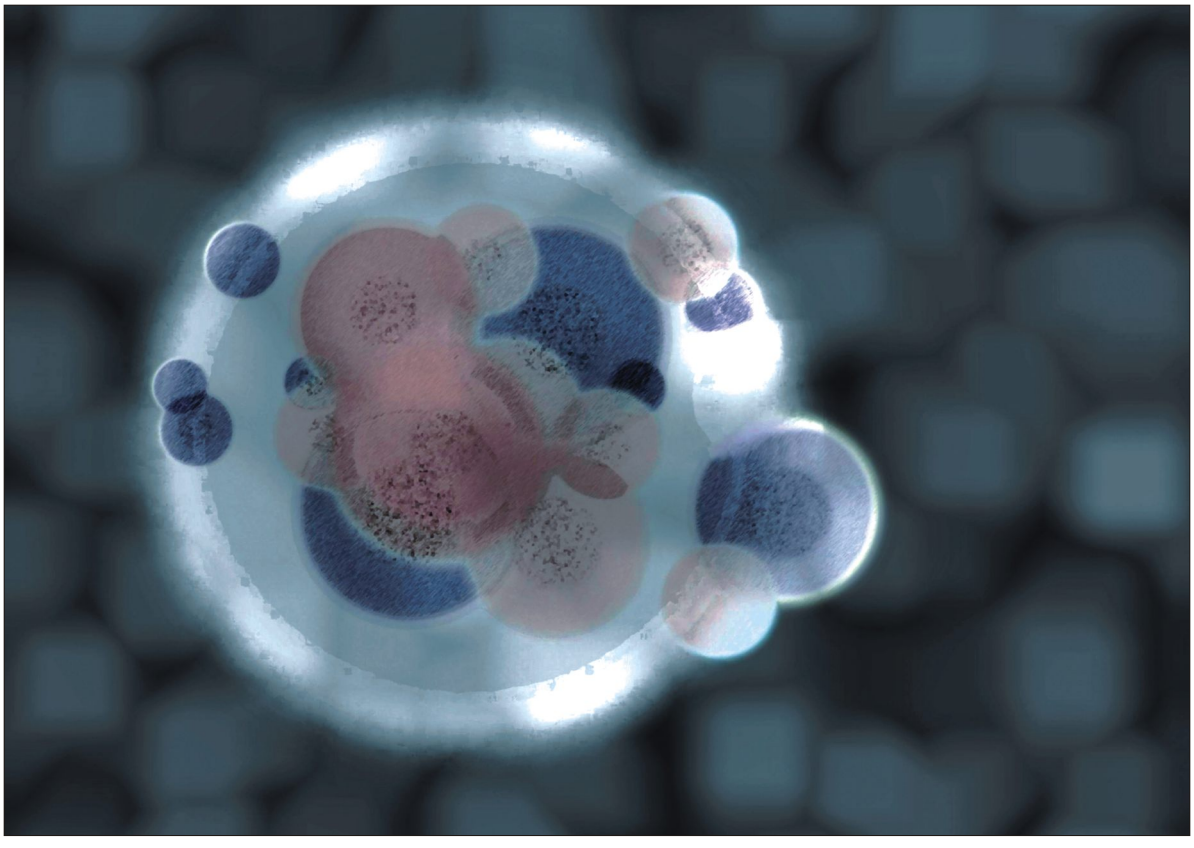

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Research Article
Source of Plants Used by Traditional Healers for Respiratory Infections and Related Symptoms in the Limpopo Province

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Abstract

Background and Objective: Establishment of therapeutic plant specimen supplies used in the traditional healing sector is a crucial step towards conservation of medicinal plants and associated indigenous knowledge. The aim of the study was to evaluate sources of plants used by Bapedi traditional healers (THs) as remedies for respiratory infections (RIs) and related symptoms (RLs) in the Limpopo province of South Africa. **Materials and Methods:** For data collection, it employed a semi-structured questionnaire, supplemented by field observations with 240 Bapedi THs practicing in the Capricorn, Sekhukhune and Waterberg districts of the Limpopo province, South Africa. **Results:** A total of 224 species (83%, n = 186 indigenous and 16.9%, n = 38 exotics) belonging to 177 genera and 85 botanical families were documented. This species was obtained by THs from free access communal lands, home gardens and informal herbal medicine shops (*muthi* shops), for use against RIs and RSs. Amongst these sources, communal lands (68.3%, n=153), particularly bushvelds and grasslands were the major supplies of native plant species (98.6%, n=151). **Conclusion:** Conservation strategies of the recorded medicinal plants distributed in the communal lands are required.

Key words: Communal lands, home gardens, traditional healers, Limpopo province, *Muthi* shop

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Plants species used in traditional medicines are in general obtained by harvesters or users from a variety of sources including free access wilderness located in communal lands[1], local commercial markets[2], cultivated areas[3] and probably from all of these supplies. Indeed, a substantial body of ethnobotanical surveys conducted both in developed[4,5] and developing[6-8] countries of the world have shown that harvesters obtain medicinal plants from these sources, but with the distinct preferences of a free access wilderness. In most African countries as it is also the status quo in other developing countries, partialities of wilderness for medicinal plant materials collections by users or harvesters, specifically traditional healers (THs) is based on the cultural beliefs that materials obtained from other sources are less effective[9]. However, factors such as species abundance, accessibility due better roads and transport[10] as well as poverty[11] are repeatedly reported by other researchers as fuelling the collection of plants from the wildernesses. Apart from all these factors, prevalence of diseases, particularly respiratory infections, might encourage the collection of medicinal plants from these sources, with the aim of ensuring continual availability of these healing plant materials.

Jangu[12] and Semenya and Potgieter[13] also exists highlighting that African THs cultivate medicinal plants in their home gardens. According to these authors, propagated species provide multiple benefits apart from medicines. However, THs who do not have access to both wild and cultivated species have the option of purchasing medicinal plants from a variety of sources including local markets, herb gatherers and small-scale farmers[14]. Traditional healers who rely on these sources believe that market sells materials that are fresh and highly effective[15], other THs rely on such sources because the collection sites are far and inaccessible[16].

There are limited studies focusing on the supplies of medicinal plant materials used by THs or lay people in Africa as herbal medicines, especially in South Africa where there are over 200,000 indigenous THs[17]. Existing literature on sources of herbal medicines in Africa alluded to earlier are general and lack detailed information on sources and specific plant species collected. According to Nahashon[18], a full inventory of ethnobotanical study aimed at identifying the supplies of each medicinal plant species used by THs and other harvesters is crucial step from a conservation point of view as it offers a multi-disciplinary approach of plants resource management which will in turn assist in the identification, distribution and conservation assessment of implicated taxa at collection sites. In addition to this, all these data are critical for planning sustainable management of medicinal plants in a particular area. Therefore, the aim of present study was to evaluate sources of the plants used by Bapedi THs as remedies for respiratory infections (RIs) and related symptoms (RLs) in the Limpopo province of South Africa.

MATERIALS AND METHODS

Study area and population: This survey was carried out in the Capricorn, Sekhukhune and Waterberg districts of the Limpopo Province, South Africa (Fig. 1). Five villages within each municipality were selected as study sites. The vast majority of the residents in the studied areas belong to the Bapedi ethnic group, who constitute over 50% of population inhabiting the Limpopo province[19]. Traditional healers of this culture have a long history of utilizing medicinal plants to cure miscellaneous human ailments[20].

Capricorn has a subtropical climate[21], with most precipitation falling between October and March. Winter temperatures in this district rarely fall below 0°C and summer maximum temperature often exceed[22] 35°C. According to Victor *et al.*[23] the climate of Sekhukhune is moderate, characterized by warm moist summers and cool dry winters. However, the Waterberg has various climatic conditions, the northern and western regions of the district have a relatively hot and semi-arid climate, while the southern and eastern regions are more humid and slightly cooler[24]. The district receives high rainfall lasting from November to March, with intensity ranging from 600-650 mm annually.

Vegetation units of the studied districts appear to be homogenous, thus are mainly characterised by similar taxa comprising of a mixture of herbs, shrubs and trees[25]. The dominant trees species includes *Acacia erubescens* Welw. ex Oliv., *Combretum apiculatum* (Sond.) subsp. *apiculatum* and *Terminalia sericea* Burch. ex DC. Common shrubby taxa interspersed throughout the sampled districts encompases *Barleria lancifolia*, *T. Anderson*, *Hirpicium bechuanense* (S. Moore) Roessler. and *Melhania rehmannii* Szyszyl., with Geigeria acaulis (Sch. Bip.) Benth. and Hook. ex Oliv. and Hiern and *Osteospermum muricatum* E. Mey. Ex. DC. being amongst the most abundant herbaceous species.

Ethnobotanical survey and data collection: Prior data collection, a multipurpose pilot study was carried out in each village to, (i) Obtain a permission from local traditional leaders to conduct this study within the area of their jurisdictions and (ii) To request THs to take part in the survey. The objective of the study was elucidated to both these personnel's, using their

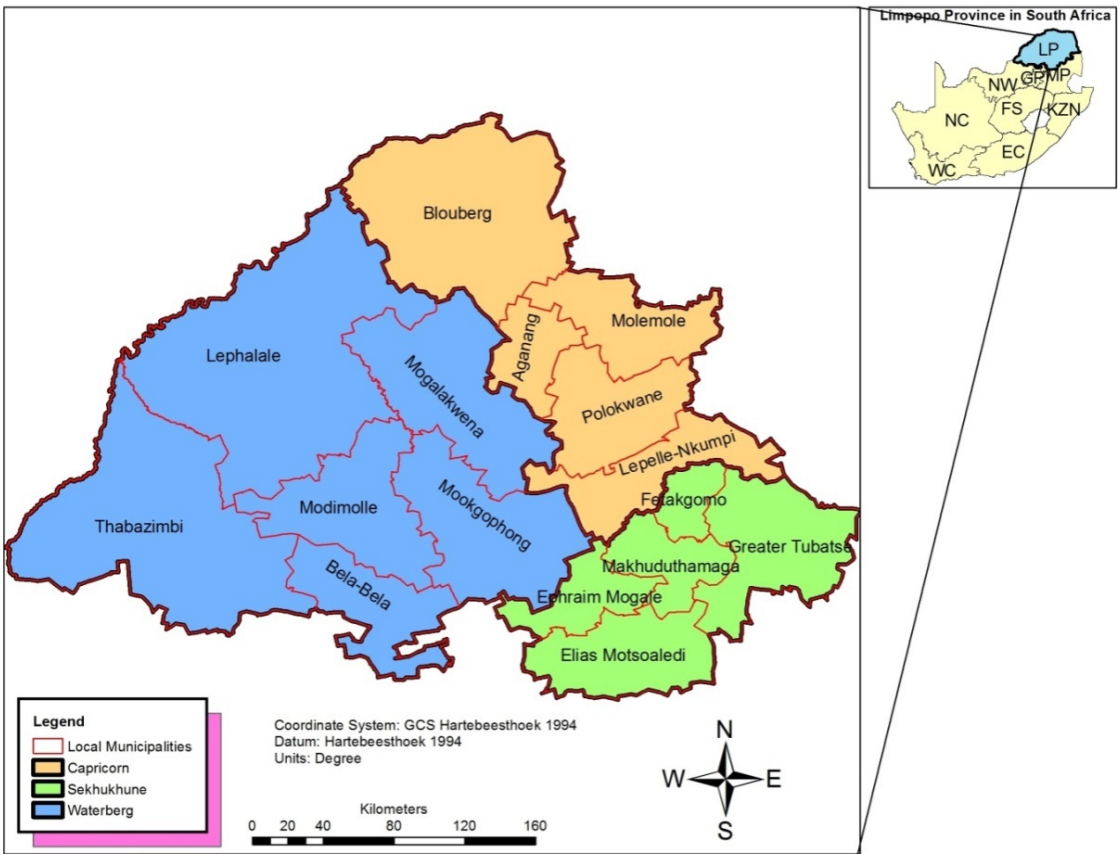

Fig. 1: Map of Limpopo province indicating the studied areas (districts and municipalities)

mother tongue of Sepedi. In addition, THs were also informed and assured that outcomes of this study will be used wholly for academic purposes and not for commercial purposes. Consequently, THs who agreed to share their knowledge were requested to sign a consent form.

Data was collected from (May, 2017 to October, 2017) using semi-structured interviews with 240 conveniently selected THs (i.e., with an assistance of local traditional leaders and THs) who signed a consent form. Questionnaire was primarily design to capture information on the species name used by THs to treat RIs and RSs, place/s where the plant species are collected and THs' preferred source for obtaining these species. Traditional healers were questioned independently in their consultation rooms, using Sepedi as a medium of communication. The interview session was followed by field observation to each supply or source of medicinal plant materials, in order to determine the habitat type were these materials are harvested and to collect their voucher specimens. During field excursions species were initially identified by THs via their vernacular name/s and subsequently, researcher collected specimens and prepared them for botanical identification at the Larry Leach Herbarium (University of Limpopo). All plant species were taxonomically identified by an expert.

Data analysis: Data gathered in the present study were collated and analyzed using Statistical Package for the Social Science (SPSS) version 14.0 and in some cases Microsoft Excel 2000. Descriptive statistics such as percentages and frequencies were used. Habitat types of each species were confirmed using published monographs including Germishuizen and Meyer[26], amongst the others.

RESULTS AND DISCUSSION

Diversity of harvested medicinal plant species: A total of 224 species (83%, n = 186 indigenous and 16.9%, n = 38 exotics) belonging to 177 genera and 85 botanical families, mostly the Fabaceae (25 spp.), Asteraceae (16 spp.) and Malvaceae (13 spp.) were obtained by Bapedi THs across the various sources located in the Limpopo province, for use as medicine to heal and manage RIs and RSs (Table 1). This finding indicate that Bapedi THs rely relatively on a

Table 1: Sources of plants used by Bapedi traditional healers to treat respiratory infections and related symptoms in the districts and municipality

		Capricorn												Sekhukhune							Waterberg							
Species name and botanical family	Habit	Source of plants	Grassland	Bushveld	Mountain	Wetland	Aganang	Blouberg	Lepelle-Nkumpi	Molemole	Polokwane	Sum of healers who use species per district	Elias motsoaledi	Ephraim mogale	Fetakgomo	Makhudumathamaga	Tubatse	Sum of healers who use species per district	Bela-Bela	Lephalale	Modimolle	Mogalakwena	Mookgophong	Thabazimbi	Sum of healers who use species per district	Sum of overall source/s treated per species
							Number of traditional healers who use the species																			
Abutilon galpinii (Malvaceae)	SH	C	G*	B	M	-	-	-	-	-	-	0	-	-	-	5	4	9	-	-	-	-	-	-	0	9
Acacia erioloba (Fabaceae)	TR	C	-	B*	M	-	13	15	12	12	15	67	13	7	13	11	6	50	4	1	2	4	4	4	19	136
Acacia senegal (Fabaceae)	TR	C	-	B*	M	-	15	15	14	13	15	72	15	10	11	13	15	64	9	9	11	13	12	12	66	202
Acacia sieberiana (Fabaceae)	TR	C	-	B*	M	-	1	1	-	-	-	2	-	-	-	-	-	0	-	-	-	-	-	-	0	2
Acacia tortilis (Fabaceae)	TR	C	-	B*	M	-	1	-	-	10	-	11	-	-	-	-	-	0	-	-	-	-	-	-	0	11
**Allium cepa* (Amaryllidaceae)	HE	H					2	-	-	-	-	2	-	-	-	-	-	0	-	-	-	-	-	-	0	2
**Allium sativum* (Amaryllidaceae)	HE	H					7	2	-	-	-	9	-	-	-	-	-	0	-	-	-	-	-	-	0	9
Acokanthera rotundata (Apocynaceae)	SH	C	G*	B	-	-	-	-	-	-	15	15	-	-	-	4	-	4	-	-	-	-	-	-	0	19
Adansonia digitata (Malvaceae)	TR	C	-	B*	M*	-	4	14	11	15	8	52	10	8	13	9	8	48	15	15	15	15	15	12	87	187
		H					11	1	4	-	7	23	5	7	2	6	7	27	-	-	-	-	-	3	3	53
Adenia fruticosa (Passifloraceae)	SH	C	-	B*	M*	-	-	2	10	-	1	13	-	-	-	8	-	8	-	-	-	-	-	-	o	21
Adenia spinosa (Passifloraceae)	SH	C	G*	B*	M	-	15	15	15	15	15	75	15	15	15	15	15	75	1	1	13	15	-	10	40	190
Adiantum capillus-veneris (Pteridaceae)	HE	C	G*	B	M	W*	-	-	-	-	-	0	-	-	-	-	-	0	6	-	1	1	2	4	11	11
Agapanthus inapertus (Agapanthaceae)	SH	C	G*	B	M	-	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	2	2	2
Albizia adianthifolia (Fabaceae)	TR	C	-	B*	M	-	3	12	-	-	-	15	-	-	-	-	-	0	-	-	-	-	-	-	0	15
Albizia anthelmintica (Fabaceae)	TR	C	-	B*	M	-	-	-	-	13	-	13	-	-	-	-	-	0	-	-	-	-	-	-	0	13
Alepidea amatymbica (Apiaceae)		C	G*	B	M	-	15	7	14	13	15	64	15	10	11	13	15	64	6	9	11	13	10	7	56	202
		MT					-	8	-	-	-	8	-	-	-	-	-	0	3	-	-	-	2	5	10	18
Aloe spp. (Asphodelaceae)	SH	H					15	15	15	15	15	75	15	10	15	13	15	68	9	9	11	13	15	12	69	212
Aloe falcata (Asphodelaceae)	SH	C	G*	B*	-	-	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	3	3	3
		H					-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	3	3	3
Aloe marlothii (Asphodelaceae)	SH	C	G*	B	M	-	2	-	2	-	-	4	-	-	-	-	-	0	-	-	-	-	-	-	0	4
Aptosimum lugardiae (Scrophulariaceae)	HE	C	G*	B	M	-	-	-	1	1	1	3	-	-	-	-	-	0	-	-	-	-	-	-	0	3
**Argemone ochroleuca* (Papaveraceae)	HE	H					-	-	4	-	-	4	-	-	-	-	-	0	-	-	-	-	-	-	0	4
Artemisia afra (Asteraceae)	HE	C	G*	-	M	-	-	5	-	-	-	5	14	15	14	14	15	72	-	-	3	1	-	-	4	81
		H					15	4	15	15	15	64	1	-	1	1	-	3	-	-	-	-	-	-	0	67
		MT					-	6	-	-	-	6	-	-	-	-	-	0	15	15	12	14	15	15	86	92
Asparagus angusticladus (Asparagaceae)	HE	C	G*	B	M	-	-	-	1	-	1	2	-	-	-	-	-	0	-	-	-	-	-	-	0	2
Asparagus buchananii (Asparagaceae)	HE	H					-	1	-	-	-	1	-	-	-	-	-	0	-	-	-	-	9	-	9	10
Athrixia phylicoides (Asteraceae)	SH	C	G*	B	M	-	2	1	1	-	3	7	-	-	-	-	-	0	-	-	-	-	-	-	0	7
Berchemia discolor (Rhamnaceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	-	1	6	-	6	13	-	-	-	-	-	-	0	13
Blepharis diversispina (Acanthaceae)	SH	C	G*	B	-	-	-	-	14	-	-	14	6	-	-	-	-	6	-	-	-	-	-	-	0	20
Blepharis subvolubilis (Acanthaceae)	SH	C	G*	B	-	-	-	6	-	-	1	7	-	-	-	-	-	0	-	-	-	-	-	-	0	7
Boscia albitrunca (Capparaceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	-	-	3	-	4	7	-	-	-	-	-	-	0	7
Brachylaena transvaalensis (Asteraceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	9	9	9
Brackenridgea zanguebarica (Ochnaceae)	TR	C	-	B*	M*	-	-	-	-	-	-	0	-	-	-	-	-	0	2	-	-	-	-	-	2	2
		MT					-	-	-	-	-	0	-	-	-	-	-	0	1	-	-	-	-	-	1	1
Buddleja salvifolia (Scrophulariaceae)	SH	C	G*	B	M	-	-	-	-	-	4	4	-	-	-	-	-	0	-	-	-	3	-	-	3	7
Burkea africana (Fabaceae)	TR	C	-	B*	M	-	-	1	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Callilepis laureola (Asteraceae)	HE	C	G*	B	M	-	15	15	15	15	15	75	15	15	15	15	15	75	15	7	15	15	10	5	67	217
		H					-	-	-	-	-	0	-	-	-	-	-	0	-	8	-	-	-	10	18	18

Table 1: Continue

Species name and botanical family	Habit	Source of plants	Grassland	Bushveld	Mountain	Wetland	Capricorn: Aganang	Blouberg	Lepelle-Nkumpi	Molemole	Polokwane	Sum of healers who use species per district	Sekhukhune: Elias motsoaledi	Ephraim mogale	Fetakgomo	Makhudumathamaga	Tubatse	Sum of healers who use species per district	Waterberg: Bela-Bela	Lephalale	Modimolle	Mogalakwena	Mookgophong	Thabazimbi	Sum of healers who use species per district	Sum of overall source/s treated per species
							Number of traditional healers who use the species																			
		MT					-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	5	-	5	5
* *Cannabis sativa* (Cannabaceae)	HE	H					14	6	15	3	1	39	-	2	1	4	3	10	-	9	-	2	10	3	24	73
Capparis tomentosa (Capparaceae)	TR	C	-	B*	M	-	15	15	14	13	15	72	15	10	11	13	15	64	9	9	11	13	13	12	67	203
* *Capsicum annuum* (Solanaceae)	SH	H					-	-	-	-	-	0	-	-	-	-	-	0	1	-	-	-	-	1	2	2
**Carica papaya* (Caricaceae)	TR	H					-	-	-	1	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Carissa bispinosa (Apocynaceae)	TR	C	G	B*	M	-	5	8	1	8	1	23	-	-	-	-	-	0	-	-	-	-	-	-	0	23
		H					-	1	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Carpobrotus edulis (Mesembryanthemaceae)	HE	H					15	15	15	15	15	74	15	11	9	-	1	36	8	12	5	8	9	5	47	157
Cassia abbreviata (Fabaceae)	TR	C	-	B*	M	-	15	-	1	-	2	18	-	-	-	-	-	0	-	-	-	-	-	-	0	18
		H					-	1	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Cassinopsis ilicifolia (Icacinaceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	-	12	-	-	-	12	-	-	-	-	-	-	0	12
Cassipourea garcini (Rhizophoraceae)	TR	C	-	B*	M	-	15	15	15	15	15	75	15	10	11	13	15	64	9	9	11	13	12	12	66	205
Catha edulis (Celastraceae)	TR	C	-	B	M*	-	15	15	15	15	15	75	15	15	15	15	15	75	15	15	15	15	15	15	90	240
Citrullus lanatus (Cucurbitaceae)	HE	H					15	15	14	13	15	72	15	10	11	13	15	64	9	9	11	13	12	12	66	202
**Citrus limon* (Rutaceae)	TR	H					3	6	3	3	2	17	-	-	-	1	-	1	4	2	3	5	8	8	30	48
**Citrus sinensis* (Rutaceae)	TR	H					1	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	0	2
Clematis brachiata (Ranunculaceae)	HE	C	G*	B	-	-	-	-	-	-	-	0	4	2	4	1	4	15	-	-	-	-	-	-	0	15
Cleome gynandra (Capparaceae)	HE	H					-	-	-	-	-	0	-	-	-	-	-	0	1	-	-	-	-	-	1	1
Clerodendrum glabrum (Lamiaceae)	TR	C	G*	B	-	-	1	5	-	-	15	21	-	5	-	1	-	6	-	-	-	-	-	-	0	27
Clerodendrum ternatum (Lamiaceae)	HE	C	G*	B	M	-	15	15	15	15	15	75	15	15	15	15	15	75	15	15	15	15	15	15	90	240
Clivia caulescens (Amaryllidaceae)	HE	C	G*	B	M	-	-	-	-	7	-	7	-	-	-	-	-	0	-	-	-	-	-	-	0	7
Combretum hereroense (Combretaceae)	TR	C	G*	B*	M	-	15	15	14	13	15	72	15	10	11	13	15	64	9	9	11	13	12	12	66	202
Combretum zeyheri (Combretaceae)	TR	C	G	B*	M	-	-	1	-	-	-	1	-	1	-	-	1	2	-	-	-	-	-	-	0	3
Commelina africana (Commelinaceae)	HE	C	G*	-	-	-	-	-	-	-	1	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Commelina subulata (Commelinaceae)	HE	C	G*	-	-	-	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	1	-	1	1
Commiphora marlothii (Burseraceae)	TR	H					1	1	-	-	-	2	-	-	-	-	-	0	-	-	-	-	-	-	0	2
Croton gratissimus (Euphorbiaceae)	TR	C	G	B*	M	-	15	15	5	15	15	65	15	15	15	15	15	75	15	15	15	15	15	15	90	230
		H					-	-	10	-	-	10	-	-	-	-	-	0	-	-	-	-	-	-	0	10
Croton menyharthii (Euphorbiaceae)	TR	C	-	B*	M	-	-	-	-	-	1	1	-	-	8	-	2	10	-	-	-	-	-	-	0	11
Cryptocarya transvaalensis (Lauraceae)	TR	C	-	-	M*	-	15	15	15	15	15	75	15	15	15	15	15	75	15	15	15	15	15	15	90	240
Cucumis metuliferus (Cucurbitaceae)	HE	H					-	-	-	-	-	0	3	-	9	6	1	19	-	-	-	-	-	-	0	19
Cucumis zeyheri (Cucurbitaceae)	HE	H					-	1	-	6	5	12	-	5	-	-	-	5	-	-	-	-	-	-	0	17
Cyperus sexangularis (Cyperaceae)	HE	C	G*	-	-	-	15	15	15	15	15	75	15	12	15	12	9	63	1	1	3	2	15	10	32	170
Cyphostemma humile (Vitaceae)	HE	C	G	B*	M	-	-	-	-	-	1	1	3	-	-	-	1	4	-	-	-	-	-	-	0	5
Cyphostemma woodii (Vitaceae)	HE	C	G*	B	M	-	-	-	-	-	-	0	1	-	-	-	-	1	-	-	-	-	-	-	0	1
**Datura ferox* (Solanaceae)	HE	H					-	1	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	0	2
**Datura stramonium* (Solanaceae)	HE	H					15	15	14	13	15	72	15	10	11	13	15	64	9	9	11	13	12	12	66	202
**Daucus carota* (Apiaceae)	HE	H					-	1	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Dicerocaryum senecioides (Pedaliaceae)	HE	C	G*	B	-	-	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	13	-	13	13
		H					-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	2	-	2	2
Dichrostachys cinerea (Fabaceae)	TR	C	-	B	M*	-	15	10	14	13	15	67	15	10	11	13	15	64	9	9	11	13	12	12	66	197

Table 1: Continue

Species name and botanical family	Habit	Source of plants	Grassland	Bushveld	Mountain	Wetland	Capricorn: Aganang	Blouberg	Lepelle-Nkumpi	Molemole	Polokwane	Sum of healers who use species per district	Sekhukhune: Elias motsoaledi	Ephraim mogale	Fetakgomo	Makhudumathamaga	Tubatse	Sum of healers who use species per district	Waterberg: Bela-Bela	Lephalale	Modimolle	Mogalakwena	Mookgophong	Thabazimbi	Sum of healers who use species per district	Sum of overall source/s treated per species
							Number of traditional healers who use the species																			
Dicoma anomala (Asteraceae)	HE	C	G*	-	M	-	15	15	14	14	13	71	15	10	11	13	15	64	9	12	11	13	13	12	70	205
Dioscorea dregeana (Dioscoreaceae)	HE	C	-	-	M*		1	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
		MT					1	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Dioscorea sylvatica (Dioscoreaceae)	HE	C	-	-	M*	-	1	-	2	-	-	3	15	10	11	15	15	66	-	1	-	-	-	3	4	73
Diospyros lycioides (Ebenaceae)	TR	C	-	B*	M	-	15	15	14	13	15	72	15	10	11	13	15	64	9	9	11	13	12	12	66	202
Diospyros mespiliformis (Ebenaceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	9	-	-	-	-	9	-	-	-	-	-	-	0	9
Dodonaea viscosa (Sapindaceae)	TR	H					1	-	11	-	-	12	-	-	-	-	-	0	-	-	-	-	-	-	0	12
Dombeya rotundifolia (Malvaceae)	TR	C	-	B*	M	-	1	1	1	1	5	9	3	4	1	-	1	9	-	-	-	-	-	-	0	18
Drimia elata (Hyacinthaceae)	HE	H					5	9	2	-	12	28	6	-	-	-	-	6	-	-	3	1	4	4	12	46
Drimia sanguinea (Hyacinthaceae)	HE	H					3	-	-	-	-	3	1	-	-	-	-	1	-	-	-	-	-	-	0	4
Ehretia rigida (Boraginaceae)	TR	C	-	B*	M	-	-	1	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Elaeodendron transvaalense (Celastraceae)	TR	H					-	-	2	-	-	2	-	-	-	-	-	0	-	-	-	-	-	-	0	2
Elephantorrhiza burkei (Fabaceae)	SH	C	G*	B*	M	-	-	2	-	-	1	3	-	-	-	-	-	0	4	-	1	-	-	4	5	12
Elephantorrhiza goetzei (Fabaceae)	SH	C	G*	B*	M	-	1	-	-	-	-	1	-	1	-	-	-	1	-	5	-	-	-	-	5	7
Encephalartos transvenosus (Zamiaceae)	TR	H					15	15	15	15	15	75	4	-	6	11	4	25	-	4	-	4	2	-	10	110
Englerophytum magalismontanum (Sapotaceae)	TR	C	-	-	M*	-	-	1	-	-	-	1	1	7	6	6	6	26	1	-	-	1	-	1	3	30
Enicostema axillare (Gentianaceae)	HE	C	G*	-	-	-	15	15	15	15	15	75	15	15	15	15	15	75	15	15	15	15	15	15	90	240
**Eriobotrya japonica* (Rosaceae)	TR	H					-	-	-	-	-	0	-	-	-	-	-	0	3	-	-	1	-	-	4	4
Erythrina lysistemon (Fabaceae)	TR	H					8	3	5	-	-	16	5	-	-	-	-	5	-	-	-	-	-	-	0	21
**Eucalyptus camaldulensis* (Myrtaceae)	TR	H					7	13	10	-	6	36	1	-	-	-	-	1	1	3	-	4	12	15	35	72
Euclea crispa (Ebenaceae)	TR	C	G	B*	M	-	1	-	-	-	-	1	-	-	-	-	-	0	-	2	1	3	-	3	9	10
Euclea undulata (Ebenaceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	-	-	2	-	-	2	-	-	-	-	-	-	0	2
Eucomis autumnalis (Hyacinthaceae)	HE	H					1	1	8	-	-	0	-	-	-	-	-	0	-	-	-	-	-	-	0	10
Eucomispallidiflora (Hyacinthaceae)	HE	H					15	15	15	15	15	75	15	10	11	14	15	65	12	9	14	14	13	14	76	216
Euphorbia inaequilatera (Euphorbiaceae)	HE	H					-	-	1	4	1	6	-	-	2	-	-	2	2	-	-	-	-	-	2	10
Euphorbia schinzii (Euphorbiaceae)	HE	C	G*	B	M	-	-	-	5	1	2	8	14	11	6	12	6	49	-	-	-	2	-	1	3	60
Ficus abutilifolia (Moraceae)	TR	C	G*	B*	M	W	-	-	-	-	-	0	15	10	11	13	15	64	-	-	-	-	-	-	0	64
Ficus burkei (Moraceae)	TR	H					-	2	-	-	-	2	-	-	-	-	-	0	-	-	-	-	-	-	0	2
Ficus ingens (Moraceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	1	-	13	14	14
Flueggea virosa (Phyllanthaceae)	SH	C	G*	B	M	-	-	1	-	-	-	1	-	-	-	-	5	5	-	-	-	-	-	-	0	6
Garciniagerrardii (Clusiaceae)	SH	C	G*	-	-	-	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	3	3	3
Geigeria	HE	C	G*	-	-	-	-	-	-	-	-	0	1	3	4	6	6	20	-	-	-	-	-	-	0	20
burkei (Asteraceae)		H					-	-	-	-	-	0	-	3	2	1	-	6	-	-	-	-	-	-	0	6
Gossypium herbaceum (Malvaceae)	SH	C	G*	B*	M	-	15	15	14	13	15	72	15	14	15	13	15	72	9	9	11	15	15	15	74	218
Grewia bicolor (Malvaceae)	TR	C	-	B*	-	-	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	4	4	4
Grewia flava (Malvaceae)	SH	C	G*	B*	M	-	-	-	-	-	-	0	-	-	-	-	-	0	9	9	11	13	12	12	66	66
Grewia flavescens (Malvaceae)	SH	C	G*	B*	M	-	-	-	-	-	-	0	-	-	-	1	-	1	-	-	-	-	-	-	0	1
Grewia hispida (Malvaceae)	SH	C	G*	B*	M	-	-	-	2	-	-	2	1	-	-	-	-	1	-	-	-	-	-	-	0	3
Grewia occidentalis (Malvaceae)	TR	C	G*	B*	M	-	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	6	6	6
Grewia sulcata (Malvaceae)	TR	C	G*	B	M	-	-	-	-	-	-	0	-	1	-	-	2	3	-	-	-	-	-	-	0	3
Gymnosporia maranguensis (Celastraceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	1	3	3	3	2	12	2	-	-	1	1	1	5	17

Table 1: Continue

Species name and botanical family	Habit	Source of plants	Grassland	Bushveld	Mountain	Wetland	Capricorn: Aganang	Blouberg	Lepelle-Nkumpi	Molemole	Polokwane	Sum of healers who use species per district	Sekhukhune: Elias motsoaledi	Ephraim mogale	Fetakgomo	Makhudumathamaga	Tubatse	Sum of healers who use species per district	Waterberg: Bela-Bela	Lephalale	Modimolle	Mogalakwena	Mookgophong	Thabazimbi	Sum of healers who use species per district	Sum of overall source/s treated per species
							Number of traditional healers who use the species																			
Gymnosporia pubescens (Celastraceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	4	4	4
Gymnosporia senegalensis (Celastraceae)	TR	C	-	B*	M	-	-	2	4	-	2	8	-	-	-	-	1	1	-	1	-	-	3	3	7	16
		H					-	-	4	-	-	4	-	-	-	-	-	0	-	-	-	-	-	-	0	4
Harpephyllum caffrum (Anacardiaceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	-	-	-	6	-	6	-	-	-	-	-	-	0	6
Helichrysum caespititium (Asteraceae)	HE	C	G*	-	M	-	1	-	-	-	-	1	-	1	-	-	-	1	-	-	-	-	-	-	0	2
Helichrysum gymnocomum (Asteraceae)	HE	MT					-	-	2	-	-	2	-	-	-	-	1	1	-	-	-	-	-	-	0	3
Helichrysum kraussii (Asteraceae)	SH	C	G*	B	M	-	-	-	-	-	-	0	-	1	-	-	-	1	-	-	-	-	-	-	0	1
Heteromopha arborescens (Apiaceae)	TR	C	-	B*	M	-	-	-	-	-	9	9	-	-	4	-	-	4	-	-	-	-	-	-	0	13
Hibiscus meyeri (Malvaceae)	HE	C	G*	-	-	-	-	-	-	3	-	3	-	-	-	-	6	6	-	-	-	-	-	-	0	9
Hypoxis hemerocallidea (Hypoxidaceae)	HE	H					2	-	-	1	15	18	-	2	-	2	-	4	-	-	-	-	-	-	0	22
Hypoxis obtusa (Hypoxidaceae)	HE	H					2	-	-	-	-	2	-	-	-	-	-	0	-	-	-	1	-	-	1	3
Indigofera circinnata (Fabaceae)	SH	C	G*	B	M	-	-	-	-	7	-	7	5	3	14	-	-	22	-	-	-	-	-	1	1	30
Ipomoea albivenia (Convolvulaceae)	SH	C	G*	B	-	-	-	2	-	-	-	2	-	-	-	-	4	4	-	-	-	-	-	-	0	6
**Jacaranda mimosifolia* (Bignoniaceae)	TR	H					14	15	15	15	15	74	15	10	9	-	1	35	8	12	5	8	9	5	47	156
Jatropha zeyheri (Euphorbiaceae)	HE	C	G*	-	-	-	5	2	-	-	-	7	-	-	-	-	-	0	-	-	-	-	-	-	0	7
Kalanchoe brachyloba (Crassulaceae)	SH	C	G*	-	-	-	15	15	15	15	15	75	14	15	13	15	13	70	10	2	-	9	15	10	46	191
Kirkia wilmsii (Kirkiaceae)	TR	C	-	-	M*	-	1	-	1	1	1	4	-	-	2	-	1	3	-	-	-	2	-	-	2	9
		H					-	-	1	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Kleinia longiflora (Asteraceae)	SH	H					3	-	-	-	1	4	2	7	6	6	6	26	5	1	-	4	8	5	23	53
Lannea discolor (Anacardiaceae)	TR	C	-	B*	M*	-	-	-	-	-	-	0	-	-	-	-	-	0	-	2	-	-	-	-	2	2
**Lantana camara* (Verbenaceae)	SH	H					-	-	-	-	-	0	-	-	-	1	-	1	-	-	-	-	-	-	0	1
Lantana rugosa (Verbenaceae)	SH	C	G*	B	M	-	-	-	-	-	-	0	-	-	-	-	-	0	-	1	6	4	5	9	15	25
Lasiosiphon caffer (Thymelaeacea)	SH	C	G*	B	M	-	15	15	15	15	15	75	15	15	15	15	15	75	15	15	15	15	15	15	90	240
Leonotis leonurus (Lamiaceae)	SH	H					-	-	-	-	-	0	3	2	2	11	1	19	-	-	-	-	-	-	0	19
Lippia javanica (Verbenaceae)	SH	H					15	15	15	15	15	75	15	15	15	15	15	75	15	10	11	15	15	15	81	231
Maerua juncea (Capparaceae)	SH	C	-	B*	M	-	1	2	3	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	0	6
Markhamia zanzibarica (Bignoniaceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	4	-	-	-	-	4	-	-	-	-	-	-	0	4
**Mangifera indica* (Anacardiaceae)	TR	H					-	-	-	-	-	0	-	-	-	-	-	0	-	1	-	-	-	-	1	1
**Melia azedarach* (Meliaceae)	TR	H					-	1	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	0	2
Mentha longifolia (Lamiaceae)	HE	H					-	-	-	-	-	0	-	-	-	-	-	0	-	1	-	1	4	4	10	10
Mimusops obovata (Sapotaceae)	TR	C	-	B*	M*	-	11	13	15	11	13	63	13	10	6	6	2	37	7	5	-	8	7	6	33	133
		H					4	2	-	-	2	8	2	-	-	1	2	5	1	-	-	-	1	-	2	15
Momordica balsamina (Cucurbitaceae)	HE	H					-	-	-	5	-	5	-	-	-	-	-	0	-	-	-	-	-	-	0	5
Monsonia angustifolia (Geraniaceae)	HE	C	G*	B	M	-	-	-	14	-	-	14	-	-	-	-	-	0	-	-	-	-	-	-	0	14
**Moringa oleifera* (Moringaceae)	TR	H					15	15	13	15	15	73	13	14	7	8	15	57	5	2	-	8	15	10	40	170
**Morus alba* (Moraceae)	TR	H					-	-	-	-	-	0	-	-	-	-	2	2	-	-	-	-	-	-	0	2
Mundulea sericea (Fabaceae)	TR	C	G	B	M*	-	-	-	-	-	1	1	-	-	-	3	-	3	-	-	-	-	-	-	0	4
**Musa sapientum* (Musaceae)	TR	H					-	1	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	1	1	2
Myrothamnus flabellifolius (Myrothamnaceae)	HE	C	-	-	M*	-	15	15	14	13	15	72	-	-	6	-	-	6	-	3	-	8	-	5	16	94
**Nicotiana tabacum* (Solanaceae)	SH	H					3	-	1	-	-	4	1	-	-	-	-	1	5	1	-	4	8	6	24	29
**Nymphaea mexicana* (Nymphaeaceae)	HE	C	-	-	-	W*	-	-	-	-	-	0	-	5	-	-	-	5	-	-	-	-	-	-	0	5

Table 1: Continue

Species name and botanical family	Habit	Source of plants	Grassland	Bushveld	Mountain	Wetland	Capricorn: Aganang	Blouberg	Lepelle-Nkumpi	Molemole	Polokwane	Sum of healers who use species per district	Sekhukhune: Elias motsoaledi	Ephraim mogale	Fetakgomo	Makhudumathamaga	Tubatse	Sum of healers who use species per district	Waterberg: Bela-Bela	Lephalale	Modimolle	Mogalakwena	Mookgophong	Thabazimbi	Sum of healers who use species per district	Sum of overall source/s treated per species
							Number of traditional healers who use the species																			
		H					-	-	-	-	-	0	1	2	7	6	6	22	-	-	-	-	-	-	0	22
Ochna pulchra (Ochnaceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	4	4	4
Olea europaea (Oleaceae)	TR	C	-	-	M*	-	-	-	-	-	-	0	2	3	1	-	9	15	-	-	-	-	-	-	0	15
**Opuntia ficus-indica* (Cactaceae)	TR	H					-	1	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	0	2
Osyris lanceolata (Santalaceae)	TR	C	-	B*	M*	-	1	-	4	7	1	13	-	1	-	-	4	5	-	-	-	-	-	-	0	18
Ozoroa sphaerocarpa (Anacardiaceae)	TR	C	-	B*	M*	-	-	-	-	-	-	0	5	-	-	-	-	5	-	-	-	-	-	-	0	5
**Panica granatum* (Punicaceae)	TR	H					-	-	-	-	-	0	-	-	1	-	2	3	-	-	-	-	-	-	0	3
Pappea capensis (Sapindaceae)	TR	C	-	B*	M*	-	-	-	-	-	-	0	1	-	-	-	-	1	-	-	-	-	-	-	0	1
Peltophorum africanum (Fabaceae)	TR	H					3	1	2	4	5	15	5	2	-	7	-	14	7	5	-	1	5	1	19	48
**Pennisetum glaucum* (Poaceae)	HE	C	Disturbed areas					-	-	-	-	-	0	-	2	-	-	-	0	-	-	-	-	-	-	0
	2																									
Pergularia daemia (Apocynaceae)	HE	C	G*	B	M	-	1	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Philenoptera violacea (Fabaceae)	TR	C	G*	-	-	-	4	-	-	13	-	17	-	-	-	-	-	0	-	-	-	-	-	-	0	17
Pleurostylia capensis (Celastraceae)	TR	C	-	-	M*	-	-	-	-	-	-	0	1	1	-	-	-	2	-	-	-	-	-	-	0	2
Plumbago zeylanica (Plumbaginaceae)	SH	C	G*	B	-	-	15	15	15	15	15	75	15	15	15	15	15	75	15	15	15	15	15	15	90	240
Portulacaria afra (Portulacaceae)	TR	C	-	B*	M*	-	10	-	-	-	-	10	-	-	-	-	-	0	-	-	-	-	-	-	0	10
**Portulaca oleracea* (Portulacaceae)	HE	H					-	-	-	-	1	1	-	-	-	-	1	1	-	-	-	-	-	-	0	2
Pouzolzia mixta (Urticaceae)	TR	C	-	B*	-	-	-	-	-	-	-	0	-	-	-	-	-	0	-	3	-	5	-	1	9	9
Pristimera longipetiolata (Celastraceae)	SH	C	G*	B*	-	-	-	-	-	-	-	0	2	-	1	-	-	3	-	-	-	-	-	-	0	3
Protea caffra (Proteaceae)	TR	C	-	B	M*	-	15	-	2	11	3	31	3	-	8	7	3	21	1	-	-	1	3	-	5	57
**Prunus persica* (Rosaceae)	TR	H					-	-	-	-	-	0	-	1	-	-	-	1	-	-	-	1	-	1	2	3
**Pseudognaphalium luteo-album* (Asteraceae)	HE	H					-	-	-	-	-	0	1	-	-	-	1	2	-	3	-	-	-	-	3	5
Psiadia punctulata (Asteraceae)	SH	C	G*	B*	M	-	15	15	15	13	15	73	15	10	11	13	15	64	9	10	11	14	15	15	74	211
**Psidium guajava* (Myrtaceae)	TR	H					-	-	-	-	-	0	-	-	-	-	1	1	-	-	-	-	-	-	0	1
Ptaeroxylon obliquum (Ptaeroxylaceae)	TR	C	-	B*	M*	-	15	3	15	10	15	58	1	15	6	6	6	34	5	1	-	4	12	5	27	119
Pyrenacantha grandiflora (Icacinaceae)	SH	C	G*	B*	M	-	-	-	-	-	-	0	1	-	-	-	-	1	9	-	-	-	-	-	9	10
**Ricinus communis* (Euphorbiaceae)	SH	H					-	1	-	1	1	3	-	-	-	-	1	1	-	-	-	-	-	-	0	4
Rhoicissus tomentosa (Vitaceae)	HE	C	-	-	M*	-	-	-	-	-	-	0	-	-	-	-	10	10	-	-	-	-	-	-	0	10
Rhoicissus tridentata (Vitaceae)	HE	C	-	-	M*	-	-	-	-	-	-	0	-	-	-	-	3	3	-	-	-	-	-	-	0	3
Rhynchosia hirta (Fabaceae)	HE	C	-	-	M*	-	-	-	-	-	-	0	-	4	-	2	15	21	-	-	-	-	-	-	0	21
**Saccharum officinarum* (Poaceae)	HE	H					-	-	-	-	-	0	-	-	-	2	-	2	-	-	-	-	-	-	0	2
Sansevieria hyacinthoides (Dracaenaceae)	HE	H					-	-	3	-	-	3	6	3	4	-	1	14	-	-	2	-	-	1	3	20
Salix mucronata (Salicaceae)	TR	H					-	1	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
**Schinus molle* (Anacardiaceae)	TR	H					3	1	5	1	8	18	3	-	-	3	10	16	-	2	9	2	15	9	37	71
**Schizoglossum nitidum* (Apocynaceae)	HE	H					-	-	1	-	-	1	-	2	-	-	-	2	-	-	-	-	-	-	0	3
**Schkuhria pinnata* (Asteraceae)	HE	H					12	13	7	10	15	57	2	7	6	6	6	27	5	1	-	8	8	5	27	111
Schotia brachypetala (Fabaceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	5	2	1	-	1	9	-	-	-	-	-	-	0	9
Sclerocarya birrea (Anacardiaceae)	TR	C	-	B	M*	-	14	14	14	14	14	70	8	15	14	14	10	61	11	6	-	12	14	11	54	185
		H					1	1	1	1	1	5	5	-	-	-	-	5	1	-	-	-	1	-	2	12
Securidaca longepedunculata (Polygalaceae)	TR	C	-	-	M*	-	15	15	15	15	15	75	15	15	15	15	15	75	15	10	12	15	15	15	82	232
Senecio serratuloides (Asteraceae)	SH	C	-	B*	-	-	-	-	4	3	-	7	15	15	15	13	15	73	-	4	-	-	-	-	4	84

Table 1: Continue

Species name and botanical family	Habit	Source of plants	Capricorn: Grassland	Capricorn: Bushveld	Capricorn: Mountain	Capricorn: Wetland	Capricorn: Aganang	Capricorn: Blouberg	Capricorn: Lepelle-Nkumpi	Capricorn: Molemole	Capricorn: Polokwane	Capricorn: Sum of healers who use species per district	Sekhukhune: Elias motsoaledi	Sekhukhune: Ephraim mogale	Sekhukhune: Fetakgomo	Sekhukhune: Makhudumathamaga	Sekhukhune: Tubatse	Sekhukhune: Sum of healers who use species per district	Waterberg: Bela-Bela	Waterberg: Lephalale	Waterberg: Modimolle	Waterberg: Mogalakwena	Waterberg: Mookgophong	Waterberg: Thabazimbi	Waterberg: Sum of healers who use species per district	Sum of overall source/s treated per species
							Number of traditional healers who use the species																			
Senna didymobotrya (Fabaceae)	SH	H					-	8	-	-	-	8	-	-	-	-	-	0	-	-	-	-	-	-	0	8
Senna italica (Fabaceae)	HE	C	G*	-	-	-	-	1	-	-	3	4	-	3	7	-	-	10	9	-	-	-	-	-	9	23
Senna occidentalis (Fabaceae)	TR	C	G*	B*	-	-	-	5	-	-	-	5	-	-	-	-	1	1	1	1	-	-	-	-	2	8
Senna petersiana (Fabaceae)	TR	H					-	-	-	2	-	2	-	-	-	-	-	0	-	-	-	-	-	-	0	2
Sida cordifolia (Malvaceae)	SH	C	G*	B	-	-	-	-	-	-	3	3	-	4	-	-	-	4	-	-	-	-	-	-	0	7
Siphonochilus aethiopicus (Zingiberaceae)	HE	C	G*	B	M*	W	-	-	14	-	10	24	15	15	12	15	-	57	15	15	15	-	10	15	70	151
		H					-	-	1	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
		MT					15	15	-	15	5	50	-	-	-	-	15	15	-	-	-	15	5	-	20	85
Solanum catombelense (Solanaceae)	HE	C	G*	B	-	-	15	15	15	15	15	75	15	15	15	15	15	75	15	15	15	15	15	15	90	240
Solanum mauritianum (Solanaceae)	HE	H					-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	1	-	-	1	1
Solanum panduriforme (Solanaceae)	HE	C	G*	B*	-	-	-	-	-	5	-	5	-	3	1	1	6	11	5	1	-	-	-	3	9	25
Sorghum bicolor (Poaceae)	HE	H					4	15	-	3	4	26	-	-	-	15	-	15	-	-	-	-	-	-	0	41
Spirostachys africana (Euphorbiaceae)	TR	C	-	B*	M*	-	11	15	7	10	15	58	1	9	6	6	6	28	5	1	-	4	8	5	23	109
Stachys aethiopica (Lamiaceae)	HE	C	G*	-	M*	-	-	-	-	-	-	0	-	-	-	3	-	3	-	-	-	-	-	-	0	3
		H					-	-	-	-	-	0	-	-	-	1	-	1	-	-	-	-	-	-	0	1
Strophanthus speciosus (Rhizophoraceae)	TR	C	-	B*	-	-	15	15	14	13	15	72	15	10	11	13	15	64	15	10	11	14	15	15	80	216
Stylochaeton natalensis (Apocynaceae)	SH	C	G*	B	M	-	15	15	15	15	15	75	15	15	15	15	15	75	15	15	15	15	15	15	90	240
Syzygium gerrardii (Myrtaceae)	TR	C	-	B*	M	-	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	2	2	2
Terminalia sericea (Combretaceae)	TR	C	G*	B*	M	-	-	2	-	-	-	2	-	10	-	-	-	10	-	-	-	-	-	-	0	12
Tragia dioica (Euphorbiaceae)	HE	H					6	-	-	-	-	6	-	4	-	1	-	5	-	-	-	-	-	-	0	11
Triaspis glaucophylla (Malpighiaceae)	SH	C	G	-	M*	-	1	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Tulbaghia violacea (Alliaceae)	HE	H					-	-	-	-	-	0	-	3	5	-	-	8	-	-	-	-	-	-	0	8
Turraea obtusifolia (Meliaceae)	SH	C	G*	B*	M*	-	-	-	-	-	-	0	1	-	1	1	1	4	-	-	-	-	-	-	0	4
Tylosema esculentum (Fabaceae)	HE	H					-	-	-	-	-	0	1	-	-	-	-	1	-	-	-	-	-	-	0	1
Tylosema fassoglense (Fabaceae)	HE	C	G*	B	-	-	-	-	12	-	-	12	-	-	-	-	-	0	-	-	-	-	-	-	0	12
Vangueria infausta (Rubiaceae)	TR	H					-	-	-	-	1	1	-	2	2	-	6	10	-	-	-	-	1	-	1	12
Vepris reflexa (Rutaceae)	TR	C	-	B*	M*	-	-	-	-	-	-	0	1	2	-	-	-	3	-	-	-	-	-	-	0	3
Vernonia natalensis (Asteraceae)	TR	C	G*	-	-	-	15	15	15	13	15	73	15	11	12	15	15	68	9	9	11	14	15	15	73	214
Vernonia wollastonii (Asteraceae)	SH	C	G*	B	M	-	-	-	-	-	-	0	-	-	-	-	-	0	4	1	2	4	4	4	19	19
Vigna frutescens (Fabaceae)	HE	C	-	-	M*	-	-	-	-	-	-	0	-	-	-	-	3	3	-	-	-	-	-	-	0	3
Waltheria indica (Malvaceae)	HE	C	G*	-	-	-	5	-	-	-	-	5	-	-	-	-	-	0	-	-	-	-	-	-	0	5
Warburgia salutaris (Canellaceae)	TR	C	-	-	M*	-	15	15	14	15	15	74	15	15	15	13	15	73	15	15	15	15	15	8	83	230
		H					-	-	1	-	-	1	-	-	-	-	-	0	-	-	-	-	-	0	0	1
		MT					-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	7	7	7

Table 1: Continue

Species name and botanical family	Habit	Source of plants	Grassland	Bushveld	Mountain	Wetland	Aganang	Blouberg	Lepelle-Nkumpi	Molemole	Polokwane	Sum of healers who use species per district	Elias Motsoaledi	Ephraime Mogale	Fetakgomo	Makhudumathamaga	Tubatse	Sum of healers who use species per district	Bela-Bela	Lephalale	Modimolle	Mogalakwena	Mookgophong	Thabazimbi	Sum of healers who use species per district	Sum of overall source/s treated per species
	Capricorn												Sekhukhune						Waterberg							
							Number of traditional healers who use the species																			
Withania somnifera (Solanaceae)	SH	C	G*	B	M	-	1	-	-	-	-	1	-	-	-	6	-	6	15	15	15	15	15	15	90	97
Xerophyta retinervis (Velloziaceae)	HE	C	-	-	M*	-	-	-	-	-	-	0	-	-	9	7	6	22	-	-	-	-	-	-	0	22
Ximenia caffra (Olacaceae)	TR	C	-	B*	M	-	1	-	13	-	1	15	-	1	-	-	-	1	1	-	-	-	-	-	1	17
Zantedeshia aethiopica (Araceae)	HE	C	G*	-	M	-	1	-	7	-	-	8	-	-	-	-	-	0	-	-	-	-	-	-	0	8
Zanthoxylum capense (Rutaceae)	TR	C	-	B	M*	-	15	15	14	15	15	74	15	15	15	15	15	75	15	15	15	15	15	15	90	239
		H					-	-	1	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Zanthoxylum humile (Rutaceae)	TR	C	-	B	M*	-	6	5	-	-	1	12	-	-	-	-	-	0	-	3	-	-	-	-	3	15
* *Zea mays* (Poaceae)	HE	H					-	-	-	-	-	0	-	1	-	-	-	1	-	-	-	-	1	1	2	3
* *Zingiber officinale* (Zingiberaceae)	HE	MT					15	15	15	15	15	75	15	15	15	15	15	75	15	15	15	15	15	15	90	240
Ziziphus mucronata (Rhamnaceae)	TR	C	-	B	M*	-	2	-	-	-	-	2	-	-	-	-	-	0	-	-	-	-	-	4	4	6
		H					-	-	-	-	1	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
Ziziphus zeyheriana (Rhamnaceae)	SH	C	G	B*	M	-	15	15	14	13	15	72	15	10	11	13	15	64	9	9	11	13	12	12	66	202

considerable number of taxa to cure and manage these ailments. Furthermore, it signifies THs' degree of knowledge, of curative plants used for the referred ailments and their miscellaneous sources across the Limpopo province.

Sources of plants: The main supplies of medicinal plant materials used by Bapedi THs for the treatments of RIs and RSs were communal lands (68.3%, n = 153), home gardens (39.2%, n = 88) and muthi shops (shops trading healing plant and animal materials) (4%, n = 9), respectively. The sum of these percentages adds up to way over 100%, because some THs obtain certain species in more than one source. For instance, depending on THs, 18 species were obtained from two of the above-three mentioned supplies and four from all the sources. To the best of our knowledge, our study is the first to comprehensively determine the sources of plants implicated by THs or lay people as medicine for RIs and RSs. As a matter of fact, ethnobotanical studies conducted in South Africa[27] and other African countries[28,29] focusing on the herbal treatments used for these ailments did not address this aspect (i.e., either in results presentation, analyze or discussion), thus the present study provide first-hand information and will remain standard reference of work for decades. According to The International Union for Conservation of Nature and Natural Resources[30], establishments of therapeutic plants materials supplies are crucial starting points towards the conservation of used species, which ultimately contributes towards preservation of associated indigenous knowledge. This is mainly because it provides the type of habitats and eventually location of population. Therefore, future ethno-botanical studies should take the sources of medicinal plants in to considerations. Nevertheless, few general surveys conducted in South Africa[10,31] and other African countries[32] broadly highlighted that harvesters obtain medicinal plants from similar sources (communal lands, muthi shops and home gardens) noted in our study but did not report on a specific source/s of each plant and establish the most preferred supplies.

Communal lands: As stated earlier, medicinal plants sourced from communal lands constituted 68.3% (n = 153) of all species used by Bapedi THs for RIs and RSs, thus being the main source of supply in this study. Preferences of these lands for species collection by interviewed THs were based on the fact that their accesses are generally free. Subsequently, they harvest as many medicinal materials they need. In addition, communal lands were favoured by THs in order to hide the identity of medicinal plants they are using from lay people in their respective municipalities. Overall, reliance of most Bapedi THs on these lands for obtaining medicinal materials has both positive and negative implications. Positively, it has the potential to provides an incentive to protect and maintain wild populations and their habitats[33], all which in turns will contribute towards the genetic diversity conservation of species used to cure RIs and RSs. Negatively, their heavy reliance on wild habitats to obtain species especially those that are indigenous (which formed the dominant proportion in this study) is likely to put more harvesting pressure on the exploited population and ecosystem diversity, thus threatening the following, (i) Sustainability of herbal remedies for these afflictions and (ii) Scientific chances of discovering novel drugs as well as transfer of Bapedi indigenous medical knowledge to the future generations.

Indigenous plants harvested from communal lands made-up 98.6% (n = 151), compared to alien plants (*Pennisetum glaucum* and *Nymphaea mexicana*) which accounted for just 13.3% (n = 2). This finding was due to the wide natural spread of native species in the studied areas and perhaps their long history of utilization by the interviewed THs, both compared to alien plants, which were introduced recently. However, such finding to some degree also shows that most of the natural habitats within the communal lands of the studied districts have not yet been invaded by exotic flora. For instance, *P. glaucum* and *N. mexicana* were both exclusively used by few THs from selected municipalities of Sekhukhune district.

Overall, Bapedi THs targeted different habitats within the communal lands for exploitation of medicinal plants. Not surprisingly *P. glaucum* was obtained from a number of habitats including arable lands and along the roads ways. This finding came as no shock, due to the species' physiological characteristics, which enable it to adapt and survive in both poor and droughty conditions[34]. Thus, the species can independently grow and spread fast across various habitats. Because of such characteristics and the fact that it also cultivated as food plant by community members and THs (Per. Com: Mr. A.H. Mello), *P. glaucum* might in the near future dominate most habitats in communal lands of various municipalities comprising the Sekhukhune district and consequently ensuring the constant supply of medicinal materials for RIs and RSs. On the other hand, *N. mexicana* was obtained from the various local waterlogged areas particularly wetlands and river streams, possibly because the species is hydromorphic[35].

Habitats preferences of collecting the remaining medicinal plants (which were entirely indigenous) in communal lands depended on a species used and was mainly comparable across the three studied districts and allied municipalities wherein they are utilized (Table 1). This outcome might have been influenced by the high similarities in the utilization of floristic diversity of therapeutic plants used for RIs and RSs amongst participants, coupled with shared environments where these plants are obtained. The latter is based on the fact that three surveyed districts are alienated by the communal lands which are the principal sources of medicinal plants materials for an overwhelming majority of questioned Bapedi THs. Amongst the different habitats namely bushvelds, grasslands as well as mountainous areas targeted and exploited by the interviewed Bapedi THs for their diversity of native plants within the communal lands, grasslands and bushvelds were the main sources of plants. This indicates that THs do necessarily narrowly favour certain habitats over the others. Healers' preferences of bushvelds and grasslands might be attributed to the fact that the habitats occupy a large proportion of the communal lands in the studied districts and thus supports various natural resources which the community depend upon for various needs including herbal medicines. Regardless of this posit, we perceived grasslands and bushvelds as crucial habitats, which their conservation might in turns, ensure both resilience and preservation of Bapedi medical system pertinent to the treatment of RIs and RSs. This is true especially since the legacy of indigenous medicinal plants knowledge is mainly threatened by the habitats loss[17]. Overall, bushvelds (32.1%, n = 72) was the most preferred areas for obtaining medicinal plants in this study. It can therefore be suggested that these habitats are the main repository of plant diversity implicated in the treatments of RIs and RSs in the studied districts. Vast majority (52.7%, n=38) of species comprising mainly of *Acacia* (*A. erioloba*, *A. senegal, A. sieberiana* and *A. tortilis*), *Gymnosporia* (*G. maranguensis*, *G. pubescens* and *G. senegalensis*), *Croton* (*C. gratissimus* and *C. menyharthii*) as well as *Albizia* (*A. adianthifolia* and *A. anthelmintica*) species amongst the others were exclusively harvested by THs in their respective districts from bushvelds even though they occur in other locations (Table 1). This finding further emphasises the significant of bushvelds as source of medicinal plants for the investigated ailments. The authors learned through literature study that habitats preference amongst the African THs, for acquiring medicinal materials varies according to the cultures, which might be attributed to variation in the local vegetation types. For instance, although not specifically focusing on RIs and RSs, Laird *et al.*[36] found that indigenous Bakweri healers from the Mount Cameroon sources most of their medicinal plant materials from forest. Preferences of forest by these THs were based on the perception that it contains the most effective species compared to other habitats. Another study[37] but conducted in Ethiopia reported distinct preferences of grasslands by THs for obtaining medicinal plant materials. In the present, study most (12%) THs prefer collecting plants from bushveld because great number of a high diversity of species used for RIs and RSs occurs in association with one another. Thus, they collect multiple therapies concurrently when out for harvesting on a single location. This clearly shows that Bapedi THs will exploit bushvelds for its useful medicinal plants until nothing is left. In addition, such rationales stated by these THs for depending on bushvelds might be reflections that the habitat is under pressure of being selectively over-exploited. Possibility is high that local bushvelds across the surveyed areas might be over-extracted with destructive harvesting techniques. Project focusing on sustainable utilization and population monitoring/status of medicinal plants in these areas will proof or reject this hypothesis.

Nevertheless, some THs from selected municipalities of Capricorn namely Lepelle-Nkumpi (53.3%) and Polokwane (6.6%) disclosed that they exclusively depend on bushvelds for the species collections because of the increased distances to the alternative harvesting locations. This rationale reflects a local decline in plant populations over time[38], which in turn suggested the following two things, (i) That other crucial habitats with diversity of useful medicinal plants for RIs and RSs have been wiped-out in the above-mentioned municipalities and (ii) That bushvelds which are closer to the human settlements still contain this diversity in abundant. To avoid further loss of current habitats were plants are collected in these municipalities, initiative to identify and manage various threatening factors should be made. In general, the distinct practice of exploiting bushvelds by most THs in this study might also be due to preferences of both shrubby and trees species, which constitute the major characteristic of this habitat (Table 1). The remaining 47.2% (n = 34) of the plants comprising the proportion (n = 72) of the species collected from bushveld was acquired in more than one habitats. Therefore, indicating that such species have the ability to grow in various habitat types and complete the life cycles. In addition, the relatively lesser preferences of some of the species particularly *Grewia* species (*G. flavescens*, *G. hispida*, *G. occidentalis* and *G. sulcata*) as RIs and RSs remedies might have to some extent contributed to their occurrence in diverse geographical habitats as they are not threated by over harvesting. In general, the year round availability of most plant

habits such trees and shrubs, harvested by Bapedi THs in the bushvelds will certainly put more harvesting pressure on it than other habitats.

Species obtained from grasslands made-up 32.5% (n = 73) in this study. This proportion can therefore be perceived as an indicator of medicinal plants diversity found on these habitats across the studied areas. Higher number (53.4%, n = 39) of such diversity namely *Abutilon galpinii*, *Acokanthera rotundata*, *Agapanthus inapertus, Alepidea amatymbica, Aloe marlothii, Aptosimum lugardiae, Artemisia afra, Asparagus angusticladus*, *Athrixia phylicoides, Blepharis diversispina, Blepharis subvolubilis*, *Buddleja salvifolia*, *Callilepis laureola, Clematis brachiata*, *Clerodendrum glabrum, Clerodendrum ternatum*, *Clivia caulescens*, *Cyphostemma woodii*, *Dicerocaryum senecioides*, *Dicoma anomala*, *Euphorbia schinzii*, *Flueggea virosa*, *Grewia sulcate, Helichrysum caespititium, Helichrysum kraussii, Indigofera circinnata, Ipomoea albivenia, Lantana rugose, Lasiosiphon caffer*, *Monsonia angustifolia*, *Pergularia daemia*, *Plumbago zeylanica*, *Sida cordifolia, Solanum catombelense*, *Stylochaeton natalensis*, *Tylosema fassoglense, Vernonia wollastonii*, *Withania somnifera* and *Zantedeshia aethiopica* were exclusively harvested even though they also occur in other natural habitats such as bushveld and mountains. When THs were asked why they favour grasslands over these habitats, one main factor namely "Easiness of collection" persisted to account for the dependency. According to THs, most of the species obtained from the grasslands are herbaceous in nature, which therefore, makes it easy to harvest them without much effort and in required quantities. In addition, grasslands were preferred for obtaining the above-mentioned species because they are easy to collect due the absence of woodiest and thorny vegetation, thus allowing them free movements. These motivations on their own might results in the extinction of targeted species and ultimately habitat degradation if destructive harvesting methods are employed. It has previously been shown that unsustainable collection of medicinal plants on grasslands has the potential to cause rapid habitat degradation[39], rendering habitat unfit to support species they dependent upon it as their home territory. Meanwhile as part of strategies to conserve grasslands in the studied areas, THs should be encouraged to sustainably utilize and interchange alternative habitats for plant collections.

The rest of plant species contributing 73 (32.5%) of those obtained from grasslands includes amongst the others, those (17.8%, n = 13) exclusively harvested on grasslands (without alternative collection sites) namely *Commelina africana*, *Commelina subulata*, *Cyperus sexangularis*, *Enicostema axillare*, *Garcinia gerrardii*, *Geigeria burkei*, *Hibiscus meyeri*, *Jatropha zeyheri*, *Kalanchoe brachyloba*, *Philenoptera violacea*, *Senna italica*, *Vernonia natalensis* and *Waltheria indica*, perhaps due their specific habitat demands. However, exclusive exploitation of these plants by Bapedi THs from a fragile ecosystem like grasslands not only has the potential to degrade the entire habitat but also can cause reduction in population integrity of targeted species[23] and even their local extinction[40]. The latter impacts might be true for *E. axillare*, *K. brachyloba* and *V. natalensis* which were exploited by extremely higher number of THs in the studied districts. Therefore, transplantation from grasslands into home gardens will be a suitable conservation strategy for both targeted taxa and their habitats. Propagation of such species should be easy especially since they are herbaceous in nature[41]. The remaining species were obtained on grasslands as well as other habitats such as bushvelds (23.2%), mountains (2.7%), wetlands (1.3%), bushvelds and mountains (1.3%) by THs who use them in their districts and allied municipalities. This may be attributed to a wider occurrence of the species in various habitats coupled with THs knowledge of their local distribution. However, despite the availability of the above-mentioned alternative habitats for harvesting the species, the earlier stated advantages of grasslands preferences reported by THs will continue increasing its exploitation. In addition, the personal safety, which THs might be felt especially by females when individually harvesting plants in open grasslands compared to other habitats such as bushvelds and mountains, which are mainly characterized by vegetation encroachments have the potential to increases its preferences over other habitats.

Plants obtained from the mountainous areas constituted 17.4% (n = 39) of all medicinal plant species recorded in the present study, thus being one of the least utilised habitat by Bapedi THs within the communal lands, perhaps due both remoteness and difficulties in accessing it. As expected the majority (38.4%, n=15) of these species namely *Cryptocarya transvaalensis*, *Englerophytum magalismontanum*, *Pleurostylia capensis*, *Olea europaea*, *Pappea capensis*, *Rhoicissus tomentosa*, *Rhoicissus tridentata*, *Rhynchosia hirta*, *Vigna frutescens* and *Xerophyta retinervis* were wholly exploited on the mountainous areas by THs in their respective municipalities. This outcome was not a surprise because most of the mentioned species are adapted to grow on the mountainous conditions and thus are naturally distributed in such areas[42]. As a result, this might partly explain why the mountainous areas are the only known habitats for obtaining such species by most interviewed THs. The remoteness and difficulties in accessing mountainous areas have potential to

contribute towards protection of their diversity and ultimately habitats itself. For instance, when harvesting species from these areas, all the questioned THs vacate their homes in the very early hours of the morning to ensure that they return same day. As such, it might be difficult for these THs to collect the larger volumes of used parts from most targeted species, carry them and physically transport them from mountains to low-lying areas. However, an assessment of frequency, quantity of the materials extracted as well as used collection techniques concerning the above 15-listed plant species will provide an insight as to whether the mountainous areas have influence on their exploitation level or not.

The above assessments are also significant to 23% (n = 9) of species (*Catha edulis*, *Dichrostachys cinerea*, *Mundulea sericea*, *Protea caffra*, *Sclerocarya birrea*, *Triaspis glaucophylla*, *Zanthoxylum capense*, *Zanthoxylum humile*and *Ziziphus mucronata*) which were preferably obtained from the mountainous areas irrespective of their occurrences in other habitats. Their exclusive harvesting on these areas by Bapedi THs was attributed to both the traditional believes and customs. For instance, some THs disclosed that they targeted mountainous areas to collect such species because is centuries-old traditional knowledge learned from mentors and other THs believe that species found in alternative habitats are less effective compared to those occurring on these areas. The latter claim is common elsewhere[43]. However, it should be stated that the high usage levels of some of the afore-said medicinal plants particularly *C. edulis*, *D. cinerea*, *Z. capense* and *Z. humile* in the present study coupled with selective exploitation of their population on mountainous habitats, may in a long run affect their availability in these areas and ultimately renders the habitats unsustainable as supplier of their materials. The remainder of the species encompassing 39 plants were obtained by THs from the mountains including the following, those procured from the mountainous habitats and the following areas bushveld (30.7%, n = 12), grassland (5.1%, n = 2), bushveld and grassland (2.5%, n = 1). This finding might not only reflect the degree of distribution of these species in various habitats across the studied districts and municipalities, but also the extent of utilization of the habitats by THs.

Species obtained in communal lands located in other areas: Further analysis of the results showed that some of Bapedi THs do not rely only on local sources within their respective districts and municipalities to obtain certain plants. Importantly, the overall proportions of specific habitats (e.g., bushvelds, grasslands, mountains and etc) targeted by these THs alluded earlier comprised that of the plant species presented in this section. A total of ten species *Adenia fruticosa*, *Catha edulis*, *Dioscorea sylvatica*, *Dioscorea dregeana*, *Kirkia wilmsii*, *Olea europaea*, *Pappea capensis*, *Ptaeroxylon obliquum*, *Securidaca longepedunculata* and *Warburgia salutaris* were sourced by some THs in various habitats, mainly mountainous areas located across the communal lands outside their respective municipalities but within the selected studied districts. This finding indicated that these species might be widely distributed and perhaps even highly localised. Traditional healers' knowledge regarding the distribution of afore-listed species outside their areas of inhabitants show that there is an intra-cultural transfer of medicinal plants knowledge including their specific habitats amongst Bapedi THs, which perhaps occurs during professional ethnic meetings/workshops. All the questioned Bapedi THs who harvested *D. salvatica* (31.2%) and *D. dregeana* (0.4%) from communal lands obtained it on the summit of Leolo Mountain (Sekhukhune district). However, the observed selective exploitations of *D. salvatica* on this mountain by higher number of THs from a sole location is possibly an indication that both the species' specific local habitat and population integrity are under severe threat of being over exploited due to its high demand. This might be probable especially since there is recently a constructed gravel road to other parts of the mountains (were the population occurs) used by people traveling with both vehicles and feet.

With the exclusion of *A. fruticosa* (Blouberg, Ga-Makgoba and Mafefe villages) and *P. obliquum* (Mafefe) which was collected by THs (53.3 and 49.5%, respectively) from bushvelds and mountains located in the mentioned villages of Capricorn district, the rest of the species namely *C. edulis* (100%) *K. wilmsii* (3.7%), *O. europaea* (6.2%), *P. capensis* (0.8%), *S. longipenduculata* (96.6%) and *W. Salutaris* (95.8%) were exclusively obtained on the mountainous areas of Capricorn district. As expected *K. wilmsii* was harvested specifically around Ga-Chuene village. This finding was projected mainly due to the fact that previously study[44], focusing on use and sources of *K. wilmsii* by Bapedi THs reported their distinct preferences of population distributed on the mountainous areas of this village (over alternative harvesting habitats). Harvesting of this species around Ga-Chuene by questioned THs in the present study is because the local mountains where it occurs are easily accessible and perhaps due to its fairly abundant population. The same can be said with respect to the habitats and status of *O. europaea* and *P. capensis* which was only used for RIs and RSs by THs from Sekhukhune district, who specially travel long distance to Mafefe village (Capricorn district) just to harvest the species. The remaining two plants, *S. longipenduculata*

and *W. Salutaris* both used extensively by THs across the three studied districts was entirely harvested on the mountainous areas of Blouberg (Blouberg municipality) and Mafefe (Lepelle-Nkumpi municipality) villages, which might be ascribed to their wider distribution in these villages. The same can be said for *C. edulis* which was harvested on the mountains located in Blouberg, Ga-Molepo and Mafefe villages. It is a common knowledge that some African THs mainly targets natural habitats with wider species population for easy exploitation of medicinal plant materials[45].

Furthermore, the results of the present study also showed that three species namely *Alepidea amatymbica*, *Brackenridgea zanguebarica* and *Siphonochilus aethiopicus* were exploited on various habitats located within communal lands in other districts (not investigated) which are mainly dominated by other ethnic groups. This therefore suggests that the mentioned species are in high demand, probably due to their high value as treatments of RIs and RSs to Bapedi THs who utilise them. Nevertheless, practice of harvesting curative plant species by THs in foreign lands was also reported by various researchers amongst other South African cultures. For instance, Liu *et al.*[46], who worked with the Xhosa and Sotho THs of the Eastern Cape Province found that they walk far distance to other villages to harvest *A. amatymbica* on the mountainous areas. Similarly, Manzini[47] found that Swati THs residing in Mpumalanga province travel to Limpopo province just to harvest *S. aethiopicus* on grasslands in unspecified geographical location. It would have been interesting to know the exact sites were Swati healers obtain this species in Limpopo in order to determine the sustainability of its exploitation and also to compare such sites with our findings. However, the fact that collection of *S. aethiopicus* by these THs in Limpopo was due to their scarcity or extinction in the local habitats within their respective locations[47], which in most cases is the repercussions of over harvesting, on its own raises concerns as to whether Swati THs employ sustainable collection techniques or not when obtaining *S. aethiopicus* in Limpopo. In the present study most THs who use *A. amatymbica* (84.1%) and *S. aethiopicus* (62.9%) gathered their materials from free access communal lands and private farms (around Tzaneen Town) in Mopani district. Harvesting of the latter species is executed illegally and in secrecy, preferably during the evening due to the restricted access by the owners. In general, collection of *A. amatymbica* and *S. aethiopicus* in the above-mentioned district by Bapedi THs was because they are only known to occur there. It will therefore not be a surprise that future studies assessing population status of both these species especially *S. aethiopicus* report either their few individuals or entirely local extinction in various grasslands located in Mopani district. As expected most interviewed THs (13.3%) in this study who use *B. zanguebarica* harvested it either on bushvelds or mountainous areas around Mutavhatsindi Nature Reserve in Thengwe area (Vhembe district) were the species is legally protected. This finding was anticipated mainly due to the fact that in South Africa *B. zanguebarica* only naturally occurs in this area[42]. Thus harvesting of its materials in South Africa will obviously occur in or around the above-mentioned Nature Reserve. Development of a controlled buffer zones or expansion of Mutavhatsindi Nature Reserve but with managed harvesting of *B. zanguebarica* bark for medicinal purposes as suggested by Tshisikhawe *et al.*[48], should indeed be adopted as a conservation strategy for both species and its habitat. Overall, collection of all the above-mentioned species by Bapedi THs in specific habitats located in other districts of Limpopo province dominated by other cultures show that there is inter-cultural relationship the amongst THs, which warrant further investigations.

Harvesting of above-mentioned species by Bapedi THs in other communal lands located across the studied districts and municipalities were generally executed in collaboration with local THs, especially those who also use the same species (Table 1). Consequently, suggesting that any initiative regarding management of habitats hosting medicinal plant diversity in the studied areas and elsewhere should incorporate the local THs.

Home gardens: Medicinal plant species obtained by Bapedi THs from home gardens constituted 39.2% (n = 88) of total taxa documented in the present study (Table 1), thus suggesting that there is a limited *in situ* conservation system amongst the interviewed THs. Cultivation of these plants by all Bapedi THs was generally inspired by the scarcity of species in the wilderness, easy access of plant species for medicinal usage and for practical purposes when mentoring apprentices. The latter motivation might be attributed to the fact that most of the interviewed THs were old, thus are not physically fit to travel/walk long distance to communal lands teaching their students live medicinal plants specimens. Nevertheless, some of the above-mentioned reasons of growing herbal plants disclosed by Bapedi THs are in line with those reported by healers of other cultures in South Africa[49,50] and other African countries[16-51], which would let one believe that African THs share similar attitudes as far as propagation of medicinal plants is concerned. Overall larger number of plants domesticated by Bapedi THs were indigenous (59%, n = 52) compared to exotics (40.9%, n = 36). Similar finding was reported for other South African cultures, notably the Xhosa

of Eastern cape province[49] and the Zulu residing in KwaZulu-Natal Province[52]. The extensive domestication of indigenous species by Bapedi and other tribal healers might be due to their perception as safe, a result of long term familiarity and experimentation. This is in contrast to the relatively short time period that exotics have been in local areas. The authors perceived higher domestication of indigenous plants species in this study as a reflection to their significance as central remedies for RIs and RSs in Bapedi traditional primary healing sectors. Generally, the authors the same sentiments with Semenya and Potgieter[13], who stated that the practice of cultivating medicinal plants (exotic or indigenous) in home gardens is a positive development that in the long term will sustain both species and accompanying indigenous knowledge as well as preserve the cultural identity of the Bapedi[53].

The most widely and highly domesticated species in the present study were *Lippia javanica* (96.2%), *Aloe* spp. (88.3%), *Eucomis pallidiflora* (90%), *Citrullus lanatus* and *Datura stramonium* (84.1%, for each), *Moringa oleifera* (70.8%), *Carpobrotus edulis* (65.4%), *Jacaranda mimosifolia* (65%), *Encephalartos transvenosus* (45.8%), *Cannabis sativa* (30.4%), *Eucalyptus camaldulensis* (30%), *Schinus molle* (29.5%) and *Adansonia digitata* (22%). As a matter of fact, with the exclusion of *A. digitata*, all the above-listed plant species were cultivated by THs who utilize them in their respective districts and associated municipalities, thus reflecting both their medicinal value and importance within Bapedi traditional healing sector. Medicinal cultivation of these species is also a common practice amongst other cultures residing in South Africa and other African countries. For instance, Batsonga THs in Limpopo province also grow *Lippia javanica*[54]. Cultivation of this aromatic herb and *M. oleifera* is also common amongst the Batswana of Botswana[55]. Comparably to Bapedi THs, the Shona people staying in Zimbabwe also propagate *S. molle* for medicinal purposes[55]. During the interview Bapedi THs who utilize all the above-mentioned species disclosed they have other usage values apart from medicine, with ornamentals being a common utility. For instance, they also use *A. digitata* (fruit and leaves), *C. edulis* (leaves), *L. javanica* (leaves), *M. oleifera* (leaves and seed) and *C. lanatus* (leaves) as food plants, thus suggesting that cultivation of species by Bapedi THs are due to their multiple-benefits. Overall, apart from the multiple-benefits, widespread domestication of some species especially those that are herbaceous in nature such as *C. edulis*, *C. lanatus*, *D. stramonium* and *L. javanica*, might be due their ease of cultivation. The same can be said for exotic woody species such as *E. camaldulensis*[56] and *S. molle*[57] which were scientifically proven to be both easy and fast growers. A wider propagation of all the afore-said species especially indigenous plants by extremely higher proportion of Bapedi THs can have profound impacts on conservation. However, this need to be better understood. For example, such initiative can reduce harvesting of wild populations, only if it substitutes the collection of wild species and not supplements it. Studies[49,58] showed that domestication of curative plant species in home gardens by South Africans normally takes place because of their use values and not necessarily with intension for conservation. Nevertheless, the repetitive and extensive use of all the earlier alluded species, albeit, in different contexts (medicinally and for other uses) by THs, emphasises their value within the consciousness of sectors and thus they have reasons to conserve and protect them.

Although not extensively cultivated compared to the above-listed taxa, indigenous plant species (48%, n = 25) such as *Asparagus buchananii*, *Cleome gynandra, Commiphora marlothii*, *Cucumis metuliferus, Cucumis zeyheri, Dodonaea viscosa*, *Drimia elata*, *Drimia sanguinea, Elaeodendron transvaalense, Erythrina lysistemon*, *Eucomis autumnalis*, *Ficus burkei, Hypoxis hemerocallidea, Hypoxis obtuse, Kleinia longiflora*, *Leonotis leonurus, Mentha longifolia*, *Peltophorum africanum*, *Salix mucronata, Sansevieria hyacinthoides, Senna petersiana, Sorghum bicolor*, *Tulbaghia violacea, Tylosema esculentum* and *Vangueria infausta* as well as exotics species namely *Allium cepa, Allium sativum*, *Argemone ochroleuca*, *Capsicum annuum*, *Carica papaya*, *Citrus limon*, *Citrus sinensis, Datura ferox, Daucus carota, Eriobotrya japonica, Lantana camara*, *Mangifera indica*, *Melia azedarach, Morus alba, Musa sapientum, Nicotiana tabacum*, *Opuntia ficus-indica*, *Panica granatum*, *Portulaca oleracea, Prunus persica*, *Pseudognaphalium luteo-album*, *Psidium guajava, Ricinus communis*, *Saccharum officinarum*, *Schizoglossum nitidum, Senna didymobotrya*, *Solanum mauritianum* and *Zea mays* were domesticated by all interviewed THs who utilize them in the three surveyed districts and allied municipalities. The extent of cultivation of these species in home gardens might be associated with THs level of knowledge regarding their utility or their preferences as useful plant resources particularly as medicines for RIs and RSs. This is due to the fact that home gardens are mainly managed by their owners[59] suggesting that the choices and perceptions of owners obviously determine which species are propagated or excluded. Comparison of our findings with previous studies showed that domestication of some the above-listed exotics and native medicinal plants in home gardens by Bapedi THs is a common practice amongst other South African and African cultures. Batswana people residing in North West province

(South Africa), also cultivate *D. sanguinea*, *E. autumnalis* and *H. hemerocallidea*[58]. Plantation of these bulbous herbs by Bapedi THs is mainly because they are utilized in their fresh states[13]. Thus, THs cultivate them in home gardens for convenience access, especially in case of emergencies. Similarly, to the finding of the present study, cultivation of *C. limon*, *C. sinensis* and *Z. mays* for therapeutic purposes is common amongst the Zulu people of KwaZulu-Natal province, South Africa[60]. N'Guessan *et al*.[61] who worked with the Abbey and KrobouTHs of Côte-d'Ivoire also reported domestication of *C. annuum, D. carota* and *S. officinarum*. Cultivation of *A. sativum*, *C. papaya*, *M. indica*, *M. sapientum*, *N. tabacum*, *P. guajava*, *R. communis* and *S. bicolor* by Bapedi THs is in line with finding of Simbo[62], who questioned THs in Babungo, Northwest Region, Cameroon. Not surprisingly many of the above-mentioned native species were also mentioned by the interviewed Bapedi THs as therapies for other human ailments apart from RIs and RLs. This is because Bapedi THs are known to cultivate multi-purposes medicinal plants[13]. Equally, the afore-listed exotics species recorded in this study are generally known food, ornamental and multi-remedy plants across South Africa, other African countries and elsewhere.

About 14.7% (n = 13) of species comprising mainly of indigenous species, *A. digitata, Aloe falcata* (n = 3), *Artemisia afra*, *Callilepis laureola*, *Carissa bispinosa*, *Siphonochilus aethiopicus*, *Stachys aethiopica*, *Warburgia salutaris*, *Zanthoxylum capense* and *Ziziphus mucronata*, *Dicerocaryum senecioides*, *Mimusops obovata*, *Sclerocarya birrea*, compared to exotics (*Nymphaea mexicana*) found in surveyed home gardens were actually not domesticated by all THs who utilized them across the studied districts and municipalities. This which might be ascribed to either their availability in wilderness or THs lack of knowledge with respect to their plantation techniques or both these factors. Healers who did not grow these species relied on other sources to obtain them (Table 1).

A further analysis of the results relating to the medicinal plant species recorded in some visited home gardens revealed that 10.2% (n = 9) comprising of *Schkuhria pinnata*, *Tragia dioica*, *Croton gratissimus*, *Euphorbia inaequilatera*, *Momordica balsamina*, *Gymnosporia senegalensis*, *Geigeria burkei*, *Cassia abbreviata* and *Kirkia wilmsii* were not cultivated by THs who use them. These species grew naturally in the healer's gardens and accordingly managed concurrently with the domesticated taxa. This practice is not restricted to the Bapedi THs. For instance, Molebatsi[58] noted similar findings for Batswana people and Milow *et al*.[63] for Bumiputera culture of Pahang (Malaysia). However, tendering of the naturally growing plant species by Bapedi THs was based on the fact that such taxa are naturally well adapted to grow in home gardens and thus can grow without human intervention (e.g., without watering or fertilizing them). Exotic species *S. pinnata* was maintained in home gardens by all interviewed Bapedi THs who utilized it across the three studied districts, because the species is both widespread and naturally occurring as weed in these districts. The same might be true for *E. inaequilatera* which were also managed by most THs in studied districts but in certain municipalities (Bela-Bela, Fetakgomo, Lepelle-Nkumpi, Molemole and Polokwane). The remaining species (*C. abbreviata*, *C. gratissimus, G. burkei*, *G. senegalensis*, *K. wilmsii*, *M. balsamina* and *T. dioica*) maintained by Bapedi THs were also distributed in certain home gardens within the selected municipalities (Table 1). It should be stated that these home gardens was located in households' adjacent to the natural distribution of the above-listed plant species. Consequently, suggesting that most of the population of these species were cleared for human inhabitants, wherein some individual were left deliberately for provision of medicinal materials. In addition, it is also possible that seeds or seedling of such species were dispersed (by any agents) from the wilderness to THs home gardens. Overall, cultivation or maintenance of diversity of plant species used for RIs and RSs in this study shows that the Bapedi THs have a clear understanding and extensive experience with regards to the various intra and inter specific interactions to grow different species (native and exotic) in a small piece of land. Importantly, cultivation of species not only guarantees the supply of stable medicinal plants treating these ailments, but also ensures both self-collections of the plants and ultimately their proper identifications. The latter is essential in relation to patients' safety and healing.

Muthi shops: Just 4% (n = 9) of plant materials therapeutically useful for RIs and RSs was purchased by THs from these shops, thus being the least preferred source for obtaining healing materials in this study. This was however, expected due to the disadvantages associated with medicinal plant-based materials obtained from such shops. For instance, plants sold in *muthi* shops are in the form of pulverised packages or plant parts, which give no guarantee that the procured materials were harvested from the correct specimens. Also, high prices of therapeutic plants ingredients (especially useful for prevalence diseases like RIs) charged by muthi traders in Limpopo Province, might have also contributed to their least preferences. Rase the (Per. Com) who surveyed muthi shops in this province found that traders escalate sale prices of materials according to their high demand (amongst other

factors), which in turn might be attributed to the local severity of sicknesses. Moreover, customs of performing rituals by most interviewed Bapedi THs prior collecting plants (from home gardens and wilderness), attributed to the beliefs that such rituals ensure efficacy of harvested part/s is another possible factor might have contributed to the least preferences of muthi shops for obtaining healing plant materials in this study. Nonetheless, procurements of medicinal plant materials from these shops is also common amongst THs of other cultures such Zulu, Tswana and Sotho[15], residing in South Africa. Similar practice was reported in African countries like Nigeria[64] and Ghana[65]. In general, lack of knowledge by Bapedi THs regarding the local natural distributions of some plants or high traveling cost to foreign communal lands for plant collections not occurring naturally in their areas was reported by the interviewed Bapedi THs as reasons for purchasing healing plant materials from local *muthi* shops[66].

Therapeutic materials obtained by Bapedi THs from *muthi* shops included *Alepidea amatymbica*, *Artemisia afra*, *Brackenridgea zanguebarica*, *Callilepis laureola*, *Dioscorea dregeana*, *Helichrysum gymnocomum*, *Siphonochilus aethiopicus*, *Warburgia salutaris* and exotic *Zingiber officinale*. Not all questioned THs across the studied districts and municipalities obtained these species from muthi shops, therefore suggesting that there are variations in the preferences of medicinal plant materials supplies amongst the Bapedi. Procuring of some of the above-mentioned species particularly *A. amatymbica* and *W. salutaris*[15] as well as *S. aethiopicus*[47] from muthi shops/markets is a common practice amongst the THs of various cultures in South Africa, which is probably attributed to the local availability of species within THs's respective communal lands. Previous surveys conducted in the three studied districts reported the scarcity of *W. salutaris*[67] and *S. aethiopicus*[68] in communal lands, which might partly explain why the some THs in the present study buy their materials from the local muthi traders. Generally, muthi traders are well-known to travel to other areas/provinces and even countries just to collect the healing plant materials from the wilderness[14]. Reliant on local muthi shops to procure *B. zanguebarica* materials by Bapedi THs (0.4%) residing in Bela-Bela is understandable from an economic point of view. This is due to the fact that the species is only localized in Venda district wherein it's legally protected[42]. Thus, it might be both costly and risky for THs to t ravel over 300 km to Venda for collection of the species outside protected areas. The same can be said for *H. gymnocomum* which were mentioned by questioned THs (0.8%) as naturally occurring in KwaZulu-Natal province (South Africa). *Zingiber officinale* was acquired from muthi shops by all THs (84.1%) who utilized it across the studied districts and municipalities, mainly due to unknown natural distribution of its population in the wilderness. This is probably due to the fact the species is exotic to South Africa and therefore it might currently occur in cultivated areas for formal commercialization. For instance, 95.5% (n = 193) of the THs who use it disclosed that they also usually buy its materials from the Morden Supermarkets such as Spar™ and Shoprite™, due to its scarceness in the local muthi shops. In general, purchasing of all the above-listed medicinal plant materials from these shops by Bapedi THs is as indication that they will accept the same materials but obtained in cultivated lands. This is based on the fact that they do ask muthi trader/sellers source/s of their materials and that they cannot differentiate between stocks harvested from wilderness and home gardens. Therefore as part of the traditional primary health care sector supports, local government should freely grand interviewed THs (who relies on muthi shops) seedlings or seeds of the afore-said species, empower them with propagation techniques and also assist them with critical resources such as water, amongst the others. This will go a long way in ensuring the sustainability of remedies needed for RIs and RSs. In addition, it will also drastically reduce the THs financial costs of buying medicinal plant materials. However, benefits of cultivation from slow-growing trees such as *B. zanguebarica* and *W. salutaris* which takes take years to reach stages that allow harvesting will be of a long term.

CONCLUSION AND FUTURE RECOMMENDATIONS

This study provides the list of plants implicated in the treatment of RIs and RSs as well as their sources. Overall, free access communal lands, with exclusive preference of bushvelds and grasslands, respectively are the main supplies of medicinal plant materials. Both these habitats were selectively favoured by THs to harvest most plant materials in spite of the availability of alternative areas. Therefore, their conservation across the studied districts and municipalities should be seen as key factor and suitable strategy for safeguarding individual or population of species used to heal RIs and RSs as well as other human afflictions. The outcomes of the present study will be useful to conservationists and other development stakeholders who has interest in medicinal plants conservation and utilization. Furthermore, it serves as an entry point for further investigation of other activities such as techniques of harvesting species, collection frequency and conservation status assessment of species distributed in the communal lands.

SIGNIFICANCE STATEMENT

This study revealed that free access communal lands, with exclusive preference of bushvelds and grasslands are the principal source of medicinal plant materials used by Bapedi THs to heal and manage RIs and RSs. Traditional healers selectively favoured these habitats in spite of the availability of alternative areas. This study provides use full information pertinent to the sources of medicinal plants, which can be used by people who has interest in medicinal plants conservation and utilization.

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