An Ethnobotanical Study of Medicinal Plants in Asgede Tsimbila District, Northwestern Tigray, Northern Ethiopia

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Research

Abstract

Investigation and documentation of the status of medicinal plants and associated knowledge was conducted in Asgede Tsimbila district, northwestern Tigray, northern Ethiopia. Data was collected and evaluated with a questionnaire survey, semi-structured interviews, field observations, direct matrix ranking, preference ranking, abundance scores, and vegetation surveys. Sixty-eight medicinal plant species used to treat 50 different ailments (in humans and livestock) were recorded. Leaves are the most commonly collected plant parts for medicinal purposes. Much of the ethno-medicinal knowledge is concentrated in elderly members of the community. The medicinal plants are facing threats from agricultural expansion, wood extraction and overgrazing. Consequently, abundance of medicinal plant resources is declining with time. Furthermore, effort to conserve and cultivate medicinal plants is virtually non-existent. Thus, participation of the local people and awareness creation on sustainable utilization and management of these resources is vital.

Introduction

About 80% of Ethiopian people rely on traditional medicine to meet their health care needs (Bekele 2007). The wide spread use of traditional medicine could be attributed to cultural acceptability, perceived efficacy against certain types of diseases, physical accessibility and affordability as compared to modern medicine (Bekele 2007, Defar 1998, Hunde *et al*. 2006). Nevertheless, little effort has so far been made to properly document the associated knowledge base and conserve medicinal plants in the country (Gidey *et al*. 2009). Even though encouraging initiatives have emerged in recent years, studies conducted hitherto are far from complete owing to the multi-ethnic cultural diversity and the diverse flora of Ethiopia (Bekele 2007, Yineger *et al*. 2008). Medicinal plants and the associated knowledge are being threatened by ongoing deforestation, environmental degradation and 'modernization' (Balemie *et al*. 2004, Bekele 2007). All this necessitates the need to investigate the status of medicinal plant resources and knowledge base associated with it for successful resource conservation and development.

The present study was, therefore, initiated in Asgede Tsimbila district, northwestern Tigray, northern Ethiopia in a context where medicinal plants suffer notable disregard from research and development strategies. The objective of the study was to investigate and document the status, trends in abundance and threats to medicinal plants, and the associated indigenous knowledge in the study area.

Materials and Methods

Description of the study area

The study was carried out in northwestern part of Tigray Regional State, northern Ethiopia, in Asgede Tsimbila dis-

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trict (14°42' to 14°11'N and 37°34' to 38°19'E) (Figure 1). The district covers a total surface area of about 239,955 ha, which is 4.4% of the total Tigray regional area (Genzebu 2009). The agro-climatic zone of the district is characterized by hot to warm semi-arid lowlands, hot to warm sub-moist lowlands and tepid to cool sub-moist mid highlands. The area has a unimodal rainfall pattern (June to September) with a total annual rainfall ranging between 500 and 750 mm. The mean annual temperature ranges between 20 and 35^{0}C with an altitudinal range of 800 to 2300 m.a.s.l.

The vegetation cover of the area can be grouped into four major plant communities: *Acacia-Commiphora* woodland, *Combretum-Terminalia* woodland, Riparian woodland and Dry-evergreen mountain woodlands. The district has 23 rural **kebeles** (rural sub-districts- the smallest administrative unit next to district in Ethiopia) with a total population of about 128,363. The livelihood of the local people is mainly based on subsistence mixed agriculture (crop-livestock production) (Kahsay 2007).

Selection of study sites and informants

A reconnaissance survey was first conducted to have an overview of the demographic, socio-economic and bio-physical conditions of the study area. Development agents of the district and elders were contacted during the survey. The preliminary survey results indicated that the **kebeles** are essentially similar to one another. Consequently, three study site **kebeles** were randomly selected: Alogien, Lemlem and Hintset. Simple stratified random sampling (based on age and sex) was employed to select informants. Accordingly, a total of 72 respondents (36 males and 36 females) stratified into two age classes (below 40 and above 40 years) were selected from the study sites constituting about 5% of the total population. Out of these, 20 key informants (12 males and 8 females) were selected as recommended by local knowledgeable elders.

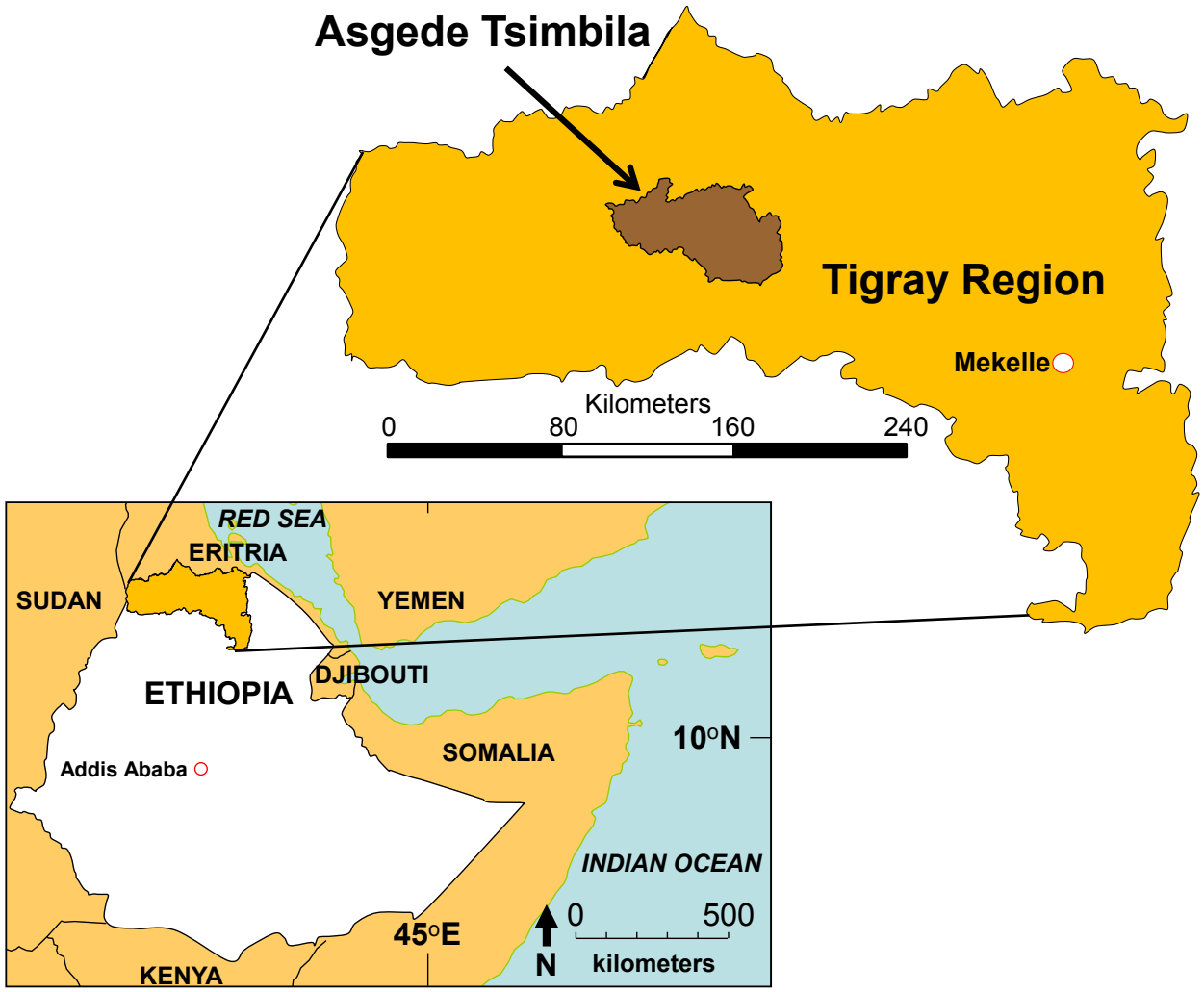

Figure 1. Study site in Asgede Tsimbila District, Tigray Region, Ethiopia.

Data collection

Ethnobotanical data

Ethnobotanical data were collected between June and September 2010 using a questionnaire survey, semi-structured interviews with key informants (knowledgeable elders, religious leaders and other individuals), field observation, and ranking and scoring methods (Cotton 1996, Martin 1995, Nanyunja 2003). Interviews and discussions were conducted in Tigrigna (the local language) using a checklist of topics. At the start of each interview the aim of the interview was explained to invoke clear and objective responses and then informants were asked for their consent. A range of ethnobotanical information including plant local names, uses, parts used, mode of utilization, plant habit and habitat, conservation status, trends in abundance of the species and existing threats to the plants were covered. Ethnobotanical surveys of local knowledge can be used as a tool for investigating human perceptions of biodiversity loss (change in abundance and use of plant species through time) (Nanyunja 2003). This technique enables us to tap people's memories, to recall important historical events which have taken place in a given area (Nanyunja 2003). Hailemariam *et al*. (2009) have also confirmed that ethnobotanical data collection tools can be used to glean information related with the conservation status and cultivation practices of medicinal plants. In a similar vein, this study has emphasized on the indigenous knowledge of the local people to investigate the conservation status and/or abundance of medicinal plants, and the possible causes of these changes. Vegetation surveys and field observations (through transect walks) were also conducted to corroborate these results.

Direct matrix and preference ranking

Direct matrix ranking was exercised for seven commonly reported multipurpose medicinal plants in order to assess their relative importance to local people (Martin 1995). Based on their relative uses, selected informants were asked to assign use values for each plant (5 = best, 4 = very good, 3 = good, 2 = less used, 1 = least used and 0 = not used) to each use category. Use categories in the comparison include construction, medicine, fruit, fodder, fuel wood, shade and fence.

Preference ranking was also conducted to determine the relative importance of six commonly reported medicinal plants used in the treatment of stomach pain/'abdominal disorder', a common ailment in the district (Martin 1995). The traditional healers in the locality do treat livestock although the frequency of livestock disease is not comparable to human illness. Six traditional healers were given specimens of the medicinal plants and asked to arrange them based on their personal preference of efficacy. The medicinal plant supposedly most effective was given the highest score (6), while the one with the least effectiveness given the lowest score (1).

Threats to and trends in abundance of medicinal plants

In the study area preliminary investigation identified various human induced and natural factors possibly threatening the survival of medicinal plants. Five threatening factors were considered in this ranking: agricultural expansion, drought incidence, fire wood extraction, overgrazing, and construction. The relative importance of the threatening factors was ranked using priority ranking (Martin 1995). Priority ranking was based on the level of destructive effects of each threatening factor (1 to 5 scores were assigned where one is for the least and five the most destructive threat). Furthermore, abundance scores were established for some of the most commonly reported and valuable medicinal plants in the study area for the period 1970 to 2010. The procedure of abundance scores is adopted from Nanyunja (2003). The scores were used to reveal the trends in abundance of the selected species in the given time span. The scores used ranged from 0 to 2, where 0 is = none or almost none; 1 means a few or some; and 2 is for many.

Vegetation data and plant identification

Vegetation surveys were carried out both in homesteads and in the wild to assess the distribution of the most frequently reported plant species. A total of 18 quadrat plots (20 m x 20 m) were systematically established in the wild (12 quadrats) and in homesteads (6 quadrats) following the method of Tolassa (2007). The plots covered all habitat types occurring in the area: rocky/hilly areas, flat top mountain/plateaus, valleys and riverine areas, and plain areas. The homogeneity of each tree stand was checked through observation before laying down a sample plot. Three quadrats were established in each of the aforementioned habitat types. The remaining six quadrats were established by random identification of two homesteads from each study site. Then, counts of each species (presence or absence) were conducted in each quadrat.

Specimens of medicinal and other plants found to be major components of the vegetation of the district were collected and crosschecked for their local names with the help of key informants and development agents. Botanical names were established by comparing specimens with those at the National Herbarium, Science Faculty, Addis Ababa University using available floras (Bekele-Tesemma *et al*. 1993, Edwards *et al*. 1995, 1997, 2000, Fichtl & Admasu 1994, Hedberg & Edwards 1989, 1995, Hedberg *et al*. 2004, 2006, November *et al*. 2002).

Data analysis and presentation

Triangulation was employed to evaluate the validity of information collected using different surveying methods

(Mintsa-Mi Nzue 2009). Then, the data collected using different ethnobotanical methods such as questionnaire survey and interviews, along with the data in the form of scores were organized, entered and analyzed in Microsoft Excel. Data were subjected to descriptive analysis and percentages were generated. The data from ranking methods (direct matrix ranking, preference/priority ranking) were presented in the form of ranks where ranks were determined based on the total scores under each attribute. Pearson's correlation test was also run in SPSS 16.0 software (SPSS 2008) to find out the relationship between knowledge distribution by age and sex of respondents (Yineger & Yewhalaw 2007). Frequency and relative frequency of plant species (Martin 1995) were calculated for the vegetation data.

Results

Traditional medicinal plants reported and associated knowledge

The informants reported 68 plant species as medicinally important (Table 1). The plants belong to 44 families and 64 genera, with Euphorbiaceae and Fabaceae (six species each), and Cucurbitaceae and Solanaceae (three species each) being the most represented plant families.

Habitat, growth forms and plant parts used

Habitat

In the study area, majority of the medicinal plants (69%) were reported to be collected from the wild, 24% are do-

Table 1. Medicinal plants used to treat human/livestock ailments in Asgede Tsimbila District, Tigray Region, Ethiopia. Habits: T= tree, Sh= shrub, H= herb, C= climber. Parts used: R= root, L= leaf, F= fruit, Fl= flower, B= bark, ME= milky exudate, Yt= young twig. FMD = foot and mouth disease (livestock ailment)

Medicinal plants [Family]	Local name	Habit	Diseases treated	Parts used	Voucher number
Acokanthera schimperi (A. DC.) Benth. & Hook. f. [Apocynaceae]	**Mebtie**	Sh	Insecticide, anti-snake/ mouse	L	ZG-027
Agave sisalana Perrine ex Engelm. [Agavaceae]	**Eka**	H	Ear disease	S	ZG-011
Albuca abyssinica Jacq. [Asparagaceae]	**Shingurti-zibei**	H	Elephantiasis	R	ZG-054
Allium sativum L. [Amaryllidaceae]	**Tsaeda-shingurti**	H	Herpes virus, cough	R	ZG-066
Aloe vera (L.) Burm.f. [Xanthorrhoeaceae]	**Ere**	H	Sprain	R	ZG-028
Anogeissus leiocarpa (DC.) Guill. & Perr. [Combretaceae]	**Hanse**	T	Stomach pain, diarrhoea, malaria, wounds	B, L	ZG-032
Azadirachta indica A. Juss. [Meliaceae]	**Nim**	T	Anti-termite, petriasis versicolor, leech infestation, hen disease	L	ZG-001
Balanites aegyptiacus (L.) Delile [Xygophyllaceae]	**Mekie**	T	Abdominal problems, tuberculosis	F	ZG-008
Boscia angustifolia A. Rich. [Capparaceae]	**Kermed**	T	Evil sprit	Yt	ZG-044
Boswellia papyrifera (Del.) Hochst. [Burseraceae]	**Meker**	T	Diarrhea	B	ZG-014
Brassica rapa L. [Brassicaceae]	**Hamli-adri**	H	Wounds	L	ZG-050
Bridelia micrantha (Hochst.) Baill. [Phyllanthaceae]	**Abetere**	T	Scorpion bite	B	ZG-003
Buddleja polystachya Fresen. [Scrophulariaceae]	**Metere**	T	Headache, migrain	Yt	ZG-040
Calotropis procera (Aiton) W.T. Aiton [Apocynaceae]	**Gindiae**	Sh	Warts, swelling, inflammatory wounds	ME	ZG-012
Calpurnia aurea (Aiton) Benth. [Fabaceae]	**Hitsawutse**	Sh	Swelling, mange, tuberculosis, insecticide	R/L, F	ZG-030

Medicinal plants [Family]	Local name	Habit	Diseases treated	Parts used	Voucher number
Capparis tomentosa Lam. [Capparaceae]	**Andel**	Sh	Epilepsy, evil eye, evil sprit	R, B, S	ZG-018
Carica papaya L. [Caricaceae]	**Papayo**	T	Herpes virus, amoebas	L/Fl, F	ZG-048
Carissa edulis (Forssk). Vahl [Apocynaceae]	**Agam**	Sh	Evil eye, epilepsy	R	ZG-029
Cissus petiolata Hook.f. [Vitaceae]	**Alkie**	C	Mange, (FMD), snake bite, swelling of cattle, back pain in cattle	S, L	ZG-036
Citrus limon (L.) Burm.f. [Rutaceae]	**Lemin**	Sh	Cough, herpes virus, tuberculosis (**abay seal**)	F, L	ZG-060
Clerodendrum myricoides (Hochst.) R. Br. ex Vatke [Lamiaceae]	**Surbetri**	Sh	Sprain, headache, Epilepsy, Bovine pasteurellosis, Babesiasis	S, R, L, S	ZG-053
Combretum sp. [Combretaceae]	**Akuma**	T	Abdominal problems/ diarrhea, stomach pain	B/R	ZG-022
Cordia africana Lam. [Boraginaceae]	**Awhi**	T	Migraine, broken body/hand, wounds, gastritis/constipation	B/L, F	ZG-039
Croton macrostachyus Hochst. ex Delile [Euphorbiaceae]	**Tambok**	T	Rabies, spleenomegally, Ovine pasteurellosis, epilepsy, anti-termite, Hyper-blurbia	B, S, R, L	ZG-027
Cucumis dipsaceus Ehrenb. [Cucurbitaceae]	**Hafaflo**	C	Snake bite, insecticide, stomach pain/ diarrhea, tuberculosis	R	ZG-037
Cucurbita maxima Duchesne [Cucurbitaceae]	**Duba**	C	Tape worm	F	ZG-041
Cucurbita pepo L. [Cucurbitaceae]	**Hamham**	C	Evil eye, Dandruff, influenza	F, L	ZG-056
Datura stramonium L. [Solanaceae]	**Mezerbae**	H	Mange, teeth infection, stomach pain	L, F	ZG-009
Dichrostachys cinerea (L.) Wight & Arn. [Fabaceae]	**Gonok**	Sh	Sprain, inflammatory wounds	S, L	ZG-005
Diospyros mespiliformis Hochst. ex A. DC. [Ebenaceae]	**Aye**	T	Ring worm	F	ZG-023
Eucalyptus camaldulensis Dehnh. [Myrtaceae]	**Keyh-kelamitos**	T	Evil spirit/swells and wounds	L	ZG-031
Eucalyptus globulosus St.-Lag. [Myrtaceae]	**Tsaeda-kelamitos**	T	Cough	L	ZG-025
Euphorbia candelabrum Tremaut ex Kotschy [Euphorbiaceae]	**Kolonqual**	T	Swelling, spleenomegally	ME	ZG-046
Euphorbia tirucalli L. [Euphorbiaceae]	**Kinchib**	Sh	Warts, swelling, internal parasites, petriasis versicolor	ME	ZG-059
Flueggea virosa (Roxb. ex Willd.) Royle [Euphorbiaceae]	**Harmazo**	Sh	Sprain, rabies	R, Yt	ZG-017

Medicinal plants [Family]	Local name	Habit	Diseases treated	Parts used	Voucher number
Gardenia ternifolia Schumach. & Thonn. [Rubiaceae]	**Hatsinay**	T	Sprain	S	ZG-021
Grewia ferruginea Hochst. ex A. Rich. [Malvaceae]	**Tsinquayt**	Sh	Leech, Retained fatal placenta retention, fire burn	B, L	ZG-063
Jasminum abyssinicum Hochst. ex DC. [Oleaceae]	**Habi-tselim**	T	Tape worm, vomiting	L	ZG-051
Lepidium sativum L. [Brassicaceae]	**Shinfae**	H	Anthrax, stomach pain, tonsillitis, diarrhea	F	ZG-035
Maytenus senegalensis (Lam.) Exell [Celastraceae]	**Argudi**	T	Stomach pain	B	ZG-026
Maytenus arbutifolia R. Wilczek [Celastraceae]	**At-at**	Sh	Sprain	S	ZG-004
Nigella sativa L. [Ranunculaceae]	**Awesda**	H	Stomach pain	F	ZG-033
Olea europaea L. [Oleaceae]	**Awlie**	T	Colic	R/L	ZG-024
Ormocarpum pubescens (Hochst.) Cufod. ex J.B. Gillett [Fabaceae]	**Alendia**	Sh	Wounds	R	ZG-055
Otostegia integrifolia Benth. [Lamiaceae]	**Chiendog**	Sh	Insecticide	Wp	ZG-039
Phoenix reclinata Jacq. [Arecaceae]	**Siye**	T	Evil eye	R	ZG-016
Phytolacca dodecandra L'Hér. [Phytolaccaceae]	**Shibti**	C	Rabies, leeches, warts, herpes virus	R/F, L	ZG-038
Piliostigma thonningii (Schumach.) Milne-Redh. [Fabaceae]	**Amam-gemel**	T	Rectal prolapse	B	ZG-045
Pluchea dioscoridis (L.) DC. [Asteraceae]	**Shitene**	T	Anti-vomit	L	ZG-057
Plumbago zeylanica L. [Plumbaginaceae]	**Aftuh**	Sh	Anthrax, teeth infection, stomach pain/diarrhea	R	ZG-058
Rhamnus prinoides L'Hér. [Rhamnaceae]	**Gesho**	Sh	Tonsil, anthrax, hyper-bilirubinemia	L/Yt	ZG-002
Ricinus communis L. [Euphorbiaceae]	**Gulei**	T	Wounds	L	ZG-047
Rumex abyssinicus Jacq. [Polygonaceae]	**Moqmoqo**	H	Tuberculosis, teeth infections, abdominal problems, stomach pain	R	ZG-034
Ruta chalepensis L. [Rutaceae]	**Chena-adam**	H	Evil sprit	L	ZG-043
Schinus molle L. [Anacardiaceae]	**Tikur-berbere**	T	Herpes virus	L	ZG-052
Securidaca longipedunculata Fresen. [Polygalaceae]	**Shitara**	T	Evil eye, anthrax, stomach pain, abdominal problems	R/B	ZG-061
Senna singueana (Delile) Lock [Fabaceae]	**Hambo-hambo**	Sh	Teeth infection, stomach pain, sprain	L, R, B, S	ZG-010
Sida ovata Forssk. [Malvaceae]	**Dekidaero**	H	Inflammatory wounds, pus	L, R	ZG-020
Solanum incanum L. [Solanaceae]	**Engule**	H	Stomach pain, swelling, eye diseases, lumpyskin disease	R, B, F	ZG-015

Medicinal plants [Family]	Local name	Habit	Diseases treated	Parts used	Voucher number
Stereospermum kunthianum Cham. [Bignoniaceae]	**Adgi-zanay**	T	Broken/wounded/ bleeding body part	B	ZG-042
Tamarindus indica L. [Fabaceae]	**Humer**	T	Abdominal problems, hypertension, splenomegally	F	ZG-062
Terminalia brownii Fresen. [Combretaceae]	**Weyba**	T	Diarrhoea, hyper-bilirubinemia	B, L	ZG-019
Tragia cinerea (Pax) M.G. Gilbert & Radcl.-Sm. [Euphorbiaceae]	**Shashito**	C	Sprain, scorpion bite	R, L	ZG-049
Verbascum sinaiticum Benth. [Scrophulariaceae]	**Tirnaka**	H	Epistaxis/nasal bleeding, fire burn	F, L	ZG-053
Withania somnifera (L.) Dunal [Solanaceae]	**Agol**	Sh	Swelling/evil spirit, eye disease	R, L	ZG-006
Ximenia americana L. [Ximeniaceae]	**Mileo**	T	Anti-vomit, leech infestation, tonsillitis	L	ZG-022
Zingiber officinale Roscoe [Zingiberaceae]	**Zingible**	H	Stomach pain, corneal opacity	R	ZG-007
Ziziphus spina-christi (L.) Desf. [Rhamnaceae]	**Gaba**	T	Dandruff, stomach pain, tonsil, scorpion bite	L, B	ZG-013

mesticated and cultivated near the home, while 7% are semi-wild. The medicinal plants from the wild are distributed in forest patches, woodlands, shrub lands, rocky hillsides, around grazing and browsing lands, close to stream/river, roadsides, near farmlands, and spiritually protected areas. Cultivated medicinal plants in the area are *A. sativum*, *Aloe vera* (L.) Burm.f., *Azadirachta indica* A. Juss., *R. prinoids*, *R. communis*, and *Withania somnifera* (L.) Dunal.

Informant consensus and preference ranking

Plumbago zylanica L. was cited by 34 informants (47%); *Solanum incanum* L. was the second (28 informants, 39%). Anogeissus leiocarpa (DC.) Guill. & Perr. and *W. somnifera* ranked third (17 informants, 24% each). Favorite species in each locality were also reported on the basis of the number of citations given. *P. zeylanica* (54.2%) followed by *S. incanum* (41.2%) are of high preference in Alogien, while *P. zeylanica* (45.8%) followed by *W. somnifera* (29.2%) are most valued in Lemlem, and in Hintset, *S. incanum* (54.2%) followed by *P. zeylanica* (41.2%) are preferred.

Six informants selected among the local elders on the basis of the wealth of indigenous knowledge provided their preference ranking of six medicinal plants that are reported to be effective against abdominal disorders (Table 2).

Medicinal plants and their diversity of uses

Of the total medicinal species, 53 (77.9%) were reported to have multipurpose roles, while 15 (22.10%) have only medicinal values (Table 3). Direct matrix ranking (Table 4) showed that *Ziziphus spina-christi* (L.) Desf. is the most

Table 2. Preference ranking by six respondents of medicinal plants used for treating abdominal disorders in Asgede Tsimbila District, Tigray Region, Ethiopia.

Plant Species	Respondents						Total	Rank
	R1	R2	R3	R4	R5	R6		
Senna singueana (Delile) Lock	5	6	5	6	5	6	33	1st
Solanum incanum L.	6	4	6	3	4	5	28	2nd
Zingiber officinale Roscoe	4	5	4	5	6	3	27	3rd
Anogeissus leiocarpa Guill. & Perr.	2	3	1	4	3	4	17	4th
Ziziphus spina-christi (L.) Desf.	3	2	3	1	1	2	12	5th
Cucumis dipsaceus Ehrenb.	1	1	2	2	2	1	9	6th

Table 3. Service categories of medicinal plants in Asgede Tsimbila District, Tigray Region, Ethiopia.

Service categories	Number of species	% of total species
Medicine only	15	22.1
Medicinal plus other uses	53	77.9
Fuel wood and charcoal	37	54.4
Construction	18	26.5
Shade	16	23.5
Food/fruit	15	22.1
Fodder	14	20.6
Fence	8	11.8
Household furniture	7	10.3
Farm implements	5	7.4
Bee forage	5	7.4
Tooth brush	3	4.4
Spice	2	2.9
Gum and resin	1	1.5

preferred medicinal plant by the local people for its various uses, while *Cordia africana* Lam. was ranked second.

Current status and trends in abundance of medicinal plants

According to interview results, it is recognized that the vegetation cover of the locality has dramatically changed over time. Results of the vegetation survey (Table 5) showed that *Z. spina-christi* and *Calpurnia aurea* (Aiton) Benth. are the most common species each occurring in 14 (77.78%) of the quadrats surveyed. In order to assess trends in abundance of some of the most commonly reported medicinal plants in the district, abundance scores of seven medicinal plants for the period 1970 to 2010 were established (Figure 2).

Knowledge distribution of medicinal plants

Medicinal plant knowledge based on age and gender is reported in Figure 3. A Pearson correlation test indicated a positive and significant ($r = 0.335$, $p = 0.004$, $\alpha = 0.001$) correlation between age group and the number of species reported by the respondents in the study area.

Threats to conservation status of medicinal plants

Of five provided threats to medicinal plants (Table 6), agricultural expansion (26.7%) is the main threat to wild plant species. Overgrazing was relatively perceived to be least destructive factor (11.1%).

Discussion

Traditional medicinal plants reported and associated knowledge

The finding of Euphorbiaceae and Fabaceae (six species each), and Cucurbitaceae and Solanaceae (three species each) plant families as the contributor of higher number of species used for medicinal purposes is shared with similar studies elsewhere in Ethiopia (Gidey

Table 4. Average score for direct matrix ranking of seven medicinal plants in Asgede Tsimbila District, Tigray Region, Ethiopia. Use criteria (0= no use, 1= least, 2= less, 3= good, 4= very good and 5= excellent).

Use categories	Plant species scores							Total	Rank
	Ziziphus spina-christi (L.) Desf.	*Cordia africana* Lam.	*Tamarindus indica* L.	*Boswellia papyrifera* Hochst.	*Anogeissus leiocarpa* Guill. & Perr.	*Croton macrostachyus* Hochst. ex Delile	*Azadirachta indica* A. Juss.		
Fuel wood	5	4	4	4	4	3	3	27	1st
Construction	4	5	4	4	3	3	3	26	2nd
Medicine	4	4	3	3	3	5	4	26	
Shade	4	4	3	3	3	4	5	26	
Fodder	4	5	2	4	2	0	0	17	5th
Fruit/food	5	5	4	0	0	0	0	14	6th
Fencing	5	0	0	0	0	0	0	5	7th
Total	31	27	20	18	15	15	15		
Rank	1st	2nd	3rd	4th	5th				

Table 5. Most frequently occurring plant species in Asgede Tsimbila District, Tigray Region, Ethiopia. Uses: M (medicinal); E (edible fruits).

Species	Use	Positive number of quadrats with species	Frequency (%)	Relative Frequency
Ziziphus spina-christi (L.) Desf.	M,E	14	77.78	5.53
Calpurnia aurea (Aiton) Benth.	M	14	77.78	5.53
Cordia africana Lam.	M,E	13	72.2	5.14
Croton macrostachyus Hochst. ex Delile	M	13	72.2	5.14
Diospyros mespiliformis Hochst. ex A. DC.	M,E	12	66.67	4.74
Senna singueana (Delile) Lock	M	12	66.67	4.74
Acacia lahai Steud. & Hochst. ex Benth.		12	66.67	4.74
Ficus vasta Forssk.	E	12	66.67	4.74
Anogeissus leiocarpa (DC.) Guill. & Perr.	M	11	61.11	4.35
Dichrostachys cinerea (L.) Wight & Arn.	M	11	61.11	4.35
Carissa edulis (Forssk). Vahl	M,E	11	61.11	4.35
Trichilia emetica Vahl		11	61.11	4.35
Ficus sycomorus L.	E	11	61.11	4.35
Flueggea virosa (Roxb. ex Willd.) Royle	M,E	10	55.56	3.95
Rhus retinorrhoea Steud. ex Oliv.	E	10	55.56	3.95
Albizia amara (Roxb.) Boivin		10	55.56	3.95
Combretum hartmannianum C. Schweinf.		9	50	3.56
Combretum sp.	M	9	50	3.56
Dodonaea angustifolia L.f.		8	44.4	3.16
Tamarindus indica L.	M,E	8	44.4	3.16
Maytenus arbutifolia R. Wilczek	M	7	38.89	2.77
Balanites aegyptiacus (L.) Delile	M,E	7	38.89	2.77
Faidherbia albida (Delile) A. Chev.		6	33.33	2.37
Ximenia americana L.	M,E	6	33.33	2.37
Acacia polyacantha Willd.		6	33.33	2.37

2001, Hunde *et al*. 2006, Mesfin *et al*. 2009, Yineger *et al*. 2008). The number of traditional medicinal plants reported (68 species) and their uses by the local community (Tigryan people) is diverse and includes associated local knowledge on these resources and their applications. This is comparable to other ethnic groups in Ethiopia, i.e., the Gedeo people in southern Ethiopia who use 65 species (Mesfin *et al*. 2009), the Amhara people in northwestern Ethiopia who use 67 species and the Oromo ethnic group in southwestern Ethiopia who use about 67 species (Yine-

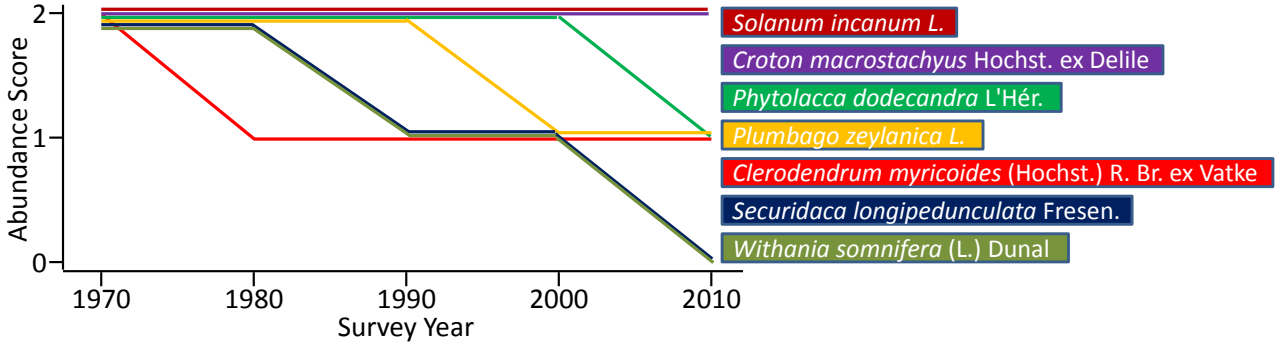

Figure 2. Trends in abundance of most commonly cited medicinal plants in Asgede Tsimbila District, Tigray Region, Ethiopia. Plant species abundance scores: 0 (none or almost none); 1 (a few or some); and 2 (many).

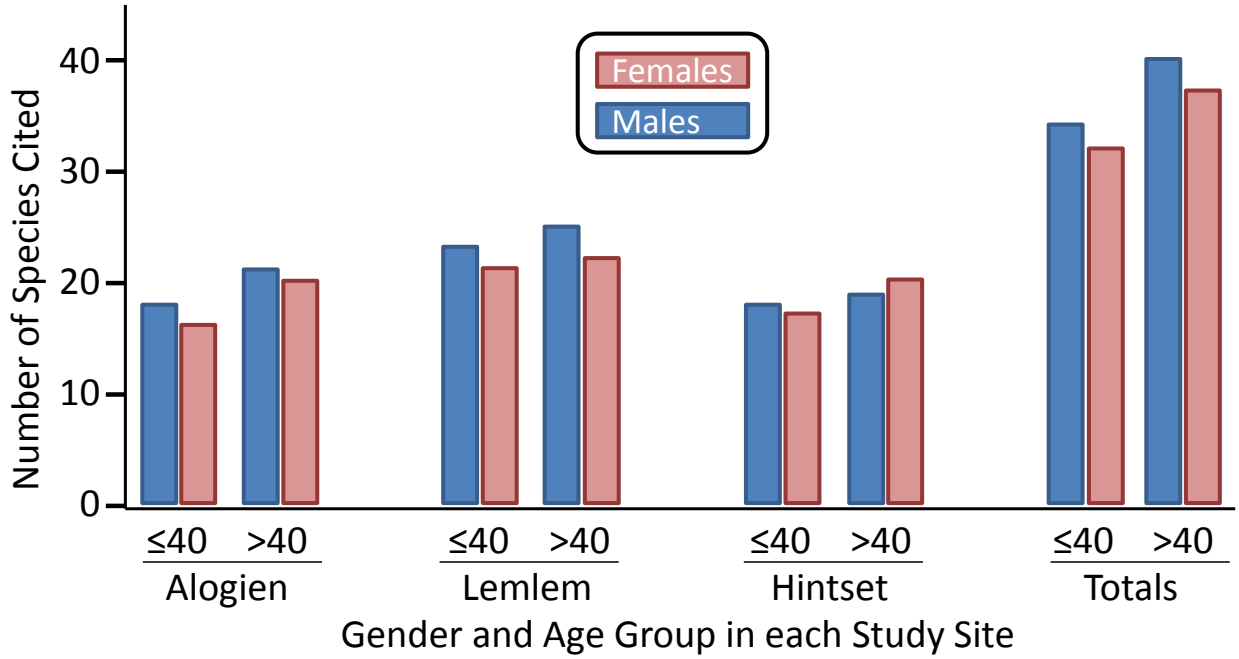

Figure 3. Medicinal plant knowledge base by age and gender in Asgede Tsimbila District, Tigray Region, Ethiopia.

ger *et al*. 2008). Other studies came up with even higher number of species used among some of the major ethnic groups in the country. For instance, the Oromo people (the major ethnic group in Ethiopia) residing in Mana Angetu district, southeastern Ethiopia make use of 230 species (Lulekal *et al*. 2008) and the Konta people in southern Ethiopia make use of about 120 species (Hailemariam *et al*. 2009). On the other hand, the Zay people use relatively fewer species (33) (Gidey 2001). This could be an indication for the assumption that the loss of tradition (cultural shift) in minorities is greater than in larger groups (Luseba & Van Der Merwe 2006).

Although the dose and mode of application may vary, an appreciable number of the medicinal plants recorded in this study are also medicinally important in other parts of Ethiopia (Amenu 2007, Gidey 2001, Hunde *et al*. 2006, Teklehaymanot & Gidey 2007). Some of the plants that were reported in common include; *Allium sativum* L., *Calotropis procera* (Aiton) W.T. Aiton, *Capparis tomentosa* Lam., *Carica papaya* L., *Carissa edulis* (Forssk). Vahl, *Clerodendrum myricoides* (Hochst.) R. Br. ex Vatke, *C. africana*, *Croton macrostachyus* Hochst. ex Delile, *Euphorbia tirucali* L., *Phytolacca dodecandra* L'Hér., *P. zylanica*, *Rhamnus prinoides* L'Hér., *Ricinus communis* L., *S. incanum*, *W. somnifera* and *Z. spina-christi*. These similarities indicate the wide use of medicinal plant species and the existence of associated knowledge shared among ethnic groups in Ethiopia. The fact that some of the reported plants are having similar uses elsewhere in the world supports their likely pharmacological effectiveness having been tested in different areas by different cultures (Hailemariam *et al*. 2009).

The medicinal plants were reported as being used for the treatment of about 50 different health problems (28 ailments in humans, 10 in livestock and 12 in both). While the majority of medicinal plants reported were used to treat human health problems (48 species, 70.6%), three species (4.4%) were used to treat livestock ailments and 17 species (25%) were used to treat ailments common to both. The study also showed that the highest propor-

Table 6. Priority ranking (1=least, 5=most) by six respondents of threatening factors based on their level of destructive effects in Asgede Tsimbila District, Tigray Region, Ethiopia.

Threatening Factors	Respondents						Total	%	Rank
	R1	R2	R3	R4	R5	R6			
Agriculture	4	2	4	5	5	4	24	26.7	1st
Firewood	3	5	5	3	4	3	23	25.6	2nd
Drought	5	1	3	4	2	5	20	22.2	3rd
Construction	2	4	2	2	1	2	13	14.4	4th
Over-grazing	1	3	1	1	3	1	10	11.1	5th

tion of medicinal plants was used for treating abdominal disorders (35.3%), then wounds (17.6%) in humans, and anthrax (5.9%), followed by mange, leech and epilepsy (4.4% each) in livestock. The term abdominal disorders, in this context, is a general term for a wide range of bowel (intestinal) related ailments which may be caused by bacteria, protozoa or parasitic worms. Although fewer medicinal plants are used to treat livestock diseases than for humans, most informants reported that in most cases they treat livestock problems with traditional medicine and rarely look for modern medications. This may be attributed to the limited veterinary services in the rural areas, economic factors and the trust the local community developed in these plants treating livestock health problems.

Traditional medicine was preferred to modern medical systems in treating herpes virus (**almaz**), epilepsy (**tezwur**), snake bite (**niksit temen**), evil eye (**buda**), rabies (**himam ebud kelbi**), anthrax (**megerem**), and abdominal disorders (**kurtset kebdi**). Modern medicine is not recommended at all for herpes virus, with the notion that modern medication for such diseases may have ill effects on the patient. However, no such taboos were reported by the informants associated with the use of traditional medicinal plants, except that there could be ill effects due to the lack of proper dosage.

Habitat, growth forms and plant parts used

Habitat

Medicinal plant source habitats in the study area are consistent with the findings of Yineger and Yewhalaw (2007) where most of the medicinal plants (85.7%) utilized in southwestern Ethiopia were harvested from the wild. Of the cultivated plants, only *W. somnifera* and *A. vera* were cultivated primarily for their medicinal values. Therefore, wild habitats are the major pool of medicinal plant resources for the local community.

Our observation is in agreement with previous reports from Ethiopia. Medicinal plants cultivated in home gardens were found to be 6% (Asfaw 1997) and 8.7% (Tolassa 2007). In the same vein, ethnobotanical study of medicinal plants in Bale Mountains National Park, southeastern Ethiopia (Yineger *et al*. 2008) and in the central Rift Valley of Ethiopia (Gidey 2001) confirmed that there is little practice of domesticating medicinal plants. The fact that most of the medicinal plants are found in the wild also poses a threat to their existence if habitats are destroyed. This concern is shared by other authors (Hailemariam *et al*. 2009, Hunde *et al*. 2006) who have called for a timely intervention for their conservation. There is need for coordinated conservation action, based on both *in-situ* and *ex-situ* strategies (Hamilton 2003) through the recognition and accommodation of local community knowledge, interests and priorities (Quansah 2004).

Growth forms

The results of growth form analysis (Figure 4) implies that majority of the medicinal plants in the study area are woody. This is not surprising since these are the dominant forms in the dry flora of the area. Herbaceous plant forms can not withstand drought and, in most cases, they are likely being over-utilized (including the whole plants). Thus, they were only rarely encountered in the study area.

Contrary to our findings, a relatively higher number of shrubs and herbs were previously reported elsewhere in Ethiopia (Amenu 2007 in western Ethiopia, Hailemariam *et al*. 2009 in the low lands of southwestern Ethiopia). Similarly, other studies undertaken in Boosat subdistrict, central eastern Ethiopia (Hunde *et al*. 2006), in Gimbi district, western Ethiopia (Tolassa 2007), in Wonago district, southern Ethiopia (Mesfin *et al*. 2009), and in Mana Angetu district, southeastern Ethiopia (Lulekal *et al*. 2008) showed that shrubs, followed by herbs and trees are the most frequently used growth forms. These variations could be attributed to agro-ecological diversity of the country that favors different plant forms, and socio-cultural factors which determine specific knowledge in different communities (Bekele 2007).

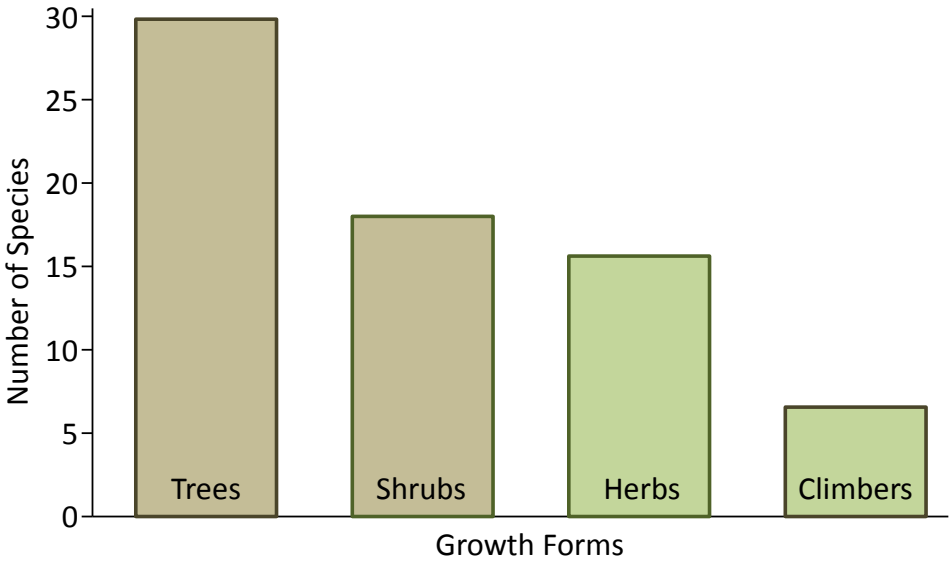

Figure 4. Distribution of medicinal plants by growth forms in Asgede Tsimbila District, Tigray Region, Ethiopia.

Plant parts used

With regard to plant parts used medicinally, leaves (48.5%) followed by roots (32.4%) are the most commonly used. Previous works carried out elsewhere in Ethiopia also revealed that leaves followed by roots were the most common parts (Amenu 2007, Gidey 2001, Hailemariam *et al*. 2009, Ragunathan & Solomon 2009). Other reports showed roots to be the most widely used plant parts (Hunde *et al*. 2006, Lulekal *et al*. 2008, Mesfin *et al*. 2009).

Studies have shown that removal of up to 50% of tree leaves does not significantly affect plant growth (Poffenberger *et al*. 1992). However, medicinal plant harvest involving roots, rhizomes, bulbs, bark, stems or whole parts have grave consequences both from an ecological point of view and for the survival of the mother plants (Abebe & Ayehu 1993, Gidey 2001, Hunde *et al*. 2006). Given that leaves constitute the most frequently sought plant parts in this study, the threat to the destruction of medicinal plants due to plant part extraction appears minimal. Nonetheless, the fact that roots and bark provide the next largest proportion may warrant a possible conservation threat. For example, medicinal plants such as *Securidaca longipedunculata* Fresen., *Aloe* sp., *C. myricoides* and *P. zeylanica* L., which are harvested for their roots, are scarce, perhaps because of medicinal use. Therefore there is need to pay special attention to determine their status and what measures should be taken to ensure their conservation (Gidey 2001).

Informant consensus and preference ranking

Informant consensus values give good indications about species that serve for particular health problems. Such information underlines the ethnopharmacological significance of medicinal plants in an area (Hailemariam *et al*. 2009). Some medicinal plants are more popular because they are more familiar to informants being widely recognized due to the wide range of indications in the locality. Other species may have received higher consensus scores due to local abundance and easy access. In general, medicinal plants with higher informant consensus need to be seriously considered for further ethnopharmacological studies since they are species widely applied by many people and probably have been utilized for a long time (Macia *et al*. 2005). The results imply that species preference within the study sites (sub-districts) did not vary greatly as species distribution, traditional ecological knowledge and economic pursuits of the communities are essentially similar.

Preference ranking (Table 2) showed that *Senna singueana* (Delile) Lock and *S. incanum* were ranked first and second thus are considered locally to be the most effective medicinal plants treating abdominal disorders. This is likely due to active anti-microbial substances present within these plants. Therapeutic activity of *S. incanum* extracts has been attributed to the presence of flavonoids, chlorogenics, adenosine, glycopyranoside, solasodine and phenylalkanoic acids (Beaman-Mbaya & Muhammed 1976, Mwonjoria *et al*. 2011).

Medicinal plants and their diversity of uses

Local people in the study area harvest plants with medicinal values for a variety of other uses; mostly for firewood and charcoal, construction, fodder and production of equipment (farm implements and furniture). In line with our results (Table 3), Tolassa (2007) reported that 78.82% of the total medicinal plants used by local people in western Ethiopia have multipurpose roles. The utilization of medicinal plants for variety of added values may result in additional pressures to these resources. This calls for practical solutions like domestication, *in-situ* conservation, and introduction of other tree species for non-medicinal uses to reduce pressures on the medicinal plants (Tolassa 2007).

In order to assess their relative importance of multi-use plants to the local people and the extent of the existing threats related to their use values, seven common multipurpose species and seven use categories were taken and direct matrix ranking was conducted (Table 4). The seven multipurpose species were selected because they were among the most commonly encountered species, and were reported in equal frequency before the ranking exercise. The results showed that the local people harvest the seven multipurpose species mainly for fuel wood which ranked first. The lowest category is for fencing. These observations may indicate that the sustainability of the top-ranking (most preferred) species may be threatened particularly in view of the daily demand of the local community for these resources (Amenu 2007).

Current status and trends in abundance of medicinal plants

According to interview results (Table 5), it is likely that the vegetation cover of the locality has changed over time. Obviously, there is a chance of finding plant species either clumped together in one spot or evenly distributed in a given area. Similarly, this study revealed that about 60% of the most frequent plants in the district are medicinal plants (Table 5). Nevertheless, medicinal plants that received the highest informant consensus are not frequently distributed in the district. This is consistent with Tolassa (2007) where some medicinal plants (e.g., *Warburgia ugandensis* Sprague) were reported to be less frequently distributed in the face of over utilization and habitat destruction even though they received the highest informant consensus among indigenous people in Gimbi district, western Ethiopia. A similar study undertaken in the central rift valley of Ethiopia (Gidey, 2001) has also reported the abundance of valuable medicinal plants (e.g., *S. longepedunculata*) to be decreasing with time. These observa-

tions indicate that valuable medicinal plants in different parts of the country are being depleted. This could be due to the fact that they are over utilized for diversity of uses and disappeared from some parts, or that the destruction of their habitat through deforestation restricted their occurrence to only some sites.

Abundance scores for seven medicinal plants (Figure 3) show five species have declined with time. Only two remained constant within the given period. Therefore, the abundances of a majority of the medicinal plants declined within the given period. Some of these (e.g., *W. somnifera* and *S. longepedunculata*) have shown dramatic declines. The decreasing trend in abundance of medicinal plants could be attributed to the fact that most of the species are heavily harvested because of the multiple uses they have. A similar observation was made in Uganda by Nanyunja (2003) where he stated that the trend in abundance of medicinal plants could be related with the multiple uses of the species.

In general, wild vegetation resources including medicinal plants in different parts of the country are continuously shrinking. The loss of medicinal plants could be due to multiple factors such as deforestation (expansion of agriculture), charcoal production, cutting trees for construction, and fire wood collection, among others. These resources are openly accessed. Repeated drought incidences and poverty (the lack of livelihood options) have aggravated the situation. Drought in the 1970s was mentioned by informants as a major historical event which contributed to the degradation of plant resources.

Knowledge distribution of medicinal plants

Knowledge distribution of medicinal plants was compared between those ≤40 years and >40 years, and between gender (Figure 4). Those older than 40 years tended to cite a higher number of medicinal plants. This is comparable with the findings of Gidey (2001) who found that those above 40 identified more medicinal plants among the Zay people of Ethiopia. A similar observation was also reported by Hunde *et al*. (2006) and Tolassa (2007). A higher number of species was also reported by males in each locality.

Gidey *et al*. (2009) also a significantly higher number of medicinal plants are reported by informants above 40 years of age among the Bench ethnic group. However, Yineger and Yewhalaw (2007) reported a statistically insignificant correlation between age and the number of medicinal plants by the local people in Jimma zone, south western Ethiopia. This could be related to knowledge acquisition by the lower age class in that locality. In the present study, the reason elders are more knowledgeable is due to their personal experiences using these plants. The difference in the perception of the two age classes concerning the utilization of traditional medicinal plants will likely result in the loss of plant lore over time (Abebe *et al*. 2003, Hunde *et al*. 2004).

No significant correlation between gender and the number of species reported was found ($r = -0.034$, $p = 0.778$, $\alpha = 0.05$). A similar observation was reported on Himalayan medicinal plants (India) (Bisht *et al*. 2006). In contrast, Gidey *et al*. (2009) reported a positive and significant correlation between gender and the number of species reported among the Bench ethnic group. In general, various studies in different areas in the country demonstrated the existence of knowledge variations and similarities among social groups. This could be attributed to variation in the cultural and socio-economic aspects of each social group.

Threats to conservation status of medicinal plants

The study revealed that medicinal plants are under pressure from various anthropogenic and natural factors. Local people's perceptions of factors threatening the medicinal plants were determined through priority ranking among some selected informants (Table 6). Pressures from agricultural expansion, wide spread cutting for fuel wood combined with seasonal drought have been reported by Balemie *et al*. (2004), Mesfin *et al*. (2009) and Lulekal *et al*. (2008) as main factors for environmental degradation as well as the depletion of medicinal plants. In general, several studies in different parts of Ethiopia have shown that wild plant resources including medicinal plants are subjected to a number of anthropogenic and natural factors such as agricultural expansion, collection for fuel and construction, recurrent drought and overgrazing.

As for conservation status, most of the medicinal plants in the study area have no protection since they are harvested from the wild with no evident conservation practices. The few cultivated medicinal plants (e.g., *P. zeylanica*, *W. somnifera* and *Aloe* sp.) are being conserved near homes. This urges the need for participation of local people and awareness creation through training or education on sustainable utilization and management of plant resources in general and the medicinal plants in particular.

Conclusion and Recommendations

The study revealed that the area harbors a diversity of medicinal plants, and associated knowledge. Local people depend on medicinal plants to meet their basic health care needs. The dependency on these plant resources is associated with easy access, perceived efficacy, and cultural values attached to the plants. Medicinal plants are also sources of added value (e.g., wood extraction for fuel and construction, fence, fodder and production of different equipment). Majority of the medicinal plants in the district are woody species (trees and shrubs) that are collected mainly for their leaves. *P. zeylanica*, *S. incanum*, *A. leiocarpa*, *W. somnifera* and *S. longepedunculata* are the most commonly reported medicinal plants in the subdis-

trict. Age is an important factor responsible for ethnomedicinal knowledge variations with older people being more knowledgeable.

Abundance of medicinal plants is declining because of both anthropogenic and natural factors. Knowledge of medicinal plant use is probably declining through failure to transfer from the elderly to the young due to fading interest of the young. The main threats for these resources emanates from agricultural expansion, wood extraction, recurrent drought, and overgrazing. Conservation efforts are poor. Consequently, plant species will likely be lost unless timely conservation measures are launched. In this regard, public awareness and community based management activities need to be encouraged. Attention should also be geared towards research and development on various aspects of the plants such as biology, ecology, silviculture and management of the species and phytochemical activities.

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