The ethno-ecological assessment of *Cassia abbreviata* Oliv. at Matsa village, Limpopo province, South Africa

by

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by

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DECLARATION

I, the undersigned: RASEKGALA MOKGADI THELMA (Student number 11534014), declare that this dissertation is my own work, and all the sources I have used or quoted have been indicated and acknowledged by means of complete references. This project work is being submitted for the degree of Master of Science in Botany at the University of Venda, Limpopo Province, South Africa, and the work contained herein is original and has not been submitted at any other University for any degree.

…… ……

RASEKGALA MT Date

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DEDICATION

I dedicate this work to my father Mr Peter Joshua Mochabo Rasekgala who believed in me. A special dedication is extended to my only son Thendo.

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Abstract

Since time immemorial plants have traditionally been used for various purposes in many parts of the world including Vhembe district, Limpopo province of South Africa. The use of *C. abbreviata* plants at Matsa village of Vhembe district also contributes significantly to the livelihood of the community. However, little work has been made in the past to properly document and promote the knowledge. The purpose of the present study was to record and analyse the ethnobotanical knowledge of *C. abbreviata* within the people of Matsa village around Nzhelele in Vhembe district. Semi-structured questionnaires were administered on 50 informants from different households selected randomly to gather data regarding the local name of *C. abbreviata*, the uses and its availability.

Significantly higher number of medicinal use was reported by elderly people including both men and women as compared to middle-aged, younger people. Other use categories included firewood, furniture and joinery production and shade for people in the area. Awareness on the importance of the species should therefore be created amongst the people, especially the young ones. Understanding the ethnobotanical knowledge of indigenous species within an area is crucial towards development of its management plan.

Keywords: *Cassia abbreviata*, ethnobotanical, ethnoecological, Medicinal plants,

CHAPTER 1

INTRODUCTION

1.1 Background and literature review

Ethnobotanical knowledge is common amongst people of the world and also play an important role among the communities of Limpopo province and the rest of South Africa. These days few effort has so far been made to document local knowledge on the utilization of indigenous plants despite the continuation of deforestation as well as environmental degradation in the province. There is however, a need for immediate ethnobotanical and ecological surveys in order to rescue medicinal plants and the knowledge associated with them from further loss. The majority of communities residing in rural areas are partially or fully dependent on the natural resources in order to meet their daily requirements (Slater and Twyman, 2003).

Over the past three decades, the environmental crisis of the world has led to a rather belated appraisal that man is part of nature, and that there was a new paradigm challenging biological and ecological research, which in the past has tended to consider natural objects as totally independent of any social or political sphere (Latour, 1993; Potvin *et al*., 2001). The Earth Summit in Rio de Janeiro in 1992, through the Convention for Biological Diversity (CBD), strongly acknowledged the role of indigenous knowledge systems in biodiversity conservation, especially under Article 8j, thus taking into effect its

use as a new norm in environmental management as acknowledged by Ghimire *et al*., (2004). Since then, academics and decision-makers have started to emphasize the value of local knowledge in determining the co-viability of social and ecosystem dynamics and in informing the development of people centered resource management approaches (Cunningham, 2001; Gunderson and Holling, 2002). The importance of ethnobiological knowledge (considering ethnobotany and ethnoecology as different subjects of the overall discipline known as ethnobiology) in suggesting new paths in scientific research, conservation monitoring, or understanding ecological processes, has enjoyed much needed attention in management of resources (Berkes *et al.,* 2000; Huntington, 2000; Olsson and Folke, 2001).

International bodies like the World Wildlife Fund (WWF) and United Nations Educational Scientific and Cultural Organization (UNESCO), in the context of their joint program of People and Plants initiative, have also encouraged research on ethnobotanical knowledge, as well as inclusion of people's way of thinking and the practices thereof in management of resources at the local levels (Cunningham, 2001). Inclusion of local-use patterns and of social and institutional background that guides the relationships between people and nature into biological and ecological studies, has led to a greater understanding of the association between social and ecological dynamics (Gunderson and Holling, 2002). The close relationship between ethnobiological knowledge and local practices had shaped the ecosystem and affected its constituent plant populations. In the context of community-based projects, global perceptions of biodiversity conservation and scientific understanding of ecosystem dynamics are confronted with knowledge of local

communities' perceptions and values linked to different elements of the ecosystem. Local knowledge and practices therefore need to be analyzed and understood in order to appreciate how management practices that build on both scientific and local knowledge may be developed (DeWalt, 1994; Berkes *et al*., 2000; Berkes and Folke, 2002; Ticktin and Johns, 2002). Recent natural resource studies also showed that local knowledge and practices associated with it have certain similarities to facilitate adaptive systems, having the capacity to deal with uncertainty and to respond to ecosystem change (Berkes and Folke, 2002). Henfrey (2002), suggested that by including local knowledge and practices in the process of scientific research, new hypotheses can be developed which may lead to research experiments that will be more relevant to management of natural resources.

The objective of this work was to conduct an ethnoecological study in order to develop new sets of hypotheses for ecological research that test the effect of variation in knowledge and practices on the ecology and conservation of *C. abbreviata* species. Beyond the importance of local knowledge and practices this study also unpacked the complexity of local knowledge and resource management systems. Knowledge variation across and within cultural groups has in the past not been given enough attention, nor has knowledge variation been clearly assessed in relation to the goals and behavior of the knowledge holders (Ross 2002). Quantitative approaches have generally been noted to be lacking in most of the ethnobiological literature (Phillips and Gentry, 1993; Höft *et al.,* 1999).

1.2 Description of the studied species

Cassia, a major genus of the family Fabaceae subfamily Caesalpiniaceae, is made up of about 600 species and it is well known for its diverse range of biological and pharmacological properties (Silva *et al.,* 2005; Ayo, 2010; Chanda *et al.,* 2012; Singh *et al.,* 2013). *Cassia abbreviata* Oliv. is a shrub belonging to the genus Cassia and it grows up to 10 m in height (Figure 1.1). Its bark is light brown in colour, and it has a rounded crown with yellowish leaves. Its leaves are compound arranged in 5 to 12 pairs, and has brown black pods which are cylindrical in shape. As shown in figure 1.2, flowers are yellow, sweet-scented, large, loose, becoming brown-veinted with age and fruits are long cylindrical dark brown hanging pod (Venter and Venter, 2009).

Figure 1.1: *Cassia abbreviata* tree image.

Cassia abbreviata is widespread in Africa, from Somalia to South Africa and it occurs mostly at low to medium altitudes (between 220 and 1520 m above sea level), in open bushveld, woodland or wooded grasslands, along rivers, on hillsides and frequently on termite mounds (Palgrave, 2005). *C. abbreviata* is endangered in the majority of areas and is reported to be in rank 3, score 401 and frequency of 33 of the top 10 priority medicinal trees in Shinyama region, Zambia (Dery *et al.*, 1999). Due to its scarcity in the majority of African countries, there is a need to have a policy in place to reinforce

protection measures and promote sustainable use of resources from this plant (Schmelzer *et al*., 2010). However, its ethnomedicinal uses are also of major importance, especially in remote areas where traditional medicine serve as a basic primary healthcare, compromising the rational use of its resources.

Figure 1.2: *Cassia abbreviata* flowering branch with hanging pods.

In some communities within the Capricorn District, South Africa, *C. abbreviata* bark is used in the doctoring of homesteads on annual basis. Such plants grow in clusters or multiple stems which are believed to resemble architecture of cultural mud-made huts. This review highlights the phytochemical constituents, pharmacology, indigenous

ethnobotanical uses, propagation procedures and toxicity of *C. abbreviata*. The ethno-medicinal use of *C. abbreviata* is poorly documented in South Africa, especially so in the Limpopo Province. Apart from Mongalo *et al*., (2013) who reviewed its general ethnomedicinal uses, Mabogo (1990) and Semenya *et al*., (2013) who briefly highlighted its use in treatment of hypertension, there is no other record on its medicinal use in this province. This lack of information on the medicinal uses of *C. abbreviata* is in spite of the fact that various studies noted the high prevalence of hypertension among residents of the Limpopo Province (Alberts *et al*., 2005; Mkhonto *et al.*, 2012).

1.3 Study aim and objectives

The main aim of this study is to do assessment on the ethnobotany and ecology of *C. abbreviata* in the Matsa village, Limpopo province, South Africa.

The following specific objectives were investigated:

i. To determine the extent of bark harvesting on *C. abbreviata* individuals.
ii. To document ethnobotanical profile of *C. abbreviata* amongst Matsa community.
iii. To establish the status of *C. abbreviata* population within the settlement area.

The study will apply a population centered approach to knowledge, thereby determining which parts of a given human population hold specific types of knowledge, in addition to that generally held. The present study was carried out with an aim of understanding the people's perceptions and knowledge on the use of *C. abbreviata* in Matsa area. The study further aimed to understand people's knowledge about its trade potential, existing threats,

and conservation perspectives in Matsa. This may have important implications for sustaining knowledge transmission in relation to resource management. Furthermore, to understand the dynamics of knowledge and the relationships between knowledge and practices. Local institutions controlling access to resources have been considered an important element of the success of local resource management (Ostrom, 1992; Berkes *et al.,* 2000).

1.4 Hypothesis

The hypothesis of the study is that *Cassia abbreviata* has an important role in the lives of communities of the remote areas. Because of its demand in the communities its populations are being threatened as a result of overharvesting.

1.5 Problem statement

The documentation of ethnobotanical information of *Cassia abbreviata* in the Vhembe district communities of Limpopo province is vague and limited. The plant species is playing an important role and it is abundantly growing in the area. The people in the area uses the species for different purposes for example firewood, shade during hot summer, etc. Little research has been done on this species that is being overharvested for its various purposes. This ill harvesting or improper harvesting of the plant may leads to its extinction. This research project will develop ways for preserving the species.

1.6 Structure of dissertation

This dissertation is structured in such a way that objectives are presented in stand-alone chapters. Repetition of certain aspects will therefore be unavoidable. Chapter 1 covers the background and literature review. Chapter 2 focuses on the ethnobotanical importance of *Cassia abbreviata* and Chapter 3 provides the population dynamic of *C. abbreviata.* General conclusions and recommendations are given in Chapter 4.

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CHAPTER 2

ETHNOBOTANICAL SURVEY OF *Cassia abbreviata* Oliv. AT MATSA VILLAGE, LIMPOPO PROVINCE, SOUTH AFRICA

2.1 Introduction

Ethnobotanical studies are often reveal the locally important plant species especially for the discovery of new drugs. The documentation of traditional knowledge, especially on the medicinal uses of plants, has provided many important drugs of modern day (Cox and Balick, 1996; Flaster, 1996). The World Health Organization has estimated that over 80% of the global population rely chiefly on traditional medicine (Akerele, 1992).

In many parts of Africa, herbal medicine still plays a vital role in health care delivery system especially in remote places where clinics and hospitals are sparsely located. In these communities, traditional herbalists operate closer to the people, taking advantage of the bio-diversity of plant species in such areas to cure various diseases and ailments (Ndubani and Hojer, 1999; Gelfand *et al*., 1985).

In South Africa, though there has been some organized ethnobotanical studies, there is limited development of the indigenous knowledge on usage of indigenous plants as folk

remedies are getting lost owing to migration from rural to urban areas, industrialization, rapid loss of natural habitats and changes in life style. In addition, there is a lack of ethnobotanical survey carried out in most parts of the country. In view of these, documentation of the traditional uses of medicinal plants is an urgent matter and important to preserve the knowledge.

Cassia abbreviata is threatened in the majority of areas and is reported to be in rank 3, score 401 and frequency of 33 of the top 10 significance medicinal trees in Shinyama region, Zambia (Dery *et al*., 1999). Due to its scarcity in the majority of African countries, there is a need to have a policy in place to strengthen protection measures and promote sustainable use for this plant (Schmelzer, 2010). However, its ethnomedicinal uses are also of major importance, especially in remote areas where traditional medicine serve as basic primary healthcare, cooperating the rational use of resources.

In some tribes within the Capricorn District, South Africa, *C. abbreviata* bark is used in the doctoring of homesteads on annual basis. In South Africa and Botswana, amongst variety of tribes, *C. abbreviata* is known as “Monepenepe”. The root is crushed into powder, mixed with water and used to wash uncleanblood, referring to a woman who has miscarried and need to be cleansed (Setshogo and Mbereki, 2011).

In Tanzania, it is commonly known as “Mahemba” and decoction of the root is drunk against abdominal pains, dysentery, fever, malaria, hernia, wounds, syphilis, impotency

and snake bite (Chhabra *et al*., 1991; Muthaura *et al*., 2007; Makundi *et al*., 2006). In Mozambique, it is called “Lumanyama” and a decoction of root bark may be taken orally to treat diarrhea (Ribeiro *et al*., 2010). Root bark may be optionally combined with those of *Cissampelos mucronata* (“Makuta gambewa”) to treat malaria (Gessler *et al*., 1995). It is an aphrodisiac and is an arbotifacient (van Wyk and Gericke, 2007). In Zimbabwe, *C. abbreviata* is commonly known as “Muremberembe” and the roots may be crushed, mixed with hot water and the extract may be drunk to treat disorders like constipation, diarrhoea, venereal diseases and as an aphrodisiac (Maroyi, 2013).

The bark may be soaked into water and the resulting liquid may be taken by mouth for two days to treat abdominal pains (Chinemana *et al*., 1985). Decoction of stem bark is taken orally to treat stomach ache and malaria, while infusion of roots, leaves and stem bark mixed together is taken orally to treat stomach ache (Ribeiro *et al*., 2010). Bark and roots may also be used to treat stomach ache of a mother during pregnancy, close fontanelle of newborn babies, dysentery, blood vomits, venereal diseases, bilharzia, hernia, snake bites, post-partum pains and menstrual cycle problems (Bruschi *et al*., 2011). Moreover, bark and roots may be used as general blood cleansers and in the treatment of period, uterus and abdominal pains (Mojeremane *et al*., 2005).

In Kenya, *C. abbreviata* is known as “Malandesi” and leaf decoction may be taken to treat malaria (Keter and Mutiso, 2012). It may also be used to treat skin rashes associated with human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS)

infections (Kisangau *et al*., 2011). Roots, leaves and bark may be taken orally, chewed, nasally and anally to treat infertility, cough, vomiting, epilepsy, bilharzia, syphilis, gonorrhoea, jaundice and hernia (Augustino *et al*., 2011).

Decoction may be taken to treat malaria (Keter and Mutiso, 2012), while heating and grinding may be used to wash infected eyes (Ribeiro *et al*., 2010). The importance of ethnobiological knowledge (we consider here ethnobotany and ethnoecology as different subjects of the overall discipline known as ethnobiology) for suggesting new paths in scientific research, for conservation monitoring, or for understanding ecological processes, has received much attention in resource management (Berkes *et al*., 2000; Huntington, 2000; Olsson and Folke, 2001).

In many parts of Africa, herbal medicine still plays a vital role in health care delivery system especially in remote places where clinics and hospitals are sparsely located. In these communities, traditional herbalists operate closer to the people, taking advantage of the bio-diversity of plant species in such areas to cure various diseases and ailments (Ndubani and Hojer, 1999; Gelfand *et al*., 1985). Although herbal medicine is well established in many cultures and traditions of Africans, and is still a way of life of almost 80% of the people in Africa (Jager *et al*., 1996), unfortunately however, not much information has been documented in scientific literature about the ethnoecological assessment of *Cassia abbreviata* in Limpopo province, South Africa.

Cassia abbreviata is a medicinal plant having medicinal, ornamental and other values. Due to its current conservation status in the majority of African countries and increasing life threatening diseases, there is a need to conserve, propagate and replant in our natural ecosystems. A need to consider strict protection of *C. abbreviata* in conservation areas, with a good cooperation between indigenous traditional herbalists, traditional healers, local governments and conservation biologists in many countries (Mongalo and Mafoko, 2013).

The aim of this research project is to investigate the important ethnobotanical knowledge of *Cassia abbreviata* to the people of Matsa village. To achieve the aim the following objectives were looked at:

i. To analyze and document the ethnobotanical knowledge on the use of *C. abbreviata* by local people in the area.
ii. To document and analyze the proportionality of preferred parts used by people of the Matsa area in order to develop conservation strategies.
iii. To establish the perception of local communities of Matsa village on the availability of *Cassia abbreviata* plants.

The hypothesis is that overharvesting of *C. abbreviata* may leads to its extinction and understanding the patterns of its harvesting may assist in the management and monitoring methods.

2.2 Study area, Materials and Methods

2.2.1 Study area

The study was conducted at Nzhelele, Ha-Matsa village in the Vhembe district municipality of South Africa, within Limpopo Province (Fig. 2.1 and Fig 2.2). Vhembe district is comprised of four local municipalities, namely: Makhado, Thulamela, Messina and Mutale. Ha-Matsa is one of the villages that falls under the Makhado local municipality which cover the whole of Nzhelele villages in the Limpopo province. The Vhembe district is comprised of three ethnic groups: Vhavenda, BaPedi and Tsonga. Matsa village is dominated by Vhavenda people which is the main ethnic group of the district. The vegetation of the area is mixed Lowveld Bushveld within the savannah biome. The district has a wet and hot summer season with a mean temperature of 30 ˚C, and a dry and cool winter season with a mean temperature of 18 ˚C (Luseba and Van der Merwe, 2006). The people of this community survive on agriculture and noncommercial activities such as cow and goat breeding as the formal economic activity accepts the middle-aged group which is the working class, who are working in the urban areas or cities.

Figure 2.1: Map of Vhembe district showing four local municipalities.

Figure 2.2: Satellite map of Matsa village.

2.2.2 Materials and methods

Members of the local community were asked to give the information on the uses of *C. abbreviata.* The survey was not restricted to door to door, but people walking in the street, were also included, provided they were the residents of the area and willing to participate in the interviews. Prior informed consent was obtained from all informants who availed themselves to be interviewed in the study. The interviews and discussions were carried out in the local language of the informants which is Tshivenda. Interviews were conducted individually to avoid direct influences from third parties. The aim of the research was explained to each informant.

Data on the local or common name of the plants, use categories, plant parts used, and perception of availability were collected in the field. The interviews were conducted using a semi-structured questionnaire addressing six areas of the research (Appendix 1). Analyses of responses on *C. abbreviata* utilization (including the parts of the plant likely used, population availability, and potential causes of population decline) was done using Microsoft Excel.

2.3 Results and discussion

2.3.1 Informants profile

A total of 50 people, females and males with ages ranging between 17 and 90 years old, were interviewed. The collected ethnobotanical information showed that residents of Matsa village rely on *Cassia abbreviata* for various purposes. Figure 2.4 shows the percentage contribution of information given by different sex groups on ethnobotanical knowledge of *C. abbreviata*. The information on the uses of *C. abbreviata* increased with age of people (Figure 2.3). Older female informants contributed a bit more to the survey because they are the ones who utilize the species more in their homes. The majority of middle age group which range from 28 to 35 year old could also not be found at home since they were at work when the interviews were conducted during the day (Figure 2.4). Elderly age group contribution on the knowledge might be attributed to the fact that they are not working and they are looking after homes. Warren and Rajasekaran (1993) ascertain that indigenous knowledge accumulates over a period of time through experience of intimate understanding of the environment. It is therefore making sense to observe that more knowledge on *C. abbreviata* have been shared by the elderly who showed good command of it.

Figure 2.3 represents percentage contribution between different age groups of participants. Forty two percent of elderly people participated in the interviews with 30% of

informants beinge middle aged and 28% being the youth. The figure also shows the gender based comparison of the levels of education and the fact that higher percentage of female did not have formal education. It is not surprising because it was part of African culture that female children were denied a previlage to go to school with the perception that they are going to get married soon. Parents felt that it is a waste of time and money to educate someone who was not going to help them but help her inlaws in the future.

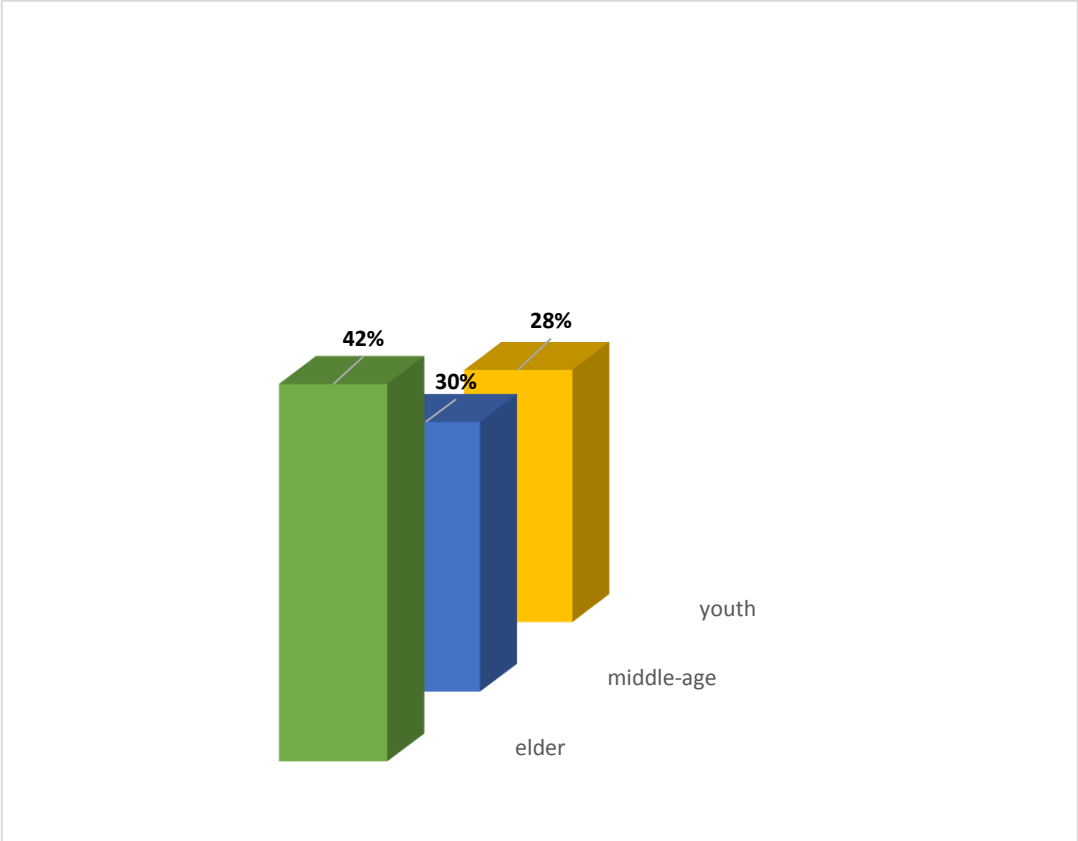

Figure 2.3: Percentage contribution between different age groups.

The older the age group, the more knowledgeable and also the more information given. An age group that also contributed more information, other than the elderly group is the middle-aged group. The youth or younger group contributed less information because people in this younger group are ignorant or lost interested on the traditional uses of plants. Therefore those that seems to have ethnobotanical knowledge especially the medicinal uses are the ones that sometimes escort elders to the fields, and help with collection but some of they stay with elderly people whilst parents went to the reef. Females contributed 54% of the information given about the uses of *Cassia abbreviata* as compared to 46% coming from the males (Fig. 2.4). This suggests that females have a bit more ethnobotanical knowledge than the female. This 54% might also be attributed to the fact that females are the ones who takes care of the sick at homes. The other thing is that men are usually away from homes during the day. According to Whaley (2011), the administration of traditional medicines has always provided some form of evidence that women were practicing medicine while taking care of the sick from their homes. It also formed part of that motherly medicine.

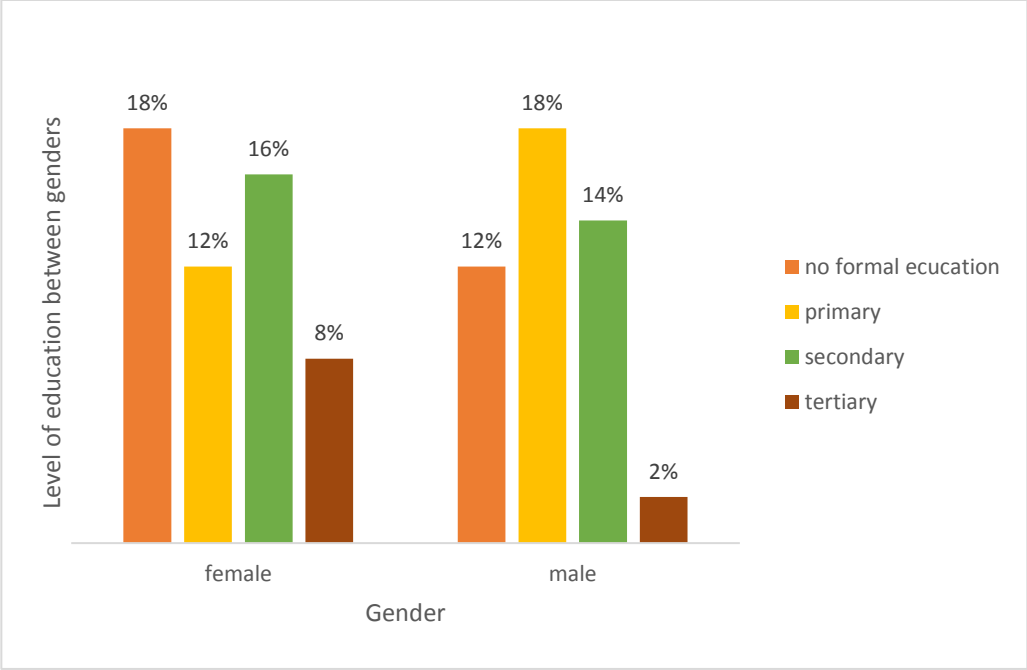

Figure 2.4: Level of education in terms of gender-based comparison.

2.3.2 Use categories of *Cassia abbreviata*

Cassia abbreviata is being used for different purposes by the resident of Matsa village. It is harvested by different age groups as resource for their daily needs such as consumptive uses as food, medicine, household furniture and firewood. Dharani *et al*. (2010), found that *C. abbreviata* may be used as fuelwood, timber, furniture making, and construction and has ornamental value.

Persistence of traditional uses of *C. abbreviata* is likely due to its multiple uses and reasonable availability in the area. Plants are collected as and when encountered, without

considering their age, form, and stage, for later use in dried forms. Presumably this is mainly done because the plants takes time to dry up or it may take a long walk to collect the species, which is not feasible during urgency. Most respondents in the present study reported the collection of fresh plants because they do not want to put effort in collecting and drying the material for later use. Because of fresh collection habits, the frequency of collection may be high which may threaten the species existence.

Despite dominance of western medicine, traditional medicine still exists in remote areas of Limpopo province where people normally do not visit health centers for the minor problems. For example, among the Bapedi and VhaVenda tribes, traditional medicine is applied but also used with western medicine when needed. Acording to Grierson & Afoloyan 1999 many rural communities still prefer cheaper traditional healing methods as opposed to the more expensive treatment by western practitioners. In many areas, ethnobotanical knowledge is transmitted from fathers to sons and rarely to daughters; therefore, as a whole, males hold relatively more traditional knowledge. Moeng and Potgieter in 2010 found that most traditional healers are males as compared to females in Limpopo province. However, while using routine medicine to treat local ailments, women possess more knowledge than the men because they are the ones who actually are involved in exchanging information and knowledge through verbal communications.

It has been found that *C. abbreviata* is recognized by most people of Matsa village. However, there were differences in knowledge between males and females, from the

same community, and the majority of informants said they were aware of the medicinal uses and powers of the species, but females stood out more often than male, which is unusual because many researchers found that male informants are more knowledgeble as compared to females. Male informants who are herbalists or traditional helears are the ones who knew the medicinal uses of the species.

The ethnobotanical information collected shows that some of Matsa people still depend on plants as a source of medication for their wellbeing.

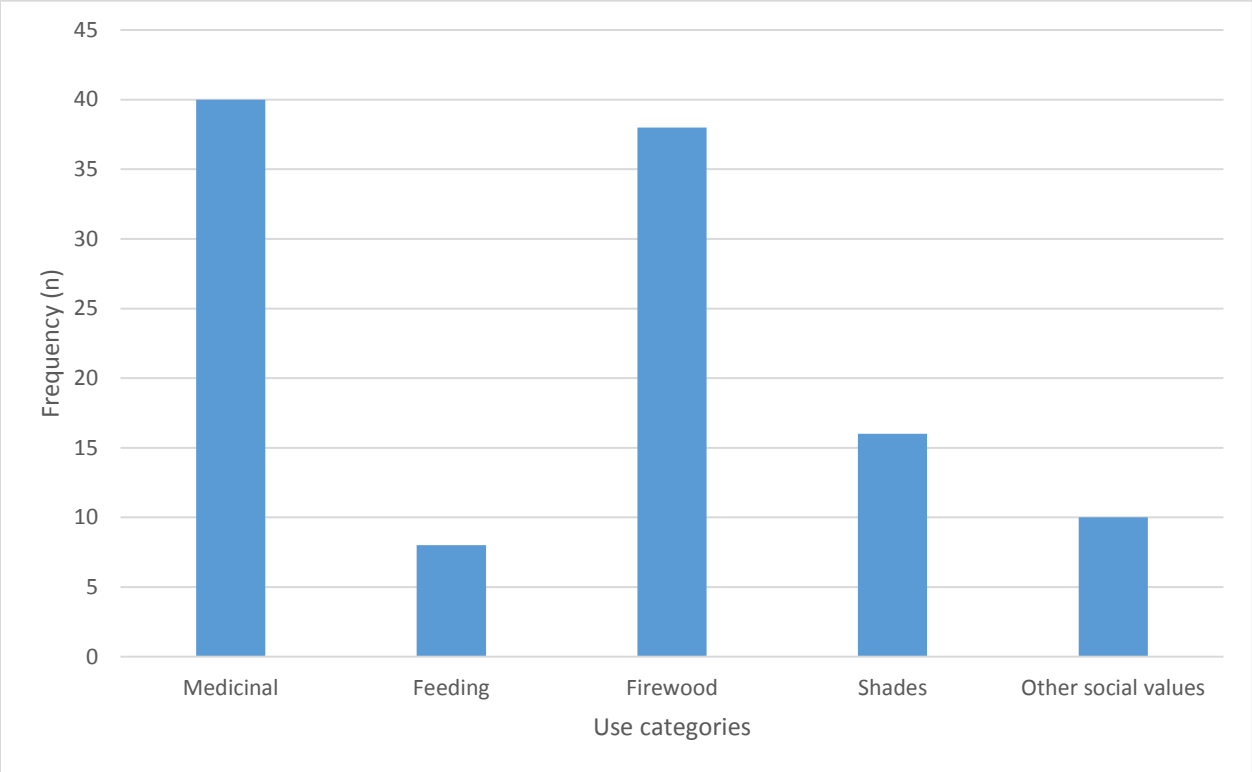

Figure 2.5: Reported uses of *Cassia abbreviata* in Matsa village.

i. Medicinal uses

Cassia abbreviata is used to treat different diseases by the residents of Matsa. It was documented to treat the following medical problems or diseases: open wounds, Arthritis, mouth and throat sores caused by flu in children, sexual transmitted infections (STI), stomach sores, headache, and menstrual pains. According to Mongalo and Mafoko (2003), *C. abbreviata* is a medicinal plant possessing medicinal, ornamental and other values. Pharmacologically, it possess antimicrobial, antimalarial, anthelmintic, antioxidant and antidiabetic properties which may well be attributed to variety of compounds including alkaloids, tannins, anthraquinones, flavonoids and polyphenols.

ii. Firewood

Cassia abbreviata is collected for firewood by the local people of Matsa mostly when it is dry. They wait for the plant species to die and dry first before firewood collection because they believe *C. abbreviata* takes time to dry and when its dry it doesn't takes time to rot and become useless. The plant species is mostly used for firewood when other plants are not available. In Botswana, it is believe that eating meat cooked over the bark of *C. abbreviata* result in successful hunting (Thomas and Grant, 1997).

iii. Feeding

Porcupines (Nungu in Venda) feeds on the roots of *C. abbreviata* and the local people of Matsa hunt the animal so that they can get its intestines which is believed to have medicinal powers. *C. abbreviata* is a deciduous plant and it is resistant to drought, as such goats and cows feed on the plant during drought seasons. There are certain birds which feed on the seed of *C. abbreviata*. Orawa *et al*., (2009) also reported that the young leaves of *C. abbreviata* are browsed by game while certain birds enjoy the fruit pulp.

iv. Shades

The local people of Matsa village use the plant species as a shade in their households. In the royal house there is a huge *C. abbreviata* which is used for shade and an assembly for the royal meetings. Orawa *et al.,* (2009) also noted that the plant provide shade and shelter amongst its environmental services.

v. Other social values

The seeds of *Cassia abbreviata* are used during the rituals performance by the local people in Matsa village. The pods of the plant species is used by traditional healers (Tshingomamutanda in Venda) in provision of light at night during the bones throwing and

that is why other people in the area called it “Muvhonetshelathangu” which means bones torcher. The roots are used in cleansing of women after they miscarry or after their husband passed on.

2.3.3 Utilized parts of *Cassia abbreviata*

As indicated in figure 2.6 roots are the part which is highly utilized. The roots, seeds, bark and leaves are the parts of the plant which are used for medicinal purposes whilst the pods and seeds are used for other social values such as rituals. Sometimes two plant parts such as bark and leaves or bark and roots are used in combination.

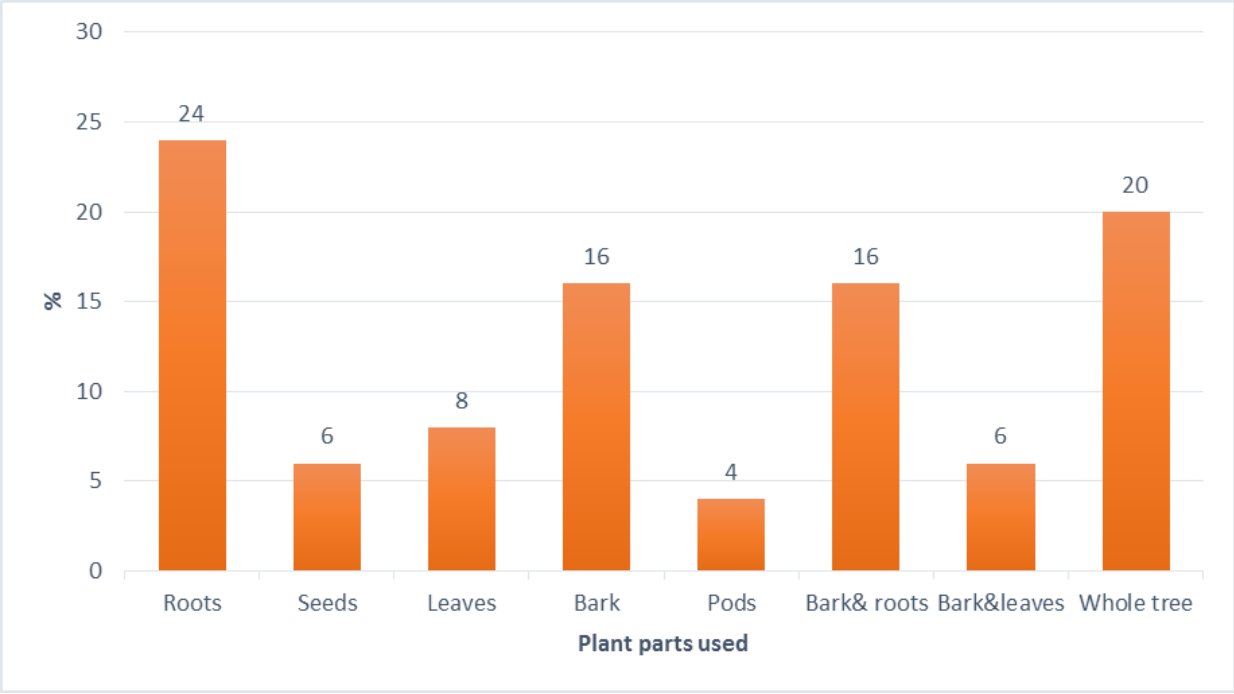

Figure 2.6: Frequency of reported plant parts used by local people of Matsa village.

The whole tree is enjoyed for its provision of quality shade during hot summer months whereas its wood is used as firewood (Hedberg *et al*., 1982, Thomas and Grant, 1997). From this study seeds are amongst the least used parts. However, in a study on natural products conducted at the University of Botswana seeds were also reported to be sucked as tonic (Majinda *et al.*, 2001). Local people in Botswana believe that eating meat cooked over the bark of *C. abbreviata* result in successful hunting (Thomas and Grant, 1997; Venter and Venter, 1996).

2.3.4 Availability status perceptions of *Cassia abbreviata*

The majority of respondents consider the current status of availability of *Cassia abbreviata* to be very high (Figure 2.7) in their surroundings and nearby bushes. With this kind of perception the communities may not see the need to protect the species that they believe is readily available. None of the respondents perceived the availability to be low or very low. According to Vincenot *et al.* (2015), respondents that are aware of the existence of a particular species they may be largely ignorant of its ecological value.

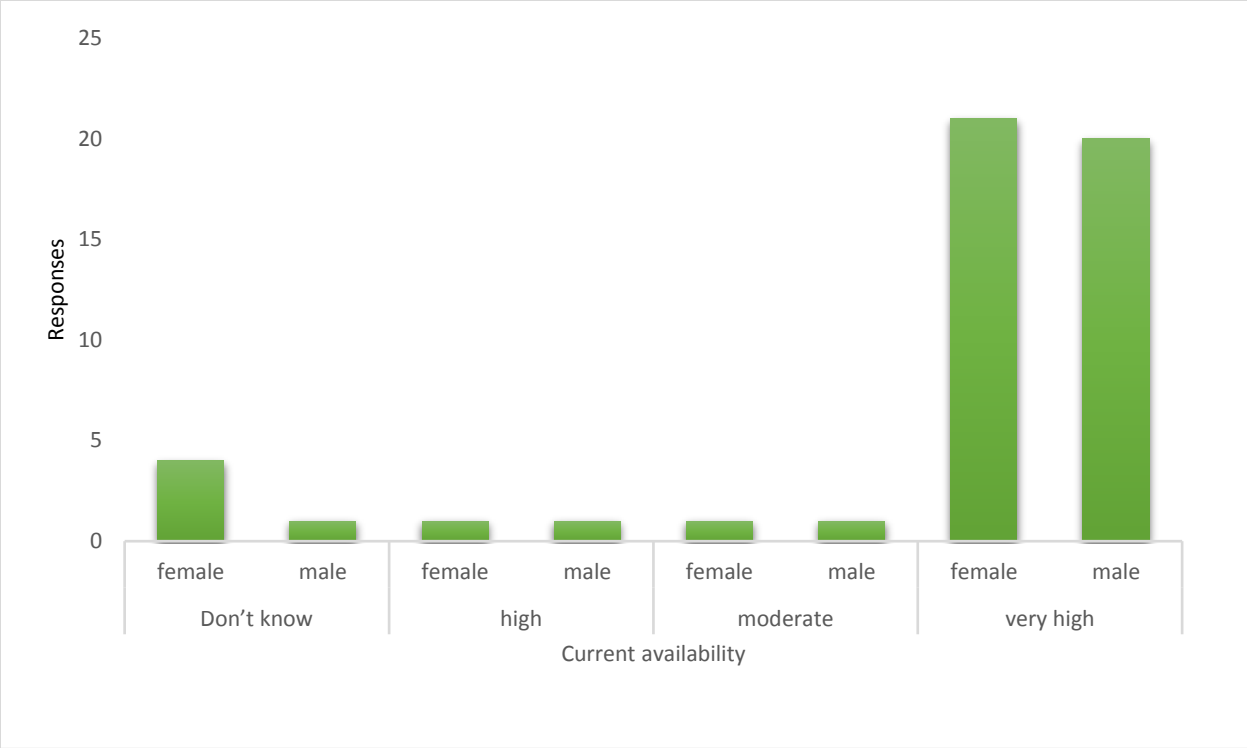

Figure 2.7: *Cassia abbreviata* availability perceptions as reported by local people of Matsa village.

This is accompanied by a perception that *C. abbreviata* seeds are able to germinate very fast compared to other plants and another thing is because animals only feed on *C. abbreviata* when there is lack of food in times of drought. According to Mojeremane (2005), fresh seeds of *C. abbreviata* germinate very well. The species has also been noted to produce seeds in the region of 1500 seeds per plant.

2.4 Conclusions

The extinction on the practice of indigenous knowledge of medicinal plants is a global problem which is happening faster because of competition from western medicine and a lack of interest amongst the younger generations. The existence of such practices is increasingly limited to remote areas where people lack health centers. Habitat destruction, human disturbances, and over-exploitation have emerged as likely factors responsible for the decline in the natural populations of *C. abbreviata* at Matsa village in the Vhembe district. The plan should be to develop monitoring techniques which will help us in gaining understanding of what is changing in the *C. abbreviata* population of that study area. Such a management plan should involve all relevant sectors of society and scientific authorities. This research project has identified a number of uses of *Cassia abbreviate.* The diversity of uses therefore subject the species under pressure which results in why the plant is being overharvested. The population of *C. abbreviata* was still in high in number according to the perceptions of the informants. It is therefore recommended that the community should be mindful of sustainable harvesting practices when they harvest the species for their daily requirements.

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CHAPTER 3

POPULATION ECOLOGY OF *Cassia abbreviata* Oliv. IN COMMUNAL AREA OF MATSA VILLAGE

3.1 Introduction

Attempts to conserve South Africa's biodiversity has been focused on exploring the potential contribution of traditional ecological knowledge systems. One of the potential approaches to conserve the biodiversity comes from the local wisdom of indigenous people. Vhembe district is also endowed by diverse tribal communities with unique social and cultural background. Indigenous knowledge has been recognized to contribute to inland management practices, particularly in order to achieve its sustainability. The district is home to Vhavenda tribal community with rich culture and traditions to use natural resources. Forest preservation has limited supports from local people. Politically, there are many approaches being implemented with minimal involvement of local people's participation. This led the forest conservation efforts to fail in implementation in implementation of conservation measures thereby resulting in increased deforestation rate.

Population dynamics attempts to explain the origin of different kinds of structure, and understand how and why they change with time (Silvertown and Charlesworth, 2001).

Population structure in forestry and ecological studies has been defined in terms of the size-class or stem diameter distribution of individuals (Klimas *et al*., 2007).

The population structure can be assessed by analysis of frequency distribution of stems across diameter classes (Condit *et al.*, 1998, Lawes *et al.*, 2004). The size class distribution data can also be used to assess the potential of the population for its sustainable use (Everard *et al*., 1994; Everard *et al.*, 1995; Obiri *et al*., 2002; Lawes and Obiri, 2003; Gaugris and Van Rooyen, 2007). Investigating the various aspects of the life cycle of a plant (e.g. age/size at flowering, seed output per size class) is crucial to gain an understanding of the dynamics of the population (Solbrig, 1980).

This knowledge can then be used to quantify the demographic variables of a population, which can be used in more refined analyses of the population, such as matrix analysis (Caswell, 2001; Crone *et al*., 2011).

Stand characteristic such as tree population size and tree density can also be strongly modified following anthropogenic disturbances which in turn may have important consequences for tree pollen flow pattern and mating (Ouborg *et al.,* 2006; Eckert *et al.*, 2010). Altogether, this can be expected to lower the opportunity for trees to outcross and can result in increased inbreeding, which may in the long term negatively impact on the genetic diversity and viability of fragmented tree populations (Young *et al*., 1996; Vranckx *et al*., 2012).

Changes in tree populations are difficult to quantify directly because there are often different controls or filters on recruitment, growth, and mortality of individuals (Coomes and Allen, 2007; Kupijeper *et al*., 2010). Despite these factors, there is an increasing desire to manage and monitor tree populations for the maintenance of forest ecosystem process or to determine the long-term effects of management's activities (Kurz *et al*., 2008; Luyssaert *et al*., 2008; Peltzer *et al*., 2010). Species and functional group size class structures can be used to assess drivers of population change in tree species (Knox *et al*., 1989; Helm and Witkowski, 2012; Cousins *et al*., 2014).

Change in size class distribution of plant population have been widely applied in ecology and evolutionary biology to quantify the effects of self-thinning, allometric scalling of resources, and abiotic influences on population demographic processes (Menning *et al*., 2007; Mullller-Landau *et al*., 2006; Coomes *et al*., 2012). For example, the "inverse j-shaped" size class distribution reflects the relatively high abundance of juveniles relative to adults, and can indicate health and growing populations, where as other distributions may not (Beschta, 2005; Feeley *et al*., 2007; Venter and Witkowski, 2010).

Traditional ecological knowledge is a cultural asset that provides a base for synthesis of conservation planning. It can be used for the recognition and preservation of valuable species as well as habitats in long term management (Dung and Webb, 2008; Gaikwad *et al*., 2011, and Jules *et al*., 2009). The prevailing poverty and expansion of agricultural land are the main causes of habitat and biodiversity loss and must be addressed when designing policies (Gorenflo and Brandon, 2005). Achieving the above mentioned

conservation goals, needs collaboration of various governmental and non-governmental agencies involved in natural resources management (Fosaa, 2004; Mucina, 1997). People can only own plant biodiversity and their associated ecosystem services if they are involved in the regeneration and conservation processes. Recent use of indigenous knowledge in conservation led to the new idea of 'ethno-conservation' in the late 1990s which is now a popular conservation approach around the globe (Jules *et al.*, 2009).

The main aim of this study was to do assessment on the population ecology of *C. abbreviata* in the Matsa village, Limpopo province, South Africa.

The following are specific objectives of the study:

1. To determine the extent of harvesting on *C. abbreviata* individuals.
2. To determine the dynamics of *C. abbreviata* population such as stem sizes and crown health status within the settlement area.

The hypothesis is that unsustainable harvesting of plant materials may have a negative impact on population of affected species.

3.2 Study area, Materials and Methods

3.2.1 Description of the study area

The study was conducted at Matsa village which is situated in Makhado local Municipality. Makhado local municipality is one of the four local municipalities that make up the Vhembe district municipality of Limpopo province in South Africa (Fig. 3.1). The Province

was named after Limpopo River, which forms the border line between South Africa and Zimbabwe. The district name was also adopted from the local Venda name (Vhembe) of Limpopo River. There are also conservation areas close to international borders like the Gonarehzou Nature Reserve in the Republic of Zimbabwe, and other smaller reserves in Botswana and Mozambique (Magwede *et al*, 2014).

Figure 3.1: Locating the Matsa village (study area) within the Map of Limpopo.

The vegetation of the Matsa village includes two vegetation types within the savannah biome; mixed Lowveld Bushveld and Mopani Bushveld (Low and Rebelo, 1998)

3.2.2 Materials and Methods

The ecological data on the population was collected using the line transect method. Thirteen 100 m x 5 m transect were subjectively laid within the population of *Cassia abbreviata.* The transect was constructed by laying a 100 m line across the area to be surveyed and *C. abbreviata* individuals within 2.5 m on either side of the 100 m transect line were sampled. Parameters sampled were: Basal stem circumference, height of the plant, crown health status estimate, harvesting impact estimate. Any other observation on the individual plants were also recorded. A total number of 13 transects of 100 m by 5m in size were sampled in the field. From the 13 transects 143 individual of *Cassia abbreviata* plants were recorded. Crown health assessment was done on individual plants using a sliding scale estimate of 0 to 5. To minimize errors and maintaining consistency, only one individual gave estimates on the health status. Classes of sliding scale were categorized as follows:

0 = dead (100%) crown,

1 = severe (three-quarter) crown damage,

2 = moderate (half) crown damage,

3 = light (quarter) crown damage,

4 = traces (less than quarter) of crown damage,

5= healthy (100%) crown health.

3.3 Results and Discussions

3.3.1 Population structure

A total of 143 individual of *Cassia abbreviata* plants sampled were categorized into twelve stem circumference size-classes as indicated in table 1.

Table 1: Number of harvested and unharvested individuals within different stem size-classes.

STEM SIZE-CLASSES (IN CM)	UNHARVESTED INDIVIDUALS	HARVERSTED INDIVIDUALS
0-10	17	95
11-20	37	20
21-30	17	8
31-40	23	5
41-50	15	8
51-60	7	0
61-70	11	2
71-80	8	3
81-90	3	1
91-100	3	0
121-130	1	0
211-220	1	0

Most of the individuals had stem circumferences in the size-class of 11 – 20 cm (n= 37), followed by 31-40 (n=23) while the least number of individuals were found in stem size-classes of 121- 130 cm (n=1) and 211-220 (n= 1). High number of individuals in the small size-classes categories indicate that the population has a good number of young individuals. According to Siaga (2006), a healthy plant is believed to produce large number of seedlings, which proceed to become older individuals. The low number of individuals in the larger size-class is a more convincing fact that local people harvest individuals with thick stems like adults rather than seedlings.

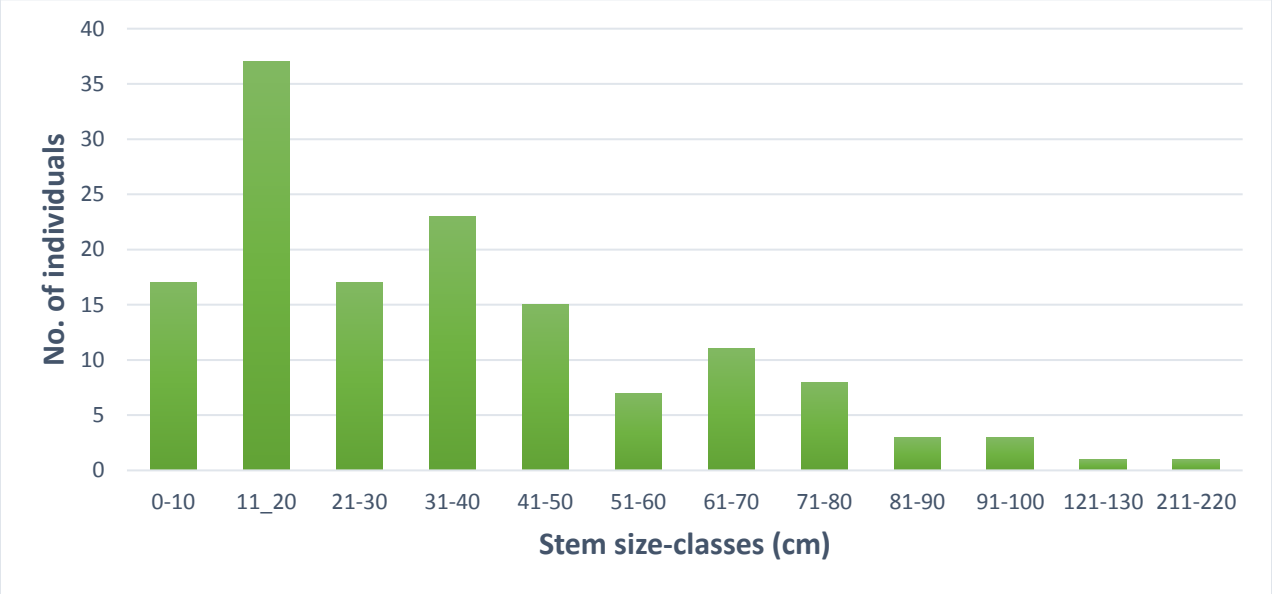

Figure 3.2: Stem size-class distribution as per data collected in 2017.

The results indicates that great number of matured *C. abbreviata* were harvested, a total removal of the top part of the tree up to the base of the stem or the soil surface. Majority of the small stem size-classes was from the re-sprouting of the plant individuals (Fig. 3.2). Larger plant individuals were very few and not healthy. According to Siaga (2006), a

healthy plant is believed to produce large number of seedlings, which proceed to become older individuals. When the large reproductive trees are cut or totally removed it may lead to a lack of sub-adults in the larger stem diameter classes, thereby reducing seed availability leading to a decrease in tree regeneration that may result in a substantial decline in population numbers (McLaren *et al*., 2005; Makana and Thomas, 2006).

3.3.2 Crown health status

The few individuals of *C. abbreviata* possess a healthy crown. The population of is dominated by trees that have moderate damage crown and a number of individuals with light damage crown. Majority of trees show unhealthy crowns (Figure 3.3)

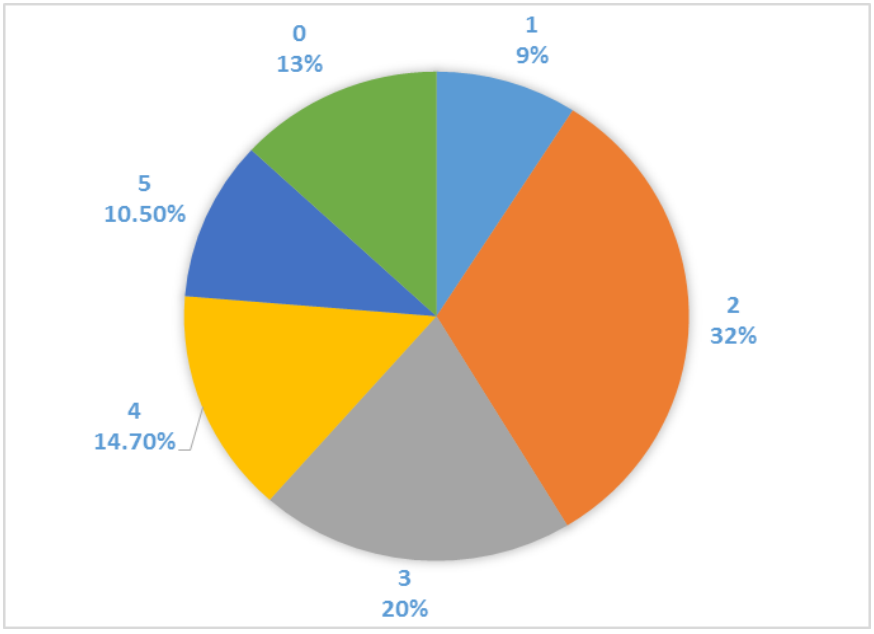

Figure 3.3: Crown health in scale of 1-5 with their percentages

Almost 90% of the plant were having an unhealthy crown which indicate that the population of *C. abbreviata* is at higher risk since bark removal is impacting on the crown cover. The majority of adult plant were intensively disturbed and the possibility of them to generate seeds is minimal. Xue *et al.*, (2018) found out that stressed plants may result in reduction in plant growth and seeds yield.

3.4.3 Harvesting impact

Taller trees were very few as compared to shorter individuals. The fact that almost 90% of the plants were harvested is the proof that this is extensively harvested in the study area. Few of *C. abbreviata* were seen to be unharvested, this proves that the community members within such area have a great use of such species. This statistics was also proved in Chapter 2 when there were lots of activities that were in use of the stems. Disturbances such as harvesting of trees by humans for firewood and medicinal purposes is likely to greatly change the size class distribution of harvested species and also result in increased mortality (Fig. 3.5).

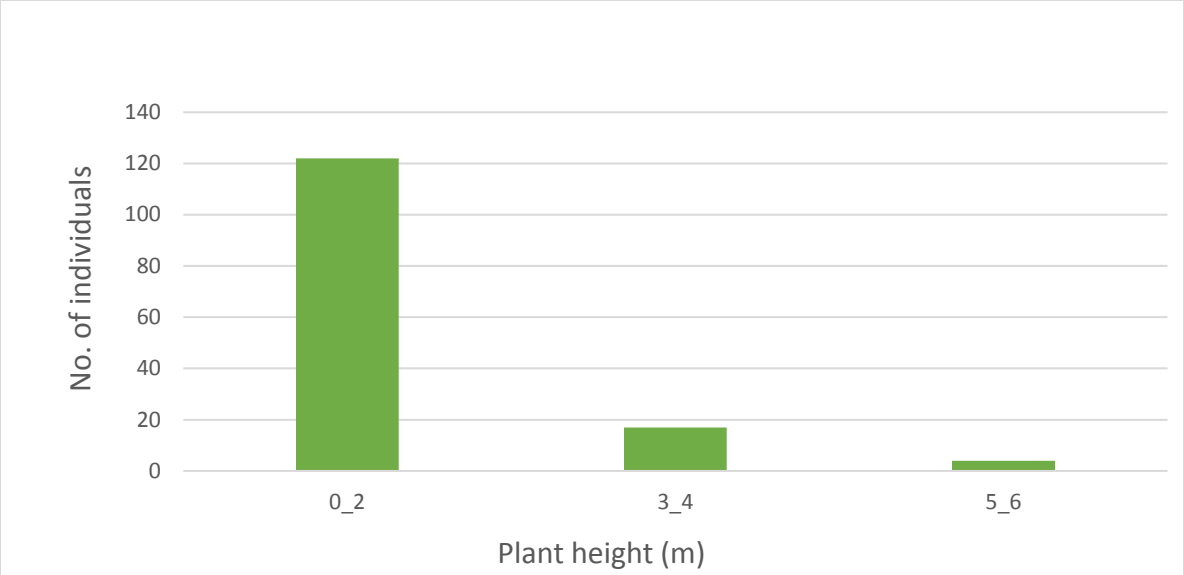

Figure 3.4: Plants heights among the individual plants.

Harvesting of the trees in the study area was seen to be done by removing branches using saws and pangas and most harvested individuals were found to have their stumps re-sprouted.

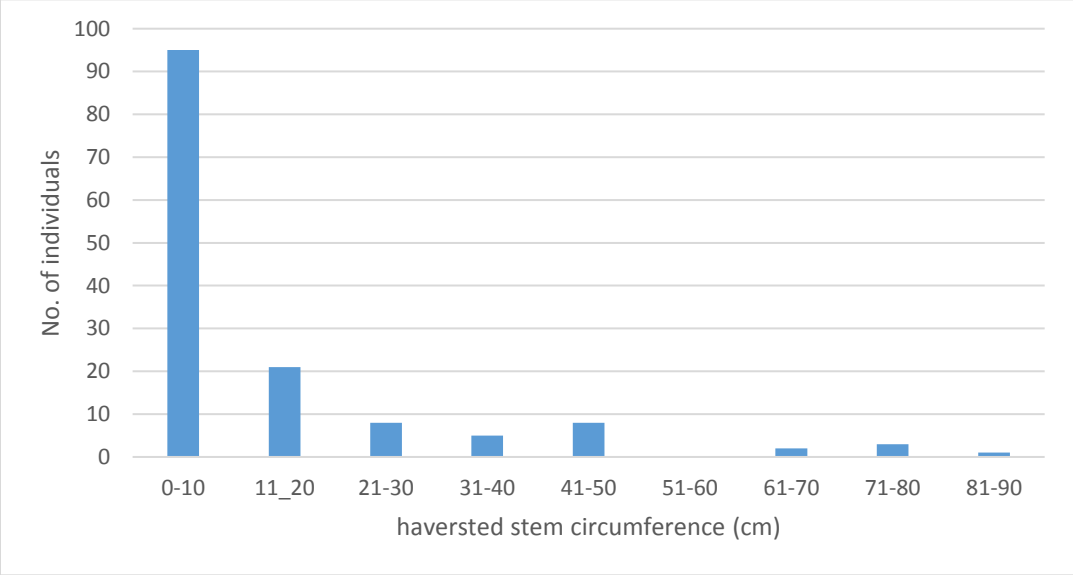

Figure 3.5: Cut stem class-size against individuals revealed by data collected.

Disturbances such as harvesting of trees by humans for fuel and building materials is likely to greatly change the size class distribution of harvested species and also result in increased mortality (Luoga and Witkowski, 2004). Debarking the stem for medicinal purpose also play a role in changing the growth pattern of individual plants.

3.4 Conclusions

Cassia abbreviata is a plant species that is very good in re-sprouting from the roots. The results showed that almost every plants was removed and only the roots were left under the ground. Data was collected from the juveniles, seedlings or young adults' plants which developed from the old *C. abbreviata* roots. It is clear from the study that the community of Matsa village have preferences when harvesting *Cassia abbreviata* wood resources. There are certain factors such as plant height and the basal diameter that they consider before they harvest it. It therefore means plants that are harvested fall under the category of either adults or young adults. Due to extreme temperature (climate change) most plants possess unhealthy crown even though the plants are seedlings and juveniles and this indicates that *Cassia abbreviata* plants are in an unhealthy state. Overharvesting was a major problem identified in the study though the ethnobotanical survey indicated that concubine feeds on the roots of the plants. The results showed nothing about the exposed roots of *C. abbrevita* which might be caused by animals. Every individual plants which was harvested showed human activities. It is recommended that villagers employ rotational harvesting so that it gives plants the best chance to recover and re-sprout. This will help in the conservation and long term management of *Cassia abbreviata*.

Future work should address the long lasting consequences of the loss of plant biodiversity for the sustainability of ecosystem services other than just provisioning services i.e., also regulatory, supporting and cultural services.

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CHAPTER 4

GENERAL CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

From the study it was proven that people in the Vhembe district still depend on indigenous plants for their primary health care. Plants are also used for other purposes and it may be influenced by poor government services or poverty. *Cassia abbreviata* is proven to be a medicinal plant and it is also used for firewood and shade. It is harvested at Matsa village without any considered methods of harvesting. The community of Matsa do not have any harvesting strategies for this plant species. The current harvesting methods are destructive and may lead to extinction of species populations and it is already considered endangerd in other country like in Shinyama region, Zambia (Dery *et al.*, 1999). The kind of perception the communities have about the species availability may influence them not see the need to protect the species because they believe it is readily available.

Fields areas at Matsa village is protected by community field rangers but they only protect the use on other plants except *C. abbreviata* because they believe the seeds are able to germinate very fast compare to other plants and another thing is because animals only feed on *C. abbreviata* when there is lack of food in times of drought.

4.2 Recommendations

As demand for *C. abbreviata* plants continue to accelerate, awareness should be made among the community to ensure sustainable use and conservation of the plants. According to Tshisikhawe 2002, a common practice is for traditional healers to collect medicinal material in ways that avoid undue damage to the plants or which promote regeneration. Future harvesting methods should be implemented and they should ensure efficient use of plant resources and they should be laws that binds one as to how to collect plant species. The community structures such as local chiefs or local authorities (Vhakoma) and all the stakeholders should collaborate in initiating a community project that aims at conservation and management of natural resources. Some educational programmes to educate local people about the need for conservation should therefore be developed. Communities in Vhembe district should be actively involved in plant resource management as they depend on these natural resources for their primary healthcare needs. This might require setting up of a committee to take the responsibility in the management of plants resources and for amendment of permits, which are in line with villagers' need and resource availability.

It is believed that this will strike an equilibrium state between meeting their health needs and wise use of plant resources to ensure sustainable development. It is now known that overexploitation of *Cassia abbreviata* plants is an issue in Limpopo province. However, future studies should focus on how Matsa people use and manage all medicinal plants.

Such studies will help in understanding how local communities relate to the plant resources that they use as medicines.

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Appendix 1

QUESTIONNAIRE

The ethno-ecological assessment of *Cassia abbreviata* Oliv. at Matsa area.

Information about the informant

NB: *Informants were interviewed with their consent.*

Age: Youth ☐ Middle- aged ☐ Elder ☐

Gender: ☐ Male ☐ Female

Education: No formal education ☐ Primary ☐ Secondary and beyond ☐

Information about the plant

Do you know this plant? If yes, what do you call it?

What is it used for?

If for medicinal purpose which diseases does it treat?

Which parts are used?

Availability

Very high (VH) ☐ High (H) ☐ Moderate (M) ☐ Low (L) ☐

Very low (VL) ☐