed by bark (20%), whole plant (10%), fruits (1%) and leaves (1%):

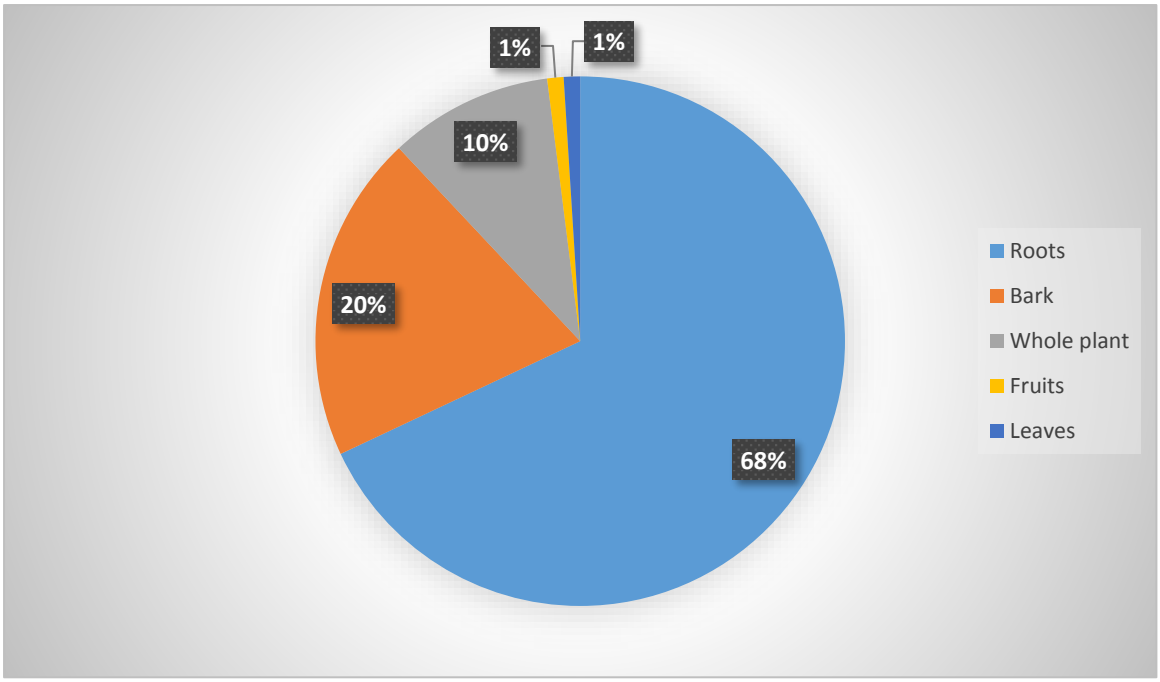

Figure 4.8: Harvested plant parts. (**Source**: Own).

However, some healers indicate that in case where the roots and bark of the same plant can be used for medicinal purposes, they would prefer to harvest bark, since it is much easier to harvest than digging roots, which is a bit tough for them to dig out – particularly during the dry season. It is more convenient to dig up bulbs or geophytes when the surface is moist after the summer rains (Mathibela, 2013:43).

The parts most preferred in medicinal plants are roots (Tshisikhawe, 2002:36). Cheikhyoussef *et al.* (2011:21) indicated that roots are the most frequently used parts

for treatment of diseases, followed by leaves, whole plant parts, bark, tubers, seeds, fruits, pods and stems. Masoko (2013:15) also confirmed that roots are the most used in preparing traditional remedies; leaves and bark are also used, but less frequently. De Wet *et al.* (2012:7), indicate that leaves were the preferred plant part used (31%) to treat skin infections, with bark in a close second place (28%), and were mostly applied topically as a paste, powder or sap on the affected skin area.

4.2.6. Methods of preparation and administration

The most common methods of preparation used by traditional healers interviewed include infusions, inhalations, ointment and lotions. The most common methods of administration are orally, topically, steaming and bathing. Most medicinal plants found in traditional healers' consulting rooms are prepared through grinding, or grated into a fine powder (Figure 4.9) for easy storage, and, in most cases, they are kept in labelled containers. Not all traditional healers label their medicines, however, since not all of them can read and write.

According to traditional healers, the roots of *Euclea crispa* are roasted before being boiled to make an infusion/decoction to treat stomach problems associated with indigestion or bloating. Preparation and administration methods of traditional medicines also depend on the disease or ailment being treated; for example, *Elaeodendron transvaalense* (bushveld saffron) and *Elephantorrhiza elephantina* (Elands bean) are used as a decoction or infusion (both hot and cold) for the treatment of, sexually transmitted infections, infertility, stomach problems and as a blood purifier. But they also form part of the ingredients of medicine used for bathing to prevent bad luck.

Clematis brachiata (Traveller’s joy/Tshiumbeumbe) is prepared by steaming in very hot water, and the patient's body is covered with a blanket to prevent heat from escaping and to induce sweating for the treatment of flu-/fever-related ailments. The remaining water can also be used for bathing (Ramawa, 2016).

Figure 4.9: Different instruments used during medicinal plant preparation. (**Source**: Own).

The method of preparation is critical, as it includes the amount of fresh or dry material to be used, the addition of appropriate volumes of solvents such as water or alcohol, and additional activities such as boiling water for a specified length of time, or partial burning to achieve a desired colour. These activities can serve to neutralise certain toxins (Van Wyk *et al*., 2013:18).

According to Ms T Tshililo, traditional healer, an infusion from the leaves of *Englerophytum megalismontanum* (Transvaal milk plum/Munombelo) is administered through an ear, for toothache. According to Mr T Mulaleni, traditional healer, an infusion from *Sonchus oleraceus* (common sowthistle/Shashe) is administered into the eyes for sore eyes.

According to traditional healers, medicinal plants used for protection against bad luck, evil spirits and also love charms, are normally administered as ointments. In most cases, incisions are made around different parts of the body, followed by the application of a mixture of one or more medicinal plants mixed with lotion/ointment

such as Vaseline. This is very common during the process called “u fara muvhili” (protection of person from bad luck, gain respect, ward off evil spirits, etc.). Examples of medicinal plants used for this function includes Murumelelwa/bastard saffron (*Pleurostylia capensis*), Mukundulela/bush cherry (*Maerua juncea*), Muangaila/panga-panga (*Milletia stuhlmanii*)**,** Muobadali/wooly-caper bush (*Capparis tomentosa*), Mutavhatsindi/yellow peeling plane *(Brackenregia zanguebarica*) and Mavhofhe/month fruit (*Acridocarpus natalitius*).

The chemical compounds in medicinal plants need to be absorbed in sufficient quantity for the products to be effective. The ease with which active ingredients can enter human cells or the bloodstream (bioavailability) depends on the polarity, stability and other chemical characteristics of the compounds involved, as well as the route of administration. Some active chemical compounds, for example, pass through the digestive tract without being absorbed, but are highly active when injected directly into the bloodstream. Volatile compounds may be effective when inhaled (as in aromatherapy) but practically inactive when taken orally (Van Wyk & Wink, 2004:20).

4.2.7. Medicinal plants storage and packaging

The traditional healers visited use various materials for packaging, including newspapers, plastics and bottles, which were the most commonly found in all the traditional healers visited. According to traditional healers, medicinal plants can be stored for a long period of time without losing their healing properties. Dried material which still need to be processed are kept in cardboard boxes and sacks. Before storage of the collected medicinal plants, they are normally dried in the sun (Figure 4.10a), and then ground and kept in plastic containers, glass jars or tins (figures 4.10b & 4.11c) and calabashes or bottle gourds (*Ngota*) (Figure 4.10d**)** made from calabash fruit (*Lagenaria siceraria*). Calabash fruit is much preferred to plastic containers and bottles, and is said to store medicine for a much longer period of time than plastics and bottles, which may develop fungal rot or mould due to vapour or humidity that may rise during the process of storage.

Figure 4.10a: Medicinal plants drying. (**Source**: Own).

Figure 4.10b: Medicinal plant storage containers in a consulting room at Itsani village. (**Source**: Own).

Figure 4.10c: Medicinal plant storage containers in a consulting room at Lufule village. (**Source**: Own).

While some whole plants, or parts of plants, can only be used in a fresh state, many can be dried and stored. Plant material may be dried in the sun or shade, or cut into slices and left to dry. Once dry, the plant material may be stored as is, or may be reduced to powder. Dry plant material is stored in paper bags, newspaper, glass jars or tin cans (Van Wyk *et al.*, 2013:14).

Products purchased from street traders, healers and shop traders are usually packed in new or recycled plastic bags, old newspapers, magazine pages, and an array of recycled liquor bottles. Liquid products are traded in recycled bottles, the size depending on the volume requested (Mander, 1998:72).

Figure. 4.10d: Healer showing fine powder stored inside calabash fruit *(Lagenaria siceraria*). (**Source**: Own).

4.3. Medicinal plant conservation

During interviews all traditional healers indicate that they practice sustainable harvesting methods, which includes selective harvesting, avoiding ring-backing in terms of bark harvesting (only harvest on the east and western side of the tree), the remaining wound after harvesting is covered with mud or cow dung to facilitate healing, returning the soil to cover the remaining roots, as well as avoiding harvesting from plants previously harvested. The majority of traditional healers (83%) indicate that they are intrested in growing medicinal plants in their backyards.

Habitat transformation is pointed out as the main driver of biodiversity loss, including medicinal plants, population growth, socio-economic conditions and a decline of the customary law controls contributing also to the dwindling of medicinal plant resources (Loundou, 2008:30). The most important medicinal plants are also fast disappearing, due to the high rate of land use (Motaleb, 2010:3).

Ring-barking or uprooting of plants is the most common method used by commercial gatherers (Cunningham 1993:3). Presently, there is a tendency for traders to harvest irresponsibly, in order to satisfy a growing muthi industry (Cumes *et al*., 2009:6). The current harvesting techniques are destructive, and are aimed at maximising the harvest in order to maintain a high level of income (Moeng, 2010:90).

The sustainable use of medicinal plants was, in the past, facilitated by several inadvertent or indirect controls and some intentional management practices. Taboos, seasonal and social restrictions on gathering medicinal plants, and the nature of plant-gathering equipment all served to limit medicinal plant gathering; for example, in South Africa and Swaziland, menstruating women were not allowed to collect medicinal plants, as this was believed to reduce the healing power of the plants (Cunningham, 1993:4).

Myth and taboos were also used to conserve some sacred species of plants; for example, a tree known as *Philonoptera violacea* (Mufhanda/apple leaf or African rain tree), a rare and sacred species, was not used as fuel because of the belief that burning it in a homestead could lead to the dissolution of marriages (Mukoni, 2015:80).

4.3.1. Threats to medicinal plant conservation

The most important threats to medicinal conservation, mentioned by traditional healers, were population growth, unsustainable harvesting, commercialisation, firewood collection and unemployment.

4.3. 2. Population growth and urbanisation

During field trips, it was evident that population growth, housing and industrial development pose a high threat to medicinal plant conservation, since, during construction and housing development, vegetation cover is destroyed (figures 4.11a & b). Care needs to be taken to transplant some plant material for later replanting, once the construction has been completed, to form part of the greening process. This can play a crucial role in conserving medicinal plants.

Figure 4.11a: Vegetation cover is removed during construction. (**Source**: Own).

Figure 4.11b: *Ficus sycomorus* (sycamore fig/Muhuyu) tree cut down during site development outside Thohoyandou CBD. (**Source**: Own).

Urbanisation or urban sprawl is the conversion of large natural areas and croplands to housing and commercial developments, parking lots, streets and highways. Undisturbed natural areas and crop fields also provide food resources and a wildlife habitat, and when these natural areas are paved over, the ecological services they provide are degraded or lost (Myers & Spoolman, 2014:61). Urbanisation is a rapidly growing phenomenon worldwide, and since 2008 urban populations have exceeded rural populations (Mutanga *et al.***,** 2013:163). Wasteful resource consumption remains the key factor that underlies ecological footprints.

As Africa's population grows, the demand for traditional medicines will increase, and pressure on wild medicinal plants resources will become greater than ever. Collection of wild plants for traditional medical use is detrimental to certain species (Rukangira, 2001:179).

4.3.3. Unemployment

Fifty-seven percent (57%) of traditional healers interviewed were full-time healers without alternative sources of income, 30% were employed or had an alternative source of income, 13% were street traders who indicated that selling medicinal plants was their only source of income in order to survive. South Africa is experiencing economic growth, but without an increase in jobs, with worsening poverty, and with declining biodiversity. To ensure sustainable livelihoods, it is important to ensure that economic opportunities are expanded in local areas, in a way that takes humans and biodiversity into account (DEAT, 1997: 51-52).

Increasing economic hardship and lack of employment opportunities in the formal sector of the economy in South Africa have led many urban dwellers to seek alternative ways of meeting their everyday livelihood needs (Ah Goo & De Wit, 2015: 69). Wild harvesting of medicinal plants is a chance for the poorest to make at least some cash income (Schippmann *et al.,* 2006:82).

4.3.4. Poaching

Poaching (illegal collection) was also noticed during the field survey at Brackenridge Reserve, where endangered, protected *Brackenregia zanguebarica* species is conserved. This threatens the survival of this species, since only a small population of *Brackenregia spp* is found in the Thengwe area in South Africa. This species has been protected by putting a fence around its population, but poaching is still taking place within the reserve itself. Several plants within the reserve were damaged, dead or dying because bark had been severely stripped (Figure 4.12.a) or cut down (Figure 4.12.b). It is clear that this species needs urgent attention concerning its protection, through the development of enforcement strategies to ensure the sustainability of this species population.

Figure 4.12a: Dead species of *Brackenridgea zanguebarica* due to bark stripping. (**Source**: Own).

Figure 4.12b: *Brackenregia zanguebarica* stem cut down. (**Source**: Own).

Although the reserve is guarded throughout the day, poachers still manage to gain entrance after hours, and poaching is currently a major threat to *B. zanguebarica* (Tshisikhawe, 2012:193). Continuous monitoring and protection of the reserve should be carried out 24hrs per day, to ensure the protection of this species.

Due to the extinction of certain popular species in the wild (outside protected areas) such as the paper bark tree (*Warburgia salutaris)* and wild ginger (*Siphonochilus aethiopicus*), harvesters are now targeting resources in formally protected areas (DWAF, 2005).

Another species identified during the field survey that is being poached, is *Encerphalartos villosus* (Modjaji cycad/Tshifhanga). This species was encountered in some traditional healers' back yards and gardens for both medicinal and ornamental purposes (see Figure 4.13). This species is, however, protected according to the Limpopo Environmental Management Act of 2003 (South Africa, 2003a). This species is conserved *in-situ* at Mphaphuli cycad reserve. *Ex-situ* conservation of this species and several plants confisticated from poachers, by rangers, was also observed at Thohoyandou Botanical Gardens.

Figure 4.13: *Encephalartos villosus.* (**Source**: Own).

Encephalartos transvenosus is used for medicinal purposes, decoration, cultural activities and as food, and the findings indicate that both youths and adult persons harvest *E. transvenosus* for income generation, while children and aged people use it mainly for subsistence purposes, and, further, that survival of this species is uncertain, due to various threats such as illegal collection, habitat destruction, fire and grazing (Ravele & Makhado, 2009:105).

The provincial conservation agencies that are mandated to protect wild cycad populations from poaching are facing severe capacity constraints such as a shortage of human resources and budget, and, further, that it is difficult to prove the origin of wild plants once present in the horticultural market (SANBI, 2014:11). *Encephalartos transvenosus* is listed as of least concern, according to the International Union for Conservation of Nature (IUCN) Red list of threatened species, due to the fact that the species is abundant in several locations, and the assessment indicates that there is no immediate threat to the species, although some sub-populations in some locations have declined due to the impact of collectors and habitat clearance. The species is also listed in Appendix 1 of the CITES appendices (Donaldson, 2010).

4.3.5. Unsustainable harvesting

The responses from the majority of the participants interviewed indicated that they practise sustainable harvesting, and they are aware that medicinal plant sustainability, and the availability of certain medicinal plants, pose a serious concern. During field trips, however, it was evident that unsustainable harvesting practices are taking place with regard to some medicinal plants (Figures 4.5 & 4.14):

Figure 4.14: *Cassia abbreviata* bark stripped from the stem. (**Source**: Own).

Ring-barking or uprooting of plants is the most common method used by commercial gatherers (Cunningham, 1993:3). Presently, there is a tendency for traders to harvest irresponsibly in order to satisfy a growing muthi industry (Cumes *et al.*, 2009:6). Current harvesting techniques are destructive, and are aimed at maximising the harvest in order to maintain a high level of income (Moeng, 2010: 90).

The essence of over-exploitation is that populations are harvested at a rate that is unsustainable, given their natural rates of mortality and capacities for reproduction (Begon *et al.*, 2014:378). If collecting a medicinal plant reduces the wild population, continuing to do so will inevitably impair the rights of future generations (WHO, 1993:20).

4.3.6. Commercialisation

Due to a large number of species and quantities of some medicinal plant species observed from street traders and medicinal plant shops around the Thohoyandou area, it was evident that medicinal plants are of commercial value and a source of income for rural communities.

The emergence of commercial medicinal plant gatherers in response to an urban demand for medicines and the rural unemployment rate, has resulted in indigenous medicinal plants being considered as an open access or common property resource, instead of a resource used by specialists. Ring-barking or uprooting is the most common method of collection used by commercial gatherers (Cunningham, 1993:13).

The traditional medicine trade in South Africa is a large and growing industry. There are 27 million consumers of traditional medicines, and the trade in these medicines contributes to an estimated R 2,9 million to the national economy.

The growing interest in medicinal plants from both the international industry and local markets requires management of tree harvesting from the natural forest, in order to prevent inappropriate exploitation of target species (Delvaux *et al.*, 2009:703). The analysis pattern of trade in medicinal plants by local markets in South Africa is posing a threat to the conservation of many plants species (Tshisikhawe, 2002:52).

4.3.7. Firewood collection

Some traditional healers also indicated that since most of them are unemployed, they are unable to afford the high cost of electricity, whereas some traditional healers also indicate that they prefer to use firewood as a free source of energy, regardless of the fact that they can afford electricity.

Despite the supply of electricity to households, people still illegally cut down trees for firewood, in turn driving away the fauna and other related ecosystem networks. The socio-economic make-up of the community is making it difficult for people to afford electricity. This puts direct pressure on natural trees as the cheapest alternative form of energy (Mutshinyalo & Siebert, 2010:167).

The rural people, who constitute the bulk of the population, are heavily dependent on the vegetation around them for fuel wood and for medicine. They are mainly subsistence farmers, and cannot afford alternative fuels, let alone the high prices of modern medicine. As a result, vegetation is lost and environmental degradation takes place (Kasagana & Karumuri, 2011:1378).

4.4. Approaches to medicinal plant conservation

Seventy-seven percent (77%) of traditional healers indicated that there is a decline in some medicinal plant species, and some medicinal plants are reported to be found in more distant areas. Eighty-seven percent (87%) of traditional healers indicated that some medicinal plant species are difficult to find.

Traditional healers indicated that they practise sustainable harvesting methods. In a case where the whole plant is harvested, some plants are left behind, and not every plant is harvested. In a case where bark is harvested, harvesting only takes place on the eastern and western side of the tree, and ring-barking is avoided at all times

In the case of bark harvesting, the wound is covered with soil or cow dung to facilitate healing. The same applies to the roots; during harvesting, some roots are left behind in order for the tree to survive, this includes covering the remaining roots with soil.

The majority of interviewees (83%) indicated that they are very much interested in growing some medicinal plants in their back yards. During field walks it was evident that traditional healers are intrested in growing medicinal plants in their back yards (Table 4.3).

Sustainable harvesting and cultivation methods are the best conservation approach to acquire most harvested wild species, it can relieve pressure in the wild and meet the growing demand for medicinal plants (Xego *et al*., 2016:177).

Extensive literature was conducted for other alternative methods that can be applied to conserve medicinal plants and the following methods were recommended:

4.4.1. *In-situ* conservation

In-situ conservation refers to the conservation of ecosystems and natural habitats and maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties (DEAT, 1997:103).

In order to ensure that representative wild populations of vulnerable medicinal species are maintained, core conservation areas or other protected habitats that will allow the natural process to continue undisturbed by human activities, should be designated (Cunningham, 1993:32). *In-situ* conservation is achieved both by setting aside areas such as nature reserves and national parks (collectively termed “protected areas”) and by ensuring that as many wild species as possible can continue to survive in managed habitat, such as farms and plantation forests (WHO,1993:24).

Two areas were visited where *in-situ* conservation of *Brackenridgea zanguebarica* (Brackenridgea Nature Reserve) and *Encephalartos villosus* (Mphaphuli Cycad Reserve) species are protected. Both species are experiencing the challenge of being poached from protected areas. Many of the protected areas are small, often isolated from one another, and separated by large areas of mostly transformed land. Aggravating this situation is the fact that protected areas have been managed as islands of biodiversity rather than as part of a holistic land-use policy (DEAT, 1997:28).

Tshisikhawe (2012:196), recommends that the conservation area of Brackenridgia reserve be increased in order to increase the distribution of the species through the available potential habitat.

4.4.2. *Ex-situ* conservation

Ex-situ conservation involves conservation outside the native habitat, and is generally used to safeguard populations in danger of destruction, replacement or deterioration. Ideally, all medicinal plant species should be conserved as evolving populations in nature; however, these species should also be conserved *ex-situ* (outside their natural habitat) (WHO, 1993:27).

There is a possibility of botanical gardens being involved in *ex-situ* conservation of plants, as a part of integrated conservation strategies aimed at particular species (Verma, 2013:164). Several species were introduced at Thohoyandou Botanical Gardens for *ex-situ* conservation purposes, including *Warburgia salutaris*, *Mondia whitei, Wrightia natalensis, Encephalartos villosus* and *Adenium multiflorum.*

The disadvantages of *ex-situ* conservation are that the sample of species conserved *ex-situ* may represent a narrower range of genetic variation than that which occurs in the wild. Species conserved *ex-situ* can also suffer genetic erosion and depend on continued human care, for this reason *ex-situ* conservation must not replace, but should complement, *in-situ* conservation (WHO, 1993:27). Secured *ex-situ* field gene banks need to be developed, particularly for habitat, slow growing species with high susceptibility of being over harvested (Schippman *et al.*, 2002:12).

4.4.3. Gene banks

As new cultivars are produced and grown for use in modern horticulture, old cultivars and wild resources of variation (which could be a source of valuable characteristics and be useful in future breeding programmes), are being lost. A gene bank provides a means of storing large quantities of seed of diverse origins at low temperatures, while some plant material that cannot be stored as seed is maintained by tissue culture (Adams *et al*., 2012:120).

4.4.4. Medicinal plant cultivation

The majority of interviewees (83%) indicated that they are very much interested in growing some medicinal plants in their back yards. Only 17% indicated that they are not interested in growing cultivated medicinal plants. Eighty percent (80%) of the participants are interested in buying cultivated medicinal plant species, compared to 20% who indicated that they are not interested in buying cultivated medicinal species (Figure 4.15, below).

The reason for not buying cultivated species was that cultivated species have less healing power than wild harvested species, and they can't buy cultivated species while wild species are still available. According to traditional healers, not all medicinal plants can be grown in home gardens, due to the taboos, rituals and magic powers associated with them.

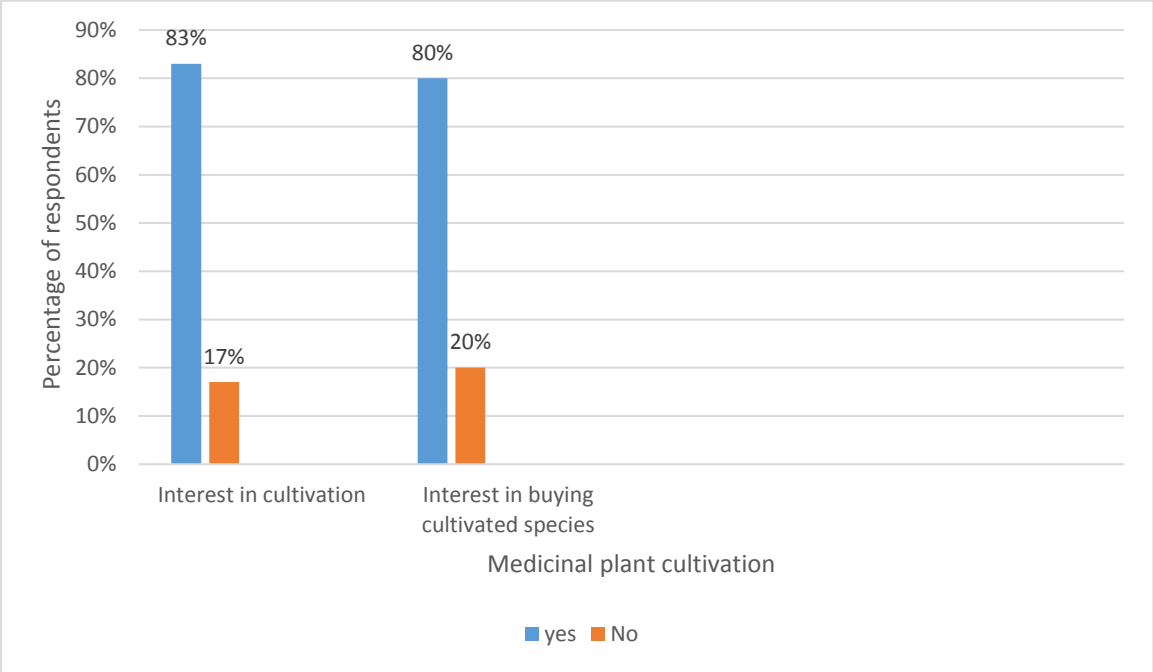

Figure 4.15: Medicinal plant cultivation. (**Source**: Own).

Traditional healers propagate medicinal plants (Table 4.3) for planting in their yards serving both medicinal and ornamental purposes, and various species were found in traditional healers' backyards.

Seventy-eight percent of respondents expressed their willingness to buy cultivated medicinal plants, with only 22% of the respondents being reluctant to purchase cultivated species. Further, the reason why some people do not buy cultivated medicinal plants is that cultivated species lack healing power, whereas others indicate that some cultural beliefs do not allow the purchase of medicinal plants (cultivated or wild collection) (Loundou, 2008:94). Chemical analyses indicated that harvested wild plants of the same species did have a stronger concentration than cultivated plants of the same species (Geldenhuys, 2007:S394).

Table 4.3: Medicinal plants found in traditional healers' backyards. (**Source**: Own).

Botanical name	**Common name**	**Vernacular name**	**Place**
Euphorbia cooperi	Bushveld candelabra	Tshikondengala	Khakhanwa
Vangueria infausta	Wild medlar	Muzwilu	Ha- Mavhunda
Encerphalartos transvernosus	Modjaji cycad	Tshifhanga	Tshisahulu
Englerophytum magalismontanum	Transvaal milk plum	Munombelo	Ha- Mavhunda
Gardenia volkensii	Transvaal gardenia	Tshiralala	Ha- Mavhunda
Bauhinia galpinii	Pride of dekaap	Mutswiriri	Ha- Mavhunda
Aloe arborescens	Krantz aloe	Tshikhopha	Ha- Mavhunda
Adenia spinosa	Elephant foot	Tshivhuyudumbu	Khakhanwa
Warburgia salutaris	Pepper- bark tree	Mulanga	Tshisahulu/ Mbaleni
Mondia whitei	Tonic root	Muungulawe	Lufule 2
Aloe greatheadii	Spotted aloe	Tshikhopha	Tshidimbini/ Mbaleni
Elephantorrhiza elephantina	Elands bean	Gumululo	Ha- Mavhunda
Cissus quadrangularis	Devil's back bone	Malongekanye	Ngovhela/ Ha- Mavhunda
Drimia elata	Brandui	Tshiganame	Lufule 2
Hypoxis hemerocallidea	African potato	Thithigwane	Lufule 2
Lippia javanica	fever tea	Musudzungwane	Lufule 2

Eighty- eight percent of both street traders and street vendors indicated that they would be willing to buy cultivated plants. Those who indicated that they were not prepared to buy such plants, believed that such plants are weak and that their healing power is destroyed by watering them (Moeng, 2010:22).

Many countries have long traditions of cultivating medicinal plants; for example, in some countries housewives traditionally grow a range of herbs, essential for the healthcare of their families, in pots around their houses. In others, most medicinal plants are still collected from the wild. As the human population increases, as forests decline, and as areas of remaining wild habitats become locked into parks and reserves, people in some areas can no longer collect the plant material they need. Therefore, the need to develop the tradition of cultivating the plants is imperative (WHO, 1993:17).

Approximately 15 different plant species were encountered in any rural garden, the best way to provide the plant material needed for medicine was to cultivate plants (Nemudzudzanyi, Siebert, Zobolo & Molebatsi, 2010:62).

In the case of rare, endangered or over-exploited plants, cultivation is the only way to provide material without further endangering the survival of those species. The plants can be grown in areas of similar climate and soil, they can be irrigated to increase yield, and they can be harvested at the right time. Cultivation also reduces the possibility of misidentification and adulteration (WHO, 1993:17).

There is a variety of medicinal plants propagated by traditional healers, Plants such as *Antidesma venosum* (Tasselberry/Mukwalikwali) and *Tecomaria capensis* (Cape honeysuckle/Mupashile) were among those commonly propagated (Khorommbi 2001). If medicinal herbs are brought into cultivation, it will at least attempt to modify the characteristics of the population in a controlled fashion, and at the same time attempt to conserve wild populations (Amujoyegbe, Agbedahunsi & Amujoyegbe, 2012:351). The acquisition of large-scale land required for cultivation can, however, be a serious obstacle (Rukangira, 2001:180).

4.4.5. Horticultural conservation approach

Horticulture can play a crucial role with regard to medicinal plant conservation. This can be achieved through the encouragement of nursery and community growers to propagate medicinal plants for ornamental as well as medicinal use, for both commercial and home gardens. Outreach programmes at community level can also play a crucial role in informing local communities about the role played by planting trees in the environment, and encouraging them to do so (Figure 4.16):

Figure 4.16: Tree planting demonstration during an environmental awareness campaign at Ga-chuene tribal council. (**Source**: Own).

Individual communities can be encouraged to buy these plants through the development of individual plant profiles indicating the plant name, growth form, climatic conditions, soil conditions, flowering/fruiting time, flower colour, position in the garden, and more. Medicinal plants are garden plants like any other plants; there is always a suitable place, climate and soil type to suit growth and development of certain plants in the garden, serving both ornamental and medicinal purposes (figures 4.17a & 4.17b). However, the skills of gardening and the correct placement of plants is lacking among the traditional healers and the community as a whole.

Local municipalities can also assist by using medicinal plants for greening and landscaping purposes. The incorporation of existing trees, when developing parks and gardens, can play a crucial role in conserving indigenous medicinal plants (figures 4.17a & 4.17b):

Figure 4.17a: Existing *Ziziphus mucronata* incorporated in to the design during park development (**Source**: Own).

Figure 4.17b: Existing *Vachellia karroo* incorporated into the design during park development. (**Source**: Own).

Trees are the most permanent plants in the garden, and therefore represent long-term investment. They should be chosen and positioned with great care. A tree should be selected according to the contribution it will make to the garden throughout the year: its size, shape, texture, shade, transparency in winter, sheltering of birds and insects, and, of course, its flower colour (a seasonal bonus). Many trees develop with age, however, and the shape of the tree may change as it grows older (Joffe & Oberholzer, 2012:46). Many South African plants are strikingly beautiful, and several popular garden ornamentals are derived from species native to the region (Van Wyk, 2000:4).

4.4.6. Awareness programmes

The government can play a pivotall role in developing awareness programmes at local level (see figures 4.18a & 4.18b), to ensure that people around the villages are aware of the importance of plants and corresponding legislation, as well as the implication of not complying with the legislation. In order to achieve the desired results and ensure the protection and sustainable use of indigenous medicinal plants, awareness should be followed by enforcement as a deterrent for non-compliance:

Figure 4.18a: Environmental awareness workshop at Ga-chuene tribal council. (**Source**: Own).

Figure 4.18b: *Olea europaea subsp. africana* planted by member of Ga-maja tribal council during environmental awareness programme workshop. (**Source**: Own).

Promotion and encouragement of research which contributes to the conservation and sustainable use of biological diversity, is essential, as well as encouragement of understanding the importance of, and the measures required for, the conservation of biological diversity, as well as its propagation through media. The inclusion of these topics in educational programmes, as well as cooperation with other states and

international organisations in developing educational public awareness programmes with respect to conservation and sustainable use of biological diversity, can play a very important role in the conservation of medicinal plants (DEAT, 1997:112).

4.4.7. Environmental management legislation

The South African Constitution is the supreme law of the country, and any law or conduct inconsistent with the constitution, is invalid. Through the inclusion of environmental rights in the constitution, environmental law found firm entrenchment in the South African legal system, with a sound basis and Constitutional mandate for further development and improvement. The Constitutional environmental right not only affords every person the entitlement to enjoy the right to an environment which is not harmful to their health and well-being, but also places a Constitutional mandate on the government to protect the environment through reasonable legislative and other measures that –

- Prevent pollution and ecological degradation;
- Promote conservation; and
- Secure ecological sustainable development and the use of natural resources, while promoting justifiable economic and social development (DEAT, 1997:11).

4.4.8. Convention on biological diversity (CBD)

While recognising that the conservation of biological diversity is a common concern of humankind, it emphasises the fact that natural resources are the property of individual countries. It ties this right to a national responsibility for environmental conservation at national level. Three objectives of the convention are the conservation of biodiversity, the sustainable use of natural resources, and the fair and equitable sharing of benefits arising from natural resources (DEAT, 1997:11).

4.4.9. National Environmental Management Act (NEMA)

The National Environmental Management Act No. 107 of 1998 (South Africa, 1998b) notes: "*The environment is held in public trust for the people. The beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage*". It is regarded as the framework legislation relating to biodiversity and conservation, and its objectives are further defined and supported by the Protected Areas Act (South Africa, 2003b) and the Biodiversity Act (South Africa, 2004).

4.4.9.1 National Environmental Management: Biodiversity Act of 2004 (NEMBA)

The Biodiversity Act provides for the management and protection of the country's biodiversity within the framework established by NEMA. It provides for the protection of species and ecosystems in need of protection, sustainable use of indigenous biological resources, equity in bioprospecting, and the establishment of a regulatory body on biodiversity (South Africa, 2004; Van der Linde & Feris, 2010:119).

It implements the White Paper on the conservation and sustainable use of South Africa's biological diversity, as well as multilateral agreements such as the Convention on Biological Diversity (DEAT, 1997:43).

4.4.9.2 National Environmental Management: Protected Areas Act No. 53 of 2003 (NEM: PAA)

The Protected Areas Act provides for the protection and conservation of ecologically viable areas representative of the country's biological diversity, its natural landscapes and seascapes. It further provides for the establishment of a national register of protected areas, the management of these areas, co-operative governance, public participation and matters related to protected areas (South Africa, 2003b; Van der Linde & Feris, 2010:87).

4.4.10. National Forests Act (NFA)

In terms of section 15(1) of the National Forests Act No. 84 of 1998 (South Africa, 1998c), no person may cut, disturb, damage or destroy any protected tree, or possess, collect, remove, transport, export, purchase, sell, donate, or in any other manner acquire or dispose of any product derived from a protected tree, except under license or exemption granted by the Minister to an applicant, and subject to such period and conditions as may be stipulated.

Examples of trees protected by this Act include *Sclerocarya birrea, Pterocarpus Angolensis, Warburgia salutaris*, *Elaeodendron transvaalense*, *Adansonia digitata*, *Combretum imberbe* and *Boscia albitrunca,* which were among those trees commonly used by traditional healers interviewed. Contravention of this declaration is regarded as a first-category offence that may result in the guilty party being sentenced to a fine, or imprisonment for a period up to three years, or to both a fine and imprisonment (SANBI, 2014:7-9, Van der Linde & Feris, 2010:306).

4.4.11. Limpopo Environmental Management Act No. 7 of 2003 (LEMA)

According to LEMA, no person may, without a permit, pick, be in possession of, sell, purchase, donate, receive as a gift, import into, export, remove from the province, or convey, a specially protected plant, or a protected plant, or pick any indigenous plant on a public road, or on land next to a public road within a distance of 100 meters (South Africa, 2003a).

4.5. What is the current status regarding medicinal plant conservation?

Eighty-six percent (86%) (Figure 4.19) of medicinal plants used by traditional healers are regarded as of least concern, 6% as not evaluated, 3% as declining, 2% as endangered, 1% as critically endangered, 1% data deficient, and 1% nearly threatened, according to the SANBI Red data list version 2015.1:

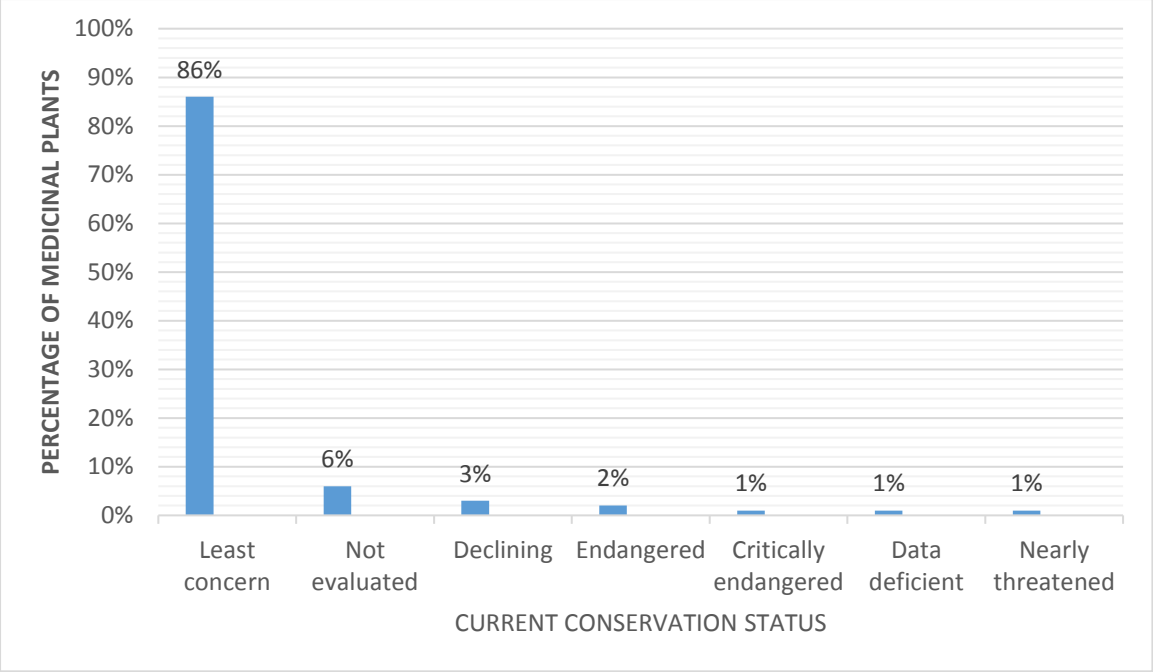

Figure 4.19: Current conservation status of medicinal plants according to SANBI red data list version 2015.1. (**Source**: Own).

Already, 3435 (15%) of South Africa's plant species are listed as threatened in the South African Red data books (DEAT, 1997:14).

According to Raimondo (2011:654), there was a 254% increase in the number of threatened taxa listed between 1997 and 2009. This increase is the result of 102 threatened taxa being listed for the first time, and 909 taxa moving from unthreatened categories (insufficient information, rare, and not threatened) to threatened categories. Overall, 2577 (13%) of South Africa's taxa are threatened with extinction. A further 2232 (11%) are listed under other categories of conservation concern. Combining the number of threatened taxa with those listed under other categories of conservation concern brings the proportion of South African flora that need to be conserved urgently to 24%, or one in every four (4) species.

According to SANBI (2014:1), cycads (*Encephalartos* species) are collectively the most threatened plant group in South Africa today, 12 of 37 (23%) *Encerphalartos* species that occur in South Africa are regarded as critically endangered, while an additional three (3) are already considered extinct in the wild. Nearly a quarter of South African flora are considered either threatened with extinction or of conservation concern (SANBI, 2015:2).

Unless ways are found to secure legal access to medicinal plant resources and promotion of cultivation, rural communities are at risk of losing their livelihoods (DWAF, 2005). If medicinal plants are being over-harvested from the wild, then it is possible that collection is not only unsustainable, but also that genetic diversity of species is being eroded, and the natural ecosystems are being degraded.

Except where there is a strong sense of community solidarity, it is often likely to be difficult to develop sustainable harvesting based on community control alone, given that collection of wild medicinal plants for sale is undertaken essentially competitively (Verma, 2013:173).

4.6. Environmental management awareness among traditional healers

The majority (87%) of traditional healers indicated that there is no awareness regarding medicinal plant conservation and sustainability. Only 13% of traditional healers interviewed indicated that there are awareness programmes regarding medicinal plants, and, further, that awareness programmes, and issues regarding medicinal plant conservation and sustainability, are discussed during meetings and workshops with traditional healers' associations (Figure 4.20). All the traditional healers interviewed indicated that they don't know of any environmental management legislation. Eighty-seven percent (87%) of healers also indicated that they are unaware of Red data or protected species. Only 13% of healers are aware that some medicinal plants are protected by tribal authorities, but they are not aware of any legislation protecting medicinal plants (Figure 4.20):

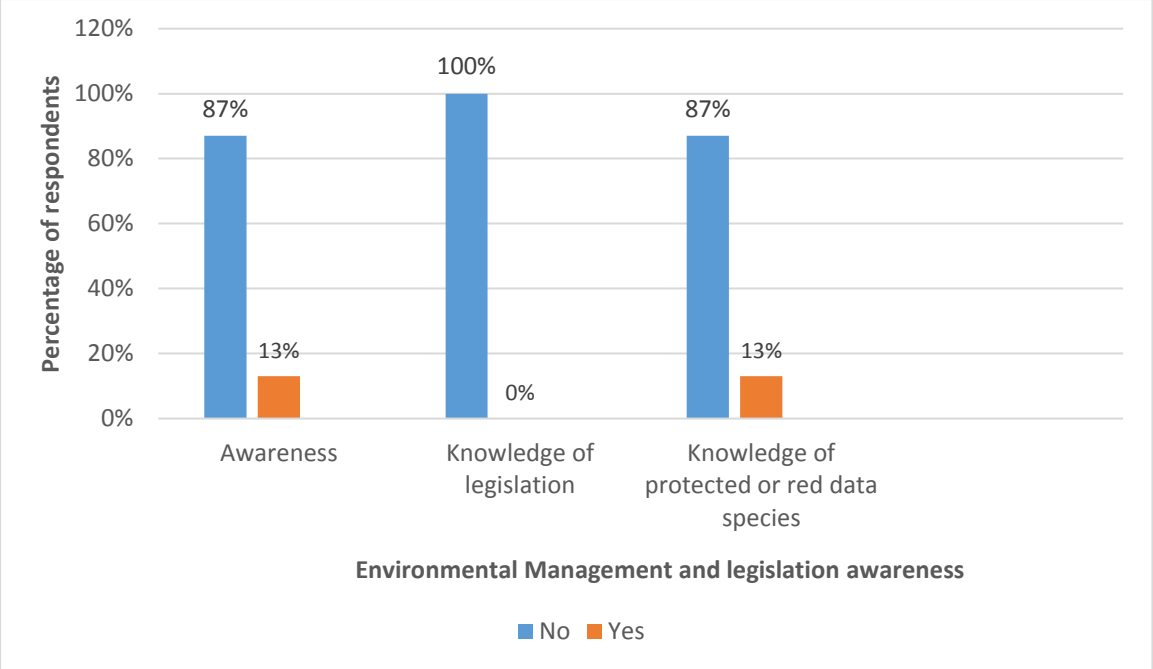

Figure 4.20: Environmental management and legislation awareness among traditional healers. (**Source**: Own).

The most common plants mentioned by healers were *Brackenridgea zanguebarica* (yellow peeling plane) and *Encephalartos villosus* (Modjaji cycad). All interviewees indicated that they were not aware of any environmental legislation. The majority of traditional healers interviewed were aware and concerned about the scarcity of certain medicinal plants species.

The government can play a crucial role in developing awareness programmes at local level, to ensure that people around the villages are aware of the relevant legislation, as well as the implication of not complying with the legislation. In order to achieve the desired results – that is, to ensure the protection and sustainable use of indigenous medicinal plants, awareness should be followed by enforcement as a deterrent to non-compliance.

Although a substantial amount of environmental legislation is in place in South Africa, poor enforcement renders much of it ineffectual. Compounding the problem are the often inappropriate penalties imposed for infringing legislation, and the lack of capacity within government agencies to monitor infringements (DEAT, 1997:93).

4.7. Medicinal plants as an alternative to biomedicine

All the traditional healers interviewed indicate that traditional medicine is playing a very crucial role in the provision of primary health care around their communities.

According to traditional healers, not all diseases can be cured by western medicine, and further indicate that in some cases they refer their patients to western doctor in case the patient is not responding well to their treatment. Extensive literature review was conducted to confirm whether if medicinal plants has been tested to prove their potential as an alternative to biomedicine.

Western (or modern) medicine was once traditional medicine. It evolved over time to where it is today by keeping up with the latest technological advancements, and research. On the other hand, traditional medicine is called as such, simply because it has, by and large, held onto the ancient ways of dealing with medical conditions, both physiological and psychiatric, and with spiritual conditions. Because of these differences, the two health systems seem far apart, and yet, what could bring them together is each healthcare system's desire and endeavour to prevent and eradicate ill-health, and maintain wellness (Mokgobi, 2012:126).

Treatment offered by traditional medicine overlaps with biomedical healthcare in cases of respiratory infections, wounds and bruises, fever and biliary colic/cholecystitis, traditional healthcare appears to be complementary to biomedical healthcare for chronic illness, especially arthritis, and folk illnesses that are particularly relevant within the local cultural context (Vandebroek *et al*., 2008:1). As conventional medical care co-exists with traditional medicine systems in many regions in Africa and elsewhere, people may use medicine from one system exclusively, or they may acquire medicine from each health system and use both simultaneously or sequentially (Shizha & Charema, 2011:174).

Ximenia caffra Sond. (Ximeniaceae), commonly known as “sour plum”, is traditionally used topically and orally, to treat a wide range of human diseases and ailments such as wounds, sexually transmitted infections (STIs), infertility, stomach ache, fever, eye problems, diarrhea, bilharzia, menorrhagia, malaria, intestinal worms and coughs. The bark and fruits are used by small-scale farmers as ethno-veterinary medicine to treat dermatophilosis, foot rot, saddle sores and ectoparasite control. Oil from *X. caffra* seed

is traditionally used as a moisturizer, soap, and shampoo for dry, fragile and damaged hair (Maroyi, 2016:1). A study conducted by Masoko (2013:8) indicated that most of the selected plant species have shown great potential as antibacterial agents.

The genus *Warburgia* (canellaceae) is represented by several medicinal trees found extensively on the African continent. Traditionally, extracts and products produced from *Warburgia* species are regarded as important African antibiotics, and have been used extensively as part of traditional healing practices for the treatment of fungal, bacterial and protozoal infections in both humans and animals (Leonard & Viljoen, 2015:1). Herbal anti-typhoid preparations are highly patronised, and have been reported to be efficacious in the treatment of typhoid fever. Experimentally, the herbal mixture prepared from *Vernonia amygdalina*, *Cassia alata*, *Phyllanthus fratermus* and *Nauclea latifolia* showed anti-salmonella activity by inhibiting the growth of *Salmonella typhi*. (Koffuor *et al*., 2016:006).

Pelargonium sidoides is native to South Africa. The extract of the plant known as Mckaloabo is sold all over Europe as a cure for pulmonary diseases and tuberculosis. Combretastatin A-4 (which is water-soluble as a phosphate derivative) is the most potent naturally occurring combretastatin known. It has shown to cause vascular disruptions of tumours in cancer patients. Rooperol is the hydrolysis product from the compound hypoxoside obtained from the rhizome of the plant *Hypoxis hemerocallidea* (African potato). Traditional healers have been using an aqueous extract of this rhizome for many years to combat ailments such as benign prostate hyperplasia, testicular cancer, cardiac diseases and intestinal parasites, as well as an immune booster (Drewes, 2012:5-6). Chances are that approximately one third of ingredients listed on a bottle of cough mixture or box of headache tablets were derived from plants (Scott, 1993:84).

Many of the plant extracts used in Western medicine were discovered through their uses in traditional medicine, though not necessarily for the same purpose (WHO 1993:10). Sanhokwe *et al.* (2016:1) revealed that nine plant species belonging to eight families were used to control parasites in goats. *Aloe ferox*, *Acokanthera oppositifolia*

and *Elephantorrhiza elephantina* were the plants having the highest fidelity level for their use to control parasites, each scoring 100%, followed by *Albuca setosa* (83.33%).

Medicinal plants and plant-derived medicines are widely used in traditional cultures all over the world, and they are becoming increasingly popular in modern society as natural synthetic chemicals. Many cultures throughout the world still rely on indigenous medicinal plants for their primary healthcare; therefore, without well-documented information on the safety and phytochemical characteristics of different compounds, it is difficult for external buyers to assess the likely utility or value of some new raw materials and extracts of African origin (Gurib-Fakim & Kasilo, 2010:65).

Using traditional medicine is the mainstay of primary healthcare in virtually all developing countries (Nzue, 2009:92). There is a growing notion worldwide that the so-called modern biomedical system approach to healthcare does not meet and address people's health needs adequately, especially, but not exclusively, in the non-Western world. Consequently, non-conventional therapies are increasingly in demand (Delvaux *et al*., 2009:703).

Approximately 25% of drugs used in modern pharmacopoeia are derived from plants, and many others are synthetic analogues built on prototype compounds isolated from plants (Oladele, Olade & Omobuwajo, 2011:476). Medicinal flora of the Venda region consist of a variety of species which may potentially provide therapeutic agents to treat different diseases (Tshisikhawe, 2012).

De Wet *et al. (*2012:4) recorded 47 plant species used for the treatment of different skin disorders, including abscesses, acne, burns, boils, ringworm, rashes, shingles, sores, wounds and warts. Low toxicity of *E. transvaalense* ethanol extract and isolated compounds can support the traditional use of this plants for various ailments. (Tshikalange & Hussein, 2010:1697). The most widely used plants for the treatment of malaria include plants such as *Cassia abbreviata* and *Aristolochia albida (*Ngarivhume *et al.,* 2015:225*).* Chinsembu (2016:1) recorded 52 plant species in 25 families and 43 genera as being used to treat gonorrhea, syphilis, chancroid, chlamydia, genital herpes and ano-genital warts.

Sexually transmitted infections were frequently managed using the following plants: *Terminalia sericea, Strychnos cocculiodes, Ximenia caffra, Cassia abbreviata, Cassia occidentalis, Combretum hereroense, Combretum imberbe, Dichrostachys cinerea, Boscia albitrunca*, *Momordica balsamin*a and *Peltophorum africanum*. Many of these plants have putative antimicrobial activities which may justify their roles as natural remedies for sexually transmitted infections (Chinsembu, 2016:1).

Hexane extracts of the bark of *Warburgia salutaris* was the most effective against all the *Fusarium* species tested. Acetone extract of the *Piper capense* roots, *Peltophorum africanum* bark and *Securidaca longipedunculata* roots were fungicidal to one or more of the fungal organisms tested (Samie & Mashau, 2013:1847).

While traditional forms of healing, both Native American and South African, are increasingly coming to be viewed as valuable by those operating with a biomedical mindset, both of these traditional systems are still largely understood to be secondary to biomedicine in their importance (Flint, 2015:4321). It is clear that traditional healers play an influential role in the lives of African people, and have the potential to serve as crucial components of a comprehensive healthcare strategy (WHO, 2002). It is evident that a traditional healthcare sector exists, and is still widely used by the majority of the country's Black population. It has not been replaced by modern scientific medicine, and will arguably continue to exist as an essential component of African traditional culture (WHO, 2001:237).

Official recognition and statutory regulation are regarded as non-negotiable requirements for cooperation with the modern medical sector and mutual referral between the two healthcare sectors, with ensuing benefits for all (WHO, 2001:238)**.** Plant chemistry in South Africa has blossomed in the last decade, with many students from previously disadvantaged backgrounds, but with keen interest in *muthi* or medicinal chemistry, entering the field. Recent findings have rekindled the belief that a major development in natural products would at last emerge from Africa (Drewes, 2012: 1).

As providers of healthcare, traditional and alternative health practitioners can play an important role in building South Africa's health system, as well as strengthening and supporting the national response to human immunodeficiency virus (HIV)*/* acquired immunodeficiency syndrome (AIDS) and tuberculosis (TB)**.** They cannot, however, fully play this important role unless human rights principles are strictly applied to all aspects of traditional and alternative healthcare. For this to happen, registering traditional medicines, and implementing the registration of traditional healers, is urgent (WHO, 2001:224).

Medicinal plants provide a cost-effective means of primary healthcare to millions of people around the world (Van Wyk & Wink, 2004:21). The main problem facing the use of traditional medicine is the requirement of proof that the active components contained in traditional medicines are useful, safe and effective. This is important, in order to assure the medical field and the public regarding the use of medicinal plants as drug alternatives (Rukangira, 2001:180).

Plants have contributed hugely to Western medicine by providing ingredients for drugs, or having played a central role in drug recovery (Hamilton, 2004:1480). Forty percent (40%) of the prescription and non-prescription drugs used throughout the world have active ingredients extracted from plants and animals. Aspirin, probably the world's most widely used drug, was derived originally from the leaves of the tropical willow, *Salix alba,* while the rose periwinkle (*Catharanthus roseus*), a plant from Madagascar, has yielded two potent drugs effective in treating blood cancer (Begon *et al*., 2014:374).

Bioprospecting, the research for new drugs from natural resources, has had some success in South Africa, with the isolation of a new antibiotic, the discovery of an anti-obesity agent and a mosquito repellent, extracted from South African plant species (DEAT, 1997:55). Despite the advances made in Western medicine, there are many diseases with no cure; therefore, herbal medicines become the default treatment option (Thomford *et al*., 2016:9).

South Africa has a wide array of medicinal plants, and, in literature, plant-isolated compounds have proven to be used for the treatment of a wide range of diseases (Hurinanthan, 2013:125). Both the literature and experimental results analysis show that *Cassytha filiformis* is a traditional remedy for cancer, which is a major threat in the

world. The plant is used to treat various human birthing issues, gonorrhea, kidney ailments, African trypanosomiasis, as well as many other diseases, and also act as a diuretic (Mythili, Gajalakshmi, Sathiavelu & Sridharan, 2011:82).

Cassia abbreviata serves as a good bioresource for generating a readily available anti-cancer herb. This study, therefore, scientifically confirms and supports the traditional use of *C. abbreviata* for the management of neoplasm (Njagi *et al*., 2016:8). *Cassia abbreviata* contains compounds that have some activity against cell proliferation, and can be a promising tool to treat cancer cells. More work needs to be done, however, to verify which compounds are mainly involved (Choene, 2015:iv).

Thomford *et al*. (2016:536) indicated that *Launaea taraxacifolia* (African lettuce) extracts were tested against esophageal cancer. It causes the arrest of the cell cycle by affecting differential expression of genes involved in cell cycle regulation, presenting its potential beneficial effects.

Generally, changes in gene expression levels that accompany the administration of herbal medicines play a vital role in treatment options available to a population in health transition. Plant-derived pharmaceuticals that constitute 30% of prescription drugs used in Western medical systems are obtained from only about 120 plant species (Scott, 1993:84).

The use of the *Combretum* species in folk medicine includes treatment of a large range of ailments including headaches, abdominal disorders, fever, gallstones, gastric ulcers, diarrhoea, bilharzia, dysentery, hookworm, urinary tract infections and conjunctivitis (Mapfunde, Sithole & Mukanganyama, 2016:2). Fouche *et al*. (2008:1) identified 32 plant extracts exhibiting potent activity against three cancers. Fourteen (14) plant species investigated were found to have some inhibitory effect on mycobacterial growth (Dzoyem, Aro, McGaw & Ellof, 2016:73). Aremu, Finnie & Van Staden (2012:134) recorded 12 medicinal plant species with anthelmintic activity.

4.8. Medicinal plant screening

The literature review conducted for this study indicated that indigenous medicinal plants were screened for various chemical igredients (Appendix C). Ten (10) plant species were screened for antibacterial activity against *Staphylococcus aureus and Pseudomonas aerugosa.* Methanol extract of *Kirkia acuminata,* and acetone extract of *Mytenus senegalensis* and *Milletia stuhlmanii* were the most active species, with values of 0.32 to 0.33mg/ml. Most of the selected plant species have shown great potential as antibacterial agents (Masoko, 2013:8).

Phytochemical investigation of *Ximenia caffra* revealed that the species has various compounds, including flavonoids, phenols, phytosteroids, tannins and fatty acids. Different aqueous and organic extracts exhibited anti-amoebic, antibacterial, antifungal, anti-inflammatory, antioxidant, antiparasitic, antiproliferative, HIV-reverse transcriptase (RT) inhibitory, insecticidal, non-mutagenic and toxicity activities (Maroyi, 2016:3). Morphine, a more potent analgesic than codeine, with additional sedative properties, and an extremely useful drug, was isolated from poppy latex (*Papaver somniferum*). Jams (*Dioscorea spp*.), sisal (*Agave spp*.) and some members of the tomato family (Solanaceae) have all proved to be good sources of steroid starter materials (Scott, 1993:84).

Most biological activities of *Warburgia salutaris* are attributed to drimane sesquiterpenoides, including polygodial, warburgnal, muzigal, mukaadial and ugandensial flavonoids, and miscellaneous compounds present in various species. Warburgia extracts are also used to treat a wide range of ailments, including stomach aches, fever and headaches, which may also be a manifestation of infection. The need to record anecdotal evidence is emphasised, and conservation efforts are highlighted, to contribute to the protection and preservation of one of Africa's most wanted resources (Leonard & Viljoen, 2015:2; Maroyi, 2013:7; Van Wyk *et al.*, 2013:308).

Qualitative phytochemical screening of *Cassia abbreviata* showed that the aqueous root bark extract contains saponins, phenolics, anthraquinones, flavonoids and tannins (Njagi *et al*., 2016:8).

Some of the proposed compounds identified from a crude herbal extract of *Cassia abbreviata* include Cassiaflavan, epicatechin and epiafzelechin, while compound

extracts identified from *Newbouldia laevis* includes Apigenin, Newbouldiside A and Luteoside B (Thomford *et al.,* 2016:8).

Phytochemical analysis of the leaves of *Asystasia gangetica*, *Bidens pilosa*, *Cleome monophylla*, *Ceratotheca triloba*, *Dicrostachys cinerea* and *Leonotis leonorus* indicated that they contain flavonoids and saponins in all the plants tested, but all plants lacked the presence of phlobatannin (Hurinanthan, 2013:97).

Pharmacological activities of *Cassytha filiformis* include anti-oxidant, anti-trypanosomal, anti-platelet and vasorelaxant activities. The alkaloids of the plant possess various applications in the field of medicine, but have to be explored further (Mythili *et al.*, 2011:82). Some isolated compounds from the extracts of this plant are aporphine alkaloids, oxo-aporphine alkaloid, cassyformine, filiformine, cathaformine, lignin, actinophine and octenine (Mythili *et al.*, 2011:77).

Phytochemical studies of *Cissus quadrangularis* on the methanol extract revealed the presence of triterpenes including α- and β- amyrins, β- sitosterol, ketosteroids, phenols, tannins, carotene and vitamin C (Shah, 2011:42).

Thirty-seven (37) secondary metabolites were reported, which includes 21 labdane diterpenes which are chemotaxonomic markers for *Leonotis* genus and the mint family lamiaceae. The leaf, flowers and sepals contains essential oils and are mostly constituted by monoterpenoids and sesquiterpenoids. The isolation of metabolises responsible for extract activities is recommended, and the data on clinical trials on the *leonotis leonorus* herb and its extracts, is of fundamental importance (Mazimba, 2005:74).

The acetone extracts of *Terminalia sericea* and *P. capense* roots showed high activity during killing curve determination. Further studies are needed, however, to isolate and identify the active compounds from these extracts that could lead to the development of new and effective antifungal drugs. Okeleye, Mkwetshana and Ndip (2013:8) also confirm that the acetate extract of *Peltophorum africanum* exhibited *in vivo* antibacterial (both gram-negative and positive species) and antifungal activity.

The roots of *Terminalia sericea* yielded anolignan B as the main active compound, with antibacterial and anti-inflammatory activity. The triterpenoides and saponins are well known for their antimicrobial and anti-inflammatory activity. The anti-diarrhoeal effects may be due to tannins. Root extracts showed significant anti-HIV-1 properties (Van Wyk *et al.* (2013:228).

It is evident that *Securidaca longipedunculata* is a very important medicinal plant used extensively for various purposes within African traditional culture. Phytochemically, salicylic acid, a variety of xanthones and esters, forms an integral part of this plant. These phytochemicals may well explain the antimicrobial, anthelmintic, antimalarial, and other biological activities of this plant. Interestingly, the use of this plant has been validated for the treatment of malaria, erectile dysfunction, pain and sexually transmitted infections (Mongalo, McGaw, Finnie & Van Staden, 2015:36).

The results of the nutritional analysis showed that *Elaeodendron transvaalense* contains rich sources of mineral elements that are essential for human health, such as Ca, Mg, K, Na, Zn, Fe, Mn and Cu (Radzuma, 2015:xii). Upon further fractionation, flavonoids, and especially isorhamnetin, were identified as active compounds of *Euphorbia tirucalli* extracts (Choene, 2015:iv). Various indigenous medicinal plants were screened against *Candida albicans* (Motsei, 2003).

4.9. Medicinal plant propagation

Study results indicated that traditional healers (83%) are interested in growing medicinal plants in their backyards for both medicinal and ornamental purposes; however, traditional healers do not have knowledge and training in basic propagation skills. During interview some traditional healers indicated that they have planted some medicinal plants in their back yards (Figure 4.21a, b & c).

The most common medicinal plants that were found in traditional healer's back yards are: *Euphorbia cooperi, Vangueria infausta, Encerphalartos transvernosus, Englerophytum magalismontanum, Gardenia volkensii, Bauhinia galpinii, Aloe arborescens, Adenia spinosa, Warbugia salutaris, Mondia whitei, Aloe greatheadii, Elephantorrhiza elephantina, Cissus quadrangularis, Drimia elata, Hypoxis hemerocallidea and Lippia javanica.*

Figure 4.21 (a): Young *Warbugia salutaris* root suckers growing away from their parent plant at Tshisahulu village (**Source:** Own).

Figure 4.21(b): *Encephalartos villosus* growing in traditional healer's garden. **(Source**: Own).

Figure 4.21(c): *Englerophytum magalismontanum* growing in traditional healer's yard **(Source:** Own).

The government can assist local communities and traditional healers by funding community projects and training in basic propagation skills such as sexual propagation (seed collection, seed-bed preparation, seed treatment, and seed sowing, watering and transplanting) and asexual propagation methods (cuttings). For traditional healers to cultivate medicinal plants, basic propagation skills are needed in order to grow plants successfully. This is essential for successful cultivation. Medicinal plant

propagation can relieve the pressure caused by the wild collection of medicinal plants. Highly valued plants facing the challenge of high demand, as well as those vigorously traded, can also be identified, selected and cultivated commercially by communities, in order to generate income as well as contribute towards medicinal plant conservation.

Many threatened plant species are easy to grow, given that the rules and requirements of how they survive in their natural habitat are understood and followed (Nichols, 2005: xiv). The soft seeds of *Warburgia salutaris* will germinate within 14 days if collected from unparasitised fruit (Nichols, 2005:24). Propagating *Warburgia salutaris* by seed is possibly the simplest and most rewarding way of bulking up this species (Nichols, 2005:86).

Plant propagation is a natural phenomenon in all plants. It is a process of multiplication of a plant by sexual or asexual means, to ensure the continuation of its progeny. This is achieved artificially in the field by adopting techniques suitable to the specific plant and its growth cycle (Oommen, 2002:18). Plants perpetuate in nature through seeds, or through vegetative parts, or special and modified organs. Based on the mode of propagation, two types of propagation are usually recognised among plants: sexual and asexual propagation (Oommen, 2002:19). Successful propagation is not dependent on elaborate and expensive equipment and technologies, but rather on some basic principles of plant growth and methods of manipulating these under controlled conditions (Geldenhuys, 1997:392).

4.9.1. Sexual propagation (Propagating from seed)

The sexual propagation method uses seed, which is a reproductive part that carries both sexes of the parents (Oommen, 2002:19). Sexual propagation is the production of new individuals by the fusion of a nucleus from the male (in pollen) and one in the female (in the ovule), to form a zygote (Adams *et al.*, 2012:136).

4.9.1.1. Seed collection

Before collecting seed, the following points should be considered: seed from cultivars/hybrids will not breed true to type. Seed must be collected when ripe, but before it disperses; however, some seed is collected before it is ripe, as this can prevent it going into a dormancy phase if sown quickly (Bird, 2014:151).

Dry seeds from dehiscent and indehiscent fruit can be collected by hand, and placed in paper bags or cloth bags. Dehiscent fruits may need paper bags put over the fruit to catch the seeds, unless conducted before fully ripe and dehiscent. Once collected, the seed is cleaned by sieving through very fine sieves, and gently blowing to remove any light chaff (Bird, 2014:151).

When seed is matured and ready to be harvested, usually either the seed pod splits or the fruit drops to the ground. (Rice & Rice 1997:48). The colour of the mature fruit will darken as it ripens, and cleaning removes the ovary tissues that surround the seed, since this can rapidly become mouldy and lose viability (fungus kills them) (Joffe, 2012:24).

The majority of seeds should be collected as they ripen. Seeds in dry fruits should be collected on a dry day, and it should be noted that when enclosed in a fruit, the seed is ready to be collected before the fruit matures and is ready for dispersal. Collecting in bags, plastic rather than cloth, to keep hands free, is an advantage, and it is essential to label samples with the name of the plant and where it was collected (Adams *et al.,* 2012:138). Some seeds of plants such as *Warburgia salutaris* are, however, recalcitrant (they lose viability after drying out), and storage of such seeds is not advised (Nichols, 2005:86).

4.9.1.2. Seedbed preparation

The best and most careful cultivation needs to be undertaken for these sites, as a seed crop would be extremely costly in terms of both time and materials. The site for seedbed preparation must be in a well-lit site with some protection from excessive rain and very high winds (Bird, 2014:114).

The seedbed position should provide the correct amount of sunlight for the species, and should also be well drained. The soil should crumble easily in the hand, and should be worked at a depth of about 30 centimetres to ensure suitable conditions for root growth. Clods should be broken and any rocks or debris removed (Rice & Rice, 1997:49).

A good seedbed should have a loose but fine physical texture that produces close contact between seed and soil, so that moisture can be supplied continuously to the seed. Such soil should provide good aeration, but not too much of it as it dries too rapidly. The surface soil should be free of clods and texture, so that it will not form a crust (Hartman, Kester, Davies and Geneve, 2011:251).

The type of substrate or medium used for germination is very important to seedling establishment; in general, a substrate should be light and porous, in order to provide adequate oxygen, yet retain moisture and allow proper drainage (Gibson, 2001:2). The main mistake made during seedbed preparation is over-preparing the soil for sowing (Durner, 2013:247).

4.9.1.3. Seed treatment

Before sowing seed, the best method of breaking dormancy is to scarify the seed coat and soak the seed in water for a day or two until it starts to swell, in order to induce the germination process. Once the seed has started to swell and split, but before root or radicle appears, place the seed into the seedling mix (Nichols, 2005:18).

This is called physical dormancy. It is characterised by a hard seed coat that has to be broken before water and oxygen can get in. Growers speed up the process by scarification – for example, sand papering or filing the coat, chipping or nicking it with a knife, or by adding acids.

Water can then get in quickly through the thin or damaged seed coat, and start the germination process. For many seeds, simply adding hot water is sufficient to remove their waterproofing qualities and let in water. In cases of physiological dormancy, this includes the effect of abscisic acid in the dry seed, which inhibits development of the embryo. Germination cannot begin until its concentration is reduced.

Growers can overcome this mechanism by exposing the seed to cold artificially; stratification is the usual method of overcoming this form of dormancy (Adams *et al.*, 2012:137).

4.9.1.4. Seed sowing

The depth of planting varies with the kind and size of seed. In general, a depth of three to four times the diameter of seed is satisfactory. Seeds can be covered with soil, coarse sand or various mulches (Hartmann, Kester, Davies & Geneve, 2011:263). The seed must be covered with enough soil to create a microclimate that supports water imbibition, but not so much soil that light penetration is severely decreased. Depth of seeding must also consider seed size and the ability of the seed to supply energy during germination via reserves until emergence and the inception of photosynthesis (Durner, 2013:247). The issue of seed quality, however, plays a major role in the success of germinating seed (Gibson, 2001:2). If planted too deeply, a seed may exhaust all stored food before it can emerge from the soil and photosynthesise; however, if seeds are not planted deeply enough, poor seedling anchorage will result, leading to poor stand establishment (Durner, 2013:247).

Seeds should be sown at the depth and spacing recommended on the package. If sowing instructions are not given, the general rule is that seeds should be planted one-and-a-half times as deep as their diameter. Spacing between the seeds can be estimated from the size of the mature plant (Durner, 2013:247). Larger seeds can be placed by hand, leaving reasonable spaces between seeds, because one will need to dig up each young plant to replant it into a larger container (Joffe, 2007:37). The finest seeds should not be covered at all, and seeds should not be buried too deeply, or they won't be able to germinate. A good guide is to cover the seed with a layer of compost as thick as the seed itself (Joffe, 2003:24).

In cases where seeds are sown in containers such as a milk carton or plastic dairy product containers, holes must be made in the base for draining of excess water. For large numbers of seedlings, plastic, Styrofoam or wood nursery flats can be purchased (Rice & Rice, 1997:50).

4.9.1.5. Watering

It is best to water trays from below to allow water into the trays by partially immersing the tray to about half its depth in a pool of water in a wheelbarrow or larger tray or basin (Nichols, 2005:23). When watering seedlings, use a fine hose to avoid digging out the soil medium with large heavy droplets (Nichols, 2005:4). A good deep watering is more beneficial than numerous short shallow sprinklings (Joffe, 2003:15).

4.9.1.6. Transplanting

As the leaves of neighbouring plants overlap, less light will be available to each seedling, and growth will slow accordingly. The competition of crowded roots for nutrients also causes stunting. At this point, usually corresponding with the emergence of true leaves, the seedlings should be transplanted into separate growing containers. Seedlings are very delicate, and transplanting must be done carefully to avoid injury. A pencil can be used to lift up groups of seedlings. After transplanting, the growing medium should be firmed lightly around the roots with finger tips, then each plant should be watered to assure contact between the growing medium and the roots.

The seedlings should be kept in a shaded location for two to three days to minimise transpiration water loss while the roots damaged during transplanting resume water absorption (Rice & Rice, 1997:51-52).

4.9.2. Vegetative propagation

Vegetative propagation involves the use of non-sexual plant organs such as leaves, stems and roots (Rice & Rice, 1997:54). Vegetative propagation is based on using parts of existing stock to generate new plants. These daughter plants will have traits identical to those of the plants from which they were derived (Rice & Rice, 1997:47; Hartmann *et al*., 1990:165). Asexual propagation is the creation of new individuals by division of genetic material and cytoplasm of the parent cell (Adams *et al*., 2012:141).

4.9.3. Cuttings

Cuttings can be harvested at most times of the year, although the time of harvest affects the strike rate (Nichols, 2005:45). Young plants propagated from cuttings and truncheons mature, flower and fruit sooner than seedlings do. They are also exact replicas of the parent plant (Joffe, 2003:26).

The type of wood, stage of growth used in making the cuttings, and the time of year when the cuttings are taken, are more important factors in the satisfactory rooting of plants. Cutting propagation utilises a portion of the stem, root or leaf that is cut from the parent or stock plant, and induced to form roots and shoots by chemical, mechanical and/or environmental manipulation. (Hartmann *et al*., 2011:345). In most cases, the new independent plant produced is a clone, which is identical to the parent plant. Cuttings are the most widespread vegetative plant parts, such as leaves, stems and roots that regenerate their missing parts to form a new plant (Rice & Rice, 1997:54).

4.9.3.1. Hardwood cuttings

Hardwood cuttings are made of matured, dormant, firm wood after leaves have abscised. The use of hardwood cuttings is one of the least expensive and easiest methods of vegetative propagation. They are prepared during the dormant season (late fall/winter, or early spring), usually from wood of previous seasons' growth (Hartmann *et al.*, 2011:345). It is preferable to take evergreen plant cuttings at the beginning of the growing season, during spring or early summer. Deciduous plant cuttings should be taken before the end of winter, when the sap is rising and the buds are about to swell (Nichols, 1995:34). Hardwood cuttings are from pieces of dormant woody stem containing a number of buds, which grows into shoots when dormancy is broken in spring (Adams *et al*., 2012:144).

Hardwood cuttings vary in length from 10 to 76 cm, the diameter of cuttings may range from 0.6 cm to 2.5 cm, depending upon species. At least two nodes are included in the cutting, the basal (bottom) cut is usually just below a node, and the top cut 1.3 to 2.5 cm above a node. In cases where it is difficult to distinguish between the top and base of the cuttings, it is advisable to make one of the cuts at a slant rather than at a

right angle. To avoid desiccation, it is important that they do not dry out during handling. The rooting process can also be accelerated by treating the base of the cuttings prior to planting, with auxin (plant growth stimulator that can stimulate cuttings to root (Hartmann *et al.*, 2011:349).

4.9.3.2. Semi-hardwood cuttings

Semi-hardwood cuttings are those made from woody, broad-leaved evergreen species, and leafy summer and early fall cuttings of deciduous plants with partially matured wood. They are generally taken during summer (or late spring through early fall, in warmer climates). Semi-hardwood cuttings are made 7.5 to 15 cm long with leaves retained at the upper end; however, if the leaves are very large, they can be trimmed one-third to one-half the size, to reduce the leaf surface area as well as to lower transpirational water loss and allow closer spacing in the cutting bed.

Shoot terminals are often used in making the cuttings, but basal parts of the stem will often root too. The basal cut is usually just below a node, and the cutting wood should be collected in the cool, early morning hours when leaves and stems are turgid, and kept in large polyethene bags to maintain high humidity (Hartmann *et al*., 2011:354). Semi-ripe cuttings are taken from stems that are just becoming woody. They are normally taken from midsummer to early autumn. Most cuttings of this kind are 5-10 cm in length. (Adams *et al*., 2012:144).

4.9.3.3. Softwood cuttings

These are prepared from the soft, succulent, new spring growth of deciduous or evergreen species. They are produced during growth flushes, and may occur just once a year. They generally root more easily and quickly (2-5 weeks) than other types, but require more attention and sophisticated equipment. This type of cutting is made with leaves attached. Softwood cuttings are 7.5 to 12.5 cm long, with two or more nodes. The basal cut is usually made just below the node. Leaves on the lower portion of the cutting are removed, but those on the upper part are retained. Large leaves can be trimmed to minimise transpirational loss, and occupy less space in the propagating bed (Hartmann *et al.*, 2011:354-355).

Because the younger parts of plants generally root more easily than matured parts, softwood cuttings are the most reliable way to vegetatively propagate most woody outdoor plants (Rice & Rice, 1997:55). Propagating *Warburgia salutaris* species using shoot tip cuttings is the best way of bulking up this species, particularly in cases of shortage of viable seeds (Nichols, 2005:86).

4.9.3.4. Herbaceous cuttings

Herbaceous cuttings are made from succulents with little woody tissue, such as geraniums, coleus, etc. Herbaceous cuttings can be taken any time of the year. They are 8 to 13 cm long with leaves retained at the upper end, and they are rooted at the same conditions as softwood cuttings (Hartmann *et al.*, 2011:356).

Herbaceous cuttings are the equivalent of softwood cuttings, and are taken from herbaceous plants which never become woody and can be rooted at any time during the growing season. They are generally 5-10 cm long, and taken from the tip of the stem. The bases of the cuttings should be planted in a damp rooting medium, and cuttings should be enclosed in a plastic bag to increase humidity. Keeping the cuttings wet from the time they are cut until they are stuck in the medium, will reduce wilting (Rice & Rice, 1997:55).

4.9.3.5. Leaf cuttings

Leaf cuttings are a single leaf and sometimes its petiole. Propagation procedures vary among genera. Leaves of the African violet and peperomia are picked with petiole attached, the leaf is buried in the rooting medium up to the blade, and new plants form at the soil line. With other succulents such as echeveria, leaves are picked directly off the plant and laid on the surface of the medium. Another plant species grown from leaf cutting is *Sansevieria spp*. A mature leaf can be cut crosswise in 3-centimetre-long sections, and the base of each stuck in rooting medium (Rice & Rice, 1997:56).

4.9.4. Rooting media

The growing medium that supports and surrounds the rooting area will determine whether roots will form, and their quality. The main requirements are that it should drain quickly to admit air to the rooting area, yet should retain some moisture (Rice & Rice, 1997:54). The rooting media into which the propagule is to be rooted or to develop shoot growth, must be chosen carefully. In an outdoor nursery bed, soil will be the main constituent. Open, well-drained soil is the best, and soil dominated by clay, for example, can be improved by the addition of washed grit and organic matter. Some specialist plants, such as succulents, will need mineral-rich gritty compost, but most are best rooted in compost where the bulk ingredient is organic. Low-nutrient compost is generally recommended, but the speed of rooting will affect this (Bird, 2014:171).The longer a cutting takes to root, the more it needs nutrients to maintain the cell tissue during the rooting process. Cuttings rooted straight into a modular container will also be better in compost with nutrient, as they will remain in this container during the stage of formative shoot growth (Bird, 2014:171).

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1. Research aim

The main aim of this research project was to investigate aspects relating to traditional healers' perceptions with regard to collection, ethnobotanical importance and conservation of indigenous medicinal plants used by traditional healers around Thulamela municipality.

The research aim was achieved through semi-structured interviews, a literature review (Chapter 2) and observation (Chapter 3). Aspects relating to traditional healers' perceptions regarding collection, ethnomedicinal importance and conservation status of indigenous medicinal plants used by traditional healers around Thulamela municipality, were investigated and documented, as indicated in Chapter 4.

5.2. Research objectives

The main objectives achieved by the study were the following:

5.2.1. To document medicinal plants collected and utilised by traditional healers, and identify their conservation status.

This research objective was achieved through semi-structured interviews, a literature review and observation. The research results indicated that medicinal plants are collected and utilised by traditional healers of Thulamela municipality, as indicated in Chapter 4.

A total of 90 medicinal plant species, which belong to 47 families, from a total of 82 genera commonly used by traditional healers, were recorded (Table 4.1). The species comprise different forms, such as trees, shrubs, climbers, bulbs and herbs that are used to treat different ailments.

Eighty-six percent (86%) of medicinal plants used by traditional healers are regarded as of least concern, 6% as not evaluated, 3% as declining, 2% as endangered, 1% as critically endangered, 1% data deficient, and 1% nearly threatened, according to the SANBI Red data list version 2015.1.

5.2.2. To determine the most-harvested plant parts, harvesting procedures and processes.

The research objective was achieved through semi-structured interviews and observation (Chapter 3).

The majority of traditional healers (73%) interviewed indicated that roots are the most-harvested plant parts, compared to 27% who indicated that bark is the most commonly harvested part. Although most of the medicinal plants found in consultation rooms visited were processed and stored inside containers, most plant parts found in street traders' shops visited around Thohoyandou were roots, followed by bark.

Harvested plant parts observed from street traders visited around the Thohoyandou area, were roots (68%), followed by bark (20%), whole plant (10%), fruits (1%) and leaves (1%).

After harvesting roots, the soil is returned into the hole to cover the remaining roots. According to traditional healers, when harvesting roots, only the side roots (adventitious roots) are targeted, while avoiding the tap root. In a case where bark is harvested, harvesting only takes place on the eastern and western side of the tree, and ring-barking is avoided at all times. In the case of bark harvesting, the wound is covered with soil or cow dung to facilitate healing.

Harvesting rituals are performed to ensure that the medicine harvested is of good quality and high potency. This includes sprinkling of snuff on the ground before harvesting commences or even before embarking on a harvesting trip; it is done to communicate with the ancestors for guidance and protection. In some instances, sprinkling of snuff is also accompanied with some coins next to the stem of the tree to be harvested, rituals before harvesting differ from one healer to the other, or even from one tree to another. In most cases, rituals before harvesting include abstinence from sexual activities.

5.2.3. To determine whether there is a potential role that medicinal plants can play as an alternative care to biomedicine in the provision of primary healthcare.

The research objective was achieved through semi-structured interviews (Chapter 3) and a literature review (Chapter 2). The potential role played by indigenous medicinal plants of Thulamela municipality as an alternative care to biomedicine in the provision of primary healthcare, was determined and recorded, as indicated in Chapter 4.

All the traditional healers interviewed indicate that medicinal plants collected (Table 1) and used by traditional healers is playing a very crucial role in the provision of primary health care around their communities.

According to traditional healers, not all diseases can be cured by western medicine, and further indicate that in some cases they refer their patients to western doctor in case the patient is not responding well to their treatment. Extensive literature review was conducted to confirm whether if medicinal plants has been tested to prove their potential as an alternative to biomedicine.

5.2.4. To determine whether there is sufficient awareness regarding environmental management regulations among traditional healers concerning harvesting and sustainability of indigenous medicinal plants of Thulamela municipality.

Semi-structured questionnaire (Appendix A) was used to determine whether there is sufficient awareness among traditional healers concerning harvesting, sustainability as well as knowledge of environmental regulations.

The majority (87%) of traditional healers indicated that there is no awareness regarding medicinal plant conservation and sustainability. Only 13% of traditional healers interviewed indicated that there are awareness programmes regarding medicinal plants, and, further, that awareness programmes, and issues regarding medicinal plant conservation and sustainability, are discussed during meetings and workshops with traditional healers' associations. All the traditional healers interviewed indicated that they don't know of any environmental management legislation. Eighty-seven percent (87%) of healers also indicated that they are unaware of Red data or protected species. Only 13% of healers are aware that some medicinal plants are protected by tribal authorities, but they are not aware of any legislation protecting medicinal plants.

5.3. Research questions

The study succeeded in addressing the following research questions:

5.3.1. What are the most-harvested plant parts, and what is being done to ensure the species' survival during and after harvesting?

Semi-structured interviews (Chapter 3) and a literature review (Chapter 2) were conducted, in order to address the research question. The research results showed that the majority (73%) of traditional healers interviewed indicated that roots are the most-harvested plant parts, followed by bark. In the case of bark harvesting, the wound is covered with soil or cow dung to facilitate healing. In cases were roots are harvested, some roots are left behind in order for the tree to survive; only side roots are targeted, while avoiding the tap root. After harvesting roots, the soil is returned into the hole to cover the remaining roots, as indicated in Chapter 4.

5.3.2. Is there any potential role that medicinal plants can play as an alternative to biomedicine in the provision of primary healthcare?

The research findings confirmed that medicinal plants, as an alternative to biomedicine, are playing an important role in providing primary healthcare to local communities as indicated in 5.2.3 above.

All the traditional healers interviewed indicate that medicinal plants collected and used by traditional healers is playing a very crucial role in the provision of primary health care around their communities.

Literature review conducted confirmed that medicinal plants are playing a significant role as an alternative to biomedicine in the provision of primary healthcare to both urban and rural communities. It is estimated that 70-80% of people worldwide rely chiefly on traditional, largely herbal, medicine, to provide their primary healthcare. Medicinal plants still provide hope for discovery of new drugs against resistant diseases and also those diseases that were not treated by conventional prescribed drugs, as indicated by Hamilton (2004:13).

5.3.3. Is there sufficient awareness regarding environmental regulations concerning collection/harvesting of medicinal plants among traditional healers?

The research findings confirmed that the majority (87%) of traditional healers indicated that there are no awareness programmes regarding medicinal plant harvesting and conservation, and further, that they are not aware of any environmental management legislation and Red data species. This indicates that there is insufficient awareness campaigns regarding environmental management regulations among traditional healers, concerning harvesting and sustainability of indigenous medicinal plants used by traditional healers around Thulamela municipality as indicated in 5.2.4.

5.3.4. What is the current conservation status regarding indigenous medicinal plants?

A literature review was conducted, and semi-structured questionnaires distributed, in order to answer the research question. Study results indicated that a total of 86% of medicinal plants used by traditional healers are regarded as of least concern, 6% as not evaluated, 3% as declining, 2% as endangered, 1% as critically endangered, 1% as nearly threatened, and 1% as data deficient, according to SANBI's Red data list version 2015.1.

5.4. Hypotheses

5.4.1. Medicinal plants are not collected and utilised by traditional healers of Thulamela municipality.

To test this hypothesis, semi-structured interviews were conducted with traditional healers. This hypothesis was rejected. The results indicate that medicinal plants are collected and utilised by traditional healers of Thulamela municipality.

5.4.2. Medicinal plants are collected and utilised by traditional healers of Thulamela municipality.

This hypothesis was accepted, as the research results indicated that traditional healers collect and utilise medicinal plants. A total of 90 medicinal plant species belonging to 47 families used by traditional healers were recorded. The species comprise different forms such as trees, shrubs, climbers, bulbs and herbs that are used to treat different ailments ranging from stomach pains, infertility and sexually transmitted infections, as well as being used for charms, and more.

5.4.3. Harvesting procedures, processes and parts harvested do not have an impact on the survival of the species being harvested by traditional healers of Thulamela municipality.

This hypothesis was rejected, as the study results indicated that harvesting procedures, processes and parts harvested have an impact on the survival of the species being harvested.

5.4.4. Harvesting procedures, processes and parts harvested have an impact on the survival of the species being harvested by traditional healers of Thulamela municipality.

This hypothesis was accepted, as the research results indicated that traditional healers practise sustainable harvesting by selective harvesting, avoiding ring-barking (bark harvesting only takes place on the eastern and western sides of the tree), harvesting side roots while avoiding tap roots, as well as covering the remaining roots after harvesting.

The majority (73%) of traditional healers indicated that roots are the most-harvested plant parts. Study results further indicated that roots are the most sensitive parts. Harvesting procedures, and the amount and type of plant material harvested, will also determine the survival of species.

5.4.5. There is insufficient awareness regarding environmental management regulations concerning harvesting/collection of medicinal plants among traditional healers.

This hypothesis was accepted, as the research results (Chapter 4) indicated that the majority (87%) of participants/healers indicated that there is no awareness regarding medicinal plants, as indicated by the research question number 5.3.3.

5.4.6. There is sufficient awareness regarding environmental management regulations concerning harvesting/collection of medicinal plants among traditional healers.

This hypothesis was rejected, as only 13% of traditional healers interviewed indicated that they know that some medicinal plant species are protected by tribal authorities, as indicated by the research question number 5.2.4.

5.4.7. Medicinal plants of Thulamela municipality are irrational and ungrounded in scientific method in academia.

This hypothesis was rejected, and a literature review was conducted to prove/disprove this hypothesis. Various medicinal plants of Thulamela municipality were found to be both rational and grounded in scientific academia, as indicated in Chapter 4.

5.4.8. Medicinal plants of Thulamela municipality are rational and grounded in scientific method in academia.

This hypothesis was accepted, as the literature review conducted confirmed that various medicinal plants have been screened for the presence of various chemicals, in order to confirm that medicinal plants of Thulamela municipality are rational and grounded in scientific academia, as indicated in Chapter 4.

5.4.9. Medicinal plants of Thulamela municipality cannot play a role as an alternative source of primary healthcare to biomedicine.

This hypothesis was rejected, as the study results obtained from interviews and the literature review indicated that medicinal plants of Thulamela municipality are playing a role in providing primary healthcare as an alternative to biomedicine.

5.4.10. Medicinal plants of Thulamela municipality can play a role as an alternative source of primary healthcare to biomedicine.

This hypothesis was accepted, as all the traditional healers interviewed indicated that medicinal plants, as an alternative to biomedicine, are playing an important role in providing primary healthcare to local communities, as indicated in Chapter 4.

5.4.11. There is no decline in the availability of some medicinal plants of Thulamela municipality.

This hypothesis was rejected, as the hypothesis was tested through semi-structured questionnaires and the literature review. Research results indicated that some medicinal plants are difficult to find, while some healers are experiencing a decline in the availability of medicinal plants.

5.4.12. There is a decline in the availability of some medicinal plants of Thulamela municipality.

This hypothesis was accepted, as research results indicated that a total of 77% of traditional healers confirmed that there is a decline in some medicinal plant species, and some medicinal plants are reported to be found in more distant areas. Eighty-seven percent (87%) of traditional healers stated that some medicinal plant species are difficult to find, as indicated in Table 4.2.

5.5. Validity and reliability

The study was successful in addressing the issue of validity and reliability.

Individual interviews were conducted with 30 traditional healers from 16 villages around Thulamela municipality. The interviews were designed to take between 20-30 minutes. The ages of the traditional healers interviewed ranged from 35 years old and above.

Information on medicinal plants was gathered by means of semi-structured interviews, field walks and personal observation. Semi-structured questionnaires were designed in English, but translated into (and asked in) *Tshivenda*, in order to overcome the language barrier. The interviewees were Vhavenda- and Vatsonga-speaking traditional healers who spoke and understood *Tshivenda* fluently.

The interview process was continued with new respondents until saturation (that is, no more substantial information can be acquired through additional respondents, or until no more respondents are available), in order to ensure validity and reliability of the semi-structured questionnaires.

To increase the validity of the results, findings from a wide range of sources were collected and compared (triangulation). Apart from the semi-structured interviews, the researcher's personal observation, field walks and literature review, during the study, contributed useful information to the data collected from the interviews. Triangulation promotes conformability, and reduces the effect of investigator bias, as indicated by Shenton (2004:72). The study results were also validated by ensuring that its findings were supported by other studies, through the literature review. Precautions were taken to ensure that the research findings were the result of the experiences and ideas of the informants, rather than characteristics and preferences of the researcher, as indicated by Shenton (2004:72).

The observational data and the field walks conducted were very useful in overcoming the discrepancies between what people say and what they actually do, and might help to uncover behaviour of which the participants themselves are not aware, as indicated by Patton and Cochran (2002:20).

5.6. Recommendations

5.6.1. Traditional healing

Traditional healing practices could be a means to a better economy and better health for traditional societies. The existence of traditional healers, and the influence they have on the day-to-day lives of both the rural and urban communities can therefore not be overlooked, as indicated by Masupha *et al*. (2013:30).

The main problem facing the use of traditional medicine, however, is the requirement of proof that the active components contained in traditional medicines are useful, safe and effective; therefore, all medicinal plants of Thulamela municipality must be screened to ensure that they are safe and effective as drug alternatives, as indicated by Rukangira (2001:180).

5.6.2. Harvesting processes and procedures

Roots and bark are the most sensitive plant parts to harvest, and that are most exploited, as indicated by Cunningham (1993:3). Collectors must therefore practise selective harvesting, and harvest such parts with extreme care, to ensure plant survival and conservation. Selective harvesting should be practised, while avoiding ring-barking at all times. The remaining roots should be covered with soil, to ensure species survival.

5.6.3. Cultivation/propagation

Medicinal plants are facing a very serious challenge, due to high demand, resulting in some of them becoming endangered, threatened or even extinct. Such plants can provide an excellent opportunity for them to be cultivated commercially, as well as relieving pressure on the wild.

In order for traditional healers to cultivate medicinal plants, basic propagation skills are needed, in order to grow plants successfully. This is essential for successful cultivation. Medicinal plant propagation can relieve pressure caused by wild collection of medicinal plants. Highly valued plants facing the challenge of high demand, and those vigorously traded, can also be identified, selected and cultivated commercially by communities, to generate income as well as contribute towards medicinal plant conservation.

The government must therefore assist local communities and traditional healers by funding community projects, and training them in basic plant propagation skills.

To use and conserve medicinal plants effectively, it is vital to know which species are concerned, their correct names and how they grow (WHO, 1993:13). For threatened medicinal plant species, cultivation is a conservation option to ensure that demand for these species can be met from cultivated medicinal plants (Coetzee *et al.*, 1999:162).

Documenting the trade and use of medicinal plants, and understanding the socio-economic conditions of resource users and their perceptions on cultivated medicinal species, should therefore be the starting point for sustainable management of medicinal plants, as indicated by Loundou (2008:30). Unless medicinal plant cultivation and propagation is instituted among local communities, medicinal plants are likely to become rare or difficult to find in the wild, as indicated by Mathibela (2013:118).

5.6.4. Conservation

In order to ensure that representative wild populations of vulnerable species are maintained, core conservation areas, or other protected areas that will allow the natural process to continue undisturbed by human activity, should be designated and monitored 24 hours per day, especially where poaching is taking place inside protected areas (Cunningham, 1993:32).

5.6.5. Horticultural approach

Horticulture can play a crucial role with regard to medicinal plant conservation. This can be achieved through the encouragement of nursery and community growers to propagate medicinal plants for the purposes of medicinal use, as well as for ornamental use for both commercial and home gardens. Threatened, endangered and protected plant species should be regarded as high-value plants by the government; therefore, such plants should be given priority by propagating and planting them in tribal councils, government offices and schools gardens, where possible.

Thohoyandou Botanical Gardens can be used as a starting point to propagate and educate local communities about gardening and greening, as well as the importance of protecting, and the sustainable use of, indigenous plants, for both medicinal and aesthetic purposes. Local municipalities can also assist by using medicinal plants for greening and landscaping purposes.

5.6.6. Public awareness

Outreach programmes at community level can also play a crucial role in informing local communities about the role played by planting trees in the environment, and encouraging them to do so.

The government can also play a crucial role in developing public education and awareness programmes at local level, to ensure that rural communities are aware of the importance of plants and their legislation, as well as the implications for not complying with the legislation. To ensure the protection as well as the sustainable use of indigenous plants, awareness programmes should be followed by enforcement as a deterrence for non-compliance. Local communities can be trained and encouraged to propagate plants and develop community nurseries. An awareness campaign is an integral part of educating a target group about the existing situation, and mobilising them to effectively manage and conserve medicinal plants and traditional practices, as indicated by (Motaleb, 2010:8).

5.6.7. Community development projects

The majority of Thulamela municipality residents live in rural tribal areas, where the unemployment rate is very high. This results in people relying on natural resources for survival, and for income generation by selling firewood and medicinal plant products. The development and funding of community projects that will assist and encourage local communities to protect their resources, and sustain natural resource management, can assist in alleviating poverty, relieve pressure on the wild, and dependence on natural resources as a means of income generation.

Without community involvement and development in natural resources management, it will be almost impossible to conserve natural resources in areas where local communities are dependent on freely available natural resources as their sole means of survival.

Community involvement and development through poverty alleviation projects can therefore play a vital role in the sustainable management of the diverse botanical resources of Thulamela municipality.

To ensure sustainable livelihoods, it is important to ensure that economic opportunities are expanded in local areas, in a way that takes both humans and biodiversity into account (DEAT, 1997:51-52).

5.7. Research limitations

The research project was aimed at the investigation of aspects relating to traditional healers' perceptions with regard to collection, ethnobotanical importance and conservation of indigenous medicinal plants used by traditional healers around Thulamela municipality.

The study entailed the following aspects:

- The documentation of medicinal plants collected and utilised by traditional healers around Thulamela municipality.
- Investigation of the potential role that medicinal plants can play as an alternative to biomedicine in the provision of primary healthcare.
- Determination of whether there is sufficient awareness regarding environmental management regulations among traditional healers concerning harvesting and sustainability of indigenous medicinal plants
- Determination of the current conservation status of indigenous medicinal plants used by traditional healers of Thulamela municipality.
- Investigation of the role played by protected areas around Thulamela municipality, as well as the challenges and threats in these conservation areas.

During the study process, the following set of limitations were encountered:

- Due to the time frame available, not all traditional healers around Thulamela municipality could be interviewed for this research project.
- Some of the traditional healers were not interested or did not want to participate in the study; therefore, their input could not be captured.

Some of the reasons given by some traditional healers for not participating in the study, was that traditional healing information is sacred, so they cannot give such information to a stranger. Some of the healers also indicated that it is taboo to share traditional healing information, since it is a gift from their ancestors; therefore, they were afraid that they might be punished by their ancestors.

Most of the interviews took longer than expected, due to the initial relationship between some traditional healers and the researcher – that is, a lack of trust between the healers and the researcher. The reason for this was that some of the healers thought that the information collected during the interviews would be used by the researcher for financial profit, and they further indicated that they had participated in previous studies by other researchers without benefiting, and they were never given feedback about the study results.

To overcome this barrier, the healers were given more time to ask questions. Clarification was given to them with regard to the study aim, giving them time, and building a relationship with them through contacting them telephonically, and allow them to suggest the most convenient time for them to be interviewed. All the participants were informed about the purpose of the study. A letter from the traditional healers' organisation and the local headmen was also used to ensure that trust was built between the researcher and the participants. Participants were also given the chance to ask clarity-seeking questions before the commencement of the interviews. In some instances, participants refused to give written consent, the reason being that their signatures might be used for criminal activities. In cases where participants refused to give written consent, verbal consent was obtained.

One of the best ways to validate findings is to triangulate using other methods, including surveys or additional sources. One weakness of qualitative research is that it is hard to establish external validity – that is, to provide corroborating evidence that the findings are not merely the opinion of the researcher. One approach to minimising the researcher’s bias is to include a section on the interviewer or principal investigator's background, and how it might influence their conclusions. Having recordings of sessions and detailed notes helps other interested parties to come with their conclusions, and can help validate findings (Sauro, 2013).

5.8. Recommendations for further research

The study results showed that medicinal plants play a crucial role as an alternative to biomedicine in both rural and urban communities around Thulamela municipality. The following topics are therefore recommended by the researcher for further investigation:

- Medicinal plant screening, with regard to the presence of toxic elements that can be harmful, and their effects on health.
- The use of popular medicinal plants in ornamental horticulture.
- Substitutes for rare, endangered, slow-growing medicinal plants.
- The integration of traditional medicine and Western medicine.

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APPENDIX A: TRADITIONAL HEALERS' QUESTIONNAIRES

A. PERSONAL INFORMATION

Respondent name												
Gender	Male								Female			
Home language	Venda		Tsonga		Sotho		Zulu		Other(specify)			
Residence												
Age group	35-45		46-55		56-65		66+					
Level of education	No schooling				Primary education							
	Secondary education				Tertiary education							

B. KNOWLEDGE OF MEDICINAL PLANTS

1. How did you become a traditional healer?

Ancestral gift		Learnt from friend	
Learnt from my parents		Other	
Trained			

If other, specify

……

……

2. Is there any potential role that indigenous medicinal plants can play as an alternative source to supplement western health systems?

YES		NO	

Give reason for your answer

……

……

3. Do you collect medicinal plants yourself?

YES		NO	

If you don't, who collects?

……

4. What are you doing to ensure the preservation of traditional healing knowledge and system?

Family members interested		No one interested in the family	
Other			

If other, specify

……

……

5. What are sources of medicinal plants supply?

Private		Communal		Other	

If other, specify

……

6. Do you have consent / permission from the landowner or traditional council?

YES		NO	

7. How far is the collection site for most of medicinal plants?

>10km		10-20km		21km-30km		31-40km		41-50km	
<51km									

8. What are the most-harvested parts?

Roots		Bark		Leaves		Flowers		Fruits		Other	

If other, specify

……

C. MEDICINAL PLANTS CONSERVATION

1. What do you do to ensure species survival during and after harvesting?

……

.....

……

2. Do you experience difficulties in finding some medicinal plant species?

YES		NO	

If yes, what is the cause? (Give examples) how does this impact on your practice?

.....

……

.....

3. Is there sufficient awareness regarding environmental regulations concerning collection / harvesting of medicinal plants among traditional healers?

YES		NO	

4. Do you have knowledge about Limpopo Environmental Management Act (LEMA)?

YES		NO	

5. Do you know about Red data / protected plant species?

YES		NO	

If yes, give examples:

……

……

6. Do you have a permit?

YES		NO	

7. Do you experience a decline in some medicinal plant resources?

YES		NO	

If yes, give examples

……..

……..

D. MEDICINAL PLANTS PROPAGATION

1. Are you willing to buy cultivated varieties of medicinal plants?

YES		NO	

If no, give reasons:

.....

.....

2. Do you have interest in growing medicinal plants in household and/or community gardens?

YES		NO	

If no, give reasons:

.....

.....

……

.....

E. LIST OF USEFUL MEDICINAL PLANTS (Data collection sheet)

Plant name	Parts used	Method of preparation	Method of administration	Diseases treated

Thank you very much for your participation.

APPENDIX B: MEDICINAL PLANTS PROPAGATION/CULTIVATION AND CONSERVATION STATUS ACCORDING TO SANBI RED DATA LIST VERSION 2015.1

Botanical name	Method of propagation	Conservation status according to SANBI Red data list version 2015.1	Legislation Protecting Species
Adansonia digitata	Seed	Least concern	LEMA, NFA
Adenia gummifera	Seed	Declining	
Adenia spinosa	Seed	Least concern	
Antidesma verosum	Seed	Least concern	
Artabotrys monteiroae	Seed	Least concern	
Boscia albitrunca	Seed	Least concern	NFA
Carrisa edulis	Seed	Least concern	
Cissus quadrangularis	Seed	Least concern	
Combretum micophylum	Seed	Least concern	
Commiphora merkeri	Seed	Least concern	
Albizia adianthifolia	Seed	Least concern	
Heteromorpha trifoliata	Seed & truncheons	Least concern	
Euphorbia cooperi	Seed/cuttings	Least concern	
Lannea schweinfurthii	Seed	Least concern	
Dalbergia melanoxylon	Seed	Least concern	
Protasparagus falcatus	Seed	Least concern	
Rhoicissus tridentata	Seed/cuttings	Not evaluated	
Terminalia sericea	Seed	Least concern	
Albizia versicolor	Seed	Least concern	
Bauhinia galpinii	Seed	Least concern	

Cassia pitersiana	Seed	Least concern	
Diospyros mespiliformis	Seed	Least concern	
Diospyros lycioides	Seed	Least concern	
Ekebergia capensis	Seed	Least concern	
Englerophytum megalismontanum	Seed	Least concern	
Euclea crispa	Seed	Least concern	
Heteropyxis natalensis	Seed	Least concern	
Indigofera arrecta	Seed	Least concern	
Lippia javanica	Seed	Least concern	
Oxalis corniculata	Bulbs	Not evaluated	
Parinari curatelifolia	Seed	Least concern	
Peltophorum africanum	Seed	Least concern	
Pseudolachnostylis maprouneifolia	Seed	Not evaluated	
Sclerocarya birrea	Seed	Least concern	NFA
Syzigium cordatum	Fresh seed	Least concern	
Ziziphus mucronata	Seed	Least concern	
Athrixia phylicoides	Seed	Least concern	
Bridellia micrantha	Seed	Least concern	
Commiphora mollis	Seed /truncheons	Least concern	
Cassia abbreviata	Seed	Least concern	
Clematis brachiata	Seed	Least concern	
Combretum imberbe	Seed	Least concern	NFA
Combretum molle	Seed	Least concern	
Cussonia spicata	Seed	Least concern	
Dicrostachys cinerea	Seed	Not evaluated	
Dombeya rotundifolia	Seed	Least concern	
Elephantorrhiza elephantina	Seed	Least concern	
Erythrina lysistemon	Seed	Least concern	

Garcinia livingstonei	seed	Least concern	
Milletia stuhlmanii	Truncheons /Seed	Least concern	
Mimusops zeyheri	Fresh seed	Least concern	
Mundulea sericea	Seed	Least concern	
Tabernaemontana elegans	Seed	Least concern	
Warburgia salutaris	Seed /cuttings	Endangered	NFA, LEMA
Acridocarpus nataliatius	Seed	Declining	
Anona senegalensis	Seed	Least concern	
Berchemia zeyheri	Seed	Least concern	
Brackenregia zanguebarica	Grows from seed in its natural area	Critically endangered	LEMA
Clausena anisata var.anisata	Seed	Least concern	
Elaeodendron transvaalense	Seed /cuttings do not grow easily	Nearly threatened	NFA
Ficus Sansibarica	Seed, cuttings & truncheons	Least concern	
Mondia whitei	Seeds	Endangered	LEMA
Osyris lanceolata	Seeds	Least concern	
Piliostigma thonningii	Seeds	Least concern	
Rauvolfia caffra	Seed	Least concern	
Salacia rhemanii	Seed	Least concern	
Schotia brachypetala	Seed	Least concern	
Searsia lancea	Seed	Least concern	
Securidaca longepedunculata	Seeds	Least concern	NFA

Vernonia colorata	Seed	Least concern	
Zanthoxylum capense	Seed	Least concern	
Xylopia odoratissima	Seed	Least concern	
Tylosema esculentum	Seed	Least concern	
Ximenia caffra	Seed	Least concern	
Bolusanthus speciosus	Seed	Least concern	
Capparis tomentosa	Seed	Least concern	
Cassytha filiformis	Seed	Not evaluated	
Conostomium natalense	Seed	Least concern	
Drimia elata	Seed	Data deficient	
Encephalartos transvernosus	Seed	Least concern	LEMA
Ficus natalensis	Seed/cuttings	Least concern	
Burkea africana	Seed	Least concern	
Holarrhena pubescence	Seed	Least concern	
Hypoxis hemerocallidea	Seed	Declining	
Kigelia Africana	Seed or truncheons	Least concern	
Pappea capensis	Seed	Least concern	
Protea caffra	Seed	Least concern	
Pterocarpus rotundifolius	Seed, cuttings & truncheons	Least concern	
Pyrenacantha grandiflora	Seed	Least concern	
Colophospermum mopane	Seed	Least concern	

APPENDIX C: MEDICINAL PLANTS SCREENING

Botanical name	Chemical ingredients	Reference
Ximenia caffra	Flavonoids, phenols, phytosteroids, tannins and fatty acids.	Maroyi, 2016:3
Milletia stuhlmanii	Antibacterial agents	Masoko, 2013:8
Warburgia salutaris	Drimane, sesquiterpenoides, polygodial, warbugnal, muzigal, mukaadial, ugandensial, and flavonoids	Leonard & Viljoen, 2015: 2, Maroyi, 2013:7, Van Wyk *et al.*, 13:308
Cassia abbreviata	Saponins, phenolics, anthraquinones, flavonoids, and tannins	Njagi *et al*., 2016:8
Cassytha filiformis	Aporphine alkaloids, Oxo-aporphine alkaloid, cassyformine, filiformine, Cathaformine, lignin, actinophine, and octenine	Mythili *et al.*, 2011:77
Cissus quadrangularis	α- and β- amyrins, β-sitosterol, ketosteroids, phenols, tannins, carotene, and vitamin C	Shah, 2011:42
Peltophorum africanum	Anti-bacterial and anti-fungal activity	Okeleye *et al*., 2013:8
Terminalia sericea	Anolignan, triterpenoides and saponins	Van Wyk *et al.*, 2013:228
Securidaca longipedunculata	salicylic acid, xanthones and esters	Mongalo *et al*., 2015:36
Ziziphus mucronata	Peptide alkaloids, Mucronine D	Van Wyk *et al*.,2013:322
Xanthoxylum capense	Benzophenanthridine and Sanguinarine alkaloids	Van Wyk *et al*., 2013:318

Botanical name	Chemical ingredients	Reference
Heteropyxis natalensis	Monoterpenoids	Van Wyk *et al*., 2013:172
Syzigium cordatum	Proanthocyanidins, Pentacyclic triterpenoids	Van Wyk *et al*., 2013:284
Lippia javanica	Monoterpenoids	Van Wyk *et al*., 2013:190
Adansonia digitata	Tartaric acid, citric acid and flavonols	Van Wyk *et al*., 2013:30
Dombeya rotundifolia	Tannins, saponins, and cardiac glycosides.	Van Wyk *et al*., 2013:124
Ekebergia capensis	Tannins, triterpenoids	Van Wyk *et al*., 2013:128
Hypoxis hemerocallidea	Phytosterol glycosides, anti-cancer, anti-HIV, and anti-inflammatory activity.	Van Wyk *et al*., 2013:178
Drimia elata	Cardiac glycosides	Van Wyk *et al*., 2013:126
Albizia adianthifolia	Histamine, imidazole derivatives, saponins and sapogenins.	Van Wyk *et al*., 2013:36
Schotia brachypetala	Polyhydroxystibenes, fatty acids	Van Wyk *et al*., 2013:262
Elephantorrhiza elephantina	Tannins, ethylgallic acid	Van Wyk *et al*., 2013:132
Erythrina lysistemon	Tetracyclic isoquinoline alkaloids, prenylated flavonoids and wighteone.	Van Wyk *et al*., 2013:140
Euclea crispa	Naphthoquinones	Van Wyk *et al*., 2013:144
Capparis tomentosa	Alkaloids	Van Wyk *et al*., 2013:76
Athrixia phylicoides	Thymol derivatives, kaurene- type diterpenoides, triterpenoids and phenolic acid.	Van Wyk *et al*., 2013:56
Kigelia africana	Naphthoquinones, Lapachol, dihydroroisocoumarin kigelin	Van Wyk *et al*., 2013:184
Rauvolfia caffra	Alkaloids	Van Wyk *et al*., 2013:242
Sclerocarya birrea	Gallotannins, flavonoids, and catechins.	Van Wyk *et al*., 2013:264
Heteromorpha arborescens	Antibacterial monoterpenoids	Van Wyk & Gericke, 2000:220
Diospyros lycioides	Naphthoquinones	Van Wyk & Gericke, 2000:250
Bridellia micrantha	Anti-microbial activity	Samie *et al*., 2005:1449
Combretum spp	Combretastatin Flavonoids, alkaloids, tannins and saponins	Drewes, 2012:5-6 Mapfunde *et al*., 2016:2

Botanical name	Chemical ingredients	Reference
Clausena anisata	Coumarins, carbazole Alkaloids, limonoids and monoterpenes	Mukandiwa, Naidoo & Katerere, 2016:1
Searsia lancea	Anti-cancer activity	Fouche *et al.*, 2008:1
Vernonia colorata	Anthelmintic activity	Aremu *et al*., 2012:8
Albizia versicolor	Anthelmintic activity	Aremu *et al*., 2012:6
Mondia whitei	Anthelmintic activity	Aremu *et al*., 2012:8
Celtis africana	Anthelmintic activity	Aremu *et al*., 2012:35
Berchemia discolor	Anticandidal activity	Motsei, 2003:35
Tabernaemontana elegans	Antibacterial activity	Dzoyem *et al*., 2016:73
Parinari curatellifolia	Anti-cancer activity	Fouche *et al.*, 2008:1
Cassia pitersiana	Anthelmintic activity	Aremu *et al*., 2012:7
Cussonia paniculata	Anti-cancer activity	Fouche *et al.*, 2008:1
Combretum bracteosum	Anthelmintic activity	Aremu *et al*., 2012:5
Combretum molle	Anthelmintic activity	Aremu *et al*., 2012:5
Combretum imberbe	Anthelmintic activity	Aremu *et al*., 2012:5