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Preface

The Faculty of Agronomy and Forestry Engineering (FAFE) at the Eduardo Mondlane University (EMU) in Maputo and the Danish Centre for Forest, Landscape and Planning at the Royal Veterinary and Agricultural University (KVL) in Copenhagen have jointly developed and implemented the project "Forests, livelihoods and farmers: increasing smallholder farmers' possibilities to use forest and trees in improving rural livelihood and poverty alleviation" (FORLIFE). This working paper reports the findings of the FORLIFE pilot field project undertaken in autumn 2004.

FORLIFE is supported by the Conselho Técnico de Investigacao Agraria (CTIA) and funded by Danida's Agricultural Sector Programme Support in Mozambique. The purposes of the project are to: (i) improve the understanding of the role of forest and trees in rural livelihoods in Mozambique, and (ii) assess how development interventions can build on the role of forests and trees to reduce poverty.

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Abstract

Medicinal plants and traditional medicine are important to urban and rural livelihoods in Mozambique. This study presents a preliminary investigation of the structure and conduct of medicinal plant markets in Maputo. First, commercial medicinal plant utilisation and trade was investigated through key informant interviews. This led to the identification of the three main medicinal plant markets in Maputo. Traders (n=28) were then interviewed at all three markets using a structured, open-ended questionnaire. In total, 198 traders were identified at the three markets. Traders sold an average of 27±12.5 plant products. Roots constituted more than 50 % of the products sold from 99 different species of which 51 were identified. Half of the identified species were tree species. The market chain was found to be simple with collectors selling harvested raw and unprocessed materials directly to traders at the markets in Maputo (no middlemen). All plant products originated from wild populations mainly located in the provinces around Maputo. Most products appear to be consumed in Mozambique though some export to South Africa was noted: some 70% of the traders had South African customers, mainly individual traditional healers or patients. These findings are discussed in relation to the limited body of literature on commercial medicinal plants in Southern Africa. It is speculated that the country's combination of low population density and large forest resources is likely to mean that supplies of most medicinal plant species is not problematic and that households, both urban and rural, can continue to benefit from traditional medicine in the near future. There are, however, two issues that require attention. First, from a conservation point of view, there may be local plant populations that are over-exploited in the provinces close to Maputo. There may also be slow growing species with limited distribution and high demand, such as *Warburgia salutaris*, that are nationally endangered. Second, from a livelihood perspective, an understanding of the economic and health importance of traditional medicine at household and individual levels is required in order to design appropriate health and medicinal plant resource management policies.

Keywords: Medicinal plants, trade, conservation, Southern Africa

Sumário

As plantas medicinais e a medicina tradicional são importantes para o bem estar nas zonas urbanas e rurais de Moçambique. Este estudo apresenta uma investigação preliminar da estrutura e conduta dos mercados de plantas medicinais em Maputo. Foi analisada rrimeiro, a utilização comercial de plantas medicinais através de entrevistas a informantes chave. O que levou a identificação de três mercados principais de plantas medicinais em Maputo. Vendedores (n=28) foram posteriormente entrevistados nos três mercados utilizando um questionário estruturado. No total, 198 vendedores foram identificados nos três mercados. Os vendedores vendiam em média cerca de 27±12.5 produtos de plantas. Raízes constituíram mais que 50% dos produtos vendidos de 99 diferente espécies das quais 51 foram identificadas. Mais de metade das espécies identificadas eram espécies arbóreas. A cadeia de Mercado encontrada é simples com colectores a venderem material explorado e não processado directamente ao vendedores nos mercados de Maputo (sem intermediários). Todos os produtos de plantas são de populações selvagens principalmente localizadas nas províncias a volta de Maputo. Muitos dos produtos parecem ser consumidos em Moçambique embora se tenha constatado que se exporta para África do Sul. Cerca de 70% dos vendedores tinha clientes Sul Africanos, principalmente pacientes ou médicos tradicionais individuais. Estes resultados são comparados a limitada literatura sobre comercialização de plantas medicinais na África Austral. Especula-se que a combinação de pouca densidade populacional Moçambicana e vastos recursos

florestais poderão significar que a oferta de muitas espécies de plantas medicinais não é problemática e que as famílias rurais e urbanas poderão continuar a beneficiar da medicina tradicional num futuro próximo. Todavia, há dois aspectos que merecem especial atenção. Primeiro, do ponto de vista de conservação poderão existir populações locais de plantas que são super-exploradas nas províncias próximo de Maputo. Há algumas espécies de crescimento lento com limitada distribuição e alta procura, como *Warburgia salutaris*, que provavelmente estsão em perigo de extinção nacional. Segundo, da perspectiva de bem estar, um conhecimento da importância economia e de saúde da medicina tradicional para as famílias e a nível individual é necessária com vista a desenhar políticas de saúde e maneio de plantas medicinais.

Palavras chave: plantas medicinais, comércio, conservação, África Austral

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1. Introduction

In July 2004, a national level workshop identified priorities for forest-livelihood research in Mozambique (Nielsen *et al.*, 2004). A knowledge gap was identified regarding the forest as a source of income:

(i) Only few studies have focused on income from forest products and none of these on the economic contribution from non-wood forest products.
(ii) Only few market analyses have been conducted to estimate actual or potential economic importance of forest products.
(iii) Limited information exists on livelihood diversification strategies in relation to the use of forest resources.

The workshop and subsequent discussions among the FORLIFE project partners (see Preface for partner overview and information on the FORLIFE project) resulted in the formulation of the present pilot field project focusing on trade in medicinal plants. The medicinal plant markets in Maputo probably constitute the main medicinal plant market in Mozambique, and are perhaps among the major markets in south-eastern Africa, and were therefore chosen for field work.

1.1 Objectives

The general research question is: What is the role and potential of environmental resources in household livelihood strategies in rural areas? In the present project, this is narrowed down to the issue of commercial medicinal plant markets and trade. The specific objective was to gain a preliminary overview of medicinal plant trade in Maputo, especially to:

(i) Analyse the structure and function of medicinal plant markets in southern Mozambique
- How many traders are found in Maputo? What are their characteristics?
- Who are the buyers?
- How do the markets function?
- From where does plant material originate?
- Are medicinal plants exported?

(ii) Identify medicinal plant products sold at the major markets in Maputo
- What types of products are sold?
- Which species are traded?
- To what extent has the plant material been processed?

(iii) Recommend further research

Key issues such as the sustainability of the medicinal plant trade and medicinal plant usage (what are particular species used for and how) and efficacy are beyond the scope of the present pilot project and are not addressed.

1.2 Current knowledge on medicinal plant trade in Mozambique

Medicinal plants are plants used for maintaining health and/or treating specific ailments and diseases. Such plants have been used throughout history and may constitute the most common human use of biodiversity (Hamilton, 2004). Use of medicinal plants is common throughout Africa, e.g. Wyk and Wink (2004) argue that African traditional medicine may the oldest and most diverse

of all medicine systems but that these are very poorly recorded. The importance of medicinal plants in southern Africa has been recognized, e.g. Staden (1999) guesses that around 80% of the southern African population use some form of traditional medicine and Cunningham (1993) argues that reliance on medicinal plants in primary health care in Southern Africa is likely to persist inter alia due to decreasing per capita income and unavailability of western medicine.

The approach of traditional medicine is holistic in the sense that the person as a whole (his or hers physical, social and spiritual well-being) is the centre of attention. In opposition to this, Western medicine may view a disease solely as e.g. a bacterial infection and prescribe antibiotics. The traditional healer will not only analyse the symptoms but will also try to understand why the patient became ill in the first place and then decide on a therapy to address the condition (Iwu, 1993; Wyk *et al.*, 1997). Traditional medicine does not only involve plant species and their practical use for medical treatment. Traditional medicine may also include links to the spiritual world through, e.g., purification rituals (Cunningham, 1996) and the use of animal parts. These are often associated with traits or powers known from the behaviour of the particular species. Skins of antelopes, baboons and dotted cats are part of the healer's traditional clothing (White *et al.*, 2004). It is believed that a person is chosen by his ancestors to become a traditional healer. When a traditional healer dies his knowledge will be left with the disciples. The disciples will transfer the knowledge to the chosen ones (pers.com. N. Mauman; Iwu, 1993). Family inheritance and training is also seen as ways of acquiring the specialized knowledge especially regarding the use of medicinal plants (Iwu, 1993). The use of some species requires special rituals performed by the healer himself when he collects the plants. It is estimated that 80% of the traditional healers do not buy medicinal plants at the market; thus it may be that only a lesser part of the medicinal plant products used by traditional healers are found at medicinal plant markets (pers.com. N. Mauman).

At least 800 of the 5500 known plant species in Mozambique are used for medicinal purposes (pers.com. da Silva). A body of ethnobotanical case studies on medicinal plants, especially on local knowledge of traditional medicinal plant use, is available (Bandeira *et al.*, 2001; Chelene, 2003; Chamba *et al.*, 2000; Dai, 1997; Gaspar, 2000; Jansen & Mendes, 1983, 1984, 1990, 1991; Jansen *et al.*, 2001; Jurg *et al.*, 1991; Mussanhane, 2000; Pereira, 2000; Simone, 2001; Verzár & Petri, 1987; Watt & Breyer-Brandwijk, 1962), mainly in Portuguese. Only one case study has been published in an international scientific journal (Matavele & Habib, 2000). These studies do not focus on medicinal plant markets and trade issues.

The role of medicinal plants as a source of income for rural and urban households in Mozambique is unknown. Information on volumes and values of trade and use of traditional plant-based medicine is almost non-existent as are studies of the impact of commercial collection on wild plant populations. We do know that trade in commercial medicinal plants in southern Mozambique has increased since the 1980s when only 10 traders were found in Xipamanine market, the main market in Maputo (Massingue, 2004). Cunningham (1993) recorded 25 medicinal plant sellers in Maputo in 1989. In addition, a bachelor project conducted at the Eduardo Mondlane University has investigated trade of medicinal plants in Maputo (Fato, 1995). Today 175 traders are registered at the Association of Medicinal Resource Traders (AVEMATRAMO); to this a number of unregistered traders should be added.

From the regional literature on medicinal plant trade, it seems that Mozambique is an important supply country and that Maputo, located in the southern most part of Mozambique close to South Africa, plays an important role in the distribution of medicinal plants from Mozambique to South Africa. In Mpumalanga Province in South Africa in markets west of the Krüger National Park, 33% of the plant material sold were imported, of these 85% came from Mozambique (Botha *et al.*,

2004a). In particular bark from the pepper-bark tree *Warburgia salutaris* (Bertol.f.) Chiov. is collected in Mozambique and sold at major medicinal plant markets in South Africa. In Durban, it is estimated that 30-40 tonnes of *W. salutaris* bark are imported from Mozambique and Swaziland annually and sold at the highest unit price (Mander, 1998; Netshiluvhi, 1999). In the main market in Johannesburg, 43% of this bark originates from Mozambique with annual traded amounts estimated at 500 – 1000 kg with a price level twice that of other important barks. This indicates high demand for this species, which again indicates pressure on the resource (Williams 2004). Staden (1999, p.76) even claims that "Unfortunately the demand for medicinal plants in southern Africa is already so large that it would be extremely difficult to meet this demand through sustainable use." Another indication of the importance of medicinal plants in the region is provided by Olsen and Helles (2000) who estimated the value of medicinal plant consumption and health services in Swaziland at more than twice the value of fuel wood. Cunningham (1993) provided an overview of medicinal plant trade in south-eastern Africa, including examples of species traded in and from Mozambique.

Box 1: Profile of *Warburgia salutaris*

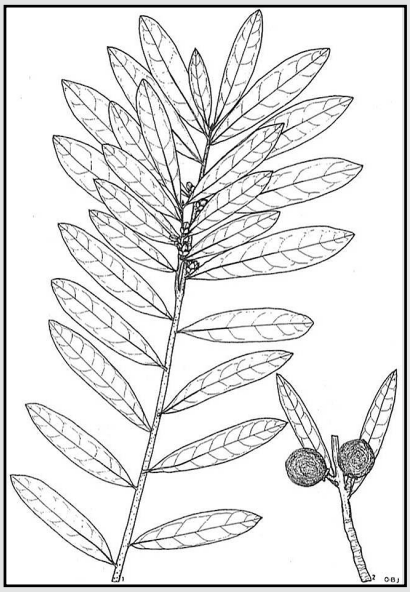
Family: Canellaceae
Botanical name: *Warburgia salutaris* (Bertol.f.) Chiov.
Vernacular names: Pepper-bark tree (English), chibaha (Tsonga, Changana), isibhaha (Zulu), mulanga (Venda)

Medicinal properties: The bark or preferably the root bark of *W. salutaris* is used; it is reddish on the inside and has a strong peppery taste (Wyk *et al.*, 1997). Its antibacterial properties have been documented (Raben & Staden, 1997). The leaves have a bitter taste and also show positive effects for antibacterial properties (Zschocke *et al.*, 2000). The bark is traditionally used against cold, coughs, fever, malaria and abdominal pain (Jansen & Mendes, 1990; Wyk *et al.*, 1997; Venter & Venter, 2002).

Botanical description: A medium-sized tree of about 10 meters in height, with a rough, mottled bark which is reddish on the inner side. The leaves are oblong, about 60 mm long, glossy green above and pale below. Small greenish-yellow flowers are produced between the leaves on the stem, followed by round, green fruits with several flat seeds inside (Wyk *et al.*, 1997).

Habitat and distribution: The tree is found in evergreen montane forest including wooded ravines and evergreen forest along the coasts (Venter & Venter, 2002; Palgrave, 2000). The tree is known from only a few localities in the north- eastern parts of South Africa, south-eastern Zimbabwe (Palgrave, 2000) and more commonly in southern Mozambique (Jansen & Mendes, 1990). It is also found in Zambia and Malawi (Palgrave, 2000).

Conservation status: The species is slow growing with a limited distribution making it vulnerable to over-exploitation. Bark from *W. salutaris* is very popular which has lead to near extinction in Zimbabwe, less than ten known specimens left (Cunningham, 2001b; Mapaura & Timberlack, 2002), and almost extinction in South Africa where it is a protected species (Venter & Venter, 2002). In Mozambique, the species is heavily utilised and in urgent need of protection (Bandeira *et al.*, 1994, 1996). The red list data classification for Mozambique is Vulnerable VU A2 cd (Izidine & Bandeira, 2002) defined as: a reduction of the population size of up to 30% within the last ten years due to declining area of occupation caused by over exploitation (Golding, 2002). Globally the status of the species is Endangered (Izidine & Bandeira, 2002).



Domestication efforts: Research with the objective of propagating *W. salutaris* from cuttings is being conducted at Eduardo Mondlane University, Department of Biology. Preliminary results indicate that it is difficult to propagate the species from cuttings. Only two seedlings survived. The cuttings need a root-stimulating hormone to be able to successfully develop roots. In South Africa (Venter & Venter, 2002) and Zimbabwe (Cunningham, 2001b), the tree is successfully cultivated from cuttings. Seeds are often infested with insects which makes it difficult to produce seedlings (Venter & Venter, 2002). The species coppices readily also after relatively heavy utilisation of bark (Botha *et al.*, 2004b).

1.3 Public health care in Mozambique

Mozambique is among the poorest countries in the world (ranked as 220 out of 226 countries in the world measured on GDP per capita), which is reflected in the level of public health care (Table 1). Only 40% of the population have access to public health care (WHO, 2004a). The two major diseases in the country are HIV/AIDS and malaria. AIDS killed more than 100,000 people in 2003 (UNAIDS/WHO, 2004) and 36.7% of deaths among children under five years of age are attributed to malaria (WHO, 2004a). The life expectancy of 42.6 years at birth is among the lowest in the world and the infant mortality rate of 146 per 1000 is among the highest. Regarding HIV/AIDS, Mozambique is ranked as the tenth hardest affected country in the world.

Table 1 *Health indicators for Mozambique*

Total population [1]	19,182,000
Per capita GDP in USD[2]	805
Total expenditure on health care as % of GDP[2]	5.9%
Life expectancy at birth (years)[2]	42.6
Infant mortality rate (per 1,000 live births)[1]	146
Under 5 years mortality rate (per 1,000 live births)[1]	206
Adults (15-49) with HIV/AIDS[1]	1,200,000
Children (0-15) with HIV/AIDS[1]	100,000
Estimated number of deaths due to AIDS in 2003[1]	110,000
Estimated number of orphans in 2003[1]	470,000

[1]UNAIDS/WHO (2004), [2]WHO (2004)

HIV/AIDS has serious implications for rural households. A study in Chokwe District showed that 45% of HIV/AIDS affected households reduced the area cultivated and that 60% reduced the number of crops grown (FAO, 2004). Other research indicates that relatively poor households do not recover quickly from head-of-household mortality. Especially if the male head-of-household dies it will have negative impact on crop production, level of assets and off-farm income (Yamano & Jayne, 2004). This will inevitably make poor farmers even poorer. Research documents that poor people depend more on natural resources from common pool resources for their survival especially in periods of stress or shock compared to more wealthy groups (Cavendish, 2000; Byron & Arnold, 1999; Falconer, 1990; Sitoe, 2004).

The ratio of doctors (practising Western medicine) to patients in Mozambique is 1:50,000. In contrast, the ratio of traditional healers to patients is only 1:200 (Hamilton, 2004). Thus, inadequate provision of Western medicine combined with deeply rooted cultural aspects of traditional medicine makes traditional medicine an important part of peoples' health care in Mozambique. This is unlikely to change significantly in the near future.

1.4 Nominal medicinal plant policy and legislation

In Mozambique during the colonial time, traditional medicine was officially viewed as superstitious and non- scientific. Practitioners were regarded as wizards and witch doctors and were not legally allowed to practice. However, the use of traditional medicine remained common (Minstério da Saúde, 2004). At the WHO organised conference in Alma Ata in 1978, it was recommended that the world's governments should start to integrate traditional medicine in official health care systems (Ministério da Saúde, 2004). In Mozambique, the office for the study of traditional medicine was established in 1977 in the Ministry of Health. The objective was to collect plants species and information about methods used by traditional healers. The association of traditional medicine practitioners (AMETRAMO - Associacao de prática de medicina tradicional de Mozambique) was created in 1990. In 2004, the national policy on traditional medicine and a strategy for its

implementation was published. The formation of the policy was based on workshops held in all ten provinces with the participation of two traditional healers from each district (more then 100 districts). The same healers were informed in similar workshops when the policy was finalised. These healers are to disseminate the existence and content of the policy to healers in their respective districts. At present, the policy is being used to formulate legislation (Minstério da Saúde, 2004). The described development in Mozambique is not unique; WHO are providing support to all member states that wants to (WHO, 2002): (i) develop traditional medicine and integrate it into national health care systems; (ii) ensure appropriate, safe and effective use of traditional medicine, and (iii) increase access to information on traditional medicine. It may be that government legislation and support will start to have a positive impact on medicinal plant utilisation in Mozambique.

2. Methods

After assessing the literature, discussions were held with key informants using semi-structured interviews. Then markets were identified and a structured questionnaire designed, tested and applied to generate market specific data. Lastly, traded species were identified.

2.1 Key informant interviews

To obtain an understanding of the broad range of issues related to commercial medicinal plant utilisation in Mozambique (including trade and marketing issues as well as use of traditional medicine), key informants from governmental institutions and non-governmental organisations were interviewed, Table 2.

Table 2 *List of key informants*

Institution name	Acronym	Key informant	Subject of interview
Organisation to the promotion of traditional medicine	PROMETA	Coordinator and traditional healer Mr. Narcito Mauman	Traditional medicine and cultural aspects
Ministry of Health	MISAU	Biologist Ms. Felisbela Gaspar	Medicinal plants and health care. Policy and legislation
Commercial medicinal plant trade company	MEDIMOC	Chefe Departamento de Marketing Dr. Jerónimo Mufume	Export of medicinal plants
National Institute for Agronomic Research	INIA	Ecologist Mr. Mário Calane da Silva	Botanical research and domestication
The organisation of traditional healers	AMETRAMO	Traditional healer and leader of AMETRAMO Mr. Silvester Zita	Traditional medicine and trade

Traditional healers and their organisations were consulted as important stakeholders and major users of traditional medicinal plants. Their views on trade and domestication of medicinal plants in relation to cultural aspects, e.g. the performance of rituals when collecting plants, were discussed. The Ministry of Health was consulted regarding the new official policy on traditional medicine and the role of traditional medicine in health care in Mozambique. The National Institute for Agronomic Research was visited in order to be updated on present botanical and agronomical research on medicinal plants including domestication efforts. Finally, the commercial company MEDIMOC, apparently a dominating player in the export of medicinal plants from Mozambique, was visited as a market actor operating outside the three market places investigated in Maputo. In addition, a number of key informants were consulted at Eduardo Mondlane University.

2.2 Market identification

Based on the literature and key informant interviews, three markets were identified for the market survey: the two major markets Xipamanine and Xikalene and the minor Adelino market. These markets are situated at the outskirts of Maputo where major roads run into the city (Figure 1). All three markets have previously been part of a market survey for medicinal plants (Fato, 1995). There are many other minor markets, serving local parts of the city, scattered all over Maputo. These trade in vegetables, meats, oil, and charcoal; medicinal plants are not a visible feature in these markets. All key informant mentioned Xipamanine as the main market for medicinal plants in Mozambique.

After the identification of the markets, an initial site assessment was undertaken to familiarise the involved researchers with the markets, including stall lay-out and types and numbers of items traded.

2.3 Interviews at markets

Following the initial market assessment, a structured open-ended questionnaire was designed in English (Appendix A) and translated to Portuguese (Appendix B). The questionnaire consisted of five parts: (i) general information about the informant (name, sex, age, education); (ii) the informant's experience with medicinal plant trade and main features of his business (years of experience, number of products sold, number of people working for him and other income sources); (iii) the ten most important medicinal plants. For these species more detailed information was collected, including plant part traded, amounts sold, price per unit, information on price changes and storage time; (iv) the geographic origin of plants and from whom the trader bought the products (e.g. middlemen or collectors). Places mentioned were used to calculate rough distances to the markets in Maputo. For each informant a range was made based on the place closest to Maputo and the place furthest away; and (v) a customer section (who are they, where do they come from, and why do they buy traditional medicine).

Two research assistants speaking Changana conducted the interviews. A mix of Portuguese and Changana were used during interviewing. The research assistants were trained in interviewing and were involved in testing and refining the questionnaire. The interviews were conducted in October 2004. The total sample size was 14% (Table 3) - 28 out of the 198 identified medicinal plant traders at the three markets were interviewed. The initial market assessment indicated that markets were uniform, therefore traders were not stratified. Interviewed traders were randomly selected. A trader known at the markets were attached to the interviewing team as this reduced trader resistance to participating in the interviews. Not all informants answered all questions: (i) only16 traders answered questions regarding from whom they got their products; (ii) questions on the origin of supplies and the amount and value of trade was originally intended to be asked for each traded species but this was too time consuming. Collecting data on amounts and prices were then prioritised over obtaining information on origin of supplies. Ten informants did not provide information on traded amounts. None of the traders kept any written records of their trade.

Table 3 *Interview sample size*

Market	No. of traders	No. of interviews	Sample size
Xipamanine	175	18	10 %
Xikalene	17	7	41 %
Adelino	6	3	50 %
Total	198	28	14 %

At the end of each day of fieldwork, the completed questionnaires were translated and reviewed. Any needs for clarifications were noted and investigated the following day.

2.4 Species identification

Species were identified using the vernacular name stated by interviewees. The link between vernacular and Latin names was made using Koning (1993), Fato (1995) and Banderia *et al.* (2002) as well as checklists from medicinal plant market surveys in South Africa (Williams *et al.*, 2001; Botha *et al.*, 2001). The names used in this report follow the nomenclature of the Missouri Botanical Garden's Nomenclature database TROPICOS (TROPICOS, 2002). Life forms for traded species were only determined for identified species, whereas plant parts used were identified for all species as part of the market survey.

Species identification using vernacular names did not make it possible to identify all the species recorded in the markets. Several problems were encountered: (i) the checklists were incomplete; (ii) the same vernacular name may in some cases have been spelled differently (e.g. due to variations in accents); and (iii) different species are known to have the same vernacular name and some species are known to have several vernacular names referring to, e.g., different plant parts or growth stages (Cunningham, 2001a). Thus, identification of plant species using vernacular names clearly has its limitations. However, it can be argued that common vernacular names, that are being used by many traders, that have been previously recorded in the literature are likely to be correct in most cases.

3. Results

3.1 Market survey

Location and general description of the markets

Location of the three investigated medicinal plant markets is provided in Figure 1. *Xipamanine* is situated approximately five km northwest of the city centre. Here all kinds of products are sold. The traders are organised according to type of product, thus medicinal plant traders are found together in the same part of the market. A banca (a stall) is normally two meters wide and the trader has all his products within this. The bancas are lined up next to each other making the market place very dense. Approximately 175 medicinal plant traders are found in this market. The traders do not pay any fee for the banca. It is the biggest market for medicinal plants in Maputo and most probably in the country. The traders were found in two areas of the market, one within the market the other just outside. *Xikalene* at Praça dos Combatantes is situated seven km northeast of the city centre. This market is bigger and is situated at a large common area with space to expand. It is the biggest market for charcoal and poles in Maputo. Seventeen medicinal plant traders were found side by side in a more quiet part of the market. *Adelino* at Praça dos Heróis is situated six km from city centre to the north. The market here is smaller than the two other markets and serves the suburbs near the airport. Six traders were found scattered all over the market.

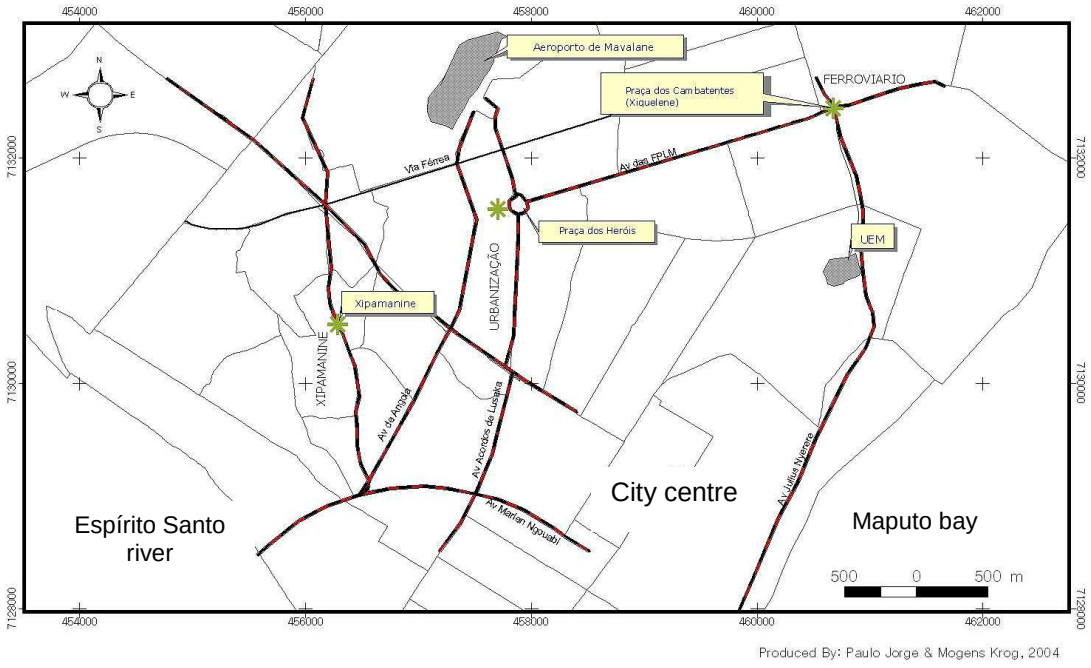


Figure 1 *Location of main medicinal plant markets in Maputo*

The medicinal plant traders

Most traders interviewed are male and most come from the neighbouring provinces Gaza (42%) and Inhambane (38%). All traders work as permanent traders at the same market all year round. 50% of the traders get assistance, either from employed assistants or from family members, to look after the banca or for collection of plant material. The average age of the traders is 35 ± 13.5 years with most

are in their 20s (38%) or 40s (33%). The traders are generally quite experienced with an average of 11 years' experience. All had at least two years of experience, 29% had less than five years, and 55% more than 10 years of experience (Table 4). Traders had from 3 to 10 years of schooling (average 6.0 ± 2.2).

Table 4 *Basic characteristics of medicinal plant traders in Maputo*

Gender (%)		***No. of products on sale***	
Male	86%	Plant products, average ± sd	27 ± 12.5
Female	14%	Animal products, average ± sd	2 ± 3.5
Age (years)		***Year of experience***	
Average ± sd	35 ± 13.5	Average ± sd	11 ± 7.9
15-19	10%	≤ 2	7%
20-29	38%	3-5	22%
30-39	10%	6-9	15%
40-49	33%	10-19	48%
≥ 50	10%	≥ 20	7%

The medicinal plant traders all have a large assortment of products. On average, traders sell 27 ± 12.5 different plant products but some sell more than 50 (Figure 2). Plant products mainly include roots but also leaves, bulbs, bark, fruits and whole plants are sold (Figure 5). Half of the traders interviewed also sell products from wild animals including skins from, e.g., reptiles, dotted cats and elephant. Some of these skins are used for the traditional healer's dress. Other products include bones, sculls, feathers, dried monkey hands and quills from porcupines. Products from the ocean include dried starfish, shark jaws, shells and dried fish parts. Live chameleons were also sold.

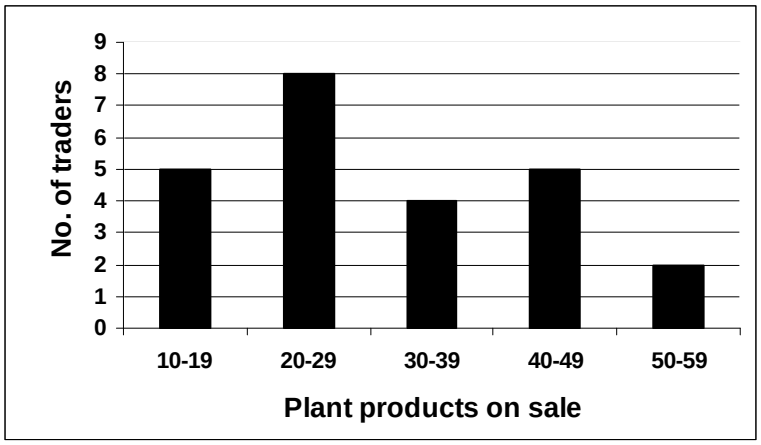


Figure 2 *Variation in number of plant products sold per trader*

Marketing chain

Almost all traders (94%) buy medicinal plant products directly from collectors who come to the markets to sell. Some traders (31%) also collect themselves or have family or other employed to collect for them (Figure 3). None of the interviewed traders mentioned buying from middlemen; however, 44% said they sell to other traders. Whether these traders are colleagues at the same market buying supplements for their own banca or whether they come from, e.g., South Africa is not known.

Traditional healers play an intermediate role in the market chain. To some extent they collect plants for their own consultation, as some species require special rituals when collected (section 1.2). However, the traditional healers are also major buyers at the markets. The market provides easy access to most medicinal plant products and use of plants collected without performed rituals is generally not regarded to effect efficacy (pers.com. S. Zita). Traditional healers add value to medicinal plants as the plants are processed and prescribed in small dozes often in mixtures of different species. These mixtures and plants are sold as part of a consultation.

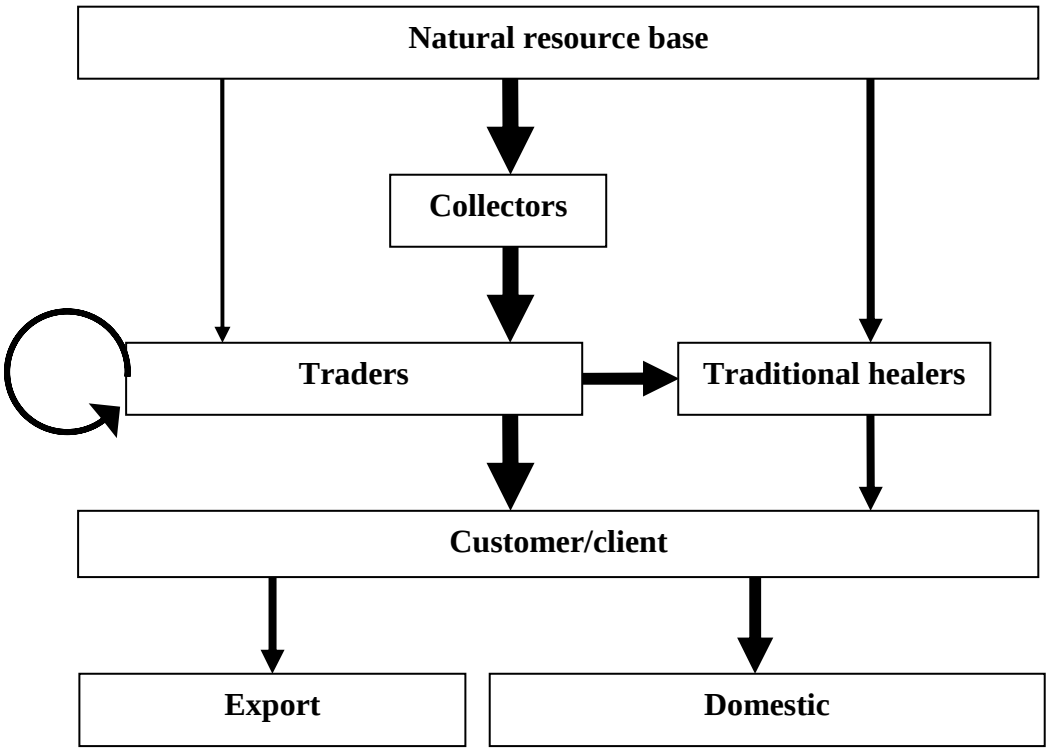


Figure 3 *Marketing chain for medicinal plants in southern Mozambique. Width of arrows indicates relative importance*

The origin of plant material traded

Plant material traded at the markets in Maputo originates from the whole country as far away as Tete (mentioned by 4% of interviewed traders) and Nampula (11%) Provinces more than 2000 km north of Maputo. However, the majority of the traders get their products from the three provinces closest to the capital: Maputo (89%), Gaza (59%) and Inhambane (52%) Provinces (Figure 4). The city of Inhambane is situated approximately 500 km up the coastline. Most traders mention Catembe, Maputo Province (59%) as the origin of plant material. Catembe is situated at the southern side of the mouth of river Espríto Santo in Maputo Bay. Maputo City is situated on the northern side of the river mouth. There are ferries crossing the river several times every day which makes access to the markets easy.

Plant material coming from abroad was mentioned by a few informants; 7% mentioned South Africa and 4% mentioned the town of Chicualacuala on the border to Zimbabwe 500 km north of Maputo as the origin of plant products, indicating some import from both countries. It seems that the Maputo markets, in addition to serving local demands, are a regional hub for medicinal plant trade.

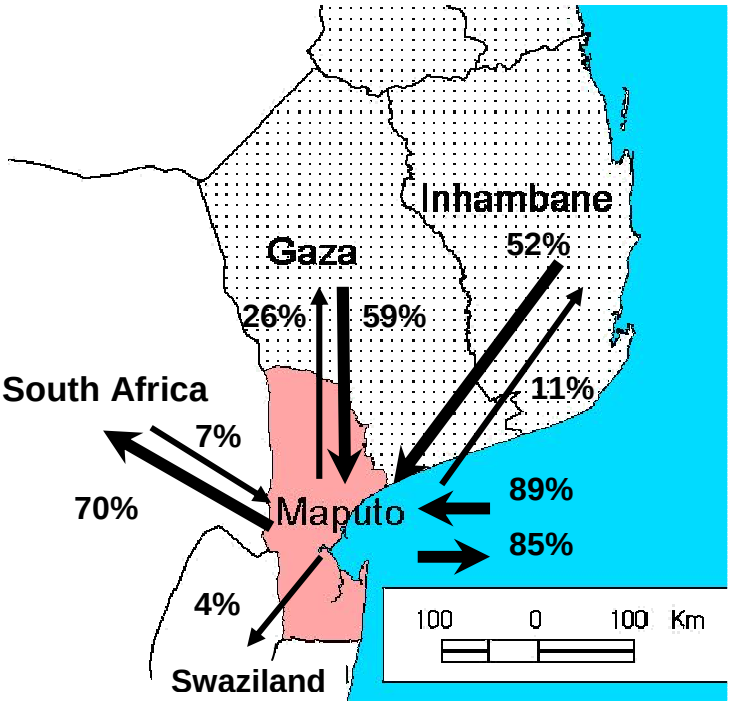


Figure 4 *Regional medicinal plant trade patterns in southern Mozambique. Percentages refer to no. of traders mentioning specific areas of resource origin (arrow into Maputo) or customer origin (arrow out of Maputo)*

Where do the customers come from and who are they?

85% of the traders say they sell to customers coming from in or around Maputo and 70% that they sell to customers coming from South Africa (Figure 4). The majority of customers are traditional healers or their patients (Figure 3). The patients go to the market and buy traditional medicine based on advice or a prescription from a traditional healer. Most customers from South Africa are said to be patients or traditional healers buying for their own consumption and not as middlemen. One informant mentioned that sometimes a South African trader would come and buy large quantities.

Plant parts traded

The most common type of plant part traded in the three markets was **roots** – these were harvested from more than 50% of all species recorded in the markets (Figure 5). Roots are sold either as a piece of root or as a small pile of mixed chips of roots from different plant species. One example is the common mix made for the improved health of babies. This mix was sold by at least 25% of the traders interviewed. It is made of roots from five species: *Cardiogyne africana*, *Artabotrys brachypetalus*, *Senna petersiana*, *Celosia* sp. and *Ficus platyphylla*. All species are found in the top eight of traded species (Table 5). The product is boiled in water and left for 24 hours and the tea is given to the baby. Making a tea in this manner is the most common means of preparation of roots for treatment. The product from the most commonly mentioned species *Hypoxis hemerocallidea* is a tuberous root the size of a turnip; these are sold per root. Another tuberous root with the shape and size of a melon is commonly sold (29% of the informants). Slides cut of this huge root is the unit traded. The vernacular name is dema; unfortunately no scientific name was found.

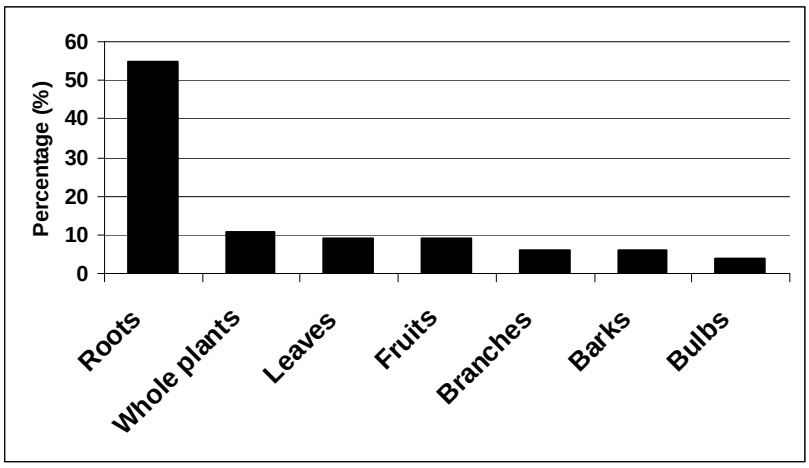


Figure 5 *Overview of plant parts traded in Maputo markets (based on 99 traded species)*

Other plant parts are harvested from 5-10 percent of the species recorded (Figure 5). *Aloe* sp. **leaves** is the most important in this category (57% of the informants) and the traded unit is per leave. For **bark** products, *Warburgia salutaris* is the most important species mentioned by 21% of the informants. Bark is either traded as small piles or a piece of bark. **Fruits** sold for medicinal purposes are from tree species such as *Adansonia digitata*, *Kigelia africana* and *Strychnos spinosa*. These are, however, not common in the market. Nor are **bulbs** common in the markets; though the large bulb of *Crinum* sp. (15-20 cm in diameter) is mentioned by 7% of the informants. This species is listed by key informants (three independent botanists) as an important medicinal plant. The small bulb of *Siphonochilus aethiopicus* (wild ginger) was only mentioned by one trader. This bulb is interesting because it is getting scarce in South Africa where it is a protected species. Several sources indicate that this species is being imported from Mozambique (Mander, 1998, Williams 2004). **Whole plants** are sold per plant and are often either herbs or parasites. **Branches** are sold in small bundles. Rhizomes and tubers are not included in Figure 5; however, both were observed at the markets. Distinction between rhizomes, tubers and roots may not have been made by informants (for linguistic reasons) or information may have been lost during translation of questionnaires from Portuguese to English. It is likely that some rhizomes and tubers may have ended up in the root category. Leaves, fruits and branches only constitute 24% of type of plant parts sold whereas roots, whole plants, bulbs and bark constitute 76%. The latter group of products is most likely to be harvested destructively.

Traded species

Plant products from a total of 99 different species were recorded of which 50% have been identified. The identified species belong to 38 different families. Species are ranked according to the number of times mentioned by traders (Appendix C). The traders were asked to mention the ten most important species (not ranked). Some informants mentioned fewer species and some mentioned up to 20 species. The total number of species records is 272.

Hypoxis hemerocallidea (African potato) was mentioned by most traders (71%). The 10 highest ranking species were mentioned by at least 25% of the traders. 40% of the species were recorded more than twice.

Table 5 *Species mentioned by more than four informants*

Rank	Species name		Informants		Life form	Family
	Vernacular	Scientific	n	%		
1	xirangabwana	*Hypoxis hemerocallidea* Fisch. & C.A. Mey.	20	71	Geophyte	Hypoxidaceae
2	pumbulu	*Cardiogyne africana* Bureau	17	61	Tree	Moraceae
3	managane	*Aloe* sp.	16	57	Aloe	Asphodelaceae
4	tita	*Artabotrys brachypetalus* Benth.	16	57	Tree	Annonaceae
5	nemberembe	*Senna petersiana* (Bolle) Lock	15	54	Tree	Caesalpinioideae
6	vela washeca	*Celosia* sp.	10	36	Herb	Amaranthaceae
7	chinezila	*Tiliacora funifera* (Miers) Oliv.	9	32	woody climber	Menispermaceae
8	tuvane	*Ficus platyphylla* Delile	8	29	Tree	Moraceae
9	dema	no identification	8	29		
10	chiurai	*Cissus rotundifolia* (Forssk.) Vahl	7	25	Shrub	Vitaceae
11	cachuana	*Tabernaemontana elegans* Stapf	6	21	Tree	Thymelaeaceae
12	xibaha	*Warburgia salutaris* (Bertol.) Chiov.	6	21	Tree	Canellaceae
13	bindamuchai	*Adenia gummifera* (Harv.) Harms	4	14	Climber	Passifloraceae
14	mahokwe	*Cussonia arenicola* Strey	4	14	Tree	Araliaceae
15	conana	no identification	4	14		
16	nhautsacana	no identification	4	14		

Trees were the most dominant life form among species identified (50%); shrubs and herbs each comprised 17% (Figure 6). The highest ranking species *H. hemerocallidea* is a geophyte found in grassland (Box 2). Three genera characterised as succulent plants were recorded at the markets: *Aloe* sp., *Optuntia* sp. and *Euphorbia* sp.

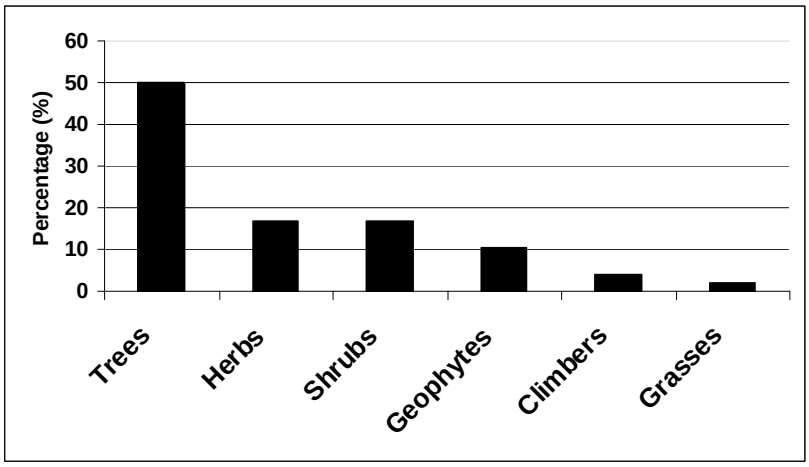


Figure 6 *Overview of life forms traded in Maputo markets (based on 48 identified species)*

Prices

The most valuable product traded was W*arburgia salutaris* bark with an average price of 11250 Meticais (21053 Mtc/USD, October 2004) per unit, followed by *Aloe* sp. leaves traded at an average price of 9650 Mtc. per unit. The following eight products, all roots, had average prices of 5300 – 6600 Mtc/unit (Table 6) and all had both median and modal values of 5000 Mtc/unit. Prices at all three markets appear comparable with a tendency for prices at Xikalene market to be a bit higher. For *W. Salutaris* bark, the price was almost three times the price compared to the two other markets, while roots from *S. petersiana* and *T. elegans* were almost twice the price. The number of observations is too low to allow any general conclusions to be drawn.

Box 2: Profile of *Hypoxis hemerocallidea*

Family: Hypoxidaceae
Scientific name: *Hypoxis hemerocallidea* Fisch. & C.A. Mey.
Previously known as: *Hypoxis rooperi* S. Moore
Vernacular names: African potato (English), xirangabwana (Tsonga, Changana), inkomfe (Zulu)

Medicinal properties: The tuberous root stock is used. The compound rooperol is believed to have anti-cancer, anti HIV and anti-inflammatory effects and clinical trials have shown promising results (Wyk *et al.*, 1997). A mixture of sterols and sterolines extracted from the species has been patented and is now available as tablets using the trade name Moducare® (George *et al.*, 2001). Clinical studies in cancer treatment have been disappointing (Wyk & Wink, 2004). The long-term safety of *H. hemerocallidea* is questioned by some researchers (George *et al.*, 2001).

Botanical description: The genus Hypoxis is a tuberous perennial with long strap-shaped leaves and yellow star-shaped flowers. *Hypoxis hemerocallidea* has broad slightly hairy leaves which are arranged one above the other to form three distinct groups spreading outwards from the centre of the plant. Bright yellow star shaped flowers are borne on long slender stalks (Wyk *et al.*, 1997).

Habitat and distribution: This geophyte grows in grasslands in southern Africa. It is known from Eastern Cape in the south-east of South Africa along the coast to Mozambique. It is also found in Lesotho and Swaziland and probably in the south-eastern parts of Zimbabwe (Wyk *et al.*, 1997).

Trade and conservation: The tuber is mentioned by most traders (71%) as an important product sold at the Maputo markets. It is so popular that sustainable harvest is unlikely to take place. 250 ha near Durban in South Africa has been set aside mainly for the conservation of *H. hemerocallidea* (George *et al.*, 2001).

Domestication efforts: It takes four years for the tuber to grow into harvestable size. Research is going on at INIA with the objective to identify the optimal growth conditions for cultivation (Pers.com. da Silva). Growth requirements have been tested in South African research. In greenhouse and field trials, different levels of nutrients and herbicides were tested. *H. hemerocallidea* prefers poor soils (McAlister & Staden, 1995).

The life form of Hypoxis hemerocallidea

The tuber on display at market

(Photos: M. Krog)

Table 6 *Average price and price variations for the 11 highest value medicinal plant products*

Species name					Prices in Meticais					
Vernacular	Scientific	Product	Trade unit	N	mean	s.d.	median	mode	min.	max.
xibaha	*Warburgia salutaris*	bark	small pile	6	11250	7027	8750	5000/20000	5000	20000
mangana	*Aloe* sp.	leaves	per leave	15	9643	6344	8750	10000	5000	30000
casho	*Tabernaemontana elegans*	root	per piece	6	6667	2582	5000	5000	5000	10000
chiurai	*Cissus rotundifolia*	root	per piece	7	6429	1967	5000	5000	5000	10000
nemberembe	*Senna petersiana*	root	per piece	9	6389	2205	5000	5000	5000	10000
xirangabwana	*Hypoxis hemerocallidea*	root/tuber	per piece	20	6325	2561	5000	5000	5000	15000
Tita	*Artabotrys brachypetalus*	root	per piece	9	6111	2205	5000	5000	5000	10000
chiwizila	*Tiliacora funifera*	root	per piece	9	6111	2205	5000	5000	5000	10000
pumbulu	*Cardiogyne africana*	root	per piece	10	5750	1687	5000	5000	5000	10000
dema	no identification	root	per slice	8	5313	884	5000	5000	5000	7500
mix for babies	mix of 5 species[1]	root	per handful	7	4643	1725	5000	5000	2500	7500
Average					6785	2854	5682		4773	12727

[1] Mix consists of *Senna petersiana*, *Artabotrys brachypetalus*, *Cardiogyne africana*, *Ficus platyphylla* and *Celosia* sp.

Table 7 *Comparison of prices between the three markets Xipamanine, Xikalene and Adelino for the 11 highest value medicinal plant products*

Species name				*Xipamanine*			*Xikalene*			*Adelino*		
Vernacular	Scientific	Product	Trade unit	mean	s.d.	N	mean	s.d.	N	mean	s.d.	N
mangana	*Aloe* sp.	leaves	per leave	10000	8667	14	5000	0	1	-	-	0
xirangabwana	*Hypoxis hemerocallidea*	root/tuber	per piece	6654	2875	13	5000	0	5	7500	3536	2
xibaha	*Warburgia salutaris*	bark	small pile	6250	1768	2	20000	0	2	7500	3536	2
chiurai	*Cissus rotundifolia*	root	per piece	5625	1250	4	5000	0	1	8750	1768	2
dema	no identification	root	per slice	5500	1118	5	5000	0	1	5000	0	2
pumbulu	*Cardiogyne africana*	root	per piece	5417	1021	6	7500	3536	2	5000	0	2
nemberembe	*Senna petersiana*	root	per piece	5417	1021	6	10000	0	2	5000	0	1
tita	*Artabotrys brachypetalus*	root	per piece	5000	0	3	8333	2887	3	5000	0	3
chiwizila	*Tiliacora funifera*	root	per piece	5000	0	4	7500	2887	4	5000	0	1
casho	*Tabernaemontana elegans*	root	per piece	5000	0	3	10000	0	2	5000	0	1
mix for babies	mix of 5 species (as above)	root	per handful	4643	1725	7	-	-	0	-	-	0
Average				5864	1768	6	8333	931	2	5972	982	1

3.2 Large scale export of medicinal plants

To further investigate the issue of medicinal plant export from Mozambique, semi-structured interviews were conducted at MEDIMOC. This is the only company officially allowed to import and export medical products, including domestically collected medicinal plant products. The company was created in 1977 as a government company; it was privatised in 1999 and now operates as a for-profit commercial company. An important part of the business is import of western pharmaceuticals. As a recognised stakeholder in the health sector, MEDICMOC attended meetings with the Ministry of Health as part of the process of formulating the government's new policy on traditional medicine.

Interviews revealed that the company has 10-12 major customers (wholesalers and processors) in Europe, two in South Africa and a few in Asia. There is limited processing in Mozambique. Products are mainly dried fruits, bark or roots sold in large units, e.g. 500 – 1000 kg. Demand is reported to be increasing and obtaining supplies is not experienced as a problem. Plant material is collected in the wild with prices paid to collectors ranging between 0.5 – 1 USD/kg. The company has a *collection program* which is a network of villages in Maputo, Gaza and Inhambane provinces. In the network, arrangements with village leaders are made in advance in order for villagers to have time to collect the requested products. MEDIMOC only buys products; they are not involved in any community development or domestication efforts. They have no policy on sustainability with regard to harvesting methods, etc.

MEDIMOC wishes to explore new markets and are presently developing new products primarily from the African potato (*Hypoxis hemerocallidea*) and *Aloe* sp. due to increasing interest from customers. Part of this process involves running a laboratory for control of the products sold. This laboratory is run in collaboration with the Ministry of Health. In addition, MEDIMOC is interested in local knowledge from traditional healers in order to identify new products. Presently exported species include Piri-piri (*Capsicum frutescens*), Beijo de mulata (*Catharanthus roseus*), Macuacue (*Strychnos innocue*) and Che-balacata (not identified). None of these species were found at the markets in Maputo.

4. Discussion

4.1 Trade

There has been a clear trend towards more traders of medicinal plants in Maputo during the last 25 years. In the beginning of the 1980s, only 10 traders were found in the main Xipamanine market (Massingue, 2004), in 1989 there were 25 (Cunningham, 1993), in 1995 there were around 106 traders in the three markets Xipamanine, Xikalene and Adelino (Fato, 1995); and today 198 traders are found at the same three markets. The increase in traders indicates an increased commercialisation of medicinal plants in Maputo and there is no reason to believe that this trend is changing. There are at least four reasons for this:

1. Rural and urban people are struggling with serious diseases like HIV/AIDS and malaria with limited health care resources available; they do not have any *de facto* alternatives to traditional healing.
2. The political signals from the government have made it more legitimate to practise traditional healing.
3. Huge international demand for traditional medicine has a direct effect on the demand at the markets in Maputo and thereby the number of people engaged in trade and collection. Besides Maputo, most traders mention South Africa as the place where customers come from. In South Africa, urbanisation has not reduced the demand for traditional medicine leading to commercialisation of medicinal plants.
4. General population growth, increasing urbanisation and the ending of the civil war have most likely added to an increasing trade in medicinal plants.

Most of the traders get their plant material from the provinces close to Maputo; this indicates that these areas supply resources in sufficient quantities to allow commercial collection. The annual deforestation rate for Maputo Province is approximately 1% which is higher than the national average of 0.23% (Saket, 1994); however, there are no studies on how deforestation impact on medicinal plant harvest. Impact is likely to vary significantly across species. Cunningham (1993) noted that no medicinal plant species in Mozambique are known to be threatened on a national scale due to the relatively small urban population and low population density.

This increased demand for medicinal plants in South Africa has created pressure on resources in South Africa where several medicinal plant species are now red listed (Cunningham, 1991; Williams *et al.*, 2000). This may contribute to more trade in Mozambiquean markets. For instance, sources indicate that large quantities of *Warburgia salutaris* are exported from Mozambique to South Africa (Mander, 1998; Williams, 2004). There were no sign of large volumes being traded at the markets in Maputo and only 21% of the traders mentioned the species as important. However, analysing prices at the markets, bark from *W. salutaris* was found to be the most expensive product indicating a high demand. Similar observations have been made at markets in Johannesburg (Williams, 2004) and Durban (Netshiluvhi, 1999). It is likely that bark exported to South Africa is not going through the major markets of Maputo. The main botanical distribution of *W. salutaris* in Mozambique is at the western borders towards Swaziland and South Africa near the Kruger National Park (Jansen & Mendes, 1990). This may indicate that trade goes straight from the collection areas near the border and directly to the markets in South Africa. There is, however, no sources documenting this hypothesis and further research is

needed. Another reason for the high price and few traders mentioning the species may simply be low supply – in Zimbabwe and South Africa, *W. salutaris* is almost extinct (Cunningham, 1993).

Written records of traded amounts are not kept; one reason being that no taxes are paid. Quantitative research is needed in order to get an accurate idea of the traded volumes. The large variety of products sold, on average 27 ± 12 per trader, and problems of species identification makes such investigations challenging. In addition, it is likely there are seasonal variations in supply and demand making it necessary to conduct monthly repeat surveys throughout a year. However, trade studies elsewhere indicate that most of the trade value and volume can be captured by focusing on a very limited sub-set of the traded species (Olsen, 2005).

4.2 Species identification

Traders in this survey mentioned 99 species of which half were identified from their vernacular names. This is an inaccurate approach and it would be better to collect voucher specimens; this was unfortunately not possible and identification should be treated with care. At present, botanical keys do not allow species identification based on market products such as roots or barks (see also Cunningham (2001a) and Grace *et al.* (2002)). Certainty in species identification is a precondition for access to published species information related to, e.g., botany, ethnopharmacology, conservation and propagation. Proper species identification is also important in relation to consumer safety. Especially with increasing commercialisation which tends to attract unskilled actors interested in financial gain and less capable of (or interested in) giving reliable advice (Grace *et al.*, 2002). This is also an issue of concern in the government's policy on traditional medicine (Ministério da Saúde, 2004). However, the majority of traders interviewed at the markets in Maputo have more than ten years of experience which indicate that this is not yet a trader related problem. It seems likely, however, that the growing trade attracts new and inexperienced collectors.

4.3 Socio-economics aspects of medicinal plant trade

There is no quantitative information on the importance of medicinal plants to rural and urban livelihoods in Mozambique. We do not know who the medicinal plant collectors are, where exactly they collect, what collection strategies they employ, what their absolute and relative income from medicinal plant harvest is, etc. The same is true for medicinal plant consumers. We do not know, for both urban and rural consumers, what species they use, how often or to what effect; their medicinal plant expenditure; etc. Even basic qualitative research, such as mapping marketing chains and tracing products from markets to rural areas of origin, has not been done in Mozambique. Also with regard to middlemen, such as the traders in this study, there is almost no information. The structure, conduct and performance of medicinal plant markets in Mozambique remain largely unknown.

4.4 Conservation, domestication and management

Of the traded plant products, 24% are leaves, fruits or branches whereas 76% are roots, bulbs, whole plants or bark. Harvest of the latter group is likely to be destructive as they are uprooted or ring barked. In addition, half of the species identified are trees: many of the indigenous tree species used for medicines are slow growing which makes domestication and cultivation efforts complicated due to an often long time horizon from planting to harvest. This also makes the species more vulnerable to over-

exploitation. Therefore, conservation or management of existing indigenous tree populations seems important. Previous research on domestication and cultivation of medicinal plants in South Africa has focused on herbs and geophytes (Grace *et al.*, 2002; Jäger & Staden, 2000; McAlister & Staden, 1995), which is not surprising due to short rotations and the obvious commercial advantage compared to growing trees.

At the markets, all traded plant products originated from wild plant populations. There is no knowledge of the state of wild medicinal plant populations in Mozambique. In the north eastern part of South Africa, the impact of commercial harvest on *Warburgia salutaris* has been investigated (Botha *et al.*, 2004b): heavy utilisation of bark coupled with fire has made trees prone to fungal disease resulting in high mortality. In addition, an uneven age distribution and lack of regeneration was found. Another study, again from north eastern South Africa, investigated the density of medicinal grassland plants and found, among others, *Hypoxis hemerocallidea* to be sensitive to harvesting and it was recommended not to harvest the species in the investigated locality (Dzerefos & Witkowski, 2001). One way to promote in situ conservation of medicinal plants is through community based forest and natural resources management. However, as discussed by Nielsen et al. (2006), there are many challenges in implementing community management of forest and natural resources in Mozambique.

In the past, traditional healers often collected medicinal plants where rituals were part of the process of harvesting. When traditional healers collect medicinal plants overexploitation may not be a problem as the healer is likely to keep his knowledge of the species to himself. Furthermore, he will tend to collect the material in a non-destructive manner in order to be able to return for more plant material (pers.com. N. Mauman). Sacred forests may play an important role in such traditional conservation of medicinal plants (Chamba & Mangue, 2001; Cunningham, 1991; Virtanen, 2002). Traditional healers are also known to keep home gardens with up to 100 different medicinal species (pers.com. N. Mauman). Both management systems may be seen as initial steps towards domestication of medicinal plants (Wiersum, 1997). Experiences from South Africa indicate that increasing commercialisation attracts people with limited knowledge of traditional management systems and harvesting techniques which may have severe consequences for wild plant population (Cunningham, 1991; Williams *et al.*, 2000). More research on traditional management systems would shed light on methods concerning harvesting, propagation and cultivation of specific medicinal plant species, methods and knowledge that is necessary if species in high demand with natural populations under heavy pressure are to survive. Besides the conservation objective, domestication of species in high demand is likely to create new income opportunities for farmers interested in cultivation for a growing market. For example, some southern African species where the bulb is used for medicine also grow flowers in high demand in international horticultural markets (Jäger and Staden, 2000). Cultivation for different markets would increase income opportunities and diversify risk for the rural farmer. However, as discussed in detail by Schippmann *et al*. (2002), there are also many reasons for farmers not to undertake domestication and cultivation, e.g. as returns from harvesting wild populations remain higher. It is not presently possible to point directly to medicinal plant species in Mozambique that are good candidates for developing publicly supported cultivation programmes. This would require identification of species where (i) it is likely that wild populations are endangered, (ii) cultivated material will meet buyer requirements, and (iii) cultivation is financially viable and competitive.

4.5 Recommendations for future research

Knowledge of the importance of medicinal plants to rural and urban livelihoods and the structure, conduct and performance of medicinal plant markets in Mozambique remain scant. Furthermore, the subject is complex and future research would benefit from applying an interdisciplinary point of departure. The following questions and items seem particularly interesting:

- The role of medicinal plants in rural and urban livelihoods – what would happen if consumers did not have access to traditional medicine?
- The structure, conduct and performance of medicinal plant markets in the country and the region – who are the market actors and are markets competitive?
- Valuation of medicinal plants at the household and national levels
- Improved tools for species identification of products on sale
- Investigation of the conservation status of nationally and locally (around Maputo) vulnerable species
- Understanding wild plant population dynamics for medicinal plant species in high demand
- Understanding and promoting domestication and cultivation of medicinal plant species in high demand
- Understanding the potential of community based forest and natural resource management for the conservation and sustainable utilisation of key medicinal plants

5. Conclusion

Urban and rural populations in Mozambique are highly dependent on medicinal plants for their primary health care. This situation is unlikely to change in the near future, e.g. due to lack of medical doctors and high population growth. Recently, the government has drawn up a national policy for support to the use of traditional medicine. And it seems clear that domestic and international demand for Mozambiquean medicinal plants is increasing, e.g. as evidenced by the increasing number of medicinal plant traders in Maputo from the 1980s till today. It can be speculated that the country's combination of low population density and large forest resources is likely to mean that supplies of most medicinal plant species is not problematic and that households, both urban and rural, can continue to benefit from traditional medicine in the near future. There are, however, two issues that require attention. First, from a conservation point of view, there may be local plant populations that are over-exploited in the provinces close to Maputo. There may also be slow growing species with limited distribution and high demand, such as *Warburgia salutaris*, that are nationally endangered. Second, from a livelihood perspective, an understanding of the economic and health importance of traditional medicine at household and individual levels is required in order to design appropriate health and medicinal plant resource management policies.

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Appendix A - Questionnaire: Traders

Investigation of the market for medicinal plants in Maputo

Market: **Interview no.** **Date:**

1.0 General information

1.1 Name of trader:

1.2 Trader type:

1.3 Name of company:

1.4 Address/phone/email:

1.5 Age:

1.6 Sex:

1.7 Ethnic group:

1.8 Write/read:

2.0 Trade patterns

2.1 Experiences with medicinal plant trade:

2.2 Do you trade all year round?

2.3 Do you always trade at this market?

2.4 Do you have any one working for you? In the market or as collectors?

2.5 How many species/products do you sell?

2.6 Which species are the 10 most important you trade? → Sheet 1

Sheet 1 – Species amounts and values

Species	Product[1]	Trade unit[2]	Amount traded		Price Mtc./unit	Price changes[3]	Storage time
			Low estimate	High estimate			

[1] Bark, rhizomes, roots, bulbs, leaves, fruits, seeds, flowers, gums, whole plant, powder, liquid …
[2] Per kilo, by the number, per pile, per glass, in bundles…
[3] Seasonal variation, increased the past 5 years compared to other products, small variations, no variation

3.0 Supply

3.1 Who do you by the products from? 3.2 Where do you buy them? 3.3 Have the products been processed?
3.4 From where do they originate? 3.5 Distance to market in Maputo? 3.6 Domesticated or wild plants?

Species	**From whom do you buy?[1]**	**Where do you buy?**	**If processed, where?[2]**	**Origin of plant**	**Distance to market**	**Domesticated or wild plants**

[1] Collector, processor, wholesaler, middleman …
[2] Rural households, urban household, family scale enterprise, large scale enterprise

4.0 Demand

4.1 Who are your customers? (percentage)

Patients Street sellers Traditional healers Others

4.2 Where do they come from?

4.3 Do your customers ask for the medicinal plant by species name? (yes/no)

or

4.4 Do your customers ask you to prescribe the appropriate medicine? (yes/no)

4.5 Why do customers come to your shop?

Customers want traditional medicine

Could not be cured at a clinic

Other medicine is too expensive

Other reason, please specify

Appendix B - Questionario: Vendedores

Análise de Mercado de plantas medicinais em Maputo

Mercado: **Entrevista n^{o}.** **Date:**

1.0 Informação geral

1.1 Nome do vendedor (opcional):

1.2 Tipo de vendedor (permanente, intermediário, etc):

1.3 Empresa:

1.4 Endereço de contacto:

1.5 Idade:

1.6 Sexo:

1.7 Grupo ethnico:

1.8 Anos de escolarização:

2.0 Comecio

2.1 A quantos anos trabalho na comercializiação de plantas medicinais:

2.2 Vende durante todo a nao?

2.3 Sempre vende neste mercado?

2.4 Trabalha com mais alguem? No Mercado ou com produtores?

2.5 Quantas especies/produtos vegetais vende?

2.6 Quantas especies/produtos animais vende?

2.7 Quais sao os 10 mais importantes productos de origem vegetal que veende?

Especies, quantidades e valores

Especies	Produto[1]	Unidades de venda[2]	Quantidade de venda		Preso Mt./unidade	Preso Mudanças[3]	Tempo de armazenamnet
			Qtde inferior	Qte superior			

[1] Casca, rizoma, raizes, bolbo, folhas, frutos, sementes, flores, planta completa, pó, liquidos...
[2] Por kilo, por numero, por pilha, por copc...
[3] Variação sazonal, aumentou nos ultimos 5 anos comparando com com outros productos, pequenas variações, não há variações .

3.0 Abastecimento

3.1 A quem é que compra os produtos? 3.2 Aonde é que compra? 3.3 os produtos são processados? Se sim onde?
3.4 De onde provem as plantas? 3.5 Distancia para Maputo? 3.6 Sao plantas cultivadas ou silvestres?

Epecies	**3.1**[1]	**3.2**	**3.3**[2]	**3.4**	**3.5**	**3.6**

[1] Collector, processador, vendedor, intermediário…
[2] Familia rural, familia urbana, empresa familiar, empresa de grande escala

4.0 Procura

4.1 Quem são os clientes? (percentagem)

Pacientes Vendedores intermediários Curandeiros

Outros (comerciante, tourists etc.)

4.2 De onde são os clientes (distancia media)?

4.3 Os clients procuram as plantas medicianais pelos nomes? (sim/não)

ou

4.4 Voce faz prescrição de medicamentos? (sim/não)

4.5 Porque é os clients vêm para sua banca?

Clientes procuram medicamentos tradicionais ( )

Não encontraram cura nas clinicas e hospitais ( )

Medicamento do hospital são caros ( )

Outros ( )

Appendix C - Ranked overview of all species recorded (ranked according to no. of traders trading the product, n=28)

Rank	Species		Informants		Product	Life forms	Family
	Vernacular name	Scientific name	N	%			
1	xirangabwana	*Hypoxis hemerocallidea* Fisch. & C.A. Mey.	20	71	root	geophyte	Hypoxidaceae
2	pumbulu	*Cardiogyne africana* Bureau	17	61	root	tree	Moraceae
3	managane	*Aloe* sp.	16	57	leaves	aloe	Asphodelaceae
4	tita	*Artabotrys brachypetalus* Benth.	16	57	root	tree	Annonaceae
5	nemberembe	*Senna petersiana* (Bolle) Lock	15	54	root	tree	Fab/Caesalpinioideae
6	vela washeca	*Celosia* sp.	10	36	root	herb	Amaranthaceae
7	chinezila	*Tiliacora funifera* (Miers) Oliv.	9	32	root	woody climber	Menispermaceae
8	tuvane	*Ficus platyphylla* Delile	8	29	root	tree	Moraceae
9	dema	no identification	8	29	root		
10	chiurai	*Cissus rotundifolia* (Forssk.) Vahl	7	25	root	shrub	Vitaceae
11	cachuana	*Tabernaemontana elegans* Stapf	6	21	root	tree	Thymelaeaceae
12	xibaha	*Warburgia salutaris* (Bertol.) Chiov.	6	21	bark	tree	Canellaceae
13	bindamuchai	*Adenia gummifera* (Harv.) Harms	4	14	root	climber	Passifloraceae
14	mahokwe	*Cussonia arenicola* Strey	4	14	root	tree	Araliaceae
15	conana	no identification	4	14	root		
16	nhautsacana	no identification	4	14	root		
17	mabope	*Acridocarpus natalitius* A. Juss.	3	11	root	shrub	Malpighiaceae
18	imbondiro/ximuvo/malambacubico	*Adansonia digitata* L.	3	11	fruit	big tree	Bombacaceae
19	chicundza	*Boscia mossambicensis* Klotzsch	3	11	fruit, bulb	tree	Capparidaceae
20	nhocana	*Cissampelos mucronata* A. Rich.	3	11	root	herb twiner	Menispermaceae
21	baramachumana	*Dietes iridioides* (L.) Sweet ex Klatt	3	11	bulb	geophyte	Iridaceae
22	kindzo	*Hyphaene* sp.	3	11	bark	palm	Arecaceae
23	ximafana	*Secamone punctulata* Decne.	3	11	root	herb twiner	Asclepiadoideae
24	mavumbule	no identification	3	11	root		
25	petso	no identification	3	11	root		
26	pacama	no identification	3	11	leaves/branches	parasite	
27	sissame	*Abrus precatorius* L.	2	7	leaves	vine	Fab/Papilionoideae
28	nala	*Albizia* sp.	2	7	root	tree	Fab/Mimosoideae
29	muposa	*Annona senegalensis* Pers.	2	7	root	tree	Annonaceae
30	wangulatilo	*Asparagus* sp.	2	7	whole plant	geophyte	Liliaceae
31	comhwa	*Crinum* sp.	2	7	bulb	geophyte	Amaryllidaceae
32	longolongo	*Diospyros* sp.	2	7	root	tree	Ebenaceae
33	vucavafile	*Myrothamnus flabellifolius* Welw.	2	7	root	shrub	Myrothamnaceae
34	mudlha-lhovu	*Securidaca longipedunculata* Fresen.	2	7	root	tree	Polygalaceae
35	tomana	*Solanum incanum* L.	2	7	fruit	shrub	Solanaceae
36	massala	*Strychnos spinosa* Lam.	2	7	fruit	tree	Loganiaceae
37	munade	*Xeroderris stuhlmannii* (Taub.) Mendonça & E.C. Sousa	2	7	root	tree	Fabaceae

Ranked species list (cont.)

Rank	Species		Informants		Product	Life forms	Family
	Vernacular name	Scientific name	N	%			
38	maulumeto	no identification	2	7	root		
39	muvava	no identification	2	7	root		
40	penhuca	no identification	2	7	root/bulb		
41	xiracarane	no identification	2	7	root		
42	hula	no identification	1	4	whole plant	herb	
43	chucutza	*Boscia foetida* Schinz	1	4	root	tree	Capparaceae
44	memesa	*Cassipourea* sp.	1	4	bark	tree	Rhizophoraceae
45	chioane	*Catunaregam spinosa* (Thunb.) Tirveng.	1	4	bulb	shrub	Rubiaceae
46	mucucue	*Cucumis hirsutus* Sond.	1	4	root	herb	Cucubitaceae
47	bswanbswnyambinda	*Cussonia arborea* Hochst. ex A. Rich.	1	4	branches	tree	Araliaceae
48	unama grande	*Cyathula natalensis* Sond.	1	4	fruit	perennial herb	Amaranthaceae
49	lishieshee	*Dicerocaryum senecioides*	1	4	whole plant	herb	Pedaliaceae
50	tzengue	*Eleusine indica* (L.) Gaertn.	1	4	root	grass	Poaceae
51	mucallelo	*Erythrophleum africanum* (Welw. ex Benth.) Harms	1	4	root	tree	Fab/Caesalpinioideae
52	tuaza	*Euphorbia* sp.	1	4	root		Euphorbiaceae
53	bimbe/pimbe	*Garcinia livingstonei* T. Anderson	1	4	bark	tree	Clusiaceae
54	chiroana	*Grewia sulcata* Mast.	1	4	root	shrub	Tiliaceae
55	pfhungula	*Kigelia africana* (Lam.) Benth.	1	4	fruit	big tree	Bignoniaceae
56	chipinga	*Maerua juncea* Pax	1	4	root	shrub	Capparaceae
57	machanganisso	*Ochna natalitia* (Meisn.) Walp.	1	4	root	tree	Ochnaceae
58	xihaha	*Opuntia* sp.	1	4	leaves	cactus	Cactaceae
59	tchanfura	*Ricinus communis* L.	1	4	fruit	shrub	Euphorbiaceae
60	ndzau yavetsa	*Siphonochilus aethiopicus* (Schweinf.) B.L. Burtt	1	4	bulp	geophyte	Zingiberaceae
61	manono	*Strychnos* sp.	1	4	root	tree	Loganiaceae
62	manunguere	*Zanthoxylum humile* (E. A. Bruce) Waterm.	1	4	root	tree	Rutaceae
63	bamuntane	no identification	1	4	root		
64	pacama de chao	no identification	1	4	whole plant		
65	bandua	no identification	1	4	bark		
66	bswanbswa (herb)	no identification	1	4	branches		
67	chiracarana	no identification	1	4	root		
68	chitzalala	no identification	1	4	fruit		
69	chivacolana	no identification	1	4	root		
70	couquelos	no identification	1	4	leaves		
71	fembo	no identification	1	4	leaves		
72	fenbo layegor	no identification	1	4	branches		
73	fulawanbe	no identification	1	4	stem		
74	hambulga watele	no identification	1	4	root		
75	hendze-hendze	no identification	1	4	whole plant		

Ranked species list (cont.)

Rank	Species		Informants		Product	Life forms	Family
	Vernacular name	Scientific name	N	%			
76	mabumento	no identification	1	4	bark		
77	machalavemide	no identification	1	4	root		
78	madjudjane	no identification	1	4	root		
79	malambacu pico	no identification	1	4	root		
80	mandzamabe	no identification	1	4	root		
81	marfebeze	no identification	1	4	leaves		
82	mubamutana	no identification	1	4	root		
83	mufumbulo	no identification	1	4	root		
84	nhadzacala	no identification	1	4	root		
85	nhanihbisare	no identification	1	4	small branch		
86	pacana is sala	no identification	1	4	whole plant	parasite	
87	pacana la wapa	no identification	1	4	whole plant	parasite	
88	pacana ya hulo	no identification	1	4	whole plant	parasite	
89	pacana ya imbe	no identification	1	4	whole plant	parasite	
90	pacona mafurar	no identification	1	4	branches		
91	pecana larndo	no identification	1	4	whole plant	parasite	
92	pucama ha xitza	no identification	1	4	root		
93	tsantsa-grante	no identification	1	4	leaves		
94	xinderana	no identification	1	4	root		
95	xirarazana	no identification	1	4	root		
96	xitsalala	no identification	1	4	branches		
97	xiumph-umpsi	no identification	1	4	root		
98	xizalazalana	no identification	1	4	leaves		
99	xiboa	no identification	1	4	whole plant		

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