Ethnobotanical Study of Medicinal Plants in two Cultures: Hadiya and Yem Peoples, SNNPR, Ethiopia

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Ethnobotanical Study of Medicinal Plants in two Cultures: Hadiya and Yem Peoples, SNNPR, Ethiopia

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This is to certify that the Dissertation prepared by Gideon Woldemariam Gebresilase, entitled: *Ethnobotanical Study of Medicinal Plants in two Cultures: Hadiya and Yem Peoples, SNNPR, Ethiopia* and submitted in fulfillment of the Requirements for the Degree of Doctor of Philosophy (Biology: Botanical Sciences) complies with the regulations of the University and meets the accepted standards with respect to originality and quality

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ABSTRACT

Ethnobotanical Study of Medicinal Plants in two Cultures: Hadiya and Yem Peoples, SNNPR, Ethiopia
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This investigation was carriedout between 2013-2016 in five districts of SNNPR (Anlemo, Duna, Gibe, Gombora and Yem) with the objective of documenting and analyzing traditional medicinal plants (MPs) and the health care knowledge of the society. Vegetation data were gathered from 123 quadrats each 30x30 m laid in different land use types in the districts. Clustering was undertaken to identify plant communities, Shannon-Weiner Index was calculated to evaluate the diversity of species, Sorenson's coefficient was calculated to assess similarity in species, and ordination was performed to identify the effects of environmental factors plant communities. Ethnobotanical data were gathered from 399 general and 102 key informants through individual interviews, focus group discussions, participant observation, market surveys and guided transect walk. Quantitative ethnobotanical tools including Preference Ranking, Direct Matrix Ranking, Informant Consensus Factor, Fidelity Level, Use Value, Relative Impotrance and Use Diversity indices were calculated to identify most culturally important MPs. A total of 468 species of vascular plants were recorded from vegetation data. Five plant communities were identified in Hadiya and three in Yem. The communities had diversity indices between 3.35-4.89 and evenness 0.87-0.97. Monte Carlo test showed that altitude, slope, aspect and disturbance in Yem, and three of the former in Hadiya had significant effects on the distribution of plant communities ($p<=0.001$-0.03). The most frequently reported growth forms were herbs (45%) for human health and shrubs (30%) for livestock health and they were mainly collected from wild habitats. The Hadiya and Yem people most frequently used leaves for treating both human and livestock ailments. Asteraceae for human and Fabaceae for livestock health were MPs richest families in all districts. The top perceived threats of loss of MPs in all districts were agricultural expansion, firewood and charcoal while modernisation was considered responsible for loss of MPK. Dermatological human ailments scored the highest ICF (0.95) in Gombora while ailments of gastrointestinal system & visceral organs scored the least ICF (0.82) in Yem. Reproductive & urogenital livestock ailments had the highest ICF (0.92) in Duna while musculoskeletal, sensory & miscellaneous category had the least ICF (0.78) in Yem. Among MPs that scored 100% FL for human ailments were Vernonia myriantha, Stephania abyssinica, Securidaca longepedunculata, Englerina woodfordioides and Inula confortiflora in Anlemo, Duna, Gibe, Gombora and Yem, respectively. Similarly, among EVMPs that scored 100% FL were Croton macrostachyus, Kalanchoe schimperiana, Securidaca longepedunculata, Asparagus africanus, Haplocarpha rueppellii in Anlemo, Duna, Gibe, Gombora and Yem, respectively. The calculated UV and RI showed that C. macrostachyus is the most culturally important species, most exploited and locally threatened in all districts. MPK was significantly different between Yem (mean =13.40) and Hadiya (mean = 10.35) ($p < 0.001$). Gender, marriage, age, religion and informant skill had significant contribution to MPK of human and livestock health in Hadiya ($p =< 0.001$-0.048) while the former four variables were not significant in Yem indicating MPK is variably dependent on these variables in the study sites. Conservation of MPs was found to be associated with gender and age in both Hadiya and Yem ($p = 0.001$-0.003). The people of the study area were known to utilise TMPs side by side with the mainstream biomedical system for maintaining both human and livestock health. The remnant forests and different land uses are still reservoirs for high diversity of medicinal and other useful species in the study area. Conducting phytochemical screening and clinical trials of the MPs with high informant consensus and FL including Englerina woodfordioides, Stephania abyssinica, Securidaca longepedunculata, Lysimachia ruhmeriana and Vernonia myriantha is suggested in the first priority line for their efficacy, safety and standard uses.

Key words: Hadiya, health care, human ailments, medicinal plants, veterinary ailments, vegetation, Yem

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DEDICATION

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LIST OF ACRONYMS

AnANRMO	Anlemo District Natural Resources and Agriculture Office
AnDHO	Anlemo District Health Office
CBD	Convention on Biodiversity
CTSCA	Culture, Tourism & State Communication Affairs of Districts
DDHO	Duna District Health Office
DMR	Direct Matrix Ranking
DNRAO	Duna District Natural Resources and agriculture Office
EBI	Ethiopian Biodiversity Institute
EVM	Ethnoveterinary medicine
EVMPs	Ethnoveterinary medicinal plants
FAO	Food and Agriculture Organisation of United Nations
FL	Fidelity Level
GDHD	Gibe District Health Department
GmHD	Gombora District Health Department
HZFEDD	Hadiya Zone Planning & Economic Development Department
IBC	Institute of Biodiversity Conservation
ICF	Informant Consensus Factor
IGAD	Intergovernmental Authority on Development
ILRI	International Livestock Research Institute
IUCN	International Union for Conservation of Nature
MEA	Millennium Ecosystem Assessment
MPs	Medicinal Plant Species
MoA	Ministry of Agriculture
MoH	Ministry of Health. Addis Ababa, Ethiopia
MPK	Medicinal Plant Knowledge
NAMSA	National Metrological Services Agency
NBSAP	National Biodiversity Strategy and Action Plan
PBBMD	Plant Biology and Biodiversity Management Department
PR	Preference Ranking
RI	Relative Importance
SNNPR	South Nations, Nationalities and Peoples Regional State
TM	Traditional Medicine
TMPs	Traditional Medicinal Plants
TMPK	Traditional Medicinal Plant knowledge
UD	Use Diversity"
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UV	Use Value
WHO	World Health Organization
WIPO	World Intellectual Property
WWF	World Wild Life Fund for Nature
YSDFEDD	Yem Special District Finance & Economic Development Department
YSNRAO	Yem Special District Natural Resources and Agriculture Off

CHAPTER ONE

1. INTRODUCTION

1.1 Background

All levels of biodiversity in general, and plant biodiversity in particular provide wide range of goods and services that are essential in supporting human health, wellbeing and the provision of livelihood (Wilson, 1991; Pearce and Moran, 2001; Pearce and Pearce, 2001; Khan *et al.*, 2013; Laurance *et al.*, 2014b; WHO and CBD, 2015). The plant biodiversity that are contained in the natural vegetation and other landscapes of the world have been reservoirs for plant species that provide resources for maintaining human health which are eventually proved to contain secondary bioactive compounds that are useful for traditional medicines and pharmaceutical manufacturing of a number of modern drugs (Farnsworth and Soejarto 1985; Balick and Mendelson, 1992; Rosenthal and Berenbaum, 1992; Elisabetsky and Laird, 1998; Rajora and Mosseler, 2001; Alamgir, 2017). Based on estimates made so far, about 35,000 - 72,000 species of world's flora have been utilized for medicinal purpose (Farnsworth *et al.*, 1991; Schippman *et al.*, 2002). Medicinal plants thus play a vital role in the maintenance of human health throughout the world and notably in the tropics. About 70-95% of the world's population, Asia, Latin America and in Africa including Ethiopia depends on TM mainly on botanical medicines that are obtained from natural forests and different anthropogenic areas and land uses as their first line of treatment in part due to inaccessibility and inadequate access of modern health care services and partly because of cultural acceptability of TM (Sofowora *et al.*, 2013; WHO and CBD, 2015; Oyebode *et al.*, 2016).

Ethiopia is one of tropical countries possessing rich ethnic diversity and the second largest human population that is dependent on natural flora which contains about 6,000 species for maintaining health care and earning livelihood (Levine 1974; Hedberg *et al.*, 2009; FAO, 2010; UNESCO, 2015). Estimates show that about 80% of human population and 90% of livestock health care in the country is based on TMPs (Dawit Abebe and Ahadu Ayehu, 1993; WHO, 2002). The people in the different cultures of the country have millennia old ethnobotanical knowledge beliefs, and practices about plant species growing in different vegetation and land

use types that used for TM of human and livestock health and this system of medicine has been normative and integral part of health care system in the country (Levine 1974; Pankhurst, 2001; Kebede Deribe *et al.*, 2006). The societies of the country obtain the MPs mainly from natural vegetation types and different land uses that are found in the various agroecological zones of Ethiopia (Edwards, 2001). About a third of the country's plant families have been already employed in traditional medicinal practices (Mesfin Tadesse and Sebsebe Demisew, 1992). So far about 1000 MPs have been documented out of which some 300 species are widely used and frequently cited while there exist big potential of unexplored flora and cultures that contribute for the development of health care system of the country (IBC, 2012). However, the TMPK is currently threatened due to modernization and current trends of economic globalization that promote homogeneity of global culture which leads to abandonment TK among new generation, the secrecy of the TMPK itself and the migration of rural populations to urban areas (Pankhurst, 2001; Zent, 2001; Najma, 2011). Similarly, the vegetation that is home for biodiversity including traditional MPs across the country are dwindled and fragmented as it is in other tropical countries mainly due to different human induced and natural drivers such as agricultural expansion and intensified cultivation, deforestation for modern development and privatized investment of monocultural farming system that is assisted with application of technologies, overharvesting of species, soil erosion, grazing and global warming (Ensermu Kelbessa *et al.*, 1992; WHO *et al*., 1993; Zerihun Woldu, 1999; Ensermu Kelbesa and Edwards, 2001; Pankhurst, 2001; Zemede Asfaw, 2001; Leonti *et al.*, 2003; Hamilton, 2004; Vivero *et al*., 2006; FAO, 2012b). Therefore, is urgent need of documenting and analysing the existing rapid loss of plant biodiversity and traditional TMK for maintaining health care of human and livestock.

Earlier efforts documentation of Ethiopian MPs and associated TK were made by European travelers, anthropologists, historians and naturalists which have considerable contributions since long times (Pankhurst, 2002). However, these were focused mainly to the northern Ethiopian Christian culture. The later pioneering efforts of 20th century were great botanical work of Austrian national Georg Cufodintis - 'Enumeratio plantarum Aethiopae Spermatophyta (Bulletin du Jardin Botanique del Etat, 1955)' and the Glossary of

Ethiopian plant names by Harold F. Mooney's (1963) (Pankhurst, 2002). The contribution of ethnobotanical works by Ethiopian and few foreign scholars cameup in the late 20th century with focus on listing of the TMPs such as that of Amare Getahun (1976), Gelahun Abate *et al*. (1976), Kloos (1976), Jansen (1981), Dawit Abebe (1986), Gelahun Abate (1986), Dawit Abebe and Ahadu Ayehu (1993), Mesfin Taddese (1986), Mesfin Tadesse and Sebsebe Demissew (1992), Abinik (1995), Fekadu Fullas (2001). In recent decades, both project based regular researches and academic based graduate studies in higher learnings mainly in Addis Ababa University flourished with themes of basic researches on ecology and diversity of MPs and documentation of associated knowledge among the diverse cultures of the country and applied phytochemical researches on scientific justification of TMPs (Sebsebe Demissew and Ermias Dagne, 2001, Sebsebe Demissew, 2011). The comtemporary ethnobotanical reseaches are becoming more advanced by employing both qualitative and hypothetico-deductive quantitative methods. The important ethnobotanical works in this regard include the works of Zemede Asfaw (2001), Mirutse Giday (2003), Mirutse Giday (2007), Tilahun Teklehaymanot and Mirutse Giday (2007), Ermias Lulekal *et al.* (2008), Fisseha Mesfin *et al.* (2009), Mirutse Giday *et al.* (2009), Seyoum Getaneh (2009), Tesfaye Hailemariam *et al*. (2009), Alemtsehay Teka *et al.* (2015), Ermias Lulekal (2014), Husien Adal (2015), Melese Maryo (2015), Tadesse Beyene (2015), Feleke Woldeyes *et al.* (2016) and Tenna Regassa (2016). These researches contributed considerable efforts to the existing database of medicinal flora and associated indigenous traditional medicinal plant knowledge in different cultures and planning conservation programmes on those medicinal species which are threatened. In these and other similar works, the expanding methodological scope has been studied with deepening understanding of MPs and IK on their uses and management. However, there exist still unexplored vast cultures and ethnicities in the country that need more ethnobotanical investigations on MPs and traditional medicinal folklore. The current study focuses on two of such cultures: Hadiya ethnic group (with focus on four districts: Anlemo, Duna, Gibe, Gombora) and Yem ethnic groups which have distinct sociocultural backgrounds that are located in southern part of Central Plateau along Gibe watershed on the Dry Evergreen Afromontane Region of Ethiopia.

1.2 Statement of the Problem

The Dry Afromontane Region of the country is generally characterised by harbouring high human population that is dependent on natural vegetation for maintaining health care and earning livelihood which inturn puts enormous pressure on forests and their biological resources with a consequent threats to wild species (Reij *et al*., 1996; Zerihun Woldu, 1999; FAO, 2010; Perrings and Halkos, 2015). As inhabitants of the Dry Afromontane Region, the study area of this research, both Hadiya and Yem people are heavily dependent on forests and agrobiodiversity for earning livelihood as a whole and for maintaining human and livestock health care in particular. People of both cultures have deeprooted and ancient traditional knowledge of of managing human and livestock health ailments and health conditions. Eventhough, the current government provided mainstream biomedical system showed better coverage than before in Districts of Anlemo, Duna, Gibe, Gombora and Yem Special District, people of these areas still use TMPs and consult local herbal experts for a number of ailments and health conditions of human livestock due to cultural trust and economic reasons. The TMPs are obtained from remnant forests and different land uses types. However, the four districts of Hadiya support dense human and livestock population relative to land mass where natural vegetation is degraded and left with few fragments of natural vegetation and relict stands of indigenous trees and shrubs associated herbs that contain MPs are scattered in secondary regrowths due to heavy agricultural expansion, fuel wood and charcoal extraction and livestock grazing pressure. The TMPK is also threatened due to reasons mentioned earlier. Consequently, the area suffers from a loss of indigenous plant biodiversity accompanied by loss of TMPK, acculturation and climate change. This is also true in the case of Yem whose population has a high dependence on the products of the existing natural vegetation which negatively affected the existing TMPs along the natural vegetation. The threat of MPs and other factors aforementioned also threatened TMPK of people of the Special District. To fill this gap, conducting floristic analysis and ethnobotanical investigation and documentation of the remnant flora and associated indigenous knowledge of both sociocultural groups is a step forward for effecting conservation measures for MPs and associated TK in both cultures.

There are few preliminary ethnobotanical reports from some districts of Hadiya Zone such as that of Habtamu Agisho *et al*. (2014), Tamiru Temam & Asalifew Dillo (2016) in Badwacho, Mulugeta Kebebew and Erchafo Mohamed (2017) indigenous knowledge on use of medicinal in Anlemo District. However, there are no studies on remnant natural vegetation and in-depth ethnobotanical investigations previously conducted in Hadiya Zone as a whole and Anlemo, Duna, Gibe, Gombora Districts in particular. Similarly, in Yem also except a single report on agroforestry uses and practices of indigenous trees by Gezahegn Kassa *et al*. (2015) and inventory of woody species in Kumuli natural forest by Gideon Woldemariam *et al*. (2016), there were no previous ethnobotanical reports or investigations. To this end, the current study aimed at documenting the flora that harboring MPs and in-depth investigation of ethnobotanical knowledge on utilization and conservation of MPs and associated indigenous knowledge used for the maintenance human and livestock health care in the cultures of Hadiya (focusing on Anlemo, Duna, Gibe and Gombora Districts) and Yem ethnic groups in the southern central Ethiopia.

1.3 Research Questions, Hypotheses and Objectives

1.3.1 Research Questions

The present study tries to answer the following research questions;

a) What is the floristic diversity, what are the plant community types and which of the environmental factors affect their distribution in Anlemo, Duna, Gibe, Gombora and Yem Districts?

b) What are the human and livestock ailments, which plant species available are used for TM, what are the diversity of MPs in the plant communities, which of the communities contain abundant and rare species in the wild, and which of the MPs are traded in the local markets of the study districts?

c) What is the perception of the local communities and the biomedical practitioners regarding the use of MPs human and livestock ailments, what are the threats to medicinal plants and indigenous plant knowledge system, how is the TMPK transferred, and what are practices of conservation of MPs the study districts?

d) What are the socio-economic and location factors that affect MPK in the study districts?

1.3.2 Research Hypotheses

The following hypotheses were forwarded in the present research and statistical significances were tested for those socio-economic data obtained from informants responses.

a) Anlemo, Duna, Gibe, Gombora and Yem Districts contain diverse plant species, the distribution of these species is uniform in the plant communities and affected by altitude, slope, aspect and disturbance.

b) The local people of in Anlemo, Duna, Gibe, Gombora and Yem Districts have rich TK of using MPs for treating human and livestock ailments.

c) Medicinal plants are obtained from local vegetation and different land uses and they are uniformly distributed in the plant communities, traded in the local markets, and there is threat against the MPs and TMPK in the study districts.

d) The MPK of human and livestock ailments in the study districts is affected by socioeconomic factors namely, gender, marriage, religion, age, education, level of expertise, agroecology and ethnicity; and there is no association between attitude of conservation of MPs, gender and age of local the people.

1.3.3 Objectives of the study

1.3.3.1 General objective

The general objective of this study was to carry out floristic analysis on local flora of Districts of Anlemo, Duna, Gibe and Gombora in Hadiya zone and Yem Special District in SNNPR and in-depth ethnobotanical investigation on MP uses and associated indigenous knowledge in both sites.

1.3.3.2 Specific objectives

The specific objectives of the study were to;

a) document the floristic diversity and plant communities and analyse the effects of topographic factors such as altitude, slope, aspect and disturbance factor against them in Anlemo, Duna, Gibe and Gombora and Yem Districts,

b) document the diversity of existing MPs and TMPK of utilizing them for maintenance of human and livestock health in the study districts,

c) investigate the diversity and distribution of MPs in the local in the plant communities and local markets, the threats of MPs and the associated medicinal knowledge , local practices of conservation, ways of transfer MPK the study districts,

d) evaluate the effects of socio-economic factors such as gender, marriage, age, education, skill of MPs and agroecology of local people on the use and knowledge of MPs used for human and livestock in the study districts.

1.4 Organisation of the thesis

This thesis is organized in five chapters. The first chapter - CHAPTER ONE includes introduction, research objectives, hypotheses and questions of the research. CHAPTER TWO - is Review of relevant literature. CHAPTER THREE is Materials and Methods that includes description of the study areas and explanation of research methods used in the research. CHAPTER FOUR presents results of vegetation analysis and diversity of TMPs used for treating human ailments & veterinary ailments in the five study districts. CHAPTER FIVE presents Discussion of the findings, Conclusion and Recommendations followed by REFERENCES.

CHAPTER TWO

2. REVIEW OF LITERATURE

2.1 Vegetation of Ethiopia

Ethiopia is one of the biodiversity rich countries in the world and shares two of the world's 35 hotspots of biodiversity: the Eastern Afromontane and the Horn of Africa that accounts for conservation concerrns (Myers, 1990; CBD Ethiopia, 2014). The country owns diverse vegetation types ranging from arid lowland to afroalpine vegetation as a result of diverse topographic, geological, edaphic and climatic factors (Friis *et al*., 2011). These diverse vegetation types and human managed land complexes make different ecosystems such as Afro-Alpine and Sub-Afroalpine, Forest, Woodland and Dryland, Wetland and Aquatic and Agro-Biodiversity ecosystems (NBSAP, 2005; Ethiopian Panel on Climate Change, 2015). The country's vegetation is home for diversity of flora and fauna consisiting of 6,000 species grouped in 245 plant families with 10% endemics (Hedberg *et al*., 2009; Ensermu Kelbessa and Sebsebe Demissew, 2014). Moreover, the country is among the 12 Vavilovian Centres/Origin and diversification for cultivated and wild relatives of several crops that maintain traditional farming and survival of the subsistent farming system that include 'teff' (*Eragrostis tef*), enset (*Ensete ventricosum*, barley (*Hordeum vulgare*, sorghum (*Sorghum bicolour* (L.) Moench) and the world's cash crop coffee (*Coffea arabica*) that exists both in the wild and cultivations (Vavilov, 1951; Endashaw Bekele, 1983; Harlan, 1992).

In addition to being rich in biodiversity, the vegetation of the country provides immense ecosystem including services regulating hydrological cycle, reduce the effects of climate change, provide cultural and aesthetic services, and provisioning of sevices including economic goods such as such as ensuring food security, resources for TMs for maintaining primary health care, material culture, apiculture, frankincense and myrrh, spices, forest coffee and timber that help maintaining sustainable livelihoods for millions of households (Demel Teketay, 1992; FAO, 2003; UNFF, 2007; IBC, 2012; Ethiopian Panel on

Climate Change, 2015). However, the forest vegetation cover of the country that was reported to cover about 40% of the land mass in the 1950s dramatically reduced to 3.6% in 1990s 16% in with annual loss of 140,000 to 160,000 and 200,000 ha that left (NFSAP, 1994; Reusing, 1998; Thomas and Million Bekele, 2002). Nonetheless, some recent reports indicate recovery of the forest cover of the country to 11.40% (FAO, 2015; Kilawe and Habimana, 2016). The underlying reasons for the loss of forests in Ethiopia is linked to poverty and livelihood. The forests are cleared for cultivation of crops, conversion forest lands to plantation of monoculture exotic crops, poor land use management, political unrest, absence of law enforcement, lack of awareness of the abenefits to be gained from forest vegetation, exclusion of local communities from conservation schemes (FAO, 1985, 2003; Reusing, 2003; Nyssena *et al*., 2004; Friis *et al*., 2011; FAO, 2012a; Engdawork Assefa and Hans-Rudolf, 2014). The loss of forest ecosystems led to the loss of flora including MPs and faunal diversity, climate change and desertification. Eventhough there have been efforts addressing the problem, such efforts couldn't overcome loss of natural forest ecosystems and this needs more commitments of different stakeholders to reverse the problem .

Records show that the efforts to study forests and vegetation types of the country started in the first quarter and mid 20th century by foreign scientists based on criteria of physiognomy, climate and species composition (Logan, 1946; Pichi-Sermolli 1957; Mooney, 1961; von Beithenbach, 1963). Based on these works, several updated classification of vegetation of the country were made (Sebsebe Demissew *et. al*., 1996; EPA, 1997; Zerihun Woldu, 1999; Friis and Sebsebe Demissew, 2001). A recent mapping and classification of Ethiopian vegetation done by Friis *et al*. (2011) showed twelve vegetation types. These are: Desert and Semi-desert Scrubland (DSS) and *Acacia-Commiphora* woodland and bushland (ACB), Wooded grassland of the western Gambela region (WGW), *Combretum-Terminalia* woodland (CTW) and wooded grassland, Dry evergreen Afromontane Forest and Grassland Complex (DAF), Moist Evergreen Afro-Montane Forest (MAF), Transitional Rain Forest (TRF), Ericaceous Belt (EB), Afroalpine Vegetation, Riverine Vegetation, Freshwater Lakes, Lake shores, Marshes, Swamps and Floodplain Vegetation and Saltwater Lakes, Lake

shores and Salt Marshes on pan Vegetation. In broader sense, the country's regional phytogeographic units of vegetation include Afrotropical and montane, Sudanian, Guineo-Congolese and Somali-Maasai arid zone centres of endemism (White, 1983). The present work is particularly based on contribution of plant genetic resources for maintenance of human and livestock welfare along five districts whose vegetation is in mainly categorized in Dry evergreen Afromontane Forest and Grassland complex vegetation under the Afromontane archipelago-like centre of endemism that is briefly described next.

2.1.2 Dry Evergreen Afromontane Forest and Grassland Complex

The Dry Evergreen Afromontane Forest and Grassland Complex is part of the Afromontane vegetation that comprises over 50% of the African land area (White, 1983). Previous studies in this vegetation complex include the works of Zerihun Woldu (1985), Sebsebe Demissew (1988), Tamrat Bekele (1993), Demel Teketay and Granstrom (1997). This vegetation type occurs between altitudes of 1800 and 3200 m, with average annual temperature and rainfall of 14-25°C and 700-1100 mm, respectively (Friis, 1992; Zerihun Woldu, 1999). The vegetation of this complex is found in a large land mass of the country which is inhabited by high number of settlements that experience sedentary agriculture for as long as five thousand years due to suitability of its climatic condition for human and livestock health (Zerihun Woldu, 1999; Ethiopian Panel on Climate Change, 2015). As a result, the the natural vegetation of this region is highly degraded. Except for few mosaics of remnant natural forests in this vegetation complex, the forests are replaced by grasslands in flatter areas, by bushlands on steeper slopes and in the northeastern Ethiopia the forests have virtually disappeared and most of the mountains sides are bare, valleys have been gullied, and springs and streams and the soils became shallow due to soil erosion and land degradation (Ensermu Kelbessa et al., 1992; Zerihun Woldu, 1999). Therefore, proper management and protection of the remnant patches of natural forest resources need to be addressed.

2.2 The Science of Ethnobotany; inception, scope, application

Plants have played integral role in the livelihood and culture of human society since the start of civilization. They provide man with important resources such as food, fuel, medicine, materials for construction and the manufacture of crafts and many other products (Hamiliton, 2003; Pandey and Tripathi, 2017). Ethnobotany is an ancient field of study which deals with the study of relationships between people and plants (Martin, 1995; Schultes and von Reis, 1995). The term "ethnobotany" was used by two American botanists S. Powers who used the term "aboriginal botany" in 1873 and later J. W. Harshberger who coined the term in 1895 defining it as "the study of plants used by primitive and aboriginal people" (Cotton, 1996). The scientific society also used the concept 'aboriginal botany' to describe studies related to indigenous plant uses through 19th century (Ford, 1994; Cotton, 1996). However, series of progresses were undergone between the emergence and development of the science of ethnobotany from two fields of study - botany and anthropology which co-evolved together with focus on the documentation of plant uses by local people and culminated with a more inclusive branch of study - Ethnobiology in 1990s with a paradigm shift from etic/scientific views to emic views (perceptions and understanding of indigenous people to their environment and their systematic classification of plants) (Cotton, 1996; Clements, 1998; Ellen, 2006). Since the papadigm shift, the importance of indigenous knowledge in ethnobotanical studies was acknowledged by western societies strengthening cooperation of ethnobotanists and indigenous communities with the motives of expansion and diversification of ethnobotany (Cotton, 1996; Clements, 1998; Gonella *et al*., 2016).

As a discipline, ethnobotany became a consolidated field of study in academic programs in undergraduate and graduate levels, media and research programs revitalizing its importance (Cotton, 1996; Alexiades, 2003; Cruiz-Garcia, 2014). It became at interface of many disciplines and its scope covers a broad range of study areas acquiring and employing wide range of its methods from botany, anthropology, linguistics, archaeology, history, molecular biology, development studies, environmental economics, ethics and law, forestry, ecology, agriculture, medicinal science, phytochemistry, pharmacology, economics, sociology, folklore, mythology and

linguistics, systematics, horticulture, agroforestry, religious studies, chemistry, geography, nutrition, bioinformatics and mathematical biology, communication and education (Cotton, 1996).

Contemporary ethnobotany is a multidisciplinary science that deals with hypothesis-driven, quantitative analysis of plant use that is usually applied for the benefits of the source community (Martin, 1995; Alexiades, 1996; Cruiz-Garcia, 2014). It is thought that the future of ethnobotany goes more than the study of plant knowledge of indigenous societies of the world to the extent development and bioprospecting (Ellen, 2006).

2.2.1 Application of Ethnobotanical Researches

Ethnobotanical studies play different roles such as increasing awareness of traditional knowledge and biodiversity, fostering understanding of the local situation and the need for joint actions and defining strategies for the development of community-based institutions for managing biological resources and associated traditional knowledge (de Boef *et al*., 2013). The moderrn ethnobotanical researches are identified into six major fields of investigations each of them acquiring theories and techniques from different established disciplines for arriving into a full-fledged scientific inference (Cotton, 1996). These are traditional phytochemistry (knowledge and use of plants for traditional medicine and pesticides), ethnoecology (investigation of traditional knowledge of plant phenology, adaptation and interaction with other organisms), traditional agriculture (study of traditional knowledge of crop varieties and agrobiodiversity), cognitive ethnobotany (study of traditional perceptions of natural world by local people and their ecological consequences), material culture (traditional knowledge and use of plants and their products in art and technology), and paleoethnobotany (past interaction of human populations and plants based on interpretation of archeobotanical remains) (Cotton, 1996).

2.3 Research Methods in Ethnobotany

There have been two approaches of ethnobotanical researches; qualitative and quantitative. The qualitative approach was mainly employed in earlier ethnobotanical studies in compilation of lists of plants used together with a description of how plants were used (Martin, 1995; Cotton, 1996). It makes use of ethnographic

method which is most useful in ethnobotanical researches for handling cultural human aspects of the study population (Mason, 2002; Hogan, 2009; Creswell, 2013). This approach is said to reveal a good range and depth of information in ethnobotanical fieldwork using tools such as open-ended interviews, market surveys and ethnobotanical inventories which allow to gain a broad and deep understanding of the relationship between people and plants. However, this approach is criticised by claiming its inability to measure the importance of species, to compare the relative usefulness of the plants, and rank the priorities of people and lack statistical robustness (Martin, 1995; Cotton, 1996).

On the other hand, quantitative approach refers to a relatively new research orientation that emphasizes quantitative data collection and statistical analysis, in testing pre-determined hypotheses and produce generalizable results, methodological integration drawing from the fields of anthropology (ethnographic interviews and observations), systematic botany (specimen collections and taxonomic determinations), community forestry (botanical inventory, census, and measurement in sample plots), economics (market survey, cost-benefit analysis), cognitive science (projective, sorting, ranking, and reasoning tasks), geography (geographical information systems)**,** and cultural importance of biodiversity (Friedman *et al.*, 1986; Prance *et al.*, 1987; Prance, 1991; Marshall, 1996; Phillips, 1996; Albuquerqe, 2006; Reyes-Garcia *et al.*, 2006; Hoffman and Gallaher, 2007; Tardío and Pardode-Santaya, 2008). Quantitative methods make use of both nominal and numerical data that are obtained via structured interviews, free-listing, transect surveys, cross-verification between and within informants, use values, relative economic importance, preference rankling and paired and triadic comparison (Cotton, 1996).

However, it is suggested that both the qualitative and quantitative methods have their own importance based on the aim of investigation to ensure complete and accurate data collection (Cotton, 1996). Albuquerque and Hanazaki (2009) suggest that it would be unproductive to try to separate qualitative and quantitative approaches assuming that both are quite valid in terms of the questions raised, that the same themes can be contemplated within these two traditions, and that ethnobotany can make good use of both. Accordingly, the qualitative and descriptive approaches tend to produce excellent case studies while quantitative approaches

must be used if the work seeks to verify relationships between variables under different situations, and deductive methods will best fit to these necessities (Cotton, 1996).

2.4 Traditional Herbal Medicine

Plants have been used in traditional medicine in all cultures of the world since immemorial times (Tomlinson and Akerele, 1998; Dery *et al*., 1999; Hoareau and DaSilva, 1999). As ancient humans resorted to plants in their surroundings for getting remedies for their infirmities, they acquired the knowledge of healing plants also called 'medicinal plants' through many years of vigilant observations, experience, and trial and error experiments (Sofowora, 1982; Martin, 1995). This led to a system of medicine called traditional herbal medicines. The therapeutic species are distinguished from other species by indigenous tribals and local communities of the world and recognized under organized indigenous system of knowledge called folk taxonomy (Berlin *et al*., 1966; Berlin, 1992). The traditional herbal medicines are mainly utilised by the biggest proportion of the population of developing countries who do not have access to basic health care due to inaffordability of current conventional treatments and (Farnsworth and Soejarto, 1991; WHO, 2003, 2008). This system of medicine has been challenged in the developed nations post industrial revolution with the advent of western/conventional medicine (Humber, 2002; Smith-Hall *et al*., 2012).

However, since the late 20th century, there has been renewed interest on traditional medicinal plants in both the developing and the industrialized countries. The new interest to herbal medicine is due to the fact that synthetic drugs could incur side effects and lose of curative ability for several chronic diseases, microbial resistance (WHO, 1998, 2002; Humber, 2002; Karunamoorthi *et al*., 2012). This based on the scientific facts that a number of plant species that are traditionally used for treating human and livestock ailments have been proved to provide a large number of important secondary bioactive metabolites that fight against pathogens and health impacts (Balick and Cox, 1996; Hamilton, 2004; WHO, 2008).

The bioactive metabolites found in plants such as phenols, tannins and flavones that are precursors for synthesis of important groups of therapeutically used drugs in modern medicine, or as models for

pharmacologically active compounds and pharmaceutical industries have shown interests of drug development out of these phytochemicals (Balick and Cox, 1996; Tomlinson and Akerele, 1998; WHO, 2008; Li and Vederas, 2009). Standing on this rational, the WHO acknowledged TMPs and TM as part of health care system of nations since the 1978 Alma Ata 'Strategy of Primary Health care' in light of increasing coverage of health care as a strategy to reach the goal of "health for all by the year 2000" which has not been met yet (De Maeseneer *et al*.,n 2007). In accord to the modality of the Primary Health Care Strategy, the international community responded with increased interest in MPs in a series of international consultations, seminars, and symposia to explore, evaluate efficacy, monitor safety and promote the use of medicinal plants in the health care system of all nations (Tomlinson and Akerele, 1998; WHO, 2003).

According to estimates made two decades past, the number of plant species that are utilized for TM is between 35,000 – 72,000 (Farnsworth and Soejarto, 1991; Schippmann *et al*., 2002, 2006). Reports indicate that there are a number of countries around the world that utilise the potentials of a number of MPs incorporating them in their health care system. For instance, China utilised about 4,941 MPs followed by India 3,000, USA 2,564, Thailand and Vietnam each 1,800, Malaysia 1,200 and R. of Korea 1,000 (Schippmann *et al*., 2006). This is also true in the case of the African continent where the herbal medicine is a fundamental element of traditional medicine (Kasilo *et al*., 2010). In the continent, over 5,000 species of MPs are used in traditional healing system for treatment of different human and animal ailments for centuries (Iwu, 2014). Some of the infectious and non-infectious diseases that are treated by herbal medicines across the continent include malaria, diabetes, mental disorders, cancer, hypertension and human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) (Okigbo *et al*., 2009).

Tomlinson and Akerele (1998) recount African herbal medicine as more than complementary that uses TMPs in more or less conventional manner in the same basic method as the western medicine with additional contribution from the spiritual dimension giving healing depth and meaning with African cosmology and experience, hence, more than herbalism. Generally, the African herbal medicine is known to have holistic

nature both curative and special religious symbolism and includes practical skills of traditional medicine practitioners (Busia, 2005; Iwu, 2014). Empirically evidences show that a number of TMPs used to treat ailments among local people in Africa were found contain bioactive chemical substances such as alkaloids, tannins, saponin, and others with therapeutic potentials (Farombi, 2003; Vinesh *et al*., 2004; Edeoga *et al.* 2005; Okigbo *et al*., 2009). The continent is known to provide *c* 60,000 species of the world's higher plant species, yet it contributes for only less than 8% of the 1100 drugs placed on the market worldwide (EL-Kamali, 2009; Dzoyem *et al*., 2013). This is largely due to lack of practical information compared to traditional medicinal system of traditions (Iwu, 2014). As part of Africa, Ethiopia's contribution in this regard is almost lacking sharing the mentioned reasons. Therefore, further research efforts on the continent's and in particular Ethiopia's plant genetic resources are expected to harness the therapeutic potential these resources.

2.5. Medicinal plants widely used in African continent

Some of the African MPs contributing to global health system include Madagascar periwinkle - (*Catharanthus roseus* L. in the family Apocynaceae) known to yield antileukemia and antitumour agents such as vinblastine and vincristine (Murata *et al*., 2006), African almond/cherry (*Prunus africana* in the family Rosaceae) from Kenya & West Africa has been a source of pygeum that is used to treat benign prostatic hyperplasia (BPH) (Stewart, 2003), caster oil plant (*Ricinus communis* in the family Euphorbiaceae) which is source of the laxative castor oil, soap berry (*Phytolacca dodecandra* in the family Phytolaccaceae) from the Ethiopian highlands was discovered to contain bioactive compounds that control schistosomiasis (Aklilu Lemma, 1970) and Devil's claw (*Harpagophytum procumbens* (Burch.) DC. ex Meisn. in the family Pedaliaceae) which is found to contain harpagoside - a crude drug used for osteoarthritis and articular pain produced for export in Botswana, Lesotho, Namibia and SouthAfrica (Abdelouahab and Heard, 2008). Further ethnobotnical and ethnopharmacological explorations among different indigenous societies in Africa, in particular in Ethiopia are expected to reveal several phytomedicinal products that help to intervene the health dilemma of the country and to bring economic benefits for the country.

2.6 Medicinal Plants and Discovery of Drugs

There are scientific justifications in support of folkloric use of plants for medicinal purposes have been sources of a number of drugs used in the modern health care system. This based on the fact that plants produce diversity of products or secondary metabolites that are involved in activities such as protection against predators and microbial pathogens with their toxic nature and repellence to herbivores and microbes, defense against abiotic stress, coevolutionary importance in attracting pollinators and seed-dispersing animals, plant-plant competition and plant-microbe symbiosis of the plants with other organisms (Levin, 1976; Robinson, 1980; Spencer, 1988; Moerman, 1991; Engelberth, 2006; Rosenthal and Berenbaum, 1992; Fürstenberg-Hägg *et al*., 2013). These bioactive substances that are concerned with the defence purpose are known to have medicinal value for human and livestock health and provide ingredients for discovery of drugs (Agrawal, 2009). In line with this foundations, the historical development of some of the modern botanical drugs from ancient the folklore and civilisations of Persia, Egypt, and the '*Materia Medica'* of Greece (Newman *et al*., 2000). For instance, seeds opium poppy (*Papaver somniferum* L. in the family Papaveraceae) and castor oil (*Ricinus communis* in the family Euphorbiaceae) that are employed in ancient medicine are still in use today (Le Strange, 1977; Iwu, 2014). Some of the examples of modern medicines that were derived from TMPs that were used by ancient societies and still in use include; latex of Opium (*P. somniferum* L.) used by ancient Sumerians, Egyptians and Greeks for the treatment of headaches, arthritis and inducing sleep - out of which analgesic agents codeine and morphine are still in use (Balick and Cox, 1996). Similarly, Salicin isolated from white willow tree (*Salix alba* L. in the family Salicaceae) was the first semi-synthetic drug aspirin that was introduced by Bayer in 1899 (Wong, 2001; Veeresham, 2012). According to literature sources, there are about 121 pharmaceutical drugs of plant origin were formulated based on the traditional knowledge of indigenous and local people across the world (Balick and Cox, 1996; Fabricant and Farnsworth, 2001; Wong, 2001; Pan *et al*., 2013; Alamgir, 2017). In line with this, estimates show that most of the current anticancer and antihypertensive drugs are of plant origin (Newman *et al*., 2003; Cragg and Newman, 2005). For instance, taxol that is obtained from bark of the Pacific yew tree (*Taxus brevifolia* Nutt. in the family Taxaceae) is

among the top sold drugs of plant origin is anticancer drug; the pharmaceutical drug of leukemia and Hodgkins disease produced from the rosy periwinkle (*Catharanthus roseus* (L.) G.Don in the family Apocynaceae); quinine - an antimalarial drug against four species of *Plasmododium* including the malignant malaria /Plasmodium falciparum/ obtained from bark of Cinchona tree (*Cinchona officinalis* L. in the family Rubiaceae) are few examples (Balick and Cox, 1996).

In addition to the past success stories in discovery of antimalarial drugs, artemisin developed from Qing-Hao (*Artemisia annua* in the family Asteraceae) is a promising candidate drug against the malignant malaria (*Plasmodium falciparaum*) that received worldwide acceptance (Pan *et al*., 2013). The past successes of discovery of drugs from the immense untapped potential active biological compounds out of the diversity of 250,000 plant species is only meagre with 6% screened for biological activity and about 15% have been screened for phytochemical activity (Fabricant and Farnsworth, 2001). There has been increased demand in herbal medicine in richer countries (Pan *et al.*, 2014). The herbal preparations are prescribed within conventional medicine in Europe and North America over recent years with considerable annual increase of its market (Balick and Cox, 1996; Cragg *et al*., 1997; Agrawal, 2009). Over decades, there are a number of botanical products sold as health foods, food supplements, herbal teas, and for various other purposes related to health and personal care (Agrawal, 2009).

There are reports that indicate the active compounds from botanical origin are showing promising results for tht fact that several bacterial strains are showing resistance for different synthetic antibiotics, hence, natural products from botanical origins are directly extracted while others are made through transformation of chemicals of unexplored structural diversity are known to have the best place to hunt for such lifesaving compounds new antibiotics such as for new drugs to combat AIDS, Alzheimer, cancer drugs instead of synthetic products which can lose their potency in patients over time (Balick and Mendelson, 1992; Wong, 2001; Agrawal, 2009; Fokunang *et al*., 2011; Veeresham, 2012). Therefore, scientific efforts of ethnobotanical explorations, bioprospecting and conservation to be exerted at global and local levels for further new drugs

discoveries for uncertainties of human and livestock ailments and health conditions. At the same vein, it calls also for documentation of oral TMPK and the plant biodiversity which are threatened due to several drivers. More researches of exploring into the active compounds found in plants more untapped from the world of plants (Agrawal, 2009).

2.7 Global Market Values of Medicinal Plants

Medicinal plants have received scientific and commercial attention globally. It is reported that about 25% of conventional pharmaceuticals both for overthecounter and prescription drugs in conventional medicine come from plant origin (Farnsworth, 1988). Eventhough the absence exact data on market values herbal drugs is reported (Principe, 1988), market values herbal drug products is estimated between US 43 - $60 billion at global scale per annum (Enwonwu, 2003; WHO, 2002, 2003). There is indication that global market of MPs showed increase per year. For instance, there was a report plant derived drugs was $18 billion for year 2005 globally, and this was projected increase to $26 billion by 2011 with 50% market demands coming from US and Canada (Pharmalicensing, 2006). However, the WWF (2000) stated that the increase in demand for medicinal and aromatic plants is expected threaten native species in some localities unless supported by commercial cultivation. The difference of between wild and cultivated plants due to a desire for the wild material or the unavailability of cultivated plant material currently encourages unsustainable collection of the wild grown species in some localities in the developing countries that lack resources for protecting plants (WWF, 2000; Schippman *et al*., 2002).

In the case of Africa, formal trade and export of MPs is limited and only few species are traded in international markets which are threatened (Cunningham, 1996). There are some examples of African MPs that are traded internationally. One of these is the African cherry (*Prunus africana* (Hook.f.) Kalkm. whose bark extract is used in the treatment of benign prostatic hyperplasia) is exported by Kenya and Cameroon and the product is marketed under the brand-names of Pigenil in Italy and Tadenan in France, Bark of yohimbe (*Pausinystalia johimbe* (K.Schum.) Pierre ex Beille in the family Rubiaceae), is exported by Cameroon to Holland, Germany, Belgium, Luxembourg and France for dietary supplements and as aphrodisiac, Muranga/pepper bark tree

Warburgia salutaris (Bertol.f.) Chiov. in the family Canellaceae and African ginger (*Siphonochilus aethiopicus* (Schweinf.) B.L.Burtt in the family Zingiberaceae) (Stewart, 2003). However, these are species threatened by overexploitation and unsustainable harvest as a result of high commercial demand (Cunningham, 1996; Stewart, 2003).

2.8 Threats of Indigenous Knowledge of Traditional Medicinal Plants

Indigenous knowledge refers to "a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission" (Berkes 1999). Indigenous peoples and local communities mainly traditional medical practitioners possess deep knowledge of MPs and how to use them. This knowledge is invaluable, not only to the indigenous peoples and local communities who have historically used herbal medicines, but also for those who trade them and the pharmaceutical companies, too (Abbot, 2014). Traditional medicional practitioners oftentimes keep the knowledge in secret with little or no information about healing plants disclosed which makes it prone to loss or distortion if the knowledgeable elders die without passing (Okigbo *et al*., 2009). Other factors contributing to loss of TMPK include loss plant biodiversity as a result of deforestation, modernization (which includes modern education, use of conventional medicine, modern lifestyle along with unrbanisation), global economic change mainly globalization, religion and gap between old and young generation (Phillips and Gentry, 1993b; Kala, 2000; Blench, 200; Zent, 2001; Case *et al.*, 2005; Kiringe, 2006; Teshome Bahiru, 2006; Brosi *et al.*, 2007; Namsa *et al*., 2011; Vandebroek and Balick, 2012; Leonti and Casu, 2013; Reyes-García *et al*., 2013). Each of them contribute to erosion of TMPK in one way or another inducing abandonment of traditional lifestyle such as use of MPs for management of infirmities of health describing it backward and unsafe and tending to the modern lifestyle. This entails urgent need of documentation and salvation of this important heritage of humanity before completely vanishes.

2.9 Traditional Medicinal Plants and Intellectual Property Rights

The use of plant genetic resources was a public domain for millennia and a principle called 'Common Heritage of Mankind' which regulated international transfer of plant genetic resources transfer and 'exchange'

of plant lifeforms between the developed North and the developing South (Mgbeoji, 2003; Gepts, 2004). Under the 'Common Heritage of Mankind' regime, scientists, breeders, and collectors of the the developed and colonizing world collected and transferred a huge quantity and diversity of economically useful or rare plant life forms to botanic gardens, gene banks, research institutions, and breeding programs which were scattered across the various outposts of the colonial empires (Herdt, 1999).

Meanwhile, the issue of Intellectual Property Rights (IPRs) were granted and limited to corporate plant breeding programs and individuals in industrialized countries leaving the biodiversity from developing countries under the 'common heritage for mankind' regime to be freely accessible without restrictions (Herdt, 1999). This led to North–South divide and the perception of inequality of access to economic resources globally (Mgbeoji, 2003). Different parties such as scholars of the developing world (the South) and activists, and some supporter individuals and organisations in the developed world held disputes on the issuance of the intellectual property rights for the biodiversity and the local people who are owners of indigenous knowledge of the biodiversity in the developing nations (Herdt, 1999). After the inauguration of Convention on Biological Diversity (CBD) - the UN Conference on Environment and Development Programme's (UNEP) Earth Summit in Rio de Janeiro in 1992, the dispute was settled with a paradigm shift from "common heritage" which provides unrestricted access to biological resources to 'national sovereign rights over indigenous germplasm' and is subject to IPRs (CBD, 1992; Herdt, 1999; Gepts, 2004). The TMPs have not been explicitly on the agenda of the various CBD meetings, albeit all three goals of the Convention were fully applicable to MP resources (CBD, 1992; Schippmann *et al.*, 2002).

The Rio de Janeiro Convention cameup with different articles that stipulate Provisions in favor of 'sovereign rights of states' (CBD, 1992; Africa-Europe Faith and Justice Network, 2002). The 'sovereign rights of states' over their biological and genetic resources in Article 3 and 15 stipulates that access to genetic resources can only occur on mutually agreed terms and with the prior and informed consent of states in Article 15.5. This requires signatories to protect and promote the rights of communities, farmers and indigenous peoples concerning the customary use of biological resources and knowledge systems as stated in Article 8j and 10.

This defends an effective protection of intellectual property rights stated Article 16.2 which enables developing countries to provide genetic resources and to have access to technology which makes use of those resources in win-win situation including technology protected by patents and other intellectual property rights stated in Article 16.3. The issue of the equitable sharing of benefits arising from the commercial use of local communities' biological resources and local knowledge is stated in Article 15.7. According to this article, intellectual property rights must be supportive of and not run counter the objectives of the CBD as stated further in Article 16.5.

In accordance with the provisions of CBD convention above, the biodiversity laws take into account the fact that many medicinal plants occur in ecological zones that span several developing countries (WHO Regional Office of Africa, 2003). The TMP products that are used for management of diseases among the local communities which are also used by a number of pharmaceutical companies for drug development are based on indigenous biodiversity and Traditional Herbal Practitioners who use their traditional medical knowledge to formulate various phytoremedies. This needs the compliance of IPRs that recognise and protect the lives and livelihoods of local communities, including farming communities, and indigenous peoples. Local communities continue to conserve and enhance biodiversity, and maintain stable ecosystems on which human beings and other species depend for their lives (Africa-Europe Faith and Justice Network, 2002; WHO Regional Office of Africa (2003).

After the resolution of the North-South debate on issues of IPRs with win-win situation of the benefit and technology share between both, there have been least 50 products patents that had been granted to U.S. and international corporations had been awarded to the nation's claim (Torrance, 2000 cited in Schippman, 2002). Reports show that some 69 plant species were researched for IPR claims and 17 cases of biopiracy had been identified by 2010s (Haas, 2010). There have been some achievements whose IPRs were resolved. One case in point is case of indigenous communities of India who have used remedy from neem (*Melia azedarach* in family Meliaceae) for centuries that were prevented patent right by American company (Haas, 2010). An other example is the case of IPR of Ethiopian cultivated Arabica coffee (*Coffea arabica* in family Rubiaceae)

on trademark and licensing and benefit sharing of its famous three Fine Coffee origin names owned by the local farmers coffee associations via Oxfam organized a publicity campaign against the Global Coffee giant Starbucks was settled by approving four coffee brands owned by Ethiopian Coffee Farmers associations (WIPO, 2010; Arslan and Reicher, 2011).

2.10 Threat to MPs and their conservation strategies

Reports show that there are about 50,000 - 80,000 spcies of flowering plants are used for TM globally (Schippmann *et al.*, 2006). Most of these species are mainly from obtained wild sources that make them prone to threat (Hamilton, 2004). The major threats to the MPs in the wild are overharvesting and habitat destruction. Globally about 15,000 MPs are threatened to extinction and some 20 % of the wild harvested MPs have been nearly exhausted (Ross, 2005; Schippmann *et al.*, 2006; Bentley, 2010). As a consequence, much of the knowledge on their use is held by traditional societies, whose very existence is now under threat (IUCN, 2007).

Habitat destruction mainly deforestation and shifting cultivation are very serious threats of medicinal and other plant biodiversity across the globe which reduces carrying capacity leading to species extinction of the unmanaged wild stock (WHO *et al.*, 1993; Camm *et al.*, 2002; Heywood and Iriondo, 2003; Hamilton, 2004; Raija, 2011). Other factors such as lack of information about the status medicinal species, over exploitation, destructive exploitation, development activities such as road construction, commercial wood exploitation, ranching, natural disasters such as flooding and drought as a result of climate change are also threats for plant biodiversity as a whole and the TMPs in particular (Cole *et al.*, 2007; Roberson, 2008; Bentley, 2010; Raija, 2011). Reports also indicate that most of the endangered species are without any conservation efforts being taken, and in most countries there is no even a complete inventory of medicinal plants due to absence of financial and logistic supports for research efforts (WHO *et al.*, 1993).

2.11 Conservation strategies of MPs

The sustainable management of TMP resources is important from view point of their contribution to TM for big proportion of global population and ther potential in development of new drugs (Cunningham, 2001). The conservation of MPs has dual roles the development of health sector and conservation of biodiversity which inturn provides other added values and ecosysytem services such as food, water, clean air, shelter and relative climatic constancy (MEA, 2005). As outcome of global consultations, recommendations were passed for developing sustainable strategies for maintenance of health combined with conservation of biological resources and linked to local knowledge and practices. Conservation has become participatory by involving different stakeholders and indigenous peoples and local communities as they have important traditional knowledge of conservation of local biodiversity, and to enable them get the benefits from conservation projects so that they feel ownership the biodiversity becoming motivated on stewardship of the biodiversity (Berkes, 2004). The recommended conservation strategies of MPs are the *in situ* and *ex situ* approaches both of which complement each other (WHO *et al.*, 1993; Heywood and Iriondo, 2003). *In situ* conservation is a strategy in which MP are protected in their natural or semi-natural ecosystems in various types of protected areas taking an approach that is ecosystem-oriented, rather than species-oriented (Heywood and Iriondo, 2003; Heywood and Dulloo, 2005; Ma *et al.*, 2012). Protection and conservation of whole communities allows maintain indigenous plants and natural communities along with their intricate network of relationships (Gepts, 2006). It also increases the amount of diversity that can be conserved and strengthens the link between resource conservation and sustainable use (Long *et al.*, 2003; Forest *et al.*, 2007). The wild-harvested medicinal plants are widely considered more efficacious than those that are grown in domestic cultivation and widely used and generally accepted practice (Gepts, 2006; Leung and Wong, 2010; Joshi and Joshi, 2014).

On the other hand, *ex situ* conservation is a strategy in which endangered medicinal species are recovered and preserved outside their natural habitat with the aim of cultivating and naturalizing threatened species for ensuring their sustainability and to produce large quantities of planting material used in the creation of drugs,

and it is often an immediate action taken to sustain medicinal plant resources (Havens *et al.*, 2006; Swarts and Dixon, 2009). This strategy creates opportunity for those MPs growing in the wild eventhough it is thought that their lose their potency when grown in gardens far away from the habitats where they naturally occur and their reproductive materials selected and stored in seed banks for future replanting (Hamilton, 2004). *Ex situ* conservation strategy includes botanic gardens, seed banks, domestication and cultivation and good agricultural practice (WHO *et al.*, 1993; Lambert *et al.*, 1997; Muchugi *et al.*, 2008; Amujoygbe *et al.*, 2012; Chan *et al.*, 2012).

2.12 Ethnobotanical Researches in Ethiopia

Ethiopians have developed deeprooted traditional knowledge of managing plants for fulfilling their livelihood, particularly for mainatining health since ancient times. The earlier attempts of ethnobotanical documentation of plant uses among Ethiopians were made by European travelers, naturalists, anthropologists and plant collectors mainly focusing on northern Christian religious culture such as the writings of Alessandro Zorzi (Pankhurst, 2002). Pankhurst (2002) and Mesfin Tadesse (2008) list out the subsequent European explorers and plant collectors documented the Ethiopian medicinal plants lore in the 20th century such as Marcel Griaule (1928–1933) and Stefan Strelcyn, Achille Richard (1847–1851), Lemordant (1960), Schoental and Coady (1968), Schoental (1972), Kloos (1976, 1978), Mercier (1979), Huntingford (1975). The later Ethiopian ethnobotany may also be related to economic and cultivated plants in ancient agriculture that includes the works of such as Vavilov (1951) and Zohary (1969) on the centre of origin and diversification, Westphal (1974) on pulses, Jansen (1981) on economic plants including spices and some MPs of common uses, Elisabeth (2003b) on yam (*Dioscorea* spp.) and wild and cultivated enset (*Ensete ventricosum* and Admasu Tsegaye (2002) on enset agronomy.

After the turn of 21st century, ethnobotanical studies of Ethiopian MPs seized two aspects as noted by Sebsebe Demissew and Ermias Dagne (2001): basic and applied researches. The role of basic research on traditional medicinal plants is in light of gathering information on conservation of MPs and IK on national and

international laws, regulations and conventions regarding medicinal plants, taxonomic identity of the medicinal species used among diverse cultures of the country. Similarly, the applied medicinal plant research would include developing the research capacity, selection of candidate plants, *in-situ* and *ex-situ* conservation of these plants, phytochemical analyses and subsequent clinical trials, and development of herbal medicines usable forms and ensuring patent rights of bearers of the indigenous knowledge get a fair share of the benefits in accordance (Sebsebe Demissew and Ermias Dagne, 2001; Tsige GebreMariam and Kaleab Asres, 2001). So far, different institutions are independently involved in the basic and applied Ethnobotanical studies of Ethiopian MPs such as the Department of Plant Biology & Biodiversity Management, the Natural Products Research Unit (Department of Chemistry), College of Pharmacy - all in Addis Ababa University, the former Institute of Biodiversity Conservation and Research (IBCR) now EBF and the Ethiopian Health and Nutrition Research Institute (EHNRI) and Institute of Pathobilogy (Sebsebe Demissew and Ermias Dagne, 2001).

List of earlier basic ethnobotanical studies undergone by native Ethiopian scholars on medicinal and useful plants of Ethiopia included studies by Amare Getahun (1976), Kloos (1976), Gelahun Abate *et al.* (1986), Tewoldeberhan GebreEgziabher *et al*. (1976), Worku Abebe (1981), Dawit Abebe (19860), Mesfin Tadesse (1986), Gelahun Abate (1989), Mesfin Taddesse and Sebsebe Demissew (1992), Zemede Asfaw (2001, 2002, 2004), Zemede Asfaw and Ayele Nigatu (1995), Zemede Asfaw and Zerihun Woldu (1997), Zemede Asfaw and Mesfin Tadesse (2001). Similarly some of the applied studies on selected ethnobotanical flora of Ethiopia that have high folkloric reputatitions include Berhanu Abegaz (1996), Berhanu Abegaz *et al.* (1999), Ermias Dagne *et al*. (1990), Noamesi *et al*. (1990), Belachew Desta (1995), Yalemtsehay Mekonnen and Amare Gessese (1998), Eyasu Mekonen *et al.* (2003), Hailu Tadeg (2004), Jemal Demma *et al*. (2005, 2007) and Tsige GebreMariam and Kaleab Asres (2006). These works have laid important base for documentation of medicinal flora and associated knowledge in different cultures across the country.

Further important effourt was that of the Ethiopian Flora Project which was launched in 1980s by foreign financial support and by the endeavors of both native foreign botanists brought the country's 6000 plant biota

into a standard data base in eight published volumes was one step forward for conservation efforts of the whole biodiversity of the country, and MPs in particular (Friis, 2001). The Flora volumes give full taxonomic, botanical and ecological information of the country's plant genetic resources with little or no information on utility of the species. There are also some compilations of botanical information useful trees and shrubs of the country by Azene Bekele *et al*. (2007) and by Admasu Adi *et al.* (2014) who compiled useful plants interms of apiculture.

2.13 The Role of TMPs in maintaining Human Health in Ethiopia

Ethiopia has a long history of traditional health care based on home remedies in self-medication and traditional health practitioners (Mekonnin Bishaw, 1991; Kebede Deribe *et al.*, 2006). Before the introduction of modern medical system, human and livestock ailments were treated by the only available traditional medical therapies for centuries. As the country is home for diverse cultures, each of these cultures have developed long lived history of use traditional medicine to combat diseases (Niguse Bilgrit, 1988). Fatal epidemics of many infectious diseases such as smallpox, cholera, typhoid and scarlet fever, tuberculosis, leprosy, malaria, sexually transmitted diseases and at times zoonotic anthrax, blackleg and other preventable diseases linked mainly to malnutrition were all the challenges of the country (Pankhurst, 1990). The different traditional medical practices employed for combating such myriads of diseases in Ethiopia were herbal medicine, inoculation, thermal baths, cauterisation, counter-irritation, bleeding and cupping, bone-setting, midwifery, surgery, a range of medico-religious treatments, Holy Water and spiritual prayer (Pankhurst, 1990; Slikkeveer, 1990; Mekonnin Bishaw, 1991). The treatment of a sick person includes the whole human/holistic nature which includes the physical body, mind and spiritual or religious component with different traditional medicines including herbal medicine and mystical and natural nonmedication religious or spiritual component of therapies which have curative ability (e.g. application of MPs), prophylactic and preventive features (e.g. fumigation of houses with medicinal plants) (WHO, 2002; Iwu, 2014). Patients have high trust in traditional healers and consult for traditional procedures (Dawit Abebe, 1986; Hodes, 1997; Kebede Deribe *et al.*, 2006).

The majority of the Ethiopian people still use TM mainly MPs due to the cultural acceptability of healers, local pharmacopoeias, the relatively low cost of TM and difficult access to modern health facilities, poor access to health services, especially in the rural areas (World Bank, 2001). Despite Ethiopia exhibited rapid economic development (World Bank, 2013), it is one of the developing African countries and exhibited low government spending on health i.e. 5.2% of GDP in 2010 - 2011 (MoH, 2015), which is far from achieving the 15% share of government expenditure agreed upon by the member states of the WHO Africa region (WHO, 2013). Eversince the emergence of the Strategy of Primary Health care of 1978, the country adopted the strategy and official attitude toward the promotion and development of traditional medicine appears to have become more positive (Mekonnin Bishaw, 1991).

The government of Ethiopia has virtually integrated the traditional and mainsream biomedical health services in agreement with the PHC strategy that is explained by maitaining heatlth with all accessible means of provision of health care. In this regard, the formal integration of traditional and western medicine systems is built upon an ancient and acceptable cultural heritage, giving strength to biodiversity conservation and management programs and provide a level of health care to all citizens that will be reflected in future social and economic prosperity (World Bank, 2001). This needs development of national pharmacopoeia that is effected by government's commitment to formalize the extraction, standardization, safety and efficacy, dosage, formulation and institutionalisation of phytomedicines (World Bank, 2001).

The mainstream human health care services of the country are provided with a total of 66, 314 health workers, including 30,950 health extension workers with national health worker ratio of 0.84 per 1,000 population which is far less than the WHO standard 2.3 per 1,000 population (MoH, 2010). A strategy called four-tier system is providing health services at primary health care units (a health centre with five satellite health posts) for a population of 25,000 people, primary hospitals for 100,000, general hospitals for 1,000,000 and specialized referral hospitals 5,000,000. The number of physicians in the country is said to be always in attrition with loss of 29%. To curb this gap, the number of universities and health science colleges has grown

from five in 2003 to 22 as of 2009 but mere staffing without quality of services couldn't address the gap (MoH, 2010). This shows that the mainstream health care provision is still far from sufficiency and accessibility, hence, the TMP support by filling this gap.

On the other hand, the institutional ownership of TM was under the Department of Traditional Medicine MoH which later shifted into the Department of Drug Research under the Ethiopian Health and Nutrition Institute (ENHRI) in 1996, which again shifted to the present Institute of Biodiversity Conservation (IBC) now EBF and research efforts in the field gained financial facility from funds World Bank initiative namely the 'Conservation and Sustainable Use of Medicinal Plants'. MoH facilitated private health enterprises as entrepreneurs in particular traditional medicinal clinics by giving permit to assist the coverage of health care system (World Bank, 2001). The private traditional clinics should be encouraged by technical assistances such as training and monitoring efforts should be in place for the safety, efficacy and quality of services they provide for the populace. Currently, the IBC organizes and launched projects of conservation of biodiversity and with emphasis on medicinal plants across the country and traditional healers affiliations by the support of funds from donors like World Bank with example of *in situ* conservation, management and cultivation of threatened medicinal plants was launched in the Bale Mountains National Park area (World Bank, 2001).

2.14 Marketability of medicinal plants in Ethiopia

Organized and documented information on marketability and economic value of plant medicine of medicinal plants in Ethiopia is fragmentary (FAO, 1998). However, a report by Mander *et al.* (2006) stated the role of the MPs in health care system in terms of government expenditure. The authors revealed that the traditional medicine trade value in the year 2005 was estimated as ETB 2 billion (some 8% of the total budget), whereas the total federal government budget expenditure in the same year was estimated at ETB 24.7 billion. Furthermore, the trade in raw MPs in the same year was some ETB 423 million (42% of expenditure on modern medicines) while the government expenditure on medicines is estimated to be just over ETB 1 billion per annum. The value of MPs domestically grown in Ethiopia was estimated at 423 million Birr creating

employment opportunity for 346,000 persons that are engaged in production and sale of plant products in 2005, and an estimated 1.6 billion Birr was paid to healers administrating these medicines (Mander *et al*., 2006). It is also estimated by the same authors that about 48 million consumers use some 56,000 tons of medicinal plants a year out of which 49, 000 tons (87%) are harvested from wild stocks while 7,000 tons (13%) were from cultivation. The market and export contribution of the country's medicinal plants as indicated is below their potential. Recent reports show that there are some enterprises that are currently engaged in processing/supplying crude herbal medicines in the country (Elerohi Mulugeta, 2011). The revenue gained from these companies and the profit these enterprises gain out the native MPs is difficult to known and not disclosed for their own sake. This enatails the need for further updated scientific analyses on hurdles that constrain trade, market value and the contribution of MPs to the health sector.

2.15 Ethnoveterinary medicinal plant use in Ethiopia

As it was true for the case of human population, Ethiopia also has the biggest livestock population in Africa with about 52 million cattle, 33 million sheep, 30 million goats and 2.5 million camels (CSA, 2016). The livestock diversity of the country includes breeds of 30 cattle, 14 sheep, 14 goat, 4 camel, 4 donkey, 2 horse, 2 mule, 5 chicken and 5 honey bee breeds/strains/populations in the country (IBC, 2009). The livestock diversity provides for a major source of livelihood for many people worldwide, particularly the rural poor in developing countries including Ethiopia (Wanzala *et al*., 2005). This sub-sector contributes an estimated 12% of the total GDP and over 45% to the agricultural sector (MoA, 2010; IGAD, 2013). However, the contribution of the livestock sector to the national economy is minimal compared to its potential due to widespread occurrence of many infectious and parasitic diseases which drastically reduce the production of livestock through morbidity, mortality and market restriction (FAO, 2002; Teshale Sori *et al*., 2004; ILRI, 2013). The annual loss due to mortality ranges an overall 30-35% which interms different breeds is 8-10% for cattle, 12-14% for sheep, 11-13% for goats and 56.9% for poultry and no data in this report about equines (FAO, 2002; ILRI, 2013). Animal diseases also have an important impact on human health, with 60% of human diseases being of animal origin (ILRI, 2013).

The government based mainstream veterinary medicine has been playing an important role in the prevention and control of the livestock diseases over the past decades in the country (Teshale Sori *et al.*, 2004; ILRI, 2013). However, the government veterinary services in Ethiopia is limited as in most of developing countries of Latin America, Asia and Africa and can't deliver complete coverage of preventive and curative health care practices because of inadequate labor, logistical problems, an erratic supply of drugs and the high cost of drugs and equipment (McCorkle; 1986; van Veen, 1997; Teshale Sori *et al.*, 2004). On the other hand, traditional EVMPs which have been the means of attempt of prevention and management of livestock ailments before the emergence of modern verterinary system is a pragmatic alternative solution for livestock health care in developing countries (van Veen,1997; WHO, 2003; Wanzala *et al.*, 2005). In this regard, the local people - the traditional practitioners and animal owners all over the developing world in general and across Ethiopia in particular have deep-rooted EVMP knowledge and practices of preventing and treating veterinary ailments that were accumulated over centuries (McCorkle; 1986; Hoareau and DaSilva, 1999; Dilshad *et al.*, 2010; Fekadu Fullas, 2010; Abbasi *et al.*, 2013; Mudzengi *et al.*, 2014). This system of medicine is widely accepted and long time tested accessible with little or no cost, practical, safe, based on local resources and effective solution for farmers, pastoralists and agropastralists as alternative to synthetic medicines in the present and future (Guéye, 1999; Raj, 2001; Teshale Sori *et al.*, 2004; McGraw and Eloff, 2008; Damtew Bekele *et al.*, 2012; Dharani *et al.*, 2015). Accordingly, 90% of the total population of Ethiopia depend on TMPs which are obtained mainly from wild habitats to treat different types of animal illnesses (Dawit Abebe and Ahadu Ayehu, 1993). This medical system has its base in oral history which is validated by applied experience through trial and error over hundreds of years and transferred from one generation to another among the communities (McCorkle and Martin, 1998; Tabuti *et al.*, 2003; Jebbar *et al.*, 2005; Fekadu Fullas, 2010; Phondani *et al.*, 2010; Mudzengi, *et al.*, 2014). Therefore, it would be a reasonable solution would be to complement modern veterinary health care with EVMPs and its practices for exploiting the potential of livestock (Ibrahim, 1986). However, the combined effects of rapid socioeconomic, ecological and technological changes and effects modern health facilities have threatened the EVMK that is characterized by mental knowledge and oral transfer

leading to disuse and erosion of the knowledge capital (McCorkle and Mathais-Mundy, 1992; Longuefosse and Nossin, 1996; Fasil Kibebew, 2001).

Moreover, the EVMPs that are resources for EV medicine threatened by different anthropological and natural factors such as deforestation, agricultural expansion, ecological and technological changes, climate change (Hamilton, 2004; Mudzengi *et al*., 2014). This necessitates basic ethnobotanical researches in Ethiopia for documenting the ever threatened MPs and associated knowledge and launch conservation scheme (Sebsebe Demissew and Ermias Dagne, 2001). So far, some attempts of conservation of EVMPs has been made by the Institute of Biodiversity Conservation and Research (IBCR) now EBI in the Bale Mountains National Park that was funded by the World Bank (World Bank, 2001). A lot should be done by concerned stakeholders in launching researches and establishing pilot conservation sites based on relevance of ecological of EVMPs and livestock population potentials in different parts of the country.

2.16 Threats to TMPK and medicinal plant species in Ethiopia

Traditional knowledge and plant diversity of developing countries including Ethiopia are currently being lost at an accelerated speed due to combination of factors such as globalization, climate change, habitat destruction for agriculture and development activities over-harvesting, fire, urbanization and "human progress" (FAO, 1998; Cox, 2000). Environmental degradation, agricultural expansion, loss of forest and woodlands, appear to be the principal threats to the medicinal plants in Ethiopia (FAO, 1998). The rural citizens of country demand strongly for arable land due to poverty and absence of alternative economic activity to the ever fast growing population that led to irreconcilable destruction of habitat, loss of native medicinal and useful plant genetic resources, loss of millennia old indigenous knowledge on traditional uses of MPs and cultural erosion (Dawit Abebe, 1986; Ensermu Kelbessa *et al.*, 1992; Abebe Demissie, 2001; Zemede Asfaw, 2001). Another threat of over 70% of MP sustainability is destructive harvesting and overexploitation of the whole plant and parts such as roots (FAO, 1998; Edwards, 2001; NBSAP, 2005). Some examples of the indigenous medicinal species are threatened to different IUCN threat categories include *Clausena anisata* in the family Rutaceae,

Clerodendrum myricoides in the family Lamiaceae, *Cucumis* sp. in the family Cucurbitaceae, *Hagenia abyssinica* in the family Rosaceae, *Taverniera abyssinica* in the family Fabaceae, *Warburgia ugandensis* in the family Canellaceae (Abebe Demissie, 2001; Zemede Asfaw, 2001). This needs research efforts on the intervention of the threats posed against the existing medicinal wealth of the country's plant biota.

2.17 Conservation of Medicinal Plants of Ethiopia

Reports show that there have been of conservation of the fast eroding medicinal plants and linked traditional knowledge in the country, there are a number of other stakeholders/actors who are actively working on biodiversity conservation of Ethiopia (Sebsebe Demissew, 2011). These include the Institute of Biodiversity Conservation (IBC), the Ministry of Science and Technology (MoST) and Higher Learning Institutions (HLIs), particularly Addis Ababa University (AAU) and The Ethiopian Institute of Agricultural Research (EIAR). Most importantly, the Federal and Regional Governments should play important roles by providing adequate policy and legal framework, enforcing regulations, building capacity and providing incentives and funds for the conservation of biodiversity and the local communities who are direct beneficiaries and custodians of biodiversity and most important stakeholders vertically linked to political governance for practical conservation measures of the biodiversity and the heritage of indigenous knowledge (Sebsebe Demissew, 2011).

The Institute of Biodiversity Conservation (IBC) is given the mandate/stewardship of mobilizing conservation and sustainable utilization of all forms of biological diversity including plant, animal and microbial genetic resources (Sebsebe Demissew, 2011). Higher learning Institutes are among the prominent stake holders in acting on biodiversity conservation as a whole and MPs in particular. Besides their roles on training manpower, they undertake researches and studies in matters of conservation of indigenous knowledge and plant diversity. Addis Ababa University Faculty of Biological Sciences, Department of Chemistry, Colleges of Pharmacy and Medical Sciences are the pioneering stakeholders engaged in undertaking and

disseminating findings of ethnobotanical researches which is the integral part of conservation of the indigenous knowledge and the biodiversity (Sebsebe Demissew, 2011).

Some of the visible conservation efforts being financed by World Bank are underway so far (World Bank, 2001). The Bale Mountains National Park (BMNP) is one focal point for *in situ* conservation of MPs due to its unique and diverse flora and fauna - about 1650 floristic diversity of which 177 are endemic to Ethiopia, and 337 species are used as medicine by local people out of which 24 species of MPs are endemic to Ethiopia. Specific sites include Adaba, Dodola, Sinnana-Dinsho, Goba and Mena–Angetu districts that are prioritized (http//www.ibc.org). The IBC has been collecting and preserving seeds of MPs in cold storage facilities (Abebe Demissie, 2001). Wendo Genet Medicinal Plant Field gene Bank (FGB) is an other *in situ* (may be *ex situ*, too) conservation site managed by IBC and Essential Oils Research Center (EORC) and Ethiopian National Traditional Medicine Preparation and Study Association (ENTMPSA) (IBC, 2012).

The Gullele Botanical Garden (GBG) a well oraganised and recently established *in situ* conservation site located at the northwestern outskirt the Addis Ababa with mission of redeeming the endemic plant species are facing extinction (http://www.hoarec.org/docs/documents/hoarem) through research. These are only meager conservation efforts as compared to the dearth of the threat posed against of the broad medicinal plant biodiversity existing in different ecological regions along with their associated indigenous knowledge of people who are living around them. Therefore, more research efforts and financial facilities for supporting them is unquestionably necessary. Problems associated with MP conservation differ from cultivated crop plants in that they are far less domesticated and accurate knowledge of the genetic structure of species is important for capturing the genetic diversity in the species to be conserved (Abebe Demissie, 2001).

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 Description of the study area

3.1.1 Hadiya Zone

Hadiya Zone is one of the administrative Zones and Special Districts of Southern Nations, Nationalities and Peoples Region (SNNPR) situated at 7°07'-7°92' N and 37°29'-38°13' E at the margin of Great Rift Valley at the northwestern part of the region (Fig. 1) (HZPEDD, 2011). Hadiya belongs to Cushetic language group and its language is Hadiyisa. Its centre is Hossana located at 232 km from Addis Ababa, the capital of Ethiopia. Its land area 346958.50 ha that has three agroecological climates: 68% 'hensewa'/midland, 19% 'ineqora'/highland and 12.9% 'qale?a' /lowland. Climate data for Hosanna station showed a high rainfall obtained between May to September with peak being 189 mm in August whereas low rainfall recorded from November to February reaching the lowest of 29 mm in December within 13 years (2000-2012) (Fig. 2) (NMSA, 2014). Similarly, the highest mean annual temperature was 21 °C recorded in May while the lowest mean annual temperature over ten years was 8 °C recorded in December between 2000-2012. Hadiya Zone is divided into 15 districts now and one city administration out of which four districts: namely Anlemo, Duna, Gibe and Gombora were purposively selected for the present study.

3.1. 2 Description of Anlemo District

Anlemo is a recently established District from part of Lemo District located at coordinates of 7.54° -7.73° N and 37.89°-38.06° E at northeast of Hossana, the Zonal Capital of Hadiya (Fig. 1). Its capital town is Fonko is located at 25 km away from Zonal capital in the northeast on the main road to Addis Ababa. The District shares boundaries with Lemo District in southwest, and Shashogo District in southeast and Silte Zone in north. Its altitude ranges between elevation of 1501-2500 m. It has a land size of 224.1 km^2 and divided into 27 rural and one urban subdistricts (subdistricts which is lowest political administration that is further subdivided units Development unit (HZFEDCD, 2011).

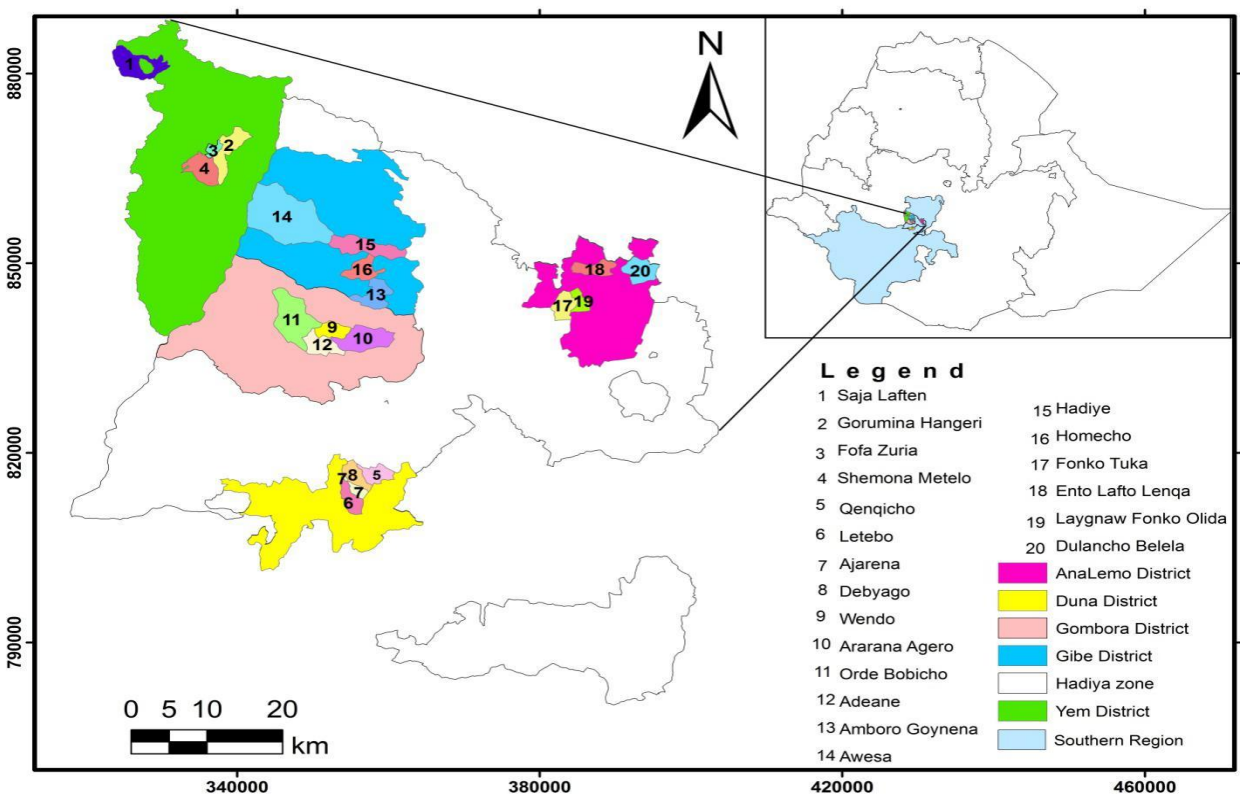


Fig. 1. Map showing the study area: Hadiya, Anlemo, Duna, Gibe, Gombora, Yem & 20 subdistricts

3.1.2.1 Climate and soil

It is important to note that there were no records of climate data in National Meteorology Service Agency (NMSA) during 2014 for Anlemo, Duna, Gibe and Gombora Districts of Hadiya Zone. The clima diagram presented is for a station located at Hossana (Fig. 2) and this data was used simply as a close location and reference for the four districts of Hadiya under this study. Based on available data source, the mean annual rainfall of Anlemo is 1001-1200 mm and its mean annual temperature is between 15 - 20 ^{O}C (HZFEDCD, 2011). Most of the landmass of the district falls in 'hensewa' (Had.)/'woinedega' (midland) agroclimate while a small proportion falls in 'ineqora'(Had.)/'dega' (highland) agroclimatic zone (ANRAO, 2016). The main types of soil in the district are andisol, leptosol and luvisol (FAO, 2009).

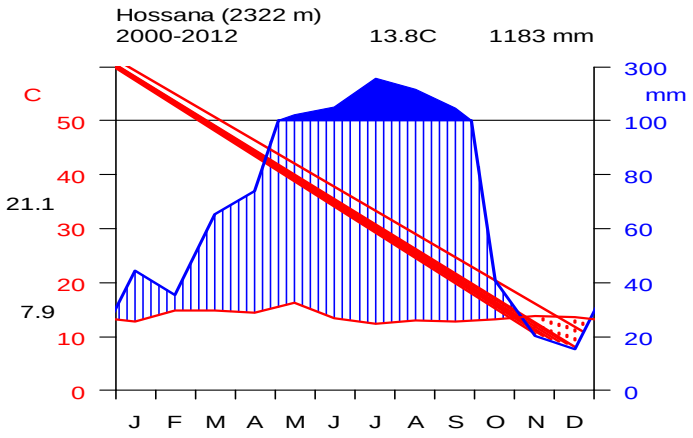


Fig. 2. Clima diagram showing climate data at Hossana Station, Hadiya Zone (Source: NMSA, National Metrological Services Agency, 2014, Addis Ababa)

3.1.2.2 Human and livestock populations

According to CSA (2007), Anlemo District had a total population of 71,963, of which 35,330 were men and 36,633 women and only 2.38 - 3.31% of this population were urban dwellers. However, projected population of the district was 87,290 of which 42,772 (49%) males, 44,518 (51%) females (CSA, 2007). The District is mainly inhabited by Hadiyas with minor ethnic Siltes. In the same report, 54.83% of the inhabitants were Muslim, 35.55% were Protestants and 9.22% were Ethiopian Orthodox Christians (CSA, 2007). Regarding livestock population of the district, a total of 134,794 livestock among which 55,726 were cattle, 18,336 sheep, 10,776 goats, 1,342 horses, 1,310 donkeys, 8,200 mules 40,340 domestic fowls were known to be raised in the district (HZFEDCD, 2011). There was one veterinary clinic that is located at the District centre, Fonko town (ANRAO, 2016).

3.1.2.3 Economic activity

The economic activities of the inhabitants of the District is mainly based on crop cultivation and animal rearing in small scale. Crop cultivation is enset based agriculture at upper altitudes and cereal crops in lower altitudes. Crops such as teff (*Eragrotis tef*), maize (*Zea mays* L.), sorghum (*Sorghum bicolor* (L.) Moench), enset (*Ensete ventricosum*), barley (*Hordeum vulgare*) and a cash crop chat (*Catha edulis*) are cultivated in the

district. Livestock farming includes raising of cattle, sheep, horses mules, donkeys and goats at lower altitudes. Remittance is the source of income from migration of young ladies and men to domestic cities and abroad to Middle East and Sudan for non-pofessional less paid labour which played important role for improving the livelihood of their parents and close kins (HZFEDCD, 2011).

3.1.2.4 Crop and Vegetation

About 15,650 ha of Anlemo District is covered with annual crops, 1765 ha permanent crops, 568 ha by natural forest fragments and 460 ha by plantation of mainly *Eucalyptus camaldulensis* and *E. globulus* stands (AnDNRAO, 2016). There is no clearly visible extension of natural vegetation except few scattered elements of scrub and woodland species in cultivation and grazing fields such as *Acacia* sp. and *Croton macrostachyus*. Regardless of the absence of intact natural vegetation, there are few wild animals such as baboons, jackals, hyenas and several bird species were observed in the District.

3.1.2 5 Mainstream Health care services

Regarding health infrastructure of human, there are 27 health posts and five health centers that serve about 5-6 catchment subdistricts in the district (AnDHO, 2015). A report from the same source showed 10 top recorded diseases averaged for the years 2014 and 2015 that that includes acute febrile disease/ 'mich' which was the most prevalent disease (3,623 (21%)) mainly among females followed by pneumonia 3,262 (19%) more prevalent among males and typhoid fever with cases of 2,771 (16%) among females while urinary tract infection, skin and subcutaneous diseases and dyspepsia were the least reported each 4%. (AnDHO, 2015). Regarding livetock health, it was reported that there is only one veterinary clinic in the District that is located at the District's capital Fonko. The inhabitants are supposed to walk all the way to the existing clinic and get the services such as vaccination and improved reproduction. However, it was reported that there is a mobile service for the cases of epidemic outbreak during which the staff goes to the remote subdistricts, too (AnLANRO, 2015). Some of the top prevalent animal diseases reported were foot-mouth disease (Anjicho (Had.), pasteurellosis/'salaqa/kuticha/', epizootic deramatitis ('chechebsa'), lumpy skin disease(loph jabo), orf, diarrhea, external parasitic insects, liver fluke and Newcastle disease (fungu?nara) (AnLANRO, 2015).

3.1.3 Description of Duna District

Duna is located in the southern part of Hadiya zone at coordinates of 7.26° -7.53° N and 37.53° - 38.82° E and distance of 277 km from Addis Ababa in the south direction and 42 km from Hossana Zonal centre (Fig. 1) (HZFEDD, 2011). It was established recently in 2010 with 32 subdistricts, 1 subdistrict being urban. Ansho is the District's centre town. The total land area of the District is estimated to be 222.50 km^2. It has boundary with Kembata Tembaro Zone on the east and south, and with 2 districts of Hadiya Zone namely, with Soro on the southeast and with Lemo on the northeast. Altitudinal range lies between 2001-3000 m reaching highest peak at Mt. Sengiye (HZFEDD, 2011).

3.1.3.1 Climate and soil

An average annual rain fall of the district ranges from 1001 - 1400 mm while the mean annual temperature 12.60 - 20 °C (HZFEDD, 2011). About 65% of the landmass of the Duna District falls in 'ineqora'(Had.)/'dega' (highland) while 35% falls in 'hensewa' (Had.)/'woinedega' (midland) agroclimatic zone.The major soil types of the district are luvisol and nitosol (FAO, 2009).

3.1.3.2 Human and livestock populations

Based on the CSA (2007), the District had a total population of 122,087, of which 60,866 are men and 61,221 women. However, based on projection of SNNPRS Statistical Abstract for Hadya Zone (2014-2015), the population of the district to be 157,936 of which 78,755 (49.87%) were males and 79,181 (50.13%) females (HZFEDD, 2011). Majority of the inhabitants (94.42%) live in rural while small proportion 5.58% live in urban settings. The density of the population was reported to be 619.58 per sq. km. The District is mainly inhabited by ethnic Hadiyas and small proportions of Kembatas and Amharas (DNRAO, 2016). The majority of the inhabitants (84.92%) were Protestants with a small proportion (8.32%) were Catholic, and 5.41% Orthodox Christians (CSA, 2007). Regarding livestock population, a total of 101,219 livestock among which 45,350 cattle, 17,820 sheep, 500 goats, 7,600 horses, 3,900 donkeys, 4,048 mules, 220,01 fowls were known to be raised in the district (HZFEDD, 2011).

3.1.3.3 Economic activity

The economic activity of the inhabitants is largely dominated by subsistence traditional agriculture farming system (85%) both crop cultivation and livestock productions. Next to agriculture, remittances from non-professional job emigration to Republic of South Africa and Middleeast countries, and petty trade are also a common income sources for the people in the district (DNRAO, 2016). Major crops grown in the district include enset (*Ensete ventricosum*), barley (*Hordeum vulgare*), wheat (*Triticum aestivum*), beans (*Vicia faba*), peas (*Pisum sativum*), potato (*Solanum tuberosum*). Enset is the staple food in the area and almost always grown for consumption (DNRAO, 2016). The livestock raised include cattle, sheep, horses, mules and poultry (DNRAO, 2016).

3.1.3.4 Modern Health care services for human and animal ailments

There were five health centres each of them thought to be accessible five rural subdistricts and 22 health posts in the district, and 1 primary hospital on the way to be built (DDHO, 2016). The health centres are supplied with BSc holders and diploma level nurses who diagnose and treat patients with the drug dispensaries allocated from the government. The most important recorded human diseases include typhoid fever, STDs, pneumonia, TB, acute febrile rheumatic fever, gastritis, gout, diarrhea, conjuctivitis and dermal diseases (DHO, 2016). With regard to veterinary services, there is a single clinic in the district that is run by 1 veterinary Dr., laboratory technicians being located at center of the district. However, the vast subdistricts located far away from centre are accessed in the form of campaign by veterinary team when epidemics outbreak.

3.1.3.5 Vegetation

About 24,388 ha of land is covered by annual crops, 5,016 ha by permanent crops, only 79 ha by natural forest fragments and 749 ha by plantation (HZFEDCD, 2011). The natural vegetation in the landscape of Duna currently is almost impoverished except few patches of communal forests including one at Qenqicho subdistrict and some scattered remnant species of indigenous natural vegetation (Gideon Woldemariam, Pesonal observation November, 2016). There were considerable stands of exotic species mainly *Eucalyptus*

globulus plantations on private lots in sites such as catchments living fences stream banks which gives grace to the landscape of the District.

3.1.4 Description of Gibe District

Gibe District is located between 7° 37'53" - 7° 42'43''N and 37°37'07''- 37°44'25'' E at 25 km from Hossana town capital of Hadiya Zone and 259 km from Addis Ababa in south west direction (Fig. 1) (HZFEDD, 2011). Gibe is bordered in the south by Gombora, on the west by Yem Special District, and in the north and east by Misha. Its capital town is Homecho. The District is divided into 21 rural subdistricts and three junior municipalities. The total area of Gibe District is 447.83 sq. km. The altitude ranges between 1500 - 2200 m a.s.l. (HZFEDD, 2011).

3.1.4.1 Climate and soil

The mean annual rainfall of Gibe District ranges between 1001 - 1200 mm with a short rainy season /'qerato(Had.)/'belg' that is followed by a longer rainy season 'hegeye'/ 'meher' (HZFEDCD, 2011). The mean annual temperature of the district ranges between 17.60 - 25 °C (HZFEDCD, 2011). The District has two traditional agoecological zones; 'hensewa' (Had.)/'woinedega' (the midland) that covers a predominant proportion of 80% of the landmass of the district while 20% falls in 'qale?a'(Had.)/'kola' (lowland) agroclimatic zone. Six of its subdistricts are situated above 2200 m a.s.l. while the rest were below that altitude (HZFEDD, 2011). The major types of soil in the district are leptosol and nitosol (FAO, 2009).

3.1.4.2 Human and livestock population

Based on CSA (2007), it had a total population of 109,256, of which 54,224 are males and 55,032 females with 5,066 (4.64%) of its population are urban dwellers. However, according to SNNPR statistical office, the projected population for years 2014 - 2015 was 133, 443 of which 67, 179 (50.34%) were males while the remaining proportion were females (HZFEDD, 2011). According to CSA (2007), the majority of the inhabitants were Evangelical believers with 92.87% and a smaller proportion of 5.73% practiced Orthodox

Christianity. Regarding livestock population, a total of 222,486 livestock among which 105,839 are Cattle, 12,737 sheep, 22,084 goats, 14,169 horses, 13,767 mules, 59,890 fowls were known to be raised in the district.

3.1.4.3 Economic activity

The major economic activity of the population is agriculture that mixes up cultivation of crops and animal husbandry as means of livelihood and sources of income. The major crops cultivated in the district are cereal crops, namely, wheat (*Triticum aestivum*), barley (*Hordeum vulgare*), maize (*Zea mays* L.), 'teff' (*Eragrostis tef*) and sorghum (*Sorghum bicolor* (L.) Moench), enset (*Ensete ventricosum*), coffee (*Coffea arabica*), vegetables and fruits (GDANRO, 2016). Enset is the main staple food in the uplands while maize is in lower altitudes and *Coffea arabica* also plays important economic roles in lower altitudes. Migration to Republic of South Africa and Gulf countries is high source of remittance income in the district (Teshome Kanko *et al*., 2013).

3.1.4.4 Health services provided

There are 1 primary hospital, four healthcentres each of them thought to be accessible to five rural subdistricts and 22 health posts in the district (GDHO, 2016). The most important recorded human diseases include malaria (*Plasmodium falciparum* and *P. vivax*), typhoid fever, STDs, pneumonia, TB, acute febrile rheumatic fever, gastritis, gout, diarrhea, conjunctivitis and dermal diseases (GDHO, 2016). With regard to to veterinary services, there is 1 clinic in the district that is run by 1 veterinary Dr., laboratory technicians being located at center of the district. However, the vast subdistricts located far away from centre are accessed in the form of campaign by veterinary team when epidemics outbreak.

3.1.4.5 Crop and Vegetation

The area coverage of the land use system indicates that 69.8% is cultivated lands, 14.5% is forest lands, 8.4% is grazing lands and 7.3% is others (HZFEDD, 2011). The land covered by annual crops is 24,621 ha, permanent crops 6,728 ha, natural forest fragments 408 ha while plantation land cover was 3,577 ha (HZFEDD, 2011). One 200 ha protected natural forest named Hunese is located in AmboroGoynena

subdistrict which is the only ever cited natural forest across all Hadiya Zone. Floristic analysis of this forest has been performed during field data collection of this investigation apart of this work.

3.1.5 Description of Gombora District

Gombora district is located at coordinates of 7.54° - 7.73° N and 37.89° - 38.06° E in the southwest direction at a distance of 26 km from Zonal town Hossana (Fig. 1). It has a land size of 462.2 sq. km. consisting of 23 subdistricts (HZFED, 2011). It is situated at elevation range between 1501 - 2500 m. Gombora is bordered in the south by Soro, in the west by the Yem Special District, in the north by Gibe, in the northeast by Misha, and in the east by Lemo (HZFEDD, 2011).

3.1.5.1 Climate and soil

The mean annual rainfall of Gombora District is 1001 -1200 mm and the mean annual temperature is 17.60 – 22.50 °C and (HZFEDD, 2011). As it was in Gibe District, Gombora District also has two traditional agoecological zones; 'hensewa' (Had.)/'woinedega' (the midland) that covers a predominant proportion of 78% of the landmass of the district while 22% falls in 'qale?a'(Had.)/'kola' (lowland) agroclimatic zone. The major types of soil in the district are leptosol and nitosol (FAO, 2009). Based on farmers' classification, the dominant soil types are red-brown ferric and acidic soils that resulted after erosion of deforested rugged lands and in lower altitude plains vertisol is common that is water logged during rainy season which is ideal for teff cultivation.

3.1.5.2 Human and livestock populations

Based on CSA (2007) report, Gombora has a total population of 93,141 out of which 46,624 are males and 46,517 females. In the former none of its population were urban dwellers while currently, there are few urban dwellers in its capital Hebicho town. The majority (91.53%) of the inhabitants were Evangelical believers while 5.16% were Catholic, and 1.58% Orthodox Christians (CSA, 2007). The livestock population of Gombora District was 854,939 out of which 787,003 cattle, 9,471 sheep, 11,052 goats, 276 horses, 4,590 donkeys, 2,207 mules, 40,340 poultry were raised by farmers of the district (HZFEDD, 2011).

3.1.5.3 Economic activity

Agriculture is the main economic activity of livelihood to the majority of the people and characterized by traditional mixed farming as it includes both crop and livestock production. Major crops include the main staple food crop enset (*Enset vetricosum*), teff (*Ergrotis tef*), maize (*Zea mays*), sorghum (*Sorghum bicolor*) Moench), taro (*Colocasia esculenta*), Irish potato (*Solanum tuberosum*), barely (*Hordeum vulgare*) and wheat (*Triticum aestivum*). Fruits such as avocado (*Persea americana*), banana (*Musa* x *paradisiaca*), papaya (*Carica papaya*) are also cultivated both for household consumption and income generation. Animal husbandry is another economic activity both for providing services such as tilling land, manuring home garden mainly enset, depositing wealth, for income generation, and also for prestige. Migration to South Africa and Gulf countries is high source of remittance income (Teshome Kanko *et al.*, 2013).

3.1.5.4 Health services available

There are six health centres one of them being private (NGO) each of them have 5 catchment subdistricts that are beneficiaries with health services, and each of the subdistrict of the district have 1 health post that is run by health extension workers. The most reported health problems include measles, giardiasis, diarrhea, amoebiasis, malaria, TB, typhoid fever, typhus and dermal ailments (GmHD, 2016). There is a single mobile veterinary clinic that is based on the District centre Habicho which provides emergency services as field work when there are reports of epidemics animals in different subdistricts of the district.

3.1.5.5 Crop and Vegetation

The land cover records of Gombora showed that annual crops cover 17,493 ha, permanent crops 5,385 ha, natural forest fragnents 1,221 ha, plantation 702 ha (HZFEDCD, 2011). The lands covered with high forests are now inhabited by human settlements partitioned by private lots that have some of remnant indigenous trees species that include *Albizia schimperiana*, *Crotom macrostachyus*, *Ficus exasperta*, *Prunus africana*, *Manilkara butugi*, *Mimusops kummel*, *Cordia africana*, *Ocotea kenyensis*, *Olea welwitschii*, *Olea. capensis* subsp. *macrocarpa*, *Podocarpus falcatus* and *Sapium ellipticum*. In accordance with this, one can observe

haphazardly scattered mosaics of native trees and shrubs that mix up *Eucalyptus camaldulensis* and *E. globulus* trees than any other three Districts of Hadiya.

3.1.6 Description of Yem Special District

Yem Special District is one of the administrations under SNNPR. The district is mainly inhabited by the Yem whose language is Yemisa. The district is located in the north-western apex of SNNPRS, Ethiopia within coordinates of 7°37'N - 8°02' N and 37°40' E - 37°61' E at 297 km from Addis Ababa in Southwest Ethiopia (Fig. 1). It has a land surface area of 724.5 sq. km (Wondimagen Bizayehu *et al.*, 2012). The District has 30 rural subdistricts and 3 towns. The topography of Yem district is characterized by rolling mountains, long gorges of Gibe River, steep slopes and flat to undulating plateaux (Wondimagen Bizayehu *et al.*, 2012). The district lies within elevations between 920–2939 m a.s.l. (Mitiku Negash, 2005).

3.1.6.1 Human and livestock populations

The total population of the district was estimated to be 80,647 of which 50.3% were males and 49.7% females and the population density was 111.3 persons per sq. km (CSA, 2007). The Special District is mainly inhabited by the Yem people (91.87%), while other ethnic groups living reported include Oromos (5.6%), Hadiyas (0.82%) and other ethnic groups made up 1.71% of the population. Yemsa is spoken by 79.05% of the inhabitants, and 19.24% spoke Oromiffa; the remaining 1.71% spoke all other primary languages reported. About 71.24% of the population said to practic Orthodox Christianity, 25.14% Muslim and 3.48% were Protestants (CSA, 2007; Wondimagen Bizayehu *et al.*, 2012). Regarding livestock population, a total of 236,102 livestock were reported out of which 87,716 were cattle, 42,585 sheep, 50,169 were goats, 3,868 horses, 4,896 donkeys, 654 mules, 46,214 poultry (Mitiku Negash, 2005; YSNAO, 2016).

3.1.6.2 Climate and soil

Yem area receives a mean annual rainfall of 900–2200 mm mainly from June to September. The Special District has three traditional agroclimatic zones; namely, Dega(cool highlands) (18.4%), WeynaDega (midlands) (57.6%) and Kolla (lowlands) (24.0%) (Mitiku Negash, 2005; YSNAO, 2016). According to

NMSA (2014) metrological data from Deri Kidame Gebeya located in Yem, high rainfall is received between May to September with peak being 256 mm in July where as low rainfall recorded from November to February reaching the lowest of 25 mm in December within 13 years (2000-2012) (Fig. 3). Similarly, the highest mean annual temperature was 21 ^{o}C recorded in May while the lowest mean annual temperature over ten years was 7 ^{o}C recorded in December between 2000-2012. The soil types in the district are predominantly aluvisols followed by eutric nitosol, leptosol, luvisol and vertisol (FAO, 2009).

3.1.6.4 Economic activity

Agriculture that includes crop cultivation and livestock rearing are the main economic activities in the District. Rain-fed agriculture is the mainstay of the district, the dominant crops being cereals such as wheat (*Triticum aestivum*), barley (*Hordeum vulgare*), teff (*Eragrostis tef*), maize (*Zea mays*), sorghum (*Sorghum bicolor*) Moench), pulses, and root crops such as 'ewa'/ (*Ensete ventricosum*), 'mareduna'/*Plecthranthus edulis*, and 'aju'/*Coccinia abyssinica* (YDAO, 2013). Subsistence agriculture is practiced in the District based on cereal, enset being the staple food. Important cash crops include teff, wheat, barley, pulses, chat, animal products (mainly butter) and remittances.

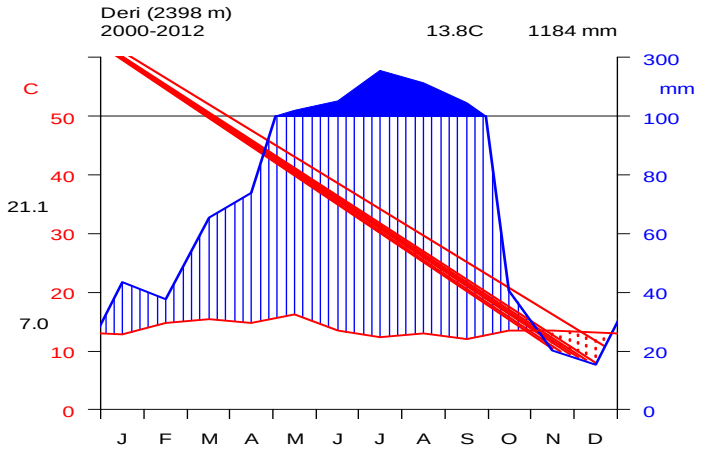


Fig. 3. Clima diagram of Deri Kidame Gebeya - a rural own 15 km away from District capital Saja

3.1.6.5 Vegetation

The landscape of Yem Special District is covered by 14,916 ha annual crops, 35,851 ha permanent crops and

7,463 ha natural forest fragments among others (YSDFEDD, 2016). The district has a rugged irregularly rolling topography. It was observed thatYem has few number of woodlands and protected remnant natural forests. The protected natural forests include Kumuli forest (that was studied Gideon Woldemariam *et al*., 2016), Hanebari Kelo and Oya forests. Moreover, private lots of farm lands traditionally have agroforestry nature with mature stands of indigenous tree species that seem deliberately left such as *Albizia schimperiana*, *Apodytes dimidiata*, *Croton macrostachyus*, *Ficus sycomorus*, *F. sur*, *F. vasta*, *Juniperus procera*, *Olea capensis* subsp. *macrocarpa*, *Podocrpus falcatus, Prunus africana* and *Syzygium guineense* subsp. *guineense*. The vegetation of Yem area includes Dry evergreen Afromontane type in the high altitude areas that reach highest peak at Bori Mt. (2939 m a.s.l.) while wooded grassland with deciduous *Combretum-Terminalia* types along the Gibe River valley which descends lower upto 1400 m a.s.l.

3.2 Vegetation Data Collection

3.2.1 Species and environmental data collection

The vegetation data were collected from quadrats laid in different land uses of the five districts following preferential sampling method as suggested by Heard and Channon (1997) and as used by Michalcová *et al*. (2011) and Cachovanová *et al*., (2012). The vegetation data collection was made considering dry and wet seasons. Accordingly, the vegetation data were collected between April to June 2013 to August 2016. The land uses types considered for the vegetation data were natural forests, mixed plantations, fallows, homegardens, farmland and their edges, grazing fields, living fences, sacred sites /church compound and grave yard, river/stream banks and woodlands. A total of 123 (30 m x 30 m = 900 m^2) quadrat were laid for sampling trees and shrubs as used by Tamrat Bekele (1993). Further for sampling herbaceous species, five 2 m x 2 m nested subquadrats were laid in 4 corners and 1 at the centre of each quadrat that latter averaged as suggested by Kent and Kocker (1992). Of the the total quadrats, 30, 24, 24, 23 and 22 quadrats were laid in Yem, Anlemo, Duna, Gibe and Gombora, respectively. The quadrats were laid using measuring tape, polythene string and Silva compass for obtaining floristic information. The following phytosociological parameters were performed in the quadrats;

i) In each quadrat, the percentage cover of species encountered in the quadrats were visually estimated and later converted to 1-9 cover/abundance scale of Braun-Blanquet (1965) modified by van der Maarel (1979) for classification of plant communities containing medicinal plant species. The modified 1-9 cover/abundance scale values are given as; 1 = rare, generally one individual with less than 5% cover of the total plot area, 2 = occasional or sporadic with less than 5% cover of the total plot area, 3 = abundant, with less than 5% cover of total plot area, 4 = very abundant, with less than 5% cover of the total plot area, 5 = 5-12% cover of the total plot area, 6 = 12.5-25% cover of total plot area, 7 = 25-50% cover of the total plot area, 8 = 50-75% cover of the total plot area, and 9 = 75-100% cover of the total plot area).

ii) Individuals of species encountered were counted in each quadrat for analysis of diversity. Diversity of plant species sampled from quadrats laid in the study areas was computed using Shannon-Weiner's Index following (Magurran 1988; Justus, 2010) by using the formula $H' = -p(\ln)p$, where H' = Shannon's diversity and p = proportion of a species abundance; Shannon's equitability index, J' = H'/lnS, where S = species richness.

iii/ The similarity of plant communities of the five study districts was calculated using Sorenson's Similarity (Ss) following Magurran (2004) and Chao *et al.* (2005) with the formula for Ss is given as;

Ss = 2a /2a+b+c, where a= species common to b & c; b = number species present in second site only and; c = number of species present in the first site only.

iii/ Environmental parameters such as altitude, slope, aspect and landuse types and their level of disturbance were considered and their measures were recorded in numerical values for ordination of species and environmental variables. Altitude was measured using Garmin H72, slope and aspect were measured using Silva Ranger Compass inbuilt with clinometer. The values of aspect were coded as east = 2, north = 0, northeast = 1, northwest = 1.3, south = 3, southeast = 3, southwest = 3.3, west = 2.5 following Zerihun Woldu *et al.* (1989). Moreover, for ordination the different land use types where samples laid for vegetation data were noted for level of disturbance as used by Anderson and Currier (1973) i.e. 0 = 0 – 1 5%, no disturbance, 1= 16-35% lightly disturbed, 2 = 36-65%, safe, 3 = 66-80%, heavily disturbed, 4 = over 80%, severely

disturbed. These scales were modified and applied to the different land uses types as; communal natural forests, homegarden, sacred sites /church compound & grave yard were assigned 0, living fence and mixed plantation were assigned 1, river/stream bank vegetation were assigned 2, edges of farmland, fallow and woodland were assigned 3, farmland and grazing field were assigned 4.

3.3 Ethnobotanical Data Collection

3.3.1 Selection of study areas (districts and subdistricts)

The study area selection was based first on the researcher's identification of the problem that was approved by supervisors with a thought of making a complete inventory of MP genetic resources and associated indigenous knowledge used for safeguarding primary health care of humans and livestock by local communities of five districts in southern Ethiopia. Four of the study districts namely, Anlemo, Duna, Gibe, Gombora all are from the same ethnic group were selected purposively for the study considering that that they represent different agroecologies: lowland, middle land and highland climates, and more or less the four geographical directions of Hadiya area. Yem Special District - the fifth study site belongs to a different ethnic group but it is a neighboring district that shares boundaries with two of the districts Gibe and Gombora in Hadiya Zone Districts being demarcated by a natural frontier of Gibe river (Table 1). These three of the districts are located inhabiting territories near Gibe valley in each district. In each of the five districts, four subdistricts (the lowest administrative unit) were selected purposively based on agroecological (climatic) barrier making the total number of subdistricts selected 20 for sampling of ethnobotanical information as used by Cadena-González *et al.* (2013).

3.3.1.1 Reconnaissance Survey

A reconnaissance survey of the study areas was conducted between 25 September and October 5, 2013 for acquaintances with administrative centres of each district and for getting information and mental map on the landscape of the subdistricts to be sampled. In each district, the distance of subdistricts to be selected was determined based on ease of access for commuting on foot for a maximum of two hours walk a day from

district centres. Selection of TMP experts and healers for both human and livestock was made with the help of Culture and Tourism Offices of the districts as they have the list of traditional healers of each subdistrict. In the same way, local guides were chosen by recommendation of district administration who took training for assisting data collection.

3.3.2 Research Design

This research employed combination of qualitative and quantitative methods following Albuquerque *et al.* (2013). A total of 501 informants (comprising of predominantly farmers, herbalists and and few government employees) were involved in semi-structured interview, in-depth interviews and focus group discussions following (Martin, 1995; Alexiades, 1996).

3.3.3 Sample Size Determination

The sample size detemination was made following Cochran's method for categorical data for alpha level at 0.05 (type I error of 5%) (Cochran, 1977) using the formula below:

$$n = \frac{N}{1 + Ne^2}$$

where; n is the sample size, N is the total value of house hold heads in the study area and e is the level of error at 95% confidence level. Here, the number of households was obtained from source of CSA (2007) and administrative offices of each study district. Accordingly, the total number of household heads that is N (total number of households) in the study areas was 218394 (CSA, 2007). Based on this, the total sample size of general (lay) informants calculated was 399 that was distributed proportionally to the 20 study subdistricts of the five districts based on the total number of households they contain. Regarding selection of key informants from each study subdistricts, five key (expert) informants were selected from 19 subdistricts while in one subdistrict i.e GoruminaHengeri of Yem Special District 7 key informants were selected with special consideration that makes a total of 102 key informants. Therefore, overall sample of informants involved in this study was 501 (Table 1).

Table 1. Demographic and Local information of sample districts along their subdistricts and informants (HHs = households, DF = Debub Fonko, H = H Letebo, Lay Fonko, *Hadeye , **Arara)

District	Subdistrict	Agroecology*	Latitude UTM	Longitude UTM	# of HHs	Proportional allocation of sample	Purposive sampling	Total
Anlemo	Fonko Toka (DF)	High land	382977.277	84241.62	567	16	5	21
	DulanchoBelela	Middle land	392819.792	849189.967	555	16	5	21
	EntoLaftolenqa	Middle land	387104.785	848131.631	656	19	5	24
	Layigna Fonko (LF)	High land	385517.282	843369.122	723	21	5	26
Duna	Ajarena	High land	355566.389	813629.896	1143	33	5	38
	Debiyago	High land	354931.388	816487.402	1033	29	5	35
	Letebo H	High land	355037.221	812148.226	847	24	5	29
	Qenqicho	High land	358106.394	815534.90	748	21	5	26
Gibe	AmboroGoyenena	Middle land	358423.895	845168.292	649	19	5	24
	Awosa	Lowland	345406.369	857021.649	1029	29	5	34
	Hadiye*	Middle land	355989.723	852153.306	1239	35	5	40
	Homecho	Middle land	356518.891	848131.631	549	16	5	21
Gombora	Adeana	Middle land	350803.88	835960.774	376	11	5	16
	Arara Agero**	Middle land	356095.557	837865.778	630	18	5	23
	OrdeBobicho	Middle land	347417.206	840511.616	972	28	5	33
	Wendo	Middle land	352285.549	839029.947	556	16	5	21
Yem	Fofa Zuria	High land	336833.852	867625.004	420	12	5	17
	GuruminaHengeri	Middle land	337574.68	873320.015	450	13	7	18
	SajaLaften	Lowland	324874.661	881361.635	445	13	5	18
	Shemona Metelo	Highland	335881.35	864535.831	387	11	5	16
	Total				13974	399	102	501

*highland =2300-2629 m; midland=2001-2299 m; lowland=1500-2000 m as.l. (Source: Hurni (1998), MOA (1998)

3.3.4 Sampling Design

For obtaining ethnobotanical information, Stratified Random Sampling (SRS) method was employed for selecting general informants within subdistricts that were proportionally distributed within 'limat budin' which a subset of the subdistricts following Martin (1995) and as used by Cadena-González *et al.* (2013). Purposive sampling method was employed for selection of key informants (herbalist healers) for gathering ethnobotanical information following Martin (1995). The total number of households selected from each study subdistrict and inturn in each 'limatbudin' were varied based on the number of households contained (Table 1). Based on this fact, in the SRS proportional allocation was used for determining the number of

general informants in each subdistrict, and in 'limatbudin'= smaller unit of subdistrict/development units' to draw informants of age 18 and above in a household following Lemeshow *et al*. (1990). Then, interviews were conducted with one person of age 18 and above in each household considering relatively equal representation of sex and age.

3.3.5 Ethical Clearance

Letters of cooperation to the respective study district administrations for conducting research in the study districts were obtained from the Department of Plant Biology and Biodiversity Management, Addis Ababa University. In the beginning of field work, the District Administrations acknowledging the cooperation letters gave permission for conducting the research. Accordingly, the offices inturn wrote letters to corresponding District Health, Agriculture and Natural Resources Management and State Communication, Culture and Tourism Offices and to the respective sample subdistricts stating that the researcher was given permission for conducting the research so that the subdistrict communities cooperate in providing necessary data, resources, allow taking plant samples, cooperate in guiding, assisting and responding to interviews. At each subdistrict, chairpersons were contacted in person providing the letters of cooperation. Acknowledging the subject of the letters, the chairpersons: i) provided data of the number of 'limat budin' under subdistricts and house holds, ii) recommended key informants and elders for interviews and guides who accompany and show the boundaries of 'limat budin' and the informant households, and iii) arranged meetings with informants so as to arrange interview and discussion dates according to informant convenience. During the meetings, the investigator introduced himself and explained the objectives of the study for the interviewees. The selected informants in each district agreed to give ethnobotanical information during interviewing.

3.3.6 Collection of Ethnobotanical information and Voucher specimens

Four field trips were made to each of the study areas considering dry and wet seasons from April to June 2013; October to December, 2013, October to December, 2016; April to August, 2016. Voucher specimens of MPs taken during interviews and during vegetation study were brought to the National Herbarium (ETH),

Addis Ababa University and processed using standard herbarium techniques for identification following Alexiades (1996). Identification samples was done by the researcher on the spot in the field for few samples and most of the plant species specimens were identified in the National Herbarium of Ethiopia (ETH) using the published volumes Flora of Ethiopia and Eritrea (Volumes 1- 8 (Hedberg *et al.*, 1989; Edwards *et al.*, 1995; Philips, 1995; Edwards *et al.*, 1997; Edwards *et al.*, 2000; Hedberg *et al.*, 2003; Hedberg *et al.*, 2004; Mesfin Tadesse, 2004; Hedberg *et al.*, 2006; Hedberg *et al.*, 2009). The identified specimemns were commented, checked and approved by Prof. Sebsebe Demissew - Professor of Plant Systematics and Biodiversity. The voucher specimens were deposited at the National Herbarium (ETH), Addis Ababa University.

3.3.7 Secondary data collection

Secondary data were obtained from the National Metrological Services Agency (NMSA), different offices of the study districts such as Culture, tourism and State communication affairs, Natural Resources and Agricultural Offices and Health Offices. Interviews were made with heads of Health Offices and Veterinary practitioners of each district.

3.3.8 Semi-structured Interviews

Semi-structured interviews were held with individual household informants on the use and conservation of MPs following 'interview guide' that was prepared priori as suggested by Martin (1995) and Cotton (1996) and used by González *et al.* (2013) (Appendix 8) (Fig. 4). The interviews were held in their native languages. Accordingly, in Hadiya area, the interviews were held in 'Hadiyisa' - the language of Hadiya where there was no need of translation as the investigator was from that community. In the case of Yem, informants were interviewed in 'Yemisa' = language of Yem by the help of guide transtors in three subdistricts while in one subdistrict i.e. Saja-Laften interviews were held in Oromifa that was assisted by a guide transilator as informants were ethnic Yem whose language was Oromifa. Some of the informants in Yem were also interviewed in Amharic when they were found to speak Amharic without assistance of translation. The interviews were conducted in places where the informants were most comfortable and during the time

convenient for them. Individual interviews were also made with mainsteam local health officers and veterinary practitioners with regard to the services they provide, the prevalent health problems and their attitudes towards use of TMPs.

During the interwiews, both general informants and key informants were asked if they prefer the mainstream biomedical health care to TMPs or use both systems.The informants freely listed human and livestock ailments, the MPs they employ for the human and livestock ailments, parts used, habitats, methods of preparation, condition, accessibility, routes and mode of application, doses, sideeffects, antidotes (if any), and threats of MPs in their localities. In-depth interviews were made with key/locally expert informants in order to collect information on their knowledge on MP use and their services offered to locals as used by González *et al.* (2013) (Fig. 4).

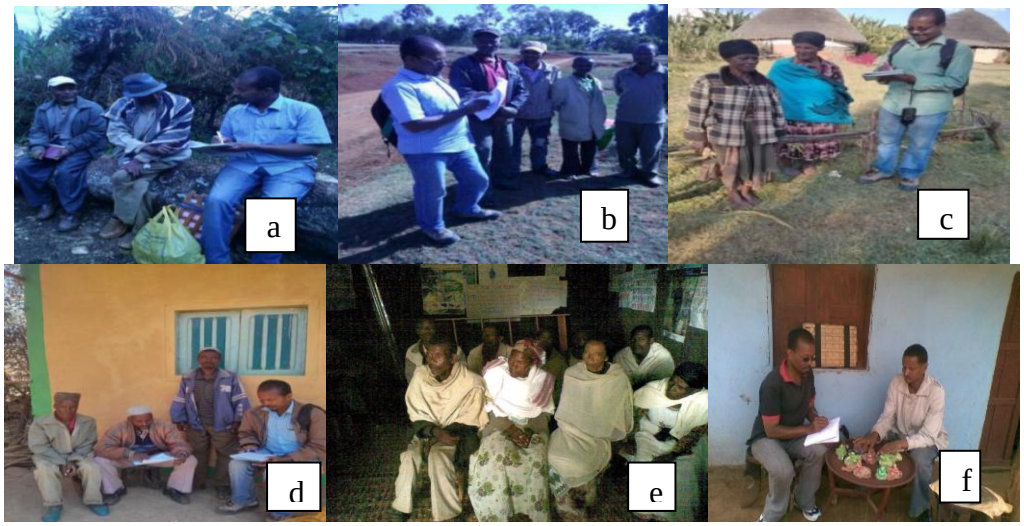


Fig. 4. Interviews underway with informants: a- d) interviews with informant & groups discussants -Adeana & Wondo-Gombora; Hadeye- Gibe, DebubFonko-Anlemo; e) meeting with key informants GoruminaHangeri, f) interview with single informant- GoruminaHengeri & FofaZuria, Yem) (Photo by Guides April 2013 & November, 2016)

3.3.9 Focus Group Discussions

Fifteen Focus Group Discussions three per district were held with selected groups of informants of different professional compositions with their respective languages on the history of human and livestock ailments, the tendency of use of traditional and western medicines, on use, the threats of MPs, indigenous knowledge, conservation practices of MPs, threats of multipurpose MPs, the status of natural vegetation containing MPs,

and on the perceptions of local health institutions/personnel and local administrations towards use of TMPs. The informants were told to freely state their ideas during the discussions. Moderation was made when few informants dominate the discussion to avoid biases of information as suggested by Martin (1995).

3.3.10 Participant Observation

Participant-observation gives opportunity for the researchers to learn about various ways people perceive, utilize, and manage plants and to gather a variety of spontaneously occurring complex data, and the opportunity to gain insight for research problems (Bernard, 1994; Alexiades, 1996). In the present study, two participant observations were made. The first one was in a renowned local traditional MP clinic in Yem that was owned by a male herbal extpert who worked on specific days of a week and he positively invited to observe his clinical services held in his residence which was visited by patients from nearby and far domestic locations (Fig. 5). Observation was made for 3 hours on healer's ways of diagnosis of his patients, what types of ailments he treated, the doses of his remedies, how much he charges for his services, the number of patients visiting him and how much MPs are accepted for treating ailments.



Fig. 5. Participant observation of. TMP clinic of Mr. Woldemeskel, local healer in Yem ((Photo by assistant, July, 2016)

The second participant observation was made in the same Yem on a traditional MP collection occasion of the ethnic group that is held every year on the 27th October at Mt. Bori from where every herb found in this site is collected –what is called 'SAMO-ETA' which is used for year round for cases of human and veterinary ailments as well as for general health. The observation was made on the occasion, who participates in collection, what MPs collected, how much collected and why they prefer that date and the site (Fig. 6).



Fig. 6. Participant observation of Yem TMP collection anniversary: on 27th October at Bor Mt. In Yem; a) part of Bori landscape, b) researcher with crew of Jounalists from southern TV and radio broadcast in interviewing informants, c – e). local .people in collection of MP (some of them along with their children) (Photo by Gideon WM and guide, October 2016, Yem)

3.3.11 Guided transect walk

Multiple of guided field walks were made accompanied by key informants which gave good opportunity for identification of different medicinal species used by the community, local names of each of medicinal plants, land use systems and habitats they grow in, their distribution pattern as used by Cadena-González *et al*. (2013). Interview was done about the medicinal species encountered, specimens of them were taken for which labeling was made and interview guide also was completed. Samples and photographs of MP species were also taken. The landscape of the study localities were also observed to learn about the availability and distribution of medicinal plants at different land use systems such as fallows, crop fields, plantations, community forests and the nature as used in Cadena-González *et al.* (2013). The management practices of relict stands of

multipurpose MP species and mosaics of vegetation by local people has been visually observed and notes have been taken on the availability of the MPs categorising into very common, common and rare status.

3.3.12 Market Surveys

Market observations were made from 2-3 times in different public markets available in the five study districts. The markets observed were Fonko market in Anlemo District, Ansho market in Duna District, Homecho market in Gibe District, Habicho market in Gombora in Hadiya area in May 2013 and October -November 2016 and June 2016. In Yem Special District, markets observed were Saja market (in April 2013), Deri market (in June 2016) and Fofa market (in April 2013 & June 2016). Interviews were conducted verbally with open market retailers, a herbal vendor and buyers of both genders about the marketability, cultivation practices, availability, threats and economic values of the MPs. Some photographs of market events are given in (Fig. 7).



Fig. 7. Observation of markets: a, d,e) - Fonko, Anlemo; b) -Fofa & d) Deri -Yem; c). Homecho, Gibe; e) *Withania somnifera* branch as seedling g) bundles of *Catha edulis* wrapped with enset leaf –Saja; h) fresh *Aframomum corrorima* – Fofa (October 2016 and August 2016) (photos by Gideon W/M & assistants)

3.4 Quantitative Analysis of Ethnobotanical Data

3.4.1 Percentages, averages and ranges

Ethnobotanical data obtained from informants and the data on vegetation were entered in an excel spreadsheet (Microsoft corporation, 2007). Then, the data were organized, where necessary they were summed and expressed in terms of proportions as percentages for comparing informant responses, identifying and comparing species, genera and families of MPs used, their growth forms, proportions of parts harvested, modes of remedy preparation and routes of administration (Alexiades, 1996).

3.4.2 Preference Ranking

A preference ranking of MPs with the highest informant consensus was computed for both human and veterinary ailments independently by responses obtained from ten key informants from each district to find out the degree of popularity and effectiveness of those MPs among the communities following Martin (1995). Moreover, in each district preference ranking of threatening factors of MPs was also computed by randomly selected 10 key informants to find out the most threatening factors such as charcoal, encroachment to communal forests, construction, drought, fuel wood for households & bakeries, grazing, household utensils, intensification of *Eucalyptus* tree species, lumbering/saw mill, modernization, soil erosion & degradation of land, unwise harvest and use of herbicides.

3.4.3 Direct Matrix Ranking

The exercise of Direct Matrix Ranking (DMR) of multipurpose MPs used for human and livestock ailments was performed separately with randomly selected 10 key informants in each district. DMR was calculated to find out the local people's preference over use of multipurpose MPs which are threatened on the course of their daily uses by the people and suggest protection and conservation of those high ranked ones following Martin (1995).

3.4.4 Informant Consensus Factor (ICF)

The ICF of MPs that had highest citations for treating human and livestock ailments were calculated to evaluate the level of homogeneity of information provided by different informants using of Informant Consensus Factor (ICF) following Trotter and Logan (1986). The index was calculated as the number of use citations in each category minus the number of species used divided by the number of use citations in each category minus one. The formula of the index is;

$ICF = \frac{Nur - Nt}{Nur - 1}$ where, Nur = number of use reports from informants for a particular plant-use category; Nt = number of taxa or species that are used for that plant use category for all informants. The index lies between 0 and 1, and values close to 1 indicate high agreement and also when only one or a few plant species are reported to be used by a high proportion of informants for a particular category, whereas low ICF values indicate that informants disagree over which plant to use (Heinrich *et al.*, 1998). For the ICF analysis, human ailments were grouped into nine categories as suggested by Cook (1995) namely; blood vascular & infectious, dermatological, gastro-intestinal & visceral organs, miscellaneous, musculo-skeletal, respiratory system, psycho-spiritual & cultural, reproductive & uro-genital ailments, miscillaneous ailments whose sign and symptoms and specific body part could not be stated clearly. Similarly, veterinary ailments were grouped into seven categories namely; blood vascular & infectious, dermatological, gastrointestinal & visceral organs, musculoskeletal-sensory & miscellaneous, psychospiritual & cultural, reproductive & urogenital and respiratory ailments.

3.4.5 Fidelity Level (FL (%)

Fidelity Level (FL (%) of MPs used for human and veterinary ailments was calculated in each of the five districts to identify MPs with highest healing potential. This index is calculated as the ratio between the number of informants who suggested the use of a species for the same major purpose (I_p) and the total number of informants who mentioned the plant for any use (I_U) (Friedman *et al.*, 1986). The index is expressed as percentage, where values closer to 100% show that almost all use-mentions refer to the same purpose, that is

the plants (and their use for a particular purpose) are most preferred, whereas low FLs are generally obtained for plants that are used for many different purposes. The formula for fidelity level (FL) is;

$$FL = \frac{I_p}{I_u}$$

$$FL\ \% = \left(\frac{I_p}{I_u}\right) \times 100$$

where I_p = the number of informants who suggested the use of a species for the same major purpose; I_U = the total number of informants who mentioned the plant for any use.

3..4.6 Use Value Index (UV) of MPs

Informants of each district free listed the number of added values of each of the MPs during individual semi-structured interviews. The added values of MPs in each district were organised and grouped into 12 use categories for calculation of Use Value (UV) of MPs following Cook (1995) namely; apiculture, farming & household tools, construction, fence, food & wild edibles, forage, fuel & charcoal, maintenance of soil & climate, medicine (both of human and livestock), ritual & cultural, shade, stimulants & spices. Then, the local importance of each medicinal species cited in the study area was calculated using the formula proposed by Phillip and Gentry (1993a) that was modified by Rossato *et al.* (1999) which is simplification the formula used by the former and the later claiming repetition of interviews with the same informant in the former is not necessary (Cadena-González *et al*., 2013; Silva *et al*., 2014). The UV index shows the relative importance of each species locally known by the informants. The plants with the highest UV index indicate species that the are most important by local people. It has also been associated with issues of conservation, based on the idea that the most important species will suffer the greatest harvesting pressure (Albuquerque *et al*., 2006). The formula of use value is given as;

$UV = \frac{\sum U}{n}$; where, UV is use value, $\sum U$ = the sum of number of uses mentioned by each informant per species, and n = the total number of informants that mentioned any use for that species.

3.4.7 Use Diversity

The proportion of medicinal taxa used in each of the 12 use categories was calculated as percentages as used in Reyes-García *et al*. (2005). Moreover, the diversity of uses (*H'*) and use evenness (*J'*) of the most cited multipurpose MPs were computed using the Shannon-Wiener diversity index (*H'*) following Rico-Gray *et al*. (1991). $H' = -\sum pi \ln pi$, where *H'* = use diversity, i = use category, and pi = proportion of species for the ith use category; and $J' = H'/Hmax = H'/\ln(i)$, where *J*' = use evenness, Hmax = maximum value of i^{th} category.

3.4.8 Relative Importance Index (RI)

The local importance of each species cited in the study area was also calculated using Relative Importance (RI) which also shows the relative importance of each species locally known by the informants (Bennett & Prance, 2000). The formula for Relative Importance;

RI = NUC + NT

where RI = Relative Importance; NUC = number of use-categories of a given species (NUCS) divided by the total number of use-categories (NTS) of the most versatile species (NUCVS) and NT - number of types of uses attributed to a given species (NTS) divided by the total number of types of uses attributed to the most important taxon (NTMIT), independent of the number of informants that cite the species. The highest possible RI value for a given species is 2.00 (Bennett & Prance, 2000).

3.4.9 Analysis of similarity of human and livestock ailments, and MPs reported in the study area

The similarity of human and livestock ailments, and MPs reported between the five study districts was calculated using Sorenson's coefficient of similarity (Ss) following Magurran (2004) and Chao *et al.* (2005). The formula Ss is; $Ss = 2a/2a+b+c$ where a= species common to b & c; b = number species present in second site only and; c = number of species present in the first site only.

3.5 Analysis of Vegetation and environmental Data

Classification of plant communities was performed by employing hierarchical clustering that uses algorithm of average linkage between subsets with similarity ratio and a resultant dendrogram tree following Day and Edelsbrunner (1984) and Rani and Rohil (2013) in R Statistical software version 3.1.1 (R Core Team, 2014). Plant communities identified thus far were further refined in a synoptic table where species occurrences are summarized as cover-abundance values (van der Maarel *et al.*, 1987). The community types in each district were named after three dominant species that have cover values in the synoptic tables that summarise the results of classification of quadrats (Weber *et al*. 2000; Lubomír *et al.*, 2010). Shannon-Weiner Indices of diversity (*H'*) and evenness (*J'*) of plant communities of each district were computed during the clustering procedure as proposed by Justus (2010).

Ordination of species-environmental factors in each district was performed in R version 3.1.1 (R Core Team, 2014). Preliminary model choice of ordination was performed using Detrended Correspondence Analysis (DCA) (Hill & Gauch, 1980) as suggested by ter Braak and Šmilauer (1998; Lepš & Šmilauer, 2001) that is based on the length of axis in the summary of DCA. The output of this analysis showed that longest axis in the output of each district was between 3.0 and 4.0 in Anlemo, Duna, Gombora and Yem, and above 4.0 in Gibe. According to ter Braak and Šmilauer (1998), if the value of longest axis is larger than 4.0, the unimodal method is employed indicating that the data are too heterogeneous and too many species deviate from the assumed model of linear response, if the longest gradient is shorter than 3.0, the linear method is employed, and if the axis length is between 3.0 and 4.0, either of the two models is employed. Then, for the purpose of this investigation, the unimodal model, Canonical Correspondence Analysis (CCA) was used to assess which environmental factors within sampled plots explain species patterns in those same plots (ter Braak, 1986). Scaling 1 (sites) procedure was used for displaying variables on ordination space in the CCA biplot.

3.6 Statistical Analyses of Ethnobotanical Data

After organisation of the raw ethnobotanical data in MS excel, both descriptive and inferential statistical tools were employed for the analysis by using Statistical Package for Social Sciences (SPSS) version 20 (IBM Corp., 2011). Parametric tests such as independent t-test, paired t-test and one way ANOVA and one non-parametrict test i.e Chi-square (χ^2) test of association/independence were used for the data analysis. Independent t test and One way ANOVA were carried out to check whether there were significant differences at 95% confidence level in MPK of different socioeconomic groups of informants in each district such as male and female, Protestants vs Muslims, and Muslim vs Orthodox religion followers. Paired t-test was used to check whether there were significant differences at 95% confidence level on the mean number of plant species belong to the plant families; the number of ailments reported and the number of MPs used to treat them in each district. Chi-square (χ^2) test and Pearson's Product Moment Correlation (r) were used to check whether there is association in gender and age in conservation of MPs at 95% confidence level. PCA was performed to see the correlation of MPK among informants of the five study districts using SPSS 20 (IBM Corp., 2011). Shannon-Weiner Index of diversity (*H'*) and evenness (*J*) and Sorenson's indices of similarity among the sample vegetation of each of the five districts were computed using MS excel (MS 2007).

CHAPTER FOUR

4. RESULTS

4.1 Results of Vegetation Data Analysis

4.1.1 Floristic diversity vegetation in the study area

An overall count of 468 vascular plant species distributed in 317 genera and 96 families were captured from quadrats laid in the five districts (Appendix 1). Except 3 species of Gymnosperms and 11 species of Pteridophytes, the remaining recorded taxa are Angiosperms. Out of the total, the highest number of 368 species 262 genera and 86 families were recorded from Hadiya while 326 species, 242 genera and 79 families were recorded in Yem. The number of species, genera and families in the four districts of Hadiya separately in descending order of the districts were 229, 189 and 74 in Gibe; 206, 154 and 61 in Gombora; 131, 115 and 58 in Duna, and 115, 98 and 46 in Anlemo.

4.1.2 Habit and species richness sample in the five districts

Results on overall habit of overall species inventoried from quadrats sampled revealed that herbs were dominant 218 (47%) followed by shrubs 104 (22%) and trees 83 (18%) (Fig. 8). Herbs were also dominant on the basis of individual district except in Anlemo where shrubs were dominant. Accordingly, the proportion of herbs, shrubs and trees was 152 (42%), 85 (24%) and 91 (25%) in Hadiya and 152 (47%), 67 (21%) and 55 (17%) in Yem, and in three districts of Hadiya in descending order were 87 (38%), 58 (25%) and 47 (21%) in Gibe; 77 (37%), 59 (30%) and 50 (23%) in Gombora; and 59 (44%), 49 (37%) and 10 (8%) in Duna while in Anlemo shrubs were 41 (35%) followed by herbs 35 (30%) and trees 25 (22%) (Fig. 8).

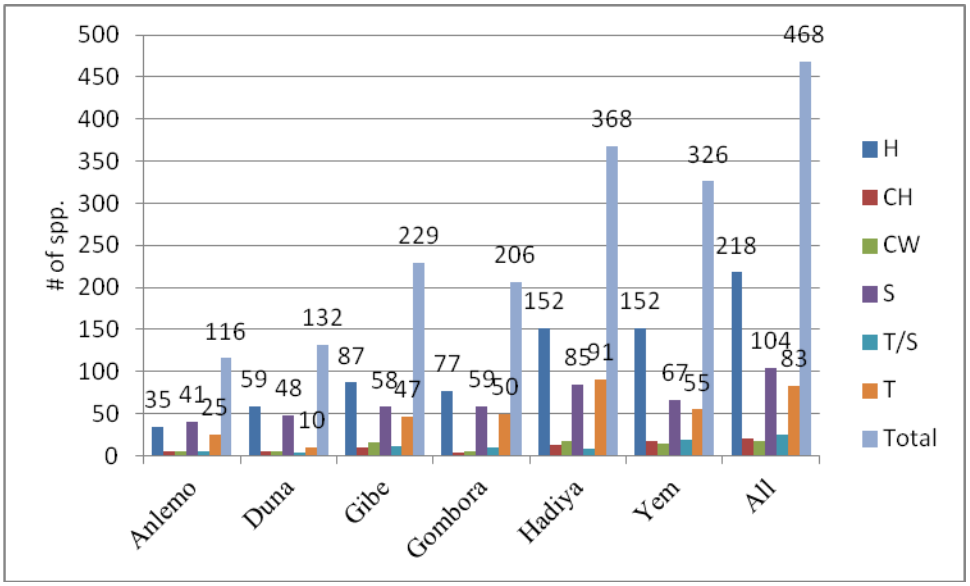


Fig. 8. Habit of species in sample quadrats of the districts
(H = herb, CH = herbaceous climber, C = woody climber, S = shrub, T/S = tree/shrub, T = tree)

Regarding species richness of families identified, most of them contained single species, others contained few more species while still few of them contained highest number of species. Families that contained big number of species in all districts were Asteraceae followed by Fabaceae (except in Duna) and Poaceae. In Hadiya, 6 (7%) of the families contained 146 (41%) of the total species, 46 (50%) of the families contained 2-9 species while 40 (43%) of the families families contained a single species. The number of species contained in Asteraceae was 42 in Hadiya and 40 in Yem while it contained 27 species in Duna followed by 25 in Gibe, 23 in Gombora and 8 in Anlemo. Fabaceae also contained the next highest number of 35 species in Hadiya and 28 species in Yem while in the four districts of Hadiya is contained a highest of 23 species in Gibe followed by 18 in Gombora, 12 in Anlemo while no record of species for the family in Duna. Similarly, Poaceae contained the highest of 27 species in Yem and 20 species Hadiya with district contribution of 19 in Gombora, 14 in Gibe, 12 in Anlemo and 9 in Duna (Fig. 9).

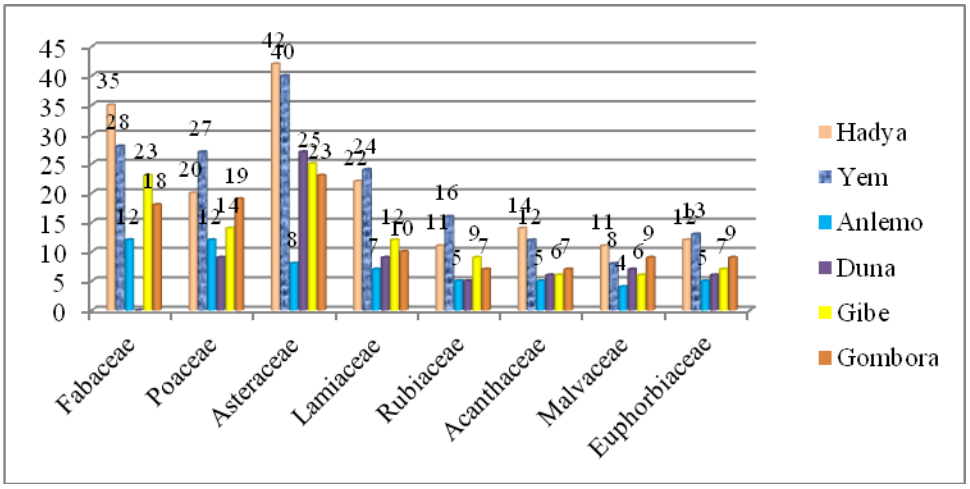


Fig. 9. Families with the highest number of species in the five districts

4.1.3 Analysis of overall diversity of vegetation of the study area

The floristic diversity of sample quadrats in the study area showed higher Shannon-Weiner's diversity (*H'*) and evenness (*J'*) values 2.89 and 0.50, respectively in Yem and that of Hadiya (four districts combined) were 2.85 and 0.48, respectively. The overall diversity and evenness indices in terms of the five districts in descending order were 3.22 and 0.59 in Gibe followed by 2.92 and 0.55 in Gombora, 2.91 and 0.59 in Duna, 2.89 and 0.50 in Yem, and 2.51 and 0.53 in Anlemo (Table. 2).

Table 2. Shannon-Wiener's indices of diversity and evenness of plant species from the study area (ind. = Individuals per quadrat)

Site/s	# of quadrats	Overall spp. richness	*H'*	*J'*
Hadiya	93	368	2.85	0.48
Yem	30	326	2.89	0.50
Anlemo	24	116	2.51	0.53
Duna	24	132	2.91	0.59
Gibe	23	229	3.22	0.59
Gombora	22	197	2.92	0.55

4.1.4 Overall floristic similarity among the study sites

The computed Sørenson's Coefficient of floristic similarity of species between Hadiya and Yem was 57% (Table 3). Further floristic similarity computed at district level showed the highest similarity of of 81% between Anlemo and Gombora followed by 77% between Gibe and Gombora, 75% between Duna and

Gombora, 72% between Anlemo and Duna, 71% between Anlemo and Gibe, 69% between Duna and Gibe, 63% between Gibe and Yem, 61% between Gombora and Yem, 52% between Anlemo and Yem, and the least similarity of 50% between Duna and Yem.

Table 3. Sorenson's similarity of species among the study sites

	Hadiya	Yem	Anlemo	Duna	Gibe	Gombora
Hadiya	1					
Yem	0.57	1				
Anlemo	-	0.52	1			
Duna	-	0.50	0.72	1		
Gibe	-	0.63	0.71	0.69	1	
Gombora	-	0.61	0.81	0.75	0.77	1

4.1.5 Classification of plant communities in Hadiya and Yem

Vegetation cover data subjected to agglomerative hierarchical cluster analysis using average linkage algorithm and similarity ratio revealed five communities in Hadiya (data of Anlemo, Duna, Gibe and Gombora combined) and three communities in Yem. The number of communities to be produced was determined priori in scree plot using the cover data matrices following elbow method in R. The abundance of species, Shannon's diversity (*H'*) and evenness (*J'*) and some quantitative information of environmental data of vegetation of Hadiya and Yem are given in Table 4.

Table 4. Shannon's diversity, evenness and quantitative information of community clusters of Hadiya and Yem (*H'* = Shannon's Diversity index, *J'* = Shannon's evenness index)

	Community no.	Quadrat no.	Altitude, m a.s.l.	Overall Richness	*H'*	*J'*
Hadya	1	1 - 18,72 - 93	1810-2629	181	4.71	0.91
	2	19 -23	1585-1774	36	3.35	0.93
	3	24 - 33	1553-2021	60	3.55	0.87
	4	34 - 47,54,64,68	2011-2559	61	3.72	0.90
	5	48 - 63,65,66,67,69,70,71	2100-2612	98	4.08	0.89
Yem	1	1,2,11 - 17	2485-2559	161	4.56	0.89
	2	3 - 10	2505-2554	151	4.56	0.91
	3	18 - 30	1677-1881	184	4.89	0.94

4.1.5.1 Classification of plant communities in Hadiya

The five communities in Hadiya (Table 4) that are named after three species with highest synoptic values (Appendix 2). The dendrogram of the plant communities is given in Fig. 10. The five communities identified were:

Community 1. *Podocarpus falcatus-Croton macrostachyus-Syzygium guineense* type:

This community contained 40 quadrats that occur between 1810 - 2629 m a.s.l. The overall species richness, Shannon's diversity (*H'*) and evenness (*J'*) of this community were 181, 4.71 and 0.91, respectively (Table 4). Species that had the highest synoptic values were *Podocarpus falcatus* (3.05), *Croton macrostachyus* (2.95), *Syzygium guineense* subsp. *gunineense* (2.93), *Olinia rochetiana* (2.40), *Eucalyptus camaldulensis* (2.20, *Calpurnia aurea* (2.18), *Achyrospermum schimperi* (2.10) and *Albizia schimperiana* (2.08). On the other hand, there were 22 species under this community that had low synoptic values. The least synoptic value was 0.50 for *Stephania abyssinica*. There were 22 species that had low synoptic values below 0.80. These include; *Apodytes dimidiata, Carduus schimperi, Clausena anisata, Clerodendrum myricoides, Combretum molle, Galiniera saxifraga, Guizotia scabra, Ilex mitis, Impatiens aethiopica, Leucas calostachys, Lippia adoensis* var. *adoensis, Manilkara butugi, Ocotea kenyensis, Olea capensis* subsp. *macrocarpa, Pentas lanceolata, Physalis*

peruviana, Premna schimperi, Rhamnus prinoides, Rubia cordifolia, Rubus sp., *Teclea nobilis* and *Vernonia amygdalina*.

Community 2. *Dodonaea angustifolia-Euclea racemosa-Hyparrhenia hirta* type

This community contained 5 quadrats that occur between 1585-1774 m. The overall species richness, Shannon's diversity (*H'*) and evenness (*J'*) of this community were 36, 3.35 and 0.93, respectively (Table 4). Species with the highest synoptic values in this community by rank were *Dodonaea angustifolia* and *Euclea racemosa* subsp. *schimperi* each (7.40), *Hyparrhenia hirta* (5.60), *Myrsine africana* (5.40), *Croton macrostachyus* and *Senna petersiana* each (4.60), *Rhyncosia viscosa* and *Combretum molle* each (4.20), *Hypericum quartinianum* (4.00), *Combretum collinum* (3.80), *Faurea speciosa* (3.60), *Entada africana, Ficus vasta, Rytigynia neglecta* each (2.80), *Terminalia brownii* (2.60), *Dichrostachys cinerea, Clutia abyssinica, Vernonia amygdalina* and *Syzygium guineense* subsp. *macrocarpum* each (2.40), and *Balanites aegyptiaca* 2.20. The least synoptic value was 0.60 for *Trichodesma zeylanicum*. There were 8 species under this community that had low synoptic values below 1.00 such as *Clausena anisata*, *Clematis longicauda*, *Clerodendrum myricoides*, *Leucas calostachys*, *Olea europaea* subsp. *cuspidata*, *Pittosporium viridiflorum*, *Sida schimperiana* and *Securidaca longepedunculata*.

Community 3. *Acacia abyssinica-Pterolobium stellantum-Cynodon dactylon* type

This community contained 10 quadrats located between altitudes of 1553-2021 m. The overall species richness, Shannon's diversity (*H*') and evenness (*J*') were 60, 3.55 and 0.87, respectively (Table 4). Species with highest synoptic values under this community are *Acacia abyssinica* and *Pterolobium stellantum* each (4.42), *Cynodon dactylon* (4.17), *Croton macrostachyus* (4.00), *Premna schimperi* and *Carissa spinarum each* (3.25), *Acacia sieberiana* and *Toddalia asiatica* each (2.75) and *Aciacia seyal* (2.50). The least synoptic value was 0.50 for *Ekebergia capensis* and species such as *Euclea racemosa* subsp. *schimperi*, *Grewia ferruginea*, *Leucas calostachys*, *Maytenus arbutifolia*, *Passiflora edulis*, *Rhus natalensis* and *Solanum incanum* had synoptic values below 0.90

Community 4. *Eucalyptus camaldulensis-Carissa spinarum-Acacia abyssinica* type

This community contained 17 quadrats that occur between altitudes of 2011 - 2559 m. The overall species richness, Shannon's diversity (*H*') and evenness (*J*') the community were 61, 3.72 and 0.90, respectively (Table 4). Species of high synoptic values under this community include *Eucalyptus camaldulensis* (3.00), *Carissa spinarum* (2.33), *Acacia abyssinica* (1.93), *Pennisetum sphacelatum* (1.67), *Croton macrostachyus* and *Eucalyptus citriodora* each (1.27). The least synoptic value was 0.53 for *Solanum incanum* and there were 15 species that had low synoptc values below 0.90 such as *Acacia polyacantha*, *Ficus vasta*, *Hyparrenia sp*., *Premna schimperi*, *Rubus steudneri*, *Acacia negrii*, *Cynodon dactylon*, *Maytenus arbutifolia*, *Dodonaea angustifolia*, *Flacourtia indica*, *Stephania abyssinica*, *Clutia abyssinica*, *Grewia ferruginea*, *Maesa lanceolata* and *Pavetta abyssinica*.

Community 5. *Eucalyptus globulus-Hypericum annulatum-Lippia adoensis* type

This community contained 21 quadrats that are located between altitudes of 2100 - 2612 m.

The overall species richness, Shannon's diversity (*H*') and evenness (*J*') the community were 98, 4.08 and 0.89, respectively (Table 4). Species with high synoptic values in this community include *Eucalyptus globulus* (3.10), *Hypericum annulatum* (2.86), *Lippia adoensis* var. *adoensis* (2.00), *Acathus senii* (1.67), *Hypoetes forskhalii* and *Leucas calostachys* (1.52), *Brucea antidysentrica* (1.50), *Maytenus arbutifolia* and *Rytigynia neglecta* each (1.24). The least synoptic value was 0.53 for *Gnidia glauca* and species such as such as *Botriocline schimperi*, *Croton macrostachyus*, *Clausenia anisata*, *Maytenus addat*, *Mikaniopsis clematoides*, *Nuxia congesta*, *Jasminum abyssinicum* and *Phytolacca dodecandra* had low synoptic values below 0.90.

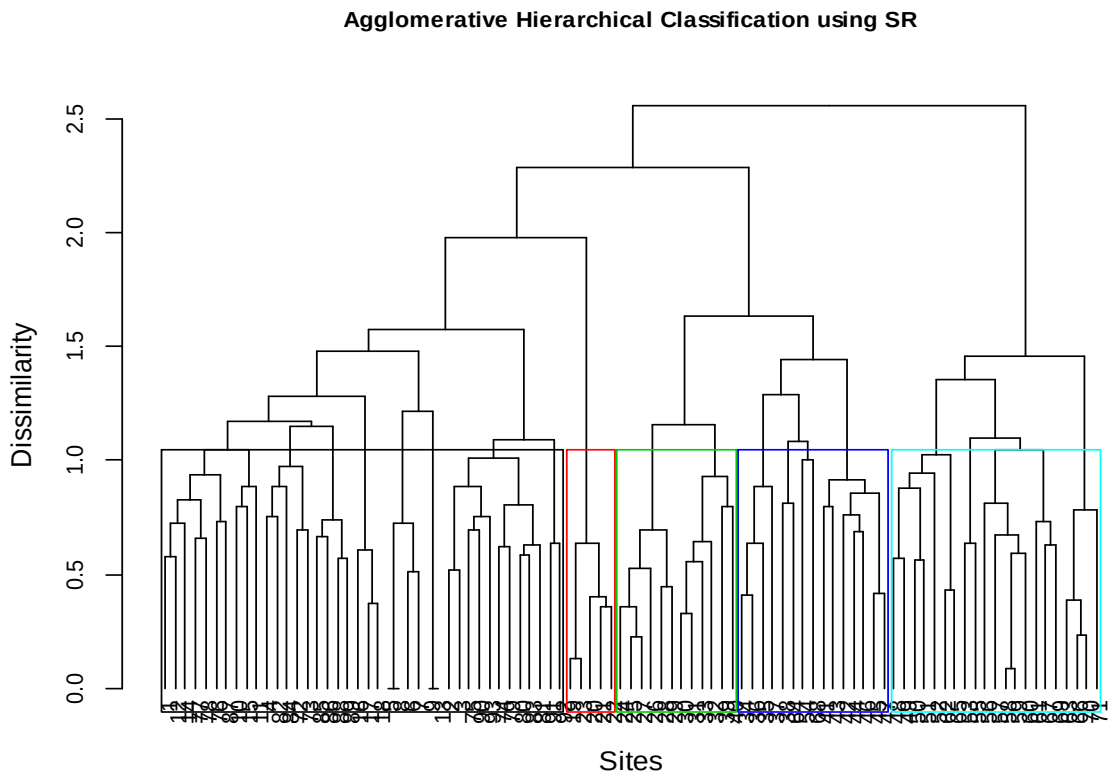


Fig. 10. Dendrogram of plant communities in different land uses of Hadiya

4.1.5.2 Classification of plant communities of Yem

Three plant communities identified in Yem are highlighted in Table 4 and the dendrogram is given in Fig. 12. The synoptic values of dominant species are given in Appendix 3. The three communities idenfified are characterised in this section:

Community 1. *Juniper procera-Syzygium guineense* subsp. *guineense-Podocarpus falcatus* type

This community consisted of 9 quadrats and its elevation range was between 2485 - 2559 m a.s.l. Its overall species richness, Shannon's diversity (*H'*) and evenness (*J*) were 161, 4.56 and 0.89, respectively (Table 4). Species with the highest synoptic values under this community in descending order are *Juniperus procera (*6.22), *Sysygium guineense* subsp. *guineense* (4.00), *Podocarpus falcatus* (3.44), *Osyris quadripartita* (2.44), *Olina rochetiana* and *Pteridium aquilinum* each (2.22), *Myrsine africana* (2.11), *Ilex mitis* (2.00), *Hypericum quartinianum* (1.89), *Euphorbia abyssinica* (1.89) and *Acanthus eminens* (1.78). The least synoptic values was

0.11 that is for *Brucea antidysentrica*, *Kalachoe schimperiana*, *Rubia cordifolia*, *Verbena officinalis* and *Vernonia hochstetteri*. There were about 92 species that scored low synoptic values below 0.90. Pictures of this community type are given in Fig. 11.



Fig. 11. *Juniprus-Podocarpus* dominated community type in Yem (woodland with *Juniperus procera* tree stands in GorunimaHengeri (left), Hengeri historic Palace compound of King Ababogibo dominated by *Podocarpus falcatus* stands (right) (Photo by Gideon WM, April 2013 & August, 2016)

Community 2. *Ficus sur-Hagenia abyssinica -Cynodon dactylon* type

This community had 8 quadrats and its altitudinal range varied between 2545 - 2555 m a.s.l. and its overall species richness, Shannon's diversity (*H'*) and evenness (*J'*) were 151, 4.56 and 0.91, respectively (Table 5). Species that had highest synoptic values include *Cynodon dactylon* (3.50), *Ficus sur* and *Hagenia abyssinica* (2.75), *Vernonia myriantha* (2.63), *Ekebergia capensis* and *Erythrina brucei* (2.50), *Croton macrostachyus* and *Rubus steudneri* (2.25), *Arundinaria alpina* (2.13) *Maesa lanceolata* (1.88) and *Taccazea conferta* (1.75). The least synoptic value was 0.13 that was scored by 41 species that include *Allophylus abyssinicus, Clematis longicauda, Clerodendrum myricoides, Embelia schimperi, Englerina woodfordioides, Phytolacca dodecandra, Prunus africana, Rumex abyssinica, Rosa abyssinica, Salvia nilotica, Teclea nobilis* and *Vernonia amygdalina.*

Community 3. *Combretum molle -Acanthus polystachius-Sapium ellipticum* type

This community included 13 quadrats and its altitudinal range varied between 1677-1881 m a.s.l. along Gibe River valley (Fig. 13). Its overall species richness, Shannon's diversity (*H'*) and evenness (*J'*) were 184, 4.89 and 0.94, respectively. The species with the highest synoptic values in this community were *Combretum molle* (2.33), *Acanthus polystachius* (2.15), *Sysygium guineense* subsp. *guineense* (2.08), *Sapium ellipticum* (1.92),

Dodonaea angustifolia, *Ficus vasta*, and *Premna schimperi* each (1.77), *Solanum incanum.* (1.69), *Carissa spinarum* (1.54), *Croton macrostachyus* (1.38) and *Dyschoriste multicaulis* (1.31). The least synoptic value was 0.08 scored by 19 species among which were *Apodytes dimidiata, Bidens prestinaria, Gomphocarpus purpurascens, Lippia adoensis* var. *adoensis, Olea europaea* subsp. *cuspidata* and *Otostegia tomentosa*. There were about 98 species that scored synoptic values below 0.50.

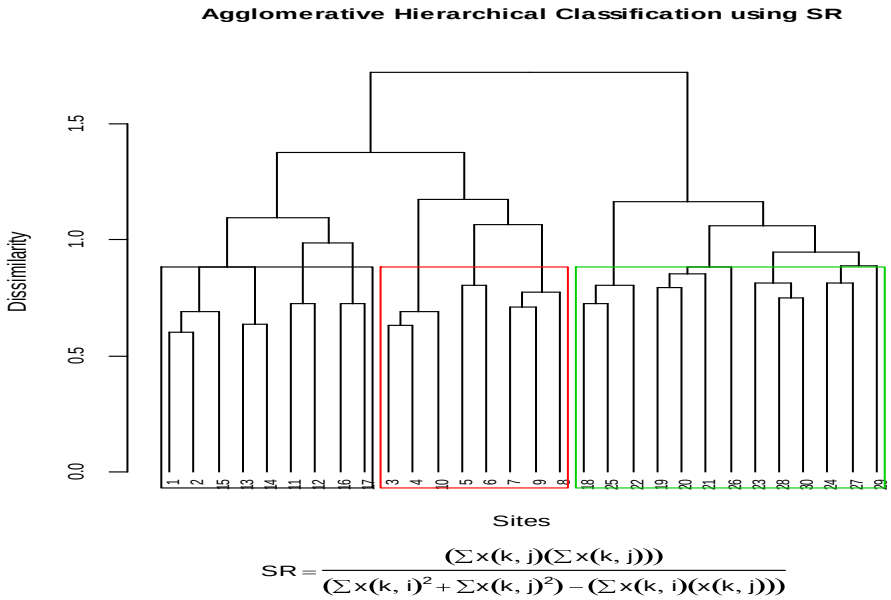


Fig. 12 . Dendrogram of plant communities in different land uses of Yem



Fig. 13. A short height *Combretum molle -Acanthus polystachius-Sapium ellipticum* community type (left), assistant & guide Mr. Abazinab Abawari assisting field data collection (Photo by Gideon WM, August 2016 Saja communal forest fragment)

4.1.6 Ordination of species-environmental factors in Hadiya and Yem

4.1.6.1 Mean square contingency coefficients (inertia) of CCA ordination

In the present investigation, the CCA results depicted that the total inertia (including constrained and unconstrained proportions) were 4.80 in Yem and 3.40 in Hadiya (Table 5). Scaling 2 was chosen for during running CCA. The environmental variables (the "constrained ordination") could explain a total of bits of inertia of 1.20 (25%) in Yem and 0.40 (12%) in Hadiya. The graphic triplots of CCA of Hadiya and Yem are presented in Figs. 14 and 15, respectively.

Table 5. Mean square contingency coefficients (total inertia) of CCA ordination in Hadiya and Yem (Prop. = proportion)

	Hadiya		Yem	
	Inertia	Prop.	Inertia	Prop.
Total	3.40	1.00	4.80	1.00
Constrained	0.40	0.12	1.20	0.25
Unconstrained	3.00	0.88	3.60	0.75

4.1.6.2 Importance of components of constrained CCA axes

As there were four environmental variables, there are equal number of constrained axes. Of these, the first and second canonical axes explain biggest proportion of variance in species data, hence, the first (CCA1) and the second (CCA2) were retained (Table 6). The CCA indicated that the primary separation of quadrats in ordination space was accounted for mainly by CCA1 with eigenvalue of 0.62 was significant ($p = 0.001$) and explained 51% total variation in Yem and 0.19 which was significant ($p = 0.001$) and explained total variation of 47% in Hadiya. Similarly, CCA2 accounted for additional variation with eigenvalue of 0.33 was significant ($p = 0.001$) and explained 27% of variationin Yem and 0.12 was also significant ($p = 0.001$) and explained 29% of variation in Hadiya. The total variation explained by CCA1 and CCA2 together were in 78% in in Yem and in Hadiya (Table 6).

Table 6 . Eigenvalues of components and % variance explained by each canonical axis in Hadiya and Yem

	Hadiya		Yem	
	CCA1	CCA2	CCA1	CCA2
Eigenvalue	0.19	0.12	0.62	0.33
Proportion explained	0.47	0.29	0.51	0.27
Cumulative proportion	0.47	0.76	0.51	0.78
Pr (>*F*)	0.001	0.001	0.001	0.001

4.1.6.3 The significance the four environmental factors in the ordination

The significance of the relationship of plant communities and environmental factors was tested by running Monte Carlo permutation test to bring stability in the data using mock anova function for CCA under reduced model by vegan algorithm in R. The test statistic (pseudo) *F*- ratio in each site revealed that altitude, slope and aspect (all, $p < 0.001$) showed significant effect in the distribution of the plant communities while disturbance was not significant ($p = 0.19$) in Hadiya. Similarly, in Yem all the four environmental variables showed significant difference - altitude and slope ($p < 0.001$, each), aspect ($p = 0.026$) and disturbance ($p = 0.0192$) indicating all are influencing factors on the distribution of the plant communities resulted (Table 7).

Table 7. ANOVA of MP Plant communities and environmental factors

Site	Variable		*DF*	*Sum Sq.*	*Mean Sq.*	*F* value	*Pr*(>F)
Hadiya	Altitude	ClusterID	4	5054356	126389	54.32	2e-16
		Residual	88	2046997	23261		
	Slope	ClusterID	4	5210.70	302.68	45.70	2e-16
		Residual	88	2508.50	28.51		
	Aspect	ClusterID	4	31.86	7.96	9.00	9e-06
		Residual	88	77.82	0.88		
	Disturbace	Cluster ID	4	11.31	2.83	1.57	0.19
		Residual	88	157.85	1.79		
Yem	Altitude	Cluster ID	2	24640475	2335238	1651.20	2e-106
		Residual	27	38185	1414		
	Slope	Cluster ID	2	183.39	91.69	12.51	0.0001
		Residual	27	197.98	7.33		
	Aspect	Cluster ID	2	3.49	1.75	4.18	0.03
		Residual	27	11.29	0.42		
	Disturbance	Cluster ID	2	49.75	24.87	4.60	0.02
		Residual	27	146.12	5.41		

4.1.6. 4 Biplot scores, environmental arrows/vectors and species correlation

The quantitative environmental variables/biplot scores in the present results show the coordinates of each variable on the ordination axes (Table 8). The vector/arrow of environmental variable points in the direction of maximum change in the value of the associated variable. The length of the arrow is proportional to the correlation between ordination and environmental variable/the maximum rate of change/direction of the gradient. The relative positioning of environmental variables and species indicates the optimum of species distribution along these environmental gradients. The distance between site and species position on the triplot shows the abundance of that species at that site where the abundance of a species is maximal.

Table 8. Biplot scores of environmental factors in Hadiya and Yem

Environmental factor	Hadiya		Yem	
	CCA1	CCA2	CCA1	CCA2
Altitude	0.97	0.21	1.00	0.03
Slope	0.75	-0.66	-0.20	0.27
Aspect	0.37	-0.10	-0.44	0.68
Disturbance	0.17	-0.39	0.31	0.57

The biplot scores in Table 8 are the coordinates of environmental factors along the two axes in both Hadiya and Yem. Altitude has arrow length of 0.97, slope 0.75, and aspect 0.37 indicating strong to modest positive correlation to CCA1 while disturbance has arrow length of -0.39 in negative direction of CCA2 indicating modest negative correlation to the axis Hadiya (Table 8 & Fig 14). In Yem, similarly altitude a longest vector of 1.00 toward CCA1 indicating strong negative correlation to the axis while slope with arrow length of 0.68 and disturbance with 0.53 showed modest positive correlation to CCA2 (Table 8 & Fig. 14).

In Hadiya, *Phytolacca dodecandra* is strongly positively correlated to CCA 1 and altitude while *Brucea antidyentrica* and *Mikaniopsis clematoides* are strongly positively correlated to the same axis and aspect (Fig. 14). On the other hand, *Embelia schimperi* and *Discopodium peninervium* are strongly positively correlated to CCA2 and disturbance. *Momordica foetida* also strongly positively correlated to CCA2 and slope. Species such as *Balanites aegyptiaca, Combretum molle* and *Securidaca longepedunculata* are outliers.

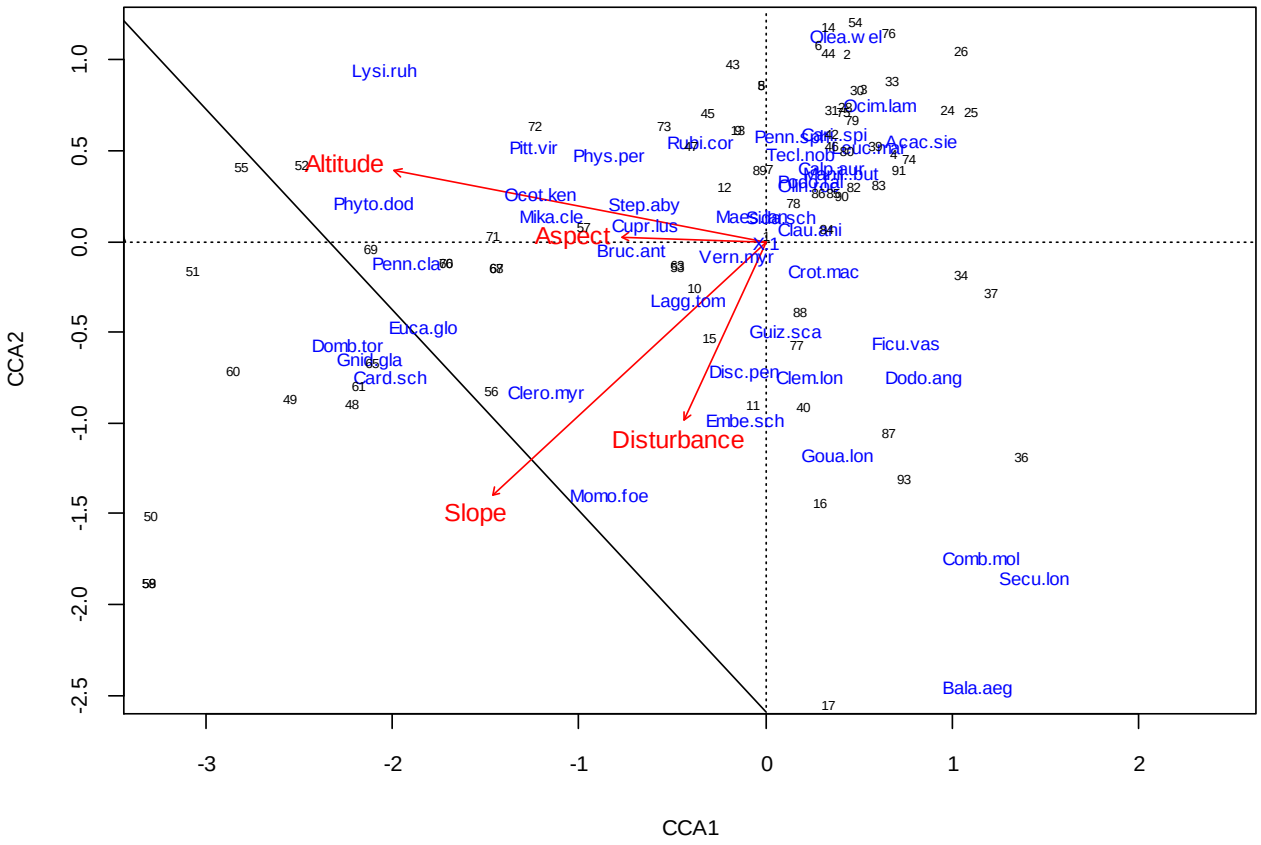


Fig. 14. CCA Triplot of site, species and environmental variables in Hadiya

In Yem, *Clerodendrum myricoides*, *Clutia abyssinica, Hagenia abyssinica, Olinia rochetiana* and *Vernonia myriantha* have shown positive correlation to CCA1 and altitude while *Ficus vasta, Combretum molle* and *Premna schimperi* have shown strong negative correlation to CCA1 and altitude. Species such as *Clematis logicauda, Ocimum lamiifolium* and *Periploca linearifolium* have shown positive correlation to CCA1 aspect and disturbance (Fig. 15). *Calpurnia aurea, Englerina woodfordioides* have positive correlation to CCA2 while *Crepis rueppellii* and *Hypericum revolutum* have negative correlation to this axis.

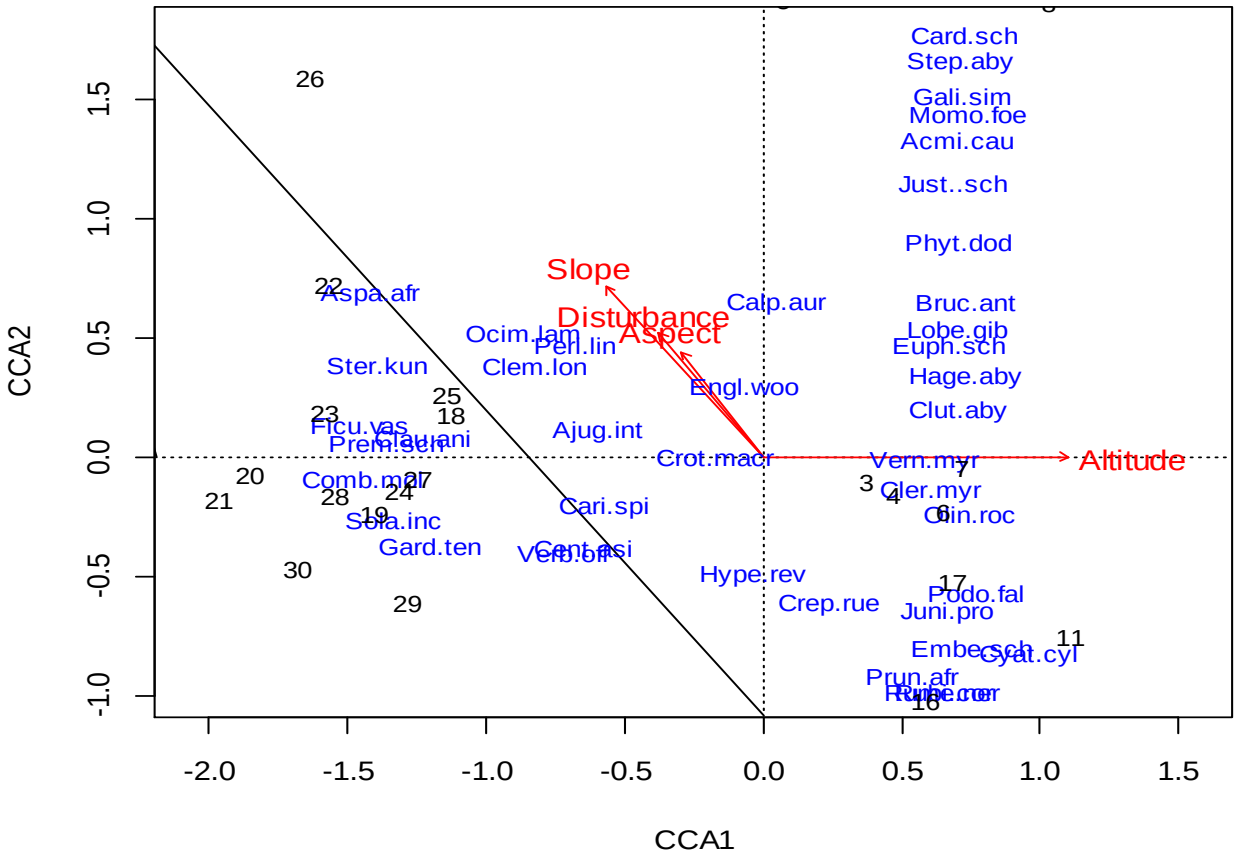


Fig. 15. CCA triplot of site, species and environmental factors in Yem

4.2 Results of Ethnobotanical Data

4.2.1 Overall diversity of MPs used for both human and livestock ailments

The results revealed an overall of 301 species belonged to 242 genera and 95 families (Appendix 6) that are used to treat 166 human and 74 livestock ailments and health conditions (Appendix 4 & 5, respectively). The medicinal species were predominantly Angiosperms with 3 species of Gymnosperms and a single species of fern and lichen each. *Ensete ventricosum* has 11 clones /landraces that are used for both human and livestock health. The hemiparasitic species *Englerina woodfordioides* that is hosted on different woody species is locally sought for high medicinal value for different human and livestock ailments depending on the host plant species. There was a single *Rubus* sp. from Gibe that was not described so far in the Ethiopian Flora. About 17 (5%) of the species were endemic to the Ethiopian flora existing with different levels of threat. Of the 301 species, about 237 species that are classified in 201 genera and 86 families were recorded in Yem while in Hadiya 209 species that are classified in 173 genera and 77 families were recorded.

Of the overall species, the highest proportion of 154 (51%) were used to treat human ailments only, 110 (36%) were used for both human and livestock ailments and 41 (13%) were used for livestock ailments only in the study area (Fig. 16). The respective proportions of MPs reported for treating human ailments only, human and livestock, and livestock ailments only in a rank order are 150 (63%), 61 (26%) and 26 (11%) in Yem and 118 (56%), 56 (27%) and 35 (17%) in Hadiya (four districts combined). In the separate districts of Hadiya, the proportions in order of rank were 82 (67%), 27 (21%) and 14 (12%) in Gibe; 75 (65%), 26 (23%), and 14 (12%) in Anlemo; 61 (58%), 25 (24%) and 20 (19%) in Gombora, and 45 (51%), 26 (29%) and 18 (20%) in Duna.

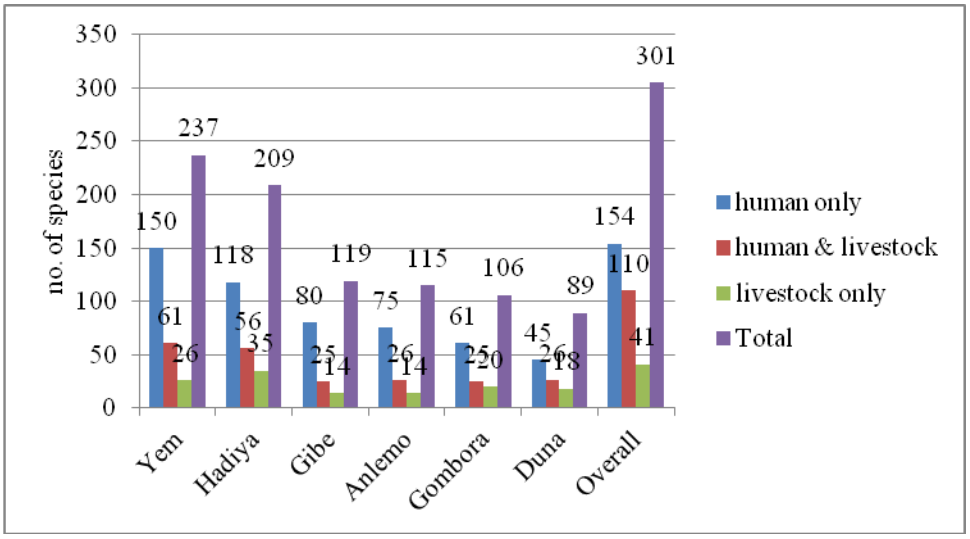


Fig. 16. Number of MPs reported for treating human and livestock ailments

4.2.2 Diversity of MPs in the vegetation and land uses studied

The proportion of MPs that were enlisted during interview and encountered in the study quadrats were highest 113 (47%) species in Yem followed by 53 (50%) in Gombora, 39 (31%) in Gibe, 20 (23%) in Duna and 19 (16%) in Anlemo. The analysis diversity of MPs in study quadrats showed that Yem had the highest diversity and evenness of 2.11 and 0.45, respectively while that of Hadiya were 1.13 and 0.23, respectively. The MP diversity and evenness in the separate districts of Hadiya in descending order were 1.15 and 0.33 in Gombora followed by 1.09 and 0.37 in Anlemo, 1.02 and 0.28 in Gibe and 0.99 and 0.33 in Duna (Table 8).

Table 8. Shannon-Wiener's indices of diversity and evenness of MPs in the quadrats

Site/s	# of quadrats	MP richness	*H'*	*J'*
Hadiya	**93**	**133**	**1.13**	**0.23**
Yem	30	113	2.11	0.45
Gombora	22	53	1.15	0.29
Anlemo	24	19	1.09	0.37
Gibe	23	39	1.02	0.28
Duna	24	20	0.99	0.33

4.2.2.1 The abundance and richness of MPs in the plant communities

4.2.2.1.1 The abundance and richness of MPs in the plant communities in Hadiya

Community 1. *Podocarpus falcatus-Croton macrostachyus-Syzygium guineense* type

This community had the highest MP richness among the communities containing 67 species. Those species with highest synoptic values (Appendix 2) were all MPs *Podocarpus falcatus* (3.05), *Croton macrostachyus* (2.95), *Syzygium guineense* subsp. *gunineense* (2.93), *Olinia rochetiana* (2.40), *Eucalyptus camaldulensis* (2.20), *Calpurnia aurea* (2.18), *Achyrospermum schimperi* (2.10) and *Albizia schimperi* (2.08). There were 22 MPs under this community with low synoptic values under 0.80. These include; *Apodytes dimidiata, Carduus schimperi, Clausena anisata, Clerodendrum myricoides, Combretum molle, Galiniera saxifraga, Guizotia scabra, Ilex mitis, Impatiens aethiopica, Leucas calostachys, Lippia adoensis* var. *adoensis, Manilkara butugi, Ocotea kenyensis, Olea capensis* subsp. *macrocarpa, Pentas lanceolata, Physalis peruviana, Premna schimperi, Rhamnus prinoides, Rubia cordifolia, Rubus* sp., *Teclea nobilis* and *Vernonia amygdalina*.

Community 2. *Dodonaea angustifolia-Euclea racemosa-Hyparrhenia hirta* type

This community had MP richness of 20 species. There were MPs with highest synoptic values in this community such as *Dodonaea angustifolia* (7.40), *Euclea racemosa* subsp. *schimperi* (7.40), *Croton macrostachyus* (4.40), *Vernonia amygdalina* (2.41), *Balanites aegyptiaca* (2.20) and *Solanum incanum* (1.40). On the other hand, there were 9 MPs with low synoptic values below 0.80 under this community such as *Clausena anisata, Clenatis longicauda, Clerodendrum myricoides, Leucas calostachys, Olea europaea* subsp. *cuspidata, Pittosporium viridiflorum, Sida schimperiana* and *Securidaca longepedunculata*.

Community 3. *Acacia abyssinica-Pterolobium stellantum-Cynodon dactylon* type

This community had MP richness of 22 species. Medicinal species with highest synoptic values under this community in a descending order include *Acacia abyssinica* (4.42), *Croton macrostachyus* (3.25), *Premna schimperi* (3.25), *Carissa spinarum* and *Acacia sieberiana* each (2.75), *Pennisetum sphacelatum* (2.16), *Leucas martiniscensis* (1.50) and *Lippia adoensis* var. *adoensis* (1.00). On the other hand, there were 20 MPs that had low synoptic values below 0.80. These include *Apodytes dimidiata, Clematis longicauda, Discopodium penninervium, Kostelezkya adoensis, Mikania clematoides, Millettia ferruginea, Lippia adoensis* var. *adoensis, Olea europea* subsp. *cuspidata, Olea welwistchi, Ocimum lamiifolium, Physalis*

peruviana, Premna schimperi, Prunus africana, Rhmanus prinoides, Rubia cordifolia, Rubus sp., *Sida schimperiana, Solanum incanum, Stephania abyssinica* and *Vernonia myriantha*.

Community 4. *Eucalyptus camaldulensis-Carissa spinarum-Acacia abyssinica* type

This community is rich with 24 MPs. Those MPs with high synoptic values under this community were *Eucalptus camaldulensis* (3.00), *Carissa spinarum* (2.33), *Acacia abyssinica* (1.93), *Pennisetum sphacelatum* (1.67), *Croton macrostachyus* while there were 9 MPs which scored synoptic values less than 0.80. These include *Dombeya torrida, Gnidia glauca, Leonotis ocymifolia, Ehretia cymosa, Lysimachia ruhmeriana, Maesa lanceolata, Microglosa pyrifolia, Momordica foetida, Phytolacca dodecandra, Rubia cordifolia* and *Stephania abyssinica*.

Community 5. *Eucalyptus globulus-Hypericum annulatum-Lippia adoensis* type

This community contained 27 MPs. Medicinal species with large synoptic values in this community include *Eucalyptus globulus* (3.10), *Lippia adoensis* var. *adoensis* (2.00), *Leucas calostachys* (1.52), *Brucea antidysentrica* (1.50) and *Achyrospermum schimperi* (1.19) while there were few MPs with synoptic value less than 0.70 such as *Aloe* sp., *Achyrospermum schimperi, Clausenia anisata* and *Olea europaea* subsp. *cuspidata*.

4.2.2.1.2 The abundance and richness MPs in the plant communities in Yem

Community 1. *Juniper procera-Syzygium guineense* subsp. *guineense-Podocarpus falcatus* type

This community is rich with 37 MPs. The medicinal species with the highest synoptic values (Appendix 3) under this community in descending order are *Juniperus procera (*6.22), *Sysygium guineense* subsp. *guineense* (4.00), *Podocarpus falcatus* (3.44), *Osyris quadripartita* (2.44), *Olina rochetiana* (2.22), *Myrsine africana* (2.11) and *Ilex mitis* (2.00). On the other hand, there were 20 MPs of this community with low synoptic values below 0.90. These include *Brucea antidysentrica*, *Canthium oligocarpum, Clutia abyssinica, Cyathula cylinderica, Dombeya torrida*, *Embelia schimperi*, *Gomphocarpus purpurascens*, *Hypericum revolutum*, *Impatiens rothii*, *Lippia adoensis* var. *adoensis*, *Lobelia giberroa*, *Ocimum lamiifolium, Orobanche minor,*

Periploca linearifolia, Phytolacca dodecandra, Plantago lanceolata, Prunus africana, Rubia cordifolia, Rumex nervosus and *Sida schimperiana*.

Community 2. *Ficus sur-Hagenia abyssinica Cynodon dactylon* type

This community had 33 MPs. The medicinal species that highest synoptic values of this community were *Cynodon dactylon* (3.50), *Ficus sur* and *Hagenia abyssinica* each (2.75), *Vernonia myriantha* (2.63), *Erythrina brucei* (2.50), *Croton macrostachyus* (2.25) and *Arundinaria alpina* (2.13). There were 22 MPs under this community that have synoptic values below 0.80. These include; *Achyrospermum schimperi, Allophylus abyssinicus, Anthospermum herbaceum, Arisaema schimperanum, Bersama abyssinica, Brucea antidysentrica, Clematis longicauda, Clerodendrum myricoides, Embelia schimperi, Englerina woodfordioides, Euphorbia schimperiana, Glycine* sp. (Nekeshilo(Yem)), *Maytenus addat, Momordica foetida, Phytolacca dodecandra, Plantago lanceolata, Prunus africana, Rumex abyssinucus, Sanicula elata, Satureja paradoxa, Solanum anguivi* and *Vernonia amygdalina*.

Community 3. *Combretum molle -Acanthus polystachius-Sapium ellipticum* type

This community has 35 MP richness. The medicinal species with the highest synoptic values in this community were *Combretum molle* (2.33), *Acanthus polystachius* (2.15), *Sysygium guineense* subsp. *guineense* (2.08) and *Sapium ellipticum* (1.92). However, this community had a highest number of 25 MPs with synoptic values less than 0.90. These include; *Achyranthus aspera, Centella asiatica, Clausena anisata, Clematis longicauda, Englerina woodfordioides, Euphorbia abyssinica, Faurea speciosa, Ficus sycomorus, Gardenia ternifolia, Indigofera spicata, Lantana trifolia, Leucas calostachys, Osyrys quadripartita, Ocimum lamiifolium, O. urcilifolium, Periploca linearifolium, Stereospermum kunthianum, Tragia doryoides, Premna schimperi* and *Verbena officinalis*.

4.2.3 Diversity of MPs used to treat Human ailments in the study area

Out of the overall species highlighted in the preceding section, 278 species that belong to 225 genera and 91 families were used to treat human ailments in all of the study area **(Appendix 4).** About 213 species that are classified in 184 genera and 80 families are used to treat 117 human ailments in Yem culture while 176 species

belonged to 149 genera and 67 families are used to treat 123 human ailments in Hadiya. The respective number of human ailments and MPs reported in the four districts of Hadiya separately in a rank order were 88 and 105 in Gibe; 84 and 95 in Anlemo; 60 and 85 in Gombora, and 61 & 70 in Duna (Fig. 17). Moreover, the respective number of medicinal families, genera and species in rank order of the four districts of Hadiya in descending order were 48, 94 and 105 in Gibe followed by 46, 88, and 95 in Anlemo, 46, 79 and 85 in Gombora and 36, 66 and 70 in Duna.

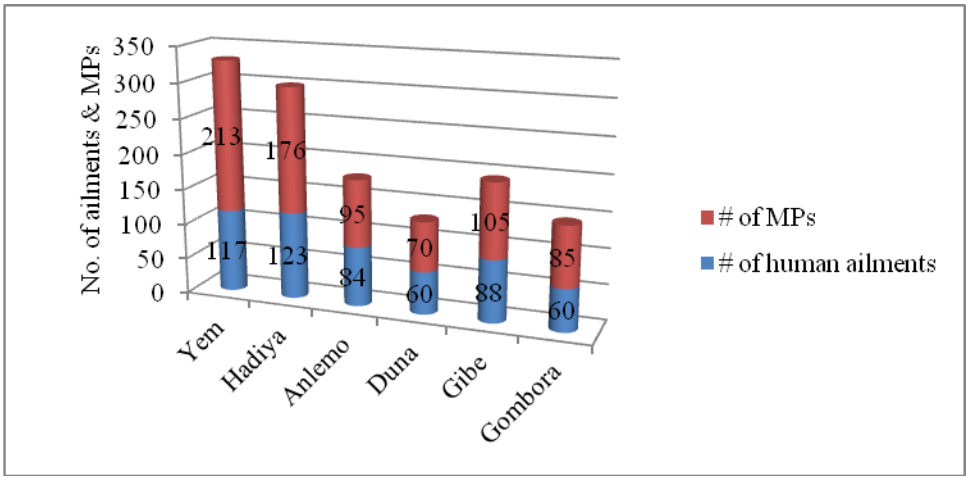


Fig. 17. Number of human ailments reported and MPs used to treat them

Further taxonomic analysis showed that most of the 91 medicinal families identified include few medicinal taxa while few the fmilies have highest proportions of medicinal taxa. For example, Asteraceae contained the highest number of MPs used for human ailments in each of the districts in decreasing order of 26, 18 12, 11, 10 and 10 species in Yem, (Hadiya), Anlemo, Gibe, Duna and Gombora, respectively. The next family with highest number of species in each district was Lamiaceae with 18, 10, 7, 7 and 7 species in Yem and Hadiya each; Anlemo, Duna, Gibe and Gombora, respectively. Similarly, Fabaceae contained as high as 12 species in Yem while it contained 4 species in Anlemo, Duna, Gibe and Gombora each. Other medicinal families with bigger number of species were Rubiaceae 8 species in Yem and 4 species in Gibe; Apiaceae 5 species in Yem and 3 species in Gibe while Myrsinaceae, and Rosaceae and Verbenaceae each contained 3 species in Gibe and Yem (Fig. 18).

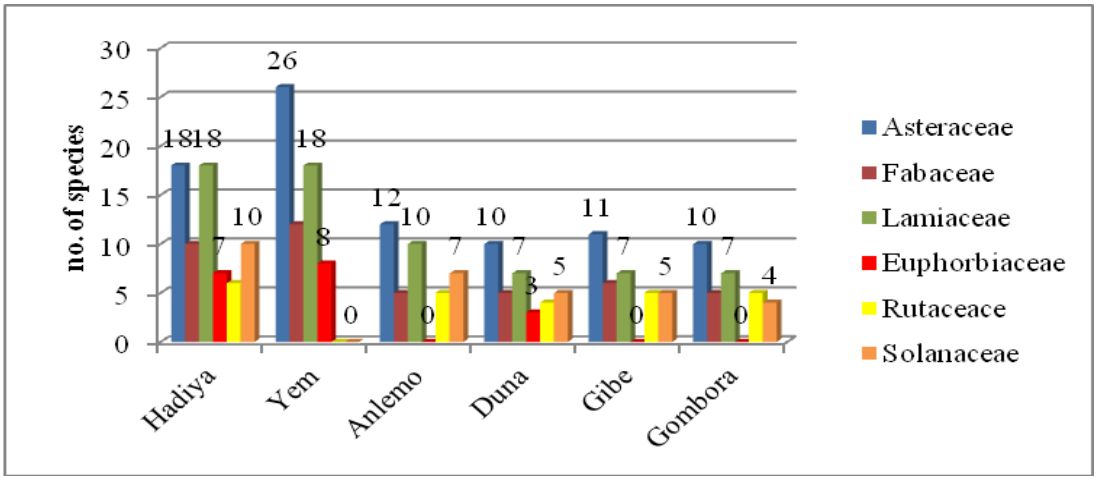


Fig. 18. Families with richest number of MP in the study area

4.2.3.1 Habit of MPs used for treating Human ailments in the study area

The analysis of overall habit of MPs used for human ailments showed that herbs were the most used habit with a highest proportion of 125 (45%) followed by shrubs 71 (26%), trees 45 (16%), tree/shrubs 14 (5%) and woody climbers 15 (5%) and herbaceous climbers 8 (3%). With the same trend, herbs were the most used habit in each district followed by shrubs while trees constituted the least proportion in each district. Accordingly, the proportion (%) of herbs were 97 (45%) in Yem and 73 (41%) in Hadiya; and in the four districts of Hadiya separately in a decreasing order was 47 (48%) in Anlemo, 46 (42%) in Gibe, 36 (51%) in Duna and 31 (36%) in Gombora. The proportions of the rest of habit in each district are presented in Fig. 19.

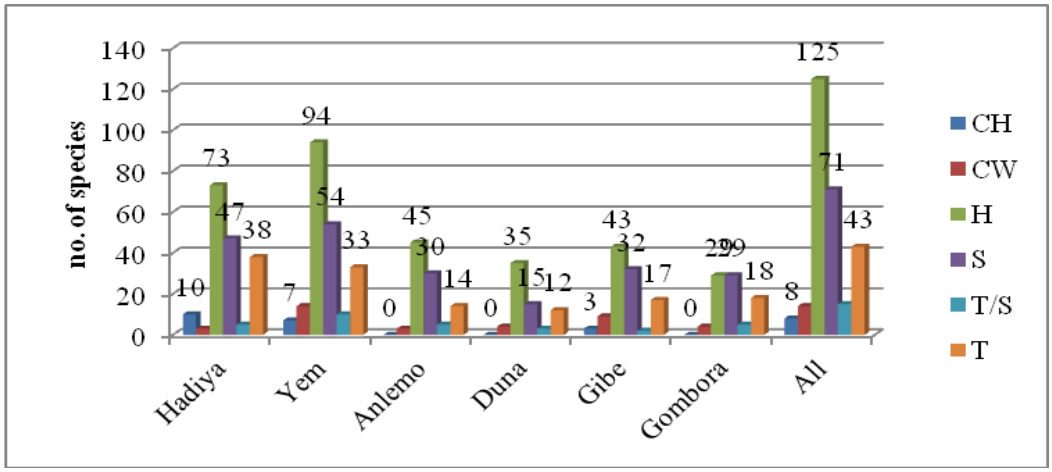


Fig. 19. Habit of MPs used to treat human ailments in the study area (percentages in the text are interms of a single district) (CH = herbaceous climbers, CW = woody climbers, H = herbs, S = shrubs, T/S = trees/shrubs, T = trees)

4.2.3.2 Source of MPs used for human ailments

Results showed that the sources of the reported MPs in the study areas were mainly from the wild while smaller proportions were also known to be from cultivation and semicultivation (cultivation & wild) (Fig. 20). Accordingly, the respective highest number (%) of MPs collected from the wild in a rank order was 177 (83%) in Yem and 140 (80%) in Hadiya. The proportion of wild collected species in the four districts of Hadiya in decreasing order was 77 (73%), 74 (87%), 60 (63%), 50 (71%) in Gibe, Gombora, Anlemo and Duna, respectively. On the other hand, the highest number of cultivated MPs was 32 (18%) in Hadiya and 32 (33%) Anlemo followed by 28 (15%) in Yem, 27 (26%) in Gibe, 17 (24%) in Duna and 9 (8%) in Gombora. Semicultivated MPs constituted the least proportion in each district.

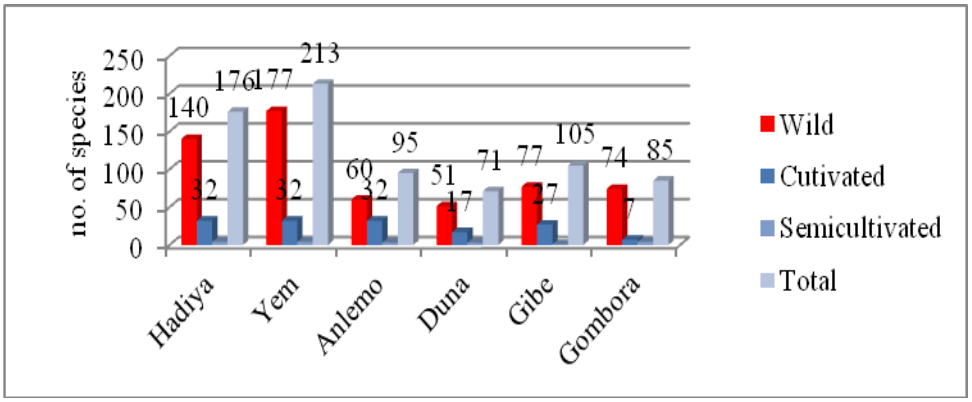


Fig. 20. Source of MPs for human use (the percentages in the text are interms of individual district)

4.2.3.3 Habitat distribution of MPs for human ailments

Interview responses of this investigation revealed about 17 different habitats from where the local people collect MPs for treating human ailments (Table 9). The overall habitats that contributed for the highest number of MPs were forests 151 (26%) followed by homegardens 119 (21%) and living fences 75(13%). With regard to individual district, habitat that contributed for the highest number of MPs in a decreasing order was forest 68 (32%) in Yem, 29 (27%) in Gibe and 27 (32%) in Gombora; homegarden 27 (28%) in Anlemo and 21 (30%) in Duna. The next habitat with bigger number of MPs in a descending order depending on district was home garden 30 (14%) in Yem; hillside 18 (17%) in Gibe; 19 (22%) in Gombora; living fence 18 (26%) in Duna and forest 14 (15%) in Anlemo. On the other hand, habitat/s that contributed for least number of (a single MPs) in each district include degraded grassland and degraded hill in Anlemo; foreyard, edge of farm, egde of forest and marsh in Duna; degraded grassland in Gibe; river bank and roadside in Gombora and edge of farm in Yem.

Table 9. Habitat of MPs in the five districts (percentages used in the text are interms of a single district)

Habitat	Anlemo		Duna		Gibe		Gombora		Yem		Total	Oveall %
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%	cit.	
Forest	17	18	9	13	30	29	27	32	68	32	151	26
Homegarden	27	28	21	30	16	15	19	22	30	14	119	21
Living fence	14	15	18	26	9	9	8	9	24	11	75	13
Fallow	8	8	6	9	10	10	3	4	24	11	54	9
Hillside	0	0	2	3	18	17	0	0	2	1	31	5
Farm	4	4	3	4	3	3	5	6	15	7	30	5
*Market	9	9	4	6	1	1	8	9	7	3	29	5
Road side	5	5	3	4	0	0	1	1	15	7	24	4
Grass land	1	1	0	0	4	4	2	2	11	5	18	3
Fore yard	4	4	1	1	3	3	5	6		0	13	2
Edge of forest	0	0	1	1	3	3	0	0	7	3	11	2
Edge of farm	3	3	1	1	2	2	3	4	1	0	10	2
Burial sites/sacred	2	2	0	0	3	3	0	0	3	1	0	0
Church yards	0	0	0	0	3	3	0	0	2	1	5	1
Degraded hill	1	1	0	0	0	0	0	0	2	1	3	1
Rriver bank	0	0	0	0	0	0	1	1	2	1	3	1
Wood land	0	0	0	0	0	0	3	4	0	0	3	1
Marsh	0	0	1	1	0	0	0	0	0	0	1	0.17
Total	95	100	70	100	105	100	85	100	213	100	580	100

*anthropogenic habitat

4.2.3.4 Accessibility of MPs for human uses

Based on interview findings and investigator's field observation, availability of MPs is determined by factors such as season, human and livestock disturbance and unsustainable extraction of the resources. The overall accessibility of the MPs for human uses in each district was observed in three status; very common, common and locally rare. Medicinal taxa in 'common' status had the highest proportion in each district with rank order of 100 (46%) taxa in Yem followed by 51 (47%) in Gibe, 36 (37%) in Anlemo, 34 (39%) Gombora and 30 (42%) in Duna (Fig. 21). Taxa in very common and rare status constituted varying proportions in the districts. Taxa in 'Very common' status in a rank were 61 (28%) in Yem followed by 33 (34%) in Anlemo, 27 (31%) in Gombora, 27 (25%) in Gibe and 20 (28%) in Duna. Taxa in 'rare' status 56 (26%) in Yem followed by 31 (28%) in Gibe, 29 (29%) in Anlemo, 26 (30%) in Gombora and 21 (30%) in Duna. The species in the 'very common' category were observed in abundance in different land uses during field survey and they are said to be collected as short as 5-10 minutes from close vicinity in all the five districts. Such species include

Achranthes aspera, *Achyrospermum schimperi*, *Brucea antidysentrica*, *Croton macrostachyus*, *Maesa lanceolata*, *Pycnostachys abyssinica*, *Rumex nepalensis*, *Vernonia myriantha*, *Solanum incanum* and *Stephania abyssinica* in all districts. Ones in 'common' category were in fairly good abundance in distances far from homesteads which might take 30-60 minutes for access. Such species include *Carduus schimperi*, *Clematis longicauda*, *Euclea racemosa* subsp. *schimperiana*, *Hypericum quartinianum*, *Physalis peruviana* and *Urera hypselodendron*. The MPs in 'rare' status were ones known locally in the past but they can be found by chance in remote areas that might take long hours from 1 - 5 hours. Such species include *Asparagus africanus* and *Cucumis ficifolius* (in Duna, Gibe & Gombora) *Englerina woodfordioides* [symbiont on *Justicia schimperiana*, *Calpurnia aurea*, *Dodonaea angustifolia*, *Vernonia amygdalina and V. myriantha*], *Haplocarpha rueppellii* and *Inula confertiflora* (in Yem), *Securidaca longepedunculata* (in Gibe, Gombora & Yem) and *Englerina woodfordioides* (symbiont on *Vernonia amygdalina* (in Duna, Gibe and Gombora).

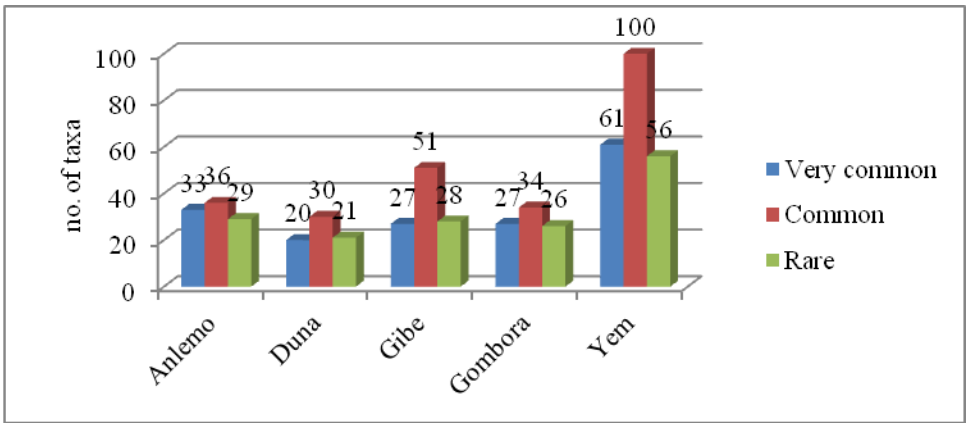


Fig. 21. The status of accessibility of MPs for human uses in all districts

4.2.3.5 Human ailments freelisted in the study sites

The number of human ailments and conditions recorded during interviews in the five districts are given Appendix 4. Among these, three highest cited human ailments in each district were - malaria 115 (10.44%) followed by abdominal pain 74 (6.72%) and dyspepsia 50 (4.54%) in Anlemo; abdominal pain 133 (14.41%) followed by arthritis 61 (6.61%) and 'mich' 50 (5.96%) in Duna; sudden ailment 86 (6.45%) followed by dyspepsia 78 (5.85%) and tonsilitis 75 (5.63%) in Gibe; abdominal pain 108 (11.04%) followed by sudden

disease 98 (10.02%) and mich 65 (6.65%) in Gombora, and abdominal pain 130 (7.59%) followed by acute febrile illness 129 (7.53%) and feet swelling disease ('dani furutu'/'awachifebe?u') 69 (4.03%), respectively , in Yem (Appendix 4).

4.2.3.6 Sign and symptoms of human ailments

About twenty three sign and symptoms of human ailments were free listed by local healers and general informants of the five districts with varying citations (Table 10). On overall, abdominal pain (which was also reported as a type of ailment) was the highest cited symptom with 223 (7%) followed by abrupt breathing 115 (4%) and blurred vision 85 (3%). Three sign and symptoms that had highest reports in the study districts were - fatigue 65 (9%) followed by sleepiness 60 (8%) and diarrhea 56 (7%) in Anlemo; headache 56 (8%) followed by poor appetite 54 (7%) and tiredness 52 (7%) in Duna; cough 59 (10%) followed by tiredness 53 (9%) and headache 46 (8%) in Gibe; inability to move 48 (9%) followed by tiredness 47 (9%) and stomach growl 42 (8%) in Gombora; and abdominal pain 60 (11%) followed by fever 50 (8%) and headache 45 (7%) in Yem.

Table 10. Symptoms of human diseases in the five study districts
(bracketed are respective ailments of the sign and symptoms, cit. = no. of citations)

Sign & symptom	Anlemo		Duna		Gibe		Gombora		Yem		Overall Total	%
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%		
Abdominal pain (parasites/dyspepsia)	40	5	50	7	33	6	40	8	60	11	223	7
Abrupt breathing (respiratory pains)	22	3	18	2	31	5	10	2	34	5	115	4
Blurred vision (anaemia)	26	3	22	3	14	2	13	2	10	2	85	3
Burning of urine (gonorrhoea, nephritis)	12	2	11	2	7	1	6	1	11	2	47	1
Cough (respiratory ailments)	34	5	50	7	59	10	39	7	35	5	217	7
Cracking of mouth (malaria, pneumonia)	19	3	16	2	21	4	17	3	21	3	94	3
Diarrhea (amoebiasis/dysentery)	56	7	37	5	15	3	32	6	31	5	171	5
Discomfort (miscellaneous pain)	20	3	51	7	45	8	23	4	25	4	164	5
Fatigue (miscellaneous pain)	65	9	52	7	53	9	47	9	42	6	259	8
Fever (malaria, pneumonia, thyphoid fever)	20	3	24	3	38	7	35	7	50	8	167	5
Headache (malaria, thyphoid fever)	52	7	56	8	46	8	11	2	45	7	210	6
Nausea (parasite infestation)	52	7	34	5	18	3	20	4	23	3	147	5
Poor appetite (malaria, thyphoid fever)	45	6	54	7	24	4	27	5	44	7	194	6
Rashes on face ('mich', allergy)	12	2	19	3	22	4	10	2	31	5	94	3
Reddening of eyes (conjunctivitis, 'mich')	30	4	23	3	16	3	6	1	27	4	102	3
Runny nose (flu, commoncold)	16	2	11	2	7	1	19	4	10	2	63	2
Sharp pain (rheumatic pain)	27	4	31	4	17	3	37	7	19	3	131	4
Sleepiness (spiritual pain, dysentery)	60	8	44	6	21	4	19	4	16	2	160	5
Sneezing (common cold, sinusitis)	15	2	10	1	12	2	8	2	8	1	53	2

Sign & symptom	Anlemo		Duna		Gibe		Gombora		Yem		Overall Total	%
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%		
Spinning sensation (anaemia, 'mich')	41	5	25	3	8	1	15	3	20	3	109	3
Stomach growling (parasite infestation)	34	5	41	6	25	4	42	8	43	6	185	6
Swellings (nephritis, hepatitis, edema)	25	3	10	1	9	2	9	2	28	4	81	3
Unable to move (miscellaneous ailments)	39	5	45	6	43	7	48	9	31	5	206	6
Total	750	100	723	100	577	100	527	100	663	100	3240	100

4.2.3.7 Number of therapeutic MPs used for human ailments

The findings showed that about 66 (56%), 51 (58%), 47 (60%), 43 (71%) and 39 (63%) of ailments in Yem, Gibe, Anlemo, Duna and Gombora, respectively, were known to be treated by a single species while the remaining proportions of ailments were known to be treated by more than single species in each district. Among ailments for which multiple of MPs reported in descending of districts were; 'mich' 17 species, anthrax, amoeba and gonorrhea each 14, hepatitis 11 and tonsillitis and toothpain 9 species in Yem; malaria 17 species, abdominal pain 12, dyspepsia and 'mich'each 9, arthritis and tonsil each 8 and flu 7 species in Anlemo; commoncold and sudden ailment 11 species, toothpain 8, abdominal pain, abdominal parasites and diarrhea each 7 species in Gibe; abdominal pain 13 species followed by sudden febrile pain 11 species; malaria 7 species and commoncold 6 species in Gombora; and abdominal pain 13 species, sudden ailment 10 species, arthritis and tonsil each 6 species and mich 5 species in Duna.

4.2.3.8 Ethnomedicinal plant species and the human ailments treated

Based on interviews with local herbal experts, it was known that almost all Yem informants and only a few of Hadiya informants used concoction of plant species for a single human ailment. The results further showed that the highest proportion of MPs i.e. 120 (55%), 74 (69%), 58 (67%), 56 (55%) and 42(59%) of MPs in Yem, Gibe, Gombora, Anlemo and Duna, respectively were used to treat single human ailment (Table 11). In the remaining least proportions, a single species is reported to treat different ailments. With regard to families of MPs, the highest proportions of 54 (67%), 31 (69%), 26 (60%), 26 (61%) and 19 (54%) families in Yem, Anlemo, Gibe, Gombora and Duna, respectively treated different ailments while the remaining proportions treated only a single ailment in the districts. Families containing species that are used to treat multiple of

human ailments in all the five districts include Asteraceae, Alliaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Rutaceae and Solanaceae. Asteraceae was the species rich family in the five districts with 24 taxa in Yem followed by 12 in Anlemo, 11 in Gibe and 10 in Duna and Gombora. The next family with rich with therapeutic species was Lamiaceae in all districts with 18 taxa in Yem followed by 12 in Gombora 10 in Anlemo and 7 in Duna (Table 11).

Table 11. Number of families treating single or multiple of ailments in the five districts

District	A single family treats a single ailment	A single family treats multiple ailments	Families treat highest # of ailments
Anlemo (45 families)	14(31%)	31(69%)	Asteraceae (12 spp.) to 22 ailments, Lamiaceae (10 spp.) to 22 illnesses, Rutaceae (5 spp.) to 19 ailments, Solanaceae (7 spp.) to 14 ailments, Alliaceae (1 sp.) & Euphorbiaceae (3 spp.) each to 9 ailments
Duna (35 families)	16(46%)	19(54%)	Rutaceae (4 spp.) to16 ailments Asteraceae (10 spp.) to 13 ailments, Lamiaceae (7 spp.) to 13 ailments, Fabaceae (5 spp.) to 7 ailments
Gibe (48 families)	19(40%)	29(60%)	Asteraceae (11 spp.) to 23 ailments, Rutaceae (5 spp.) to 18 ailments, Euphorbiaceae (4 spp.) to 15 ailments, alliaceae (1sp.) to 8 ailments
Gombora (46 families)	18(39%)	28(61%)	Lamiaceae (12 spp.) to 24 ailments, Rutaceae (5 spp.) to 14 ailments, Asteraceae (10 spp.) to 12 ailments, Fabaceae (spp.) & Solanaceae (4spp) each 12 ailments
Yem (80 families)	26(33%)	54(67%)	Asteraceae (24 spp.) to 44 ailments, Lamiaceae (18 spp.) to 36 ailments, Fabaceae (12 spp.) to 23 ailments, Euphorbiaceae (8 spp.) to 16 ailments

Based on further analyses, MPs that were reported to treat multiples of ailments in each district by rank were *Allium sativum* and *Citrus limon* each 10 (12%) followed by *Ocimum lamiifolium* 7 (8%) in Anlemo; *C. limon* 6 (8%) followed by *Asparagus africanus* and *Ruta chalepensis* each 5 (8%) in Duna; *Croton macrostachyus* 12 (14%) followed by *A. sativum* and *C. limon* each 8 (9%) in Gibe; *C. macrostachyus* 7 (13%) followed by *R. chalepensis* 5 (9%) in Gombora; and *Rumex nepalensis* 9 (8%) followed by *Artemisia abyssinica* and *Phytolacca dodecandra* 6 (5%) each in Yem. Photos of some MPs with frequent citations of human uses are given in Fig. 22.

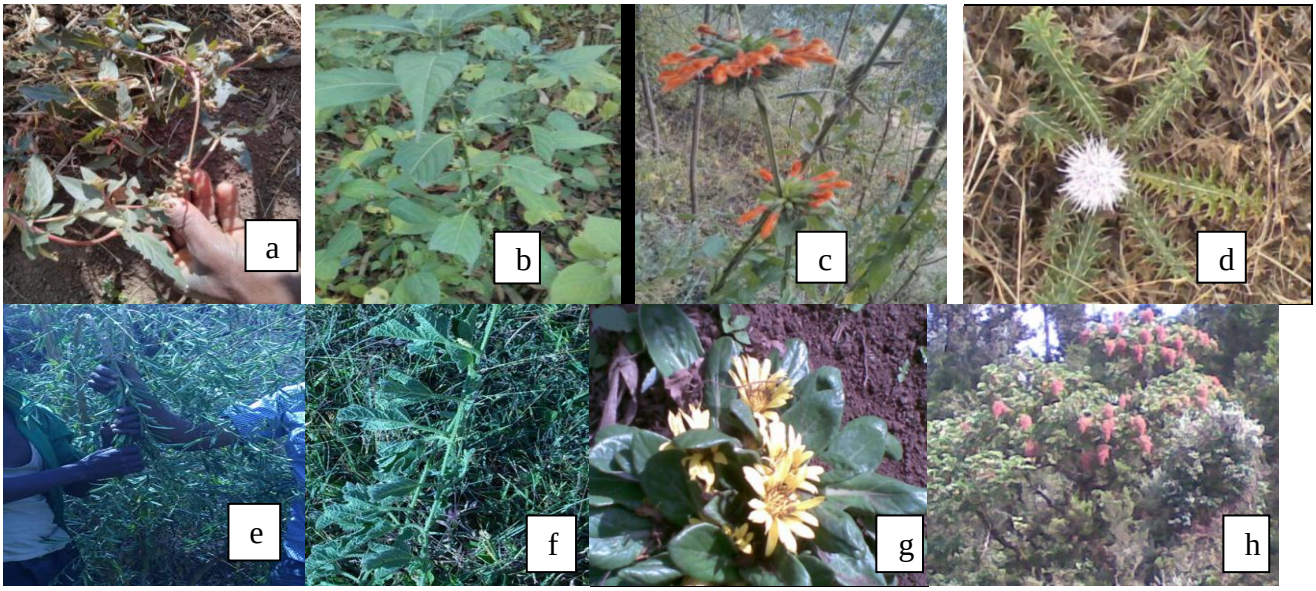


Fig. 22. Photos of some MPs of human use: (a) *Lysimachia ruhmeriana* -homegarden Ajarena-Duna, b) *Dicliptera laxata* from community forest Gombora, c) *Leonotis ocymifolia* from edge of farm Qenqicho-Duna, d) *Carduus schimperi*-from fallow Yem, e) *Securidaca longepedunculata* -from rocky hill scrub -Awosa Gibe f) *Cucumis ficifolius* from -foreyard Amboro-Gibe; g) *Haplocarpha rueppellii* h) *Hagenia abyssinica* from Mt. Bori - Yem, (Photo by Gideon W/M, 2016)

4.2.3.9 Parts of MPs used to treat human ailments

It was found that about 22 different parts of the MPs were reported to be utilised for treating human ailments in the study area (Table 12). Overall, the highest proportion of parts cited in the five districts was 448 (39%) for leaf followed by root 220 (19%), fruit 93 (8%), shoot tip 77 (7%) and seed 66 (6%) while the rest of parts constituted to 31%. With the same trend, leaf was the highest cited part in a rank order of districts was 197 (45%) in Yem followed by 89 (43%) in Anlemo, 72 (35%) in Gibe, 46 (31%) in Gombora and 44 (31%) in Duna. The next highest utilised part in all districts was root in a rank order 83 (19%) in Yem followed by 37 (18%) in Gibe, 35 (17%) in Anlemo and 35 (25%) in Duna and 29 (20%) in Gombora. Other parts constituted the remaining proportions in each district.

Table 12. Parts of MPs used to treat human ailments in the study districts

Part	Anlemo		Duna		Gibe		Gombora		Yem		Overall	
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%
Bulb	9	4	4	3	8	4	4	3	4	1	29	2.54
Bark(root)	1	1	3	2	2	1	5	3	7	2	18	1.58
Bark(stem)	4	2	9	6	14	7	14	10	22	5	63	5.53
Corm	3	1	1	1	4	2	2	1	5	1	15	1.32
Dry shoot	-	-	-	-	-	-	-		4	1	4	0.40
Fruit	21	10	21	15	20	10	11	7	20	5	93	8.16
Flower	1	1	1	1	2	1	-	-	-	-	4	0.35
Gall	1	1	-	-	-	-	1	1	-	-	2	0.20
Gum	-	-	-	-	1	0.50	1	1	-	-	2	0.20
Leaf	89	43	44	31	72	35	46	31	197	45	448	39.00
Latex	4	2	1	1	3	1	4	3	9	2	21	1.84
Nectar, pollen	1	1	-	-	-	-	-	-	-	-	1	0.09
Pseudostem	1	1	-	-	1	0.50	-	-	1	0.20	3	0.26
Seed	12	6	9	6	16	8	10	7	19	4	66	5.79
Shoot tip	16	8	8	6	14	7	12	8	27	6	77	6.75
Stem	3	1	3	2	7	3	3	2	3	0.7	19	1.67
Root	36	17	35	25	37	18	29	20	83	19	220	19.00
Resin	-	-	-	-	-	-	-	-	1	0.20	1	0.09
Rhizome	2	1	-	-	3	1	-	-	1	0.20	6	1.00
Wholepart	3	1	2	1	3	1	4	3	31	7	43	3.77
Wood	-	-	1	1	1	-	1	1	-	-	3	0.26
Wood oil	-	-	-	-	-	-	-	-	2	0.50	2	0.20
Total	207	100	142	100	208	100	147	100	436	100	1140	100

cit.=no. of citations

4.2.3.10 State of the plant remedies prepared

The results showed that the plant remedies are mostly prepared from fresh plant materials with few of them are prepared from dry material in the five districts. Overall fresh status constituted the highest citations of 970 (85%) followed by fresh/dry 109 (10%) and dry 61 (5%) (Table 13). Fresh preparations constituted the respective highest proportions (%) of 400 (92%) in Yem followed by 178 (86%) in Gibe, 151 (77%) in Anlemo 128 (90%) in Gombora and 113 (75%) in Duna. The fresh/dry condition was the least common in all districts.

Table 13. State of human remedies from plant parts (cit. = no. of citations)

Condition	Anlemo		Duna		Gibe		Gombora		Yem		Overall	
	cit.	%	cit.	%	Cit.	%	cit.	%	cit.	%	cit..	%
Dry	18	9	8	6	11	5	10	7	14	3	61	5
Fresh	151	73	128	90	178	86	113	77	400	92	970	85
Fresh/dry	38	18	6	4	19	9	24	16	22	5	109	10
	207	100	142	100	208	100	147	100	436	100	1140	100

4.2.3.11 Methods of preparation of MPs used to treat human ailments

About 10 different methods of preparations of plant remedies were reported to be used among communities of the study districts. Overall maceration was the highest used method with the highest of 391 (34%) followed by decoction 222 (19%), infusion 177 (16%), poultice 123 (11%) (Table 14). In a similar trend, macerartion was the most used method in each district with the highest proportion (%) of 185 (43%) in Yem followed by 68 (33%) in Anlemo, 59 (28%) in Gibe, 42 (30%) in Duna and 36 (24%) in Gombora. The next highest cited method of herbal remedy preparation in rank order was decoction with a proportion of 80 (18%) in Yem followed by 40 (19%) in Gibe, 32 (22%) in Gombora and 30 (21%) in Duna while infusion being most used in Anlemo with 45 (22%). The other methods constituted the remaining proportions in each district .

Table 14. Methods of preparation of MPs used for human ailments

Method	Anlemo		Duna		Gibe		Gombora		Yem		Ove	
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%	rall	%
Macerarion	68	33	42	30	59	28	36	24	185	43	391	34
Decoction	40	19	30	21	40	19	32	22	80	18	222	19
Infusion	45	22	19	13	31	15	22	15	60	14	177	16
Juice-latex	13	6	16	11	14	7	13	9	20	5	76	7
Poultice	12	6	20	14	39	19	23	16	30	7	123	11
Cook	5	2	6	4	10	5	8	5	7	2	31	3
Fumigation	-	-	-	-	-	-	-	-	11	3	11	1
Nonbody part	-	-	1	1	-	-	-	-	7	2	8	0.70
Extract oil	-	-	-	-	-	-	-	-	1	-	1	0.10
Roast-burn	3	1	4	3	5	2	3	2	10	2	25	2
Total	207	100	142	100	208	100	147	100	436	100	1140	100

cit. = no. of citations

4.2.3.12 Routes of application of MPs human health

About 10 different routes of the plant remedy application were identified and an overall three top application routes with rank of citation were 805 (71%), 177 (15%) and 63 (6%) for oral, dermal and nasal routes, respectively (Table 15). The highest cited route of remedy application in each district was via mouth with the highest proportion of 296 (68%) in Yem followed by 145 (70%) in Anlemo, 144 (69%) in Gibe, 116 (79%) in Gombora and 104 (73%) in Duna (Table 10). Dermal application was the next most cited method in all districts the highest being in Yem with 70 (16%) followed by 37 (18%) in Gibe, 31 (15%) in Anlemo, 23 (16%) in Duna and 15 (10%) in Gombora. The rest of routes of administration had lesser citations (Table 15).

Table 15. Routes of plant remedy application of human ailments (percentages in the text are in terms of each district)

Route	Anlemo		Duna		Gibe		Gombora		Yem		Overall	
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%
Aroma	-	-	-	-	1	1	-	-	-	-	1	0.10
Anal	1	1	-	-	-	-	-	-	4	1	5	0.40
Auricular	2	1	1	1	1	1	1	1	5	1	10	1
Dermal	31	15	23	16	37	18	15	10	71	16	177	15
Dental	4	2	1	1	7	3	3	2	8	2	23	2
Fumigation	9	5	1	1	2	1	-	-	12	3	24	2
Nasal	13	6	10	7	11	5	9	6	20	5	63	6
NBP*	2	1	1	1	3	1	1	1	12	3	19	1.4
Ocular	-	-	1	1	2	1	2	1	8	2	13	1
Oral	145	70	104	73	144	69	116	79	296	68	805	71
All	207	100	142	100	208	100	147	100	436	100	1140	100

*Non-body part/ritual &belief, cit. = no. of citations

4.2.3.13 Mode of application of human MP remedies

Results revealed different types of modes of application of herbal remedies from the five study districts (Table 16). Overall, the most cited mode of remedy application was 'drink' with a proportion of 688 (60%) followed by 'chew & swallow' 101 (9%) and 'paint' 91 (8%). Drink was also the most cited mode of application in each of the five districts with the highest proportion reported in Yem 310 (71%) followed by 129 (62%) in Gibe, 103 (50%) in Anlemo, 75 (51%) in Gombora and 71 (50%) in Duna (Table 16). Paint was the second highest cited mode of application in Yem with 26 (6%) followed by 25 (12%) in Anlemo, and 15 (7%) in Gibe while

chew & swallow was the second most cited in Duna with 22 (13%) and again 15 (7%) in Gibe. The rest of modes of application had minor frequencies in each district.

Table 16. Mode of administration of MPs used to treat human ailments

Mode	Anlemo		Duna		Gibe		Gombora		Yem		Overall	
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%
Amulet tie	-	-	-	-	-	-	2	1	-	-	2	0.20
Brush	2	1	-	-	-	-	-	-	-	-	2	0.20
Cauterise	-	-	-	-	1	0.50	1	1	-	-	2	0.20
Chew& swallow	22	11	22	15	17	8	20	14	20	5	101	9
Clean location	-	-	-	-	-	-	-	-	2	0.50	2	0.20
Drink	103	50	71	50	129	62	75	51	310	71	688	60
Incise-insert	-	-	-	-	1	-	-	-	3	1	4	0.40
Ear drop	2	1	1	1	1	-	1	1	5	1	10	1
Eat	22	11	10	7	15	7	12	8	5	1	64	6
Fumigate	12	6	1	1	3	1	2	1	-	-	18	2
Hold-in-hand	-	-	-	-	-	-	-	-	4	1	4	0.40
Hold-on-teeth	2	1	3	2	3	1	3	2	6	1	17	1
Inhale	9	4	7	5	7	3	6	4	25	6	54	5
Insert	1	0.50	-	-	2	1	1	1	2	0.50	6	1
Paint/streak	25	12	15	11	15	7	10	7	26	6	91	8
Place-nearby	-	-	-	-	-	-	-	-	2	0.50	2	0.20
Poultice	-	-	5	4	4	2	4	3	13	3	26	2
Repellent	-	-	-	-	-	-	1	1	-	-	1	0.10
Sniff-suck	7	3	2	1	2	1	2	1	8	2	21	2
Swallow	-	-	-	-	1	-	1	1	-	-	2	0.20
Touch-hot-paste	-	-	-	-	1	-	-	-	-	-	1	0.10
Wash	-	-	5	4	6	3	6	4	5	1	22	2
Total	207	100	142	100	208	100	147	100	436	100	1140	100

cit. = no. of citations

4.2.3.14 Dilutants of herbal remedies Human ailments

Results showed on overall of 803 (70%) remedies needed some diluents while about 345 (31%) of the remedies didn't need diluents (Table 17). At separate district level, the number of remedies that did not need diluents by rank were 192 (44%) in Yem followed by 58 (28%) in Gibe, 48 (23%) in Anlemo, 24 (17%) in Gombora and 21 (14%) in Duna. In each district, the respective proportion (%) of remedies that need dilutants in a rank order of the districts were 250 (57%) in Yem followed by 159 (77%) in Anlemo, 150 (72%) in Gibe, 126 (86%) in Gombora and 118 (83%) in Duna.. Water was the most commonly used overall dilutant of remedies with proportion of 723 (90%) followed by dilution inside mouth with saliva 33 (4%). Water was

dilutant in each district, had the highest proportions of 237 (63%) followed by 144 (74.6%) in Anlemo, 130 (68%) in Gibe, 107 (78%) in Gombora and 105 (84%) in Duna. Other kinds of dilutants such as moistening with saliva in mouth, coffee, local ethanol/'hereqe', 'keneto' and 'borde'/ local fermented beverages were the ones reported to be used with varying minimal frequencies in each district.

Table 17. Dilutants of human ailments in the five districts

Dilutant	Anlemo		Duna		Gibe		Gombora		Yem		overall	
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%
Water	144	74.6	105	84	130	68	107	78	237	63	723	90
Saliva in mouth	6	3.1	8	6.4	10	5	9	7	-	-	33	4
Porridge	3	1.6	2	1.6	1	1	1	1	-	-	7	1
Coffee	-	-	1	0.8	2	1	2	1	-	-	5	1
Ethanol/hereqe(H/Y)*	-	-	1	0.8	-	-	1	1	3	1	5	1
'Keneto'(H/Y)*	-	-	1	0.8	-	-	-	-	-	-	1	0.10
'Buluqo/borde(H/Y)*	1	0.5	-	-	1	1	2	1	-	-	4	1
Enset juice	-	-	-	-	-	-	1	1	1	-	2	0.20
Mix with 'kocho'/enset bread	-	-	-	-	-	-	2	1	-	-	2	0.20
Tea	3	1.6	-	-	4	2	-	-	1	-	8	1
Whey	2	1	-	-	2	1	1	1	-	-	5	1
Total with dilutant	159	77	118	83	150	72	126	86	250	57	803	70
Total without dilutant	48	23	24	17	58	28	21	14	192	44	345	30
Overall total	207		142		208		147		436		1140	100

*Hadiya/Yem, cit. = no. of citation

4.2.3.15 Use of additives to human MPs

Overall, a highest proportion of 1006 (88%) MP remedies were reportedly taken without additives while about 134 (12%) of the remedies were known to be used along with nonplant additives in the study districts (Table 18). A total of 26 different types of nonplant additives were reported from the five districts. The different additives reported were honey (of *Apis melifera* and *Trigona* spp./'tazmamar') (for different ailments including arthritis), milk, butter (for cough), 'gelati' of enset for coating 'koso'/*Hagenia* tree flower paste), enset soup (for diarrhea), enset porridge, niger seed/*Guizotia abyssinica* soup (for bronchitis), salt (for abdominal pain), vaseline (for hemorrhoids), brewed cereal beverages such as 'borde'(for boil/eczema), local ethanol/'hereqe' (for arthritis), ruminant stomach juice (for chronic eczema, TB), chicken soup (for fracture), earth's colored mineral soil (for general health). The number of additives used reported in each district in rank order were 8 in

Gombora followed by 7 in Gibe, 5 in Anlemo and Duna each and 4 in Yem (Table 18). The proportions (%) of remedies used with additives in each district by rank were 33 (12%) in Anlemo followed by 31 (7%) in Yem, 30 (14%) in Gibe, 23 (16%) in Gombora and 17 (12%) in Duna.

Table 18. Additives of MP remedies used in the 5 districts (H = Hadiyisa; Y = Yemisa)

Additive	Anlemo	Duna	Gibe	Gombora	Yem
'Borde(Y)shameta/buluqo(H)	1	1	1	1	-
Butter	6	3	6	2	-
Chicken soup	1	-	1	-	-
Coffee	5	4	6	7	9
Coat with bula 'gelati'	-	-	1	-	-
Coloured earth/mineral soil	-	-	-	-	2
Eagle flesh	-	-	1	-	-
Ethanol/'hereqe' (Y/H)	2	3	3	-	5
Gasoline, vaseline	-	1	-	-	-
Honey	-	4	5	-	-
Horse bone	-	-	-	-	3
Porridge	-	-	-	1	-
Enset 'kocho' juice	-	-	-	-	1
Koso	-	1	-	-	-
Goat stomach juice	1	-	1	1	-
Salt	10	-	7	5	10
Termite comb	-	-	-	-	1
Trigona bee honey	-	1	-	1	-
Whey	6	1	-	1	-
Chicken faeces	1	1	-	1	-
Dog faeces	-	-	1	-	-
Hyena faeces	-	1	1	1	-
Goat blood	-	-	1	1	-
Swine flesh & soup	-	-	1	1	-
Hayena liver	1	1		1	
Warthog flesh & soup	-	-	1	1	-
Total no of remedies used with additives	33	17	35	28	31
Total without additives	174	125	173	119	405

4.2.3.16 Dosage of herbal remedies of human ailments

Based on the results, the communities of the study districts use different traditional equipment to measure the amount of herbal remedies applied from the thought of safety. The duration and frequency of use of the remedies are also specified mostly in mornings in empty stomach, and from once a day, for 2-3 days to once a

week. Overall, the most used traditional measure of remedies was 'cup' with the highest citations of 253 (22%) followed by 'glass' 194 (17%), pieces 150 (13%) and estimation 137 (12%) (Table 19). Cup was also the highest cited measure in each district with the highest citation of 109 (25%) in Yem followed by 47 (23%) in Anlemo, 35 (24%) in Gombora and 32 (23%) in Duna while 'glass' was the highest cited measure with 47 (23%) in Gibe. Generally, for remedies that are applied in nonsolution form, count, estimation, palm and pieces were reported to be used to limit excess dose.

Table 19. Dosage of herbal remedies for human ailments (H= Hadiya; Y = Yem)

measure unit	Anlemo		Duna		Gibe		Gombora		Yem			
	#of NR	%	# of NR	%	# of NR	%	# of NR	%	# of NR	%	Overall	%
Capsule	-	-	1	1	1	0.5	-	-	-	-	2	0.20
Count	1	0.5	8	6	6	3	-	-	2	0.5	17	1
Cup (*c* 100 ml)	47	23	32	23	30	14	35	24	109	25	253	22
bush(Y)/rubber cup	-	-	-	-	-	-	-	-	6	1	6	1
½ cup	3	1	4	3	-	-	5	3	-	-	12	1
Drop	7	3	3	2	8	4	8	5	18	4	44	4
Estimation	23	11	4	3	34	16	7	5	69	16	137	12
Glass (*c* 300 ml)	44	21	32	23	47	23	19	13	52	12	194	17
½ glass (*c* 150 ml)	1	0.5	3	2	4	2	-	-	9	2	17	1
'Humbulo' (H) (*c* 500 ml)	-	-	-	-	-	-	2	1	-	-	2	0.20
'Kubaya(H)/gubaya'(Y)/	8	4	7	5	10	5	30	20	52	12	107	9
½ 'gubaya'(Y)	-	-	-	-	-	-	-	-	4	1	4	0.40
Litre/1000 ml	-	-	-	-	1	-	-	-	-	-	1	0.10
Palm	23	11	20	14	20	10	8	5	45	10	116	10
Piece	28	14	28	20	37	18	27	18	30	7	150	13
Pinch	19	9	-	-	10	5	6	4	25	6	60	5
Teaspoon (*c* 5 ml)	2	1	-	-	-	-	-	-	-	-	2	0.20
Tin/can / *c* 300-500 ml	1	0.5	-	-	-	-	-	-	15	3	16	1
	207	100	142	100	208	100	147	100	436	100	1140	100

4.2.3.17 Side effects and inconvenience of human MP remdies

Based on the findings, an overall of 894 (78%) of the herbal remedies were reported to be without observable sideeffects while 246 (22%) of them prepared from some medicinal taxa were said to incur observable sideeffects on the patients and inconvenient for application (Table 20). A total of 16 types of side effects were reported with the main ones including diarrhea, nausea and vomiting in all the five districts. The proportions (%) of remedies known to cause sideeffects in each district in a rank order were 85(19%) in Yem followed by

63 (30%) in Gibe, 43 (30%) in Duna, 31 (21%) in Gombora and 24 (12%) and in Anlemo (Table 20). Some of the medicinal species that cause side effects are given in Table 21.

Table 20. Side effects and inconvenience of human medicinal plants (cit. = no. of citations)

Side effect	Anlemo		Duna		Gibe		Gombora		Yem		Overall	%
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%		
Abdominal pain	-	-	-	-	6	10	-	-	-	-	6	2
Allergic rashes	-	-	-	-	-	-	-	-	1	1	1	0.40
Bitter taste	2	8	4	9	8	13	2	6	-	-	16	7
Gastric burning	2	8	4	9	15	24	4	13	11	13	30	12
Diarrhea	5	21	11	26	3	5	10	32	17	20	46	19
Disgusting smell	1	4	-	-	5	8	-	-	7	8	13	5
Fatality	-	-	-	-	2	3	2	6	7	8	11	4
Fatigue	-	-	-	-	-	-	-	-	3	4	3	1
Inflammation	4	17	2	5	1	2	-	-	1	1	8	3
Nausea	3	13	4	9	5	8	6	19	8	9	26	11
Sneezing	2	8	2	5	-	-	-	-	5	6	9	4
Spinning	3	13	-	-	2	3	-	-	1	1	1	0.40
Swelling	-	-	-	-	-	-	-	-	1	1	1	0.40
Toxicity	-	-	1	2	2	3	-	-	1	1	4	2
Vomiting	5	21	15	35	12	19	7	23	22	26	61	25
Total sideeffects	24	12	43	30	63	30	31	21	85	19	246	22
No side effects	183	88	99	70	145	70	116	79	351	81	894	78
Total remedies	207	100	142	100	208	100	147	100	436	100	1140	100

Table 21. Medicinal plants with sideeffects and inconvenience for intake (+ = incurs sideeffect)

Species	Anlemo	Duna	Gibe	Gombora	Yem	Type of sideeffect
Croton macrostachyus	+	+	+	+	+	severe diarrhea, fatigue
Vernonia amygdalina			+	+		bitter taste
Ajuga integrifolia	+	+	+	+	+	bitter taste, nausea
Clematis longicauda	-	-	-	-	+	burning, fatal in excess
Crepis rueppellii	+	-	-	-	+	diarrhea, abdominal pain
Cucumis ficifolius	+	+	+	+	+	fatal in excess
Teclea nobilis	-	-	+	+	-	bitter taste, vomiting
Hagenia abyssinica	+	+	+	+	+	bitter taste, vomiting, diarrhea fatigue
Allium sativum	+	+	+	+	+	heart burning
Solanum incanum	-	-	+	-	-	burning
Nicotiana tabacum	-	+	+	+	-	spinning, nausea, sneezing
Securidaca longepedunculata	-	+	+	+	+	diarrhea
Ocimum lamiifolium	+	+	+	+	+	sneezing

4.2.3.18 Antidotes of human MPs in the five districts

Interview responses showed 20 types of antidotes that were used for overall of 221 (19%) preparations (Table 22). In each district, the proportion (%) of antidotes suggested in a rank order of the districts were 75 (17%) in Yem followed by 40 (28%) in Duna, 39 (18%) in Gibe, 37 (25%) in Gombora and 30 (14%) in Anlemo. Generally, the different antidote items used were; 'beso'(a drink made of roasted barley flour mixed with water & sugar/salt for taste), 'borde/shameta'/a fermented drink made from cooked corn and sorghum/black variety of barley/, 'bula'/enset starch soup, butter, chicken soup, coffee, milk, 'qaribo'/a fermented drink made of roasted cereals, porridge, tea, whey, water as well as stay in bed and wash each with varying proportions in each district.

Table 22. Antidotes used for human phytomedicinal remedies with sideeffects

Antidote	Anlemo		Duna		Gibe		Gombora		Yem		Overall	
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%
'Beso'	-	-	9	23	-	-	-	-	-	-	9	4
'Borde/sha?meta'	-	-	2	5	2	5	4	11	7	9	15	7
Butter	-	-	1	3	4	10	1	3	13	17	19	9
Coffee with butter	3	10	-	-	-	-	-	-	-	-	3	1
Chicken soup	-	-	3	8	1	3	-	-	-	-	4	2
Coffee	5	17	2	5	1	3	4	11	7	9	19	9
Enset starch/'bula' soup (+leaves of *Rutachalepensis*.)	1	3	1	2	1	3	1	3	12	16	16	7
Honey	-	-	-	-	1	3	1	3	5	7	7	3
Honey solution/'birz'	-	-	-	-	-	-	2	6	-	-	2	1
'Keneto'	-	-	-	-	-	-	2	6	-	-	2	1
Milk	3	10	7	18	3	8	2	6	5	7	20	9
Porridge	-	-	2	5	2	5	-	-	8	11	12	5
'Qaribo'	4	13	-	-	-	-	2	6	-	-	6	3
'Tef' bread /of red variety/	-	-	-	-	-	-	-	-	1	1	1	0
Grain soup	-	-	-	-	-	-	-	-	5	7	5	2
Stay in bed/take rest	2	7	-	-	-	-	5	14	7	9	14	6
Tea	3	10	2	5	9	23	-	-	-	-	14	6
Wash	4	13	3	8	-	-	-	-	-	-	7	3
Water	4	13	-	-	-	-	3	8	5	7	12	5
Whey	2	7	9	23	16	41	11	30			38	17
Total antidotes	30	14	40	26	39	19	37	100	75	17	221	19
Total without antidotes	177	86	117	82	171	82	110	75	361	83	919	81
Total with & without antidotes	207	100	142	100	208	100	147	100	436	100	1140	100

cit. = no. ofcitations

4.2.3.19 Some taboos, symbolism and beliefs in uses of MPs in Hadiya and Yem

Outcome of interviews showed that local people of the study areas were known to have some taboos, beliefs and symbolism to some of the MPs used. For instance, healers in Anlemo and Duna indicated that it is a norm to charge clients for the phytoremedy they provide, otherwise, the remedy is thought not to work. In another interview a local healer who is a also junior member of clergy in Orthodox Christianity in Yem, indicated that he collects his MP remedies on specific dates mainly on Fridays and administers the remedies by praying mentioning the name of the patient. Similarly, a Muslim healer in Dunacho subdistrict Anlemo also indicated that she collects MPs in evenings on Tuesdays and administers to patients on Wednsdays. In Saja -Yem, a key informant indicated that when severe diarrhea results after taking remedy of *Phytolacca dodecandra*, a shadow/presence of non-relative visitor is avoided from the patient's room.

In another experience in Hadiya area, the use and disuse of some MPs is associated with some events. For instance, *Cynoglossum amplifolium* which used for child diarrhea is collected from sites far from home that is out of reach of crow of a cock in Gibe and Gombora otherwise it is considered not to work for the ailment. In other scenario, diagnosis of type of ailments is some times predicted with physical manifestations such as imparting of some colour. For instance, *Fuerstia africana* is a MP used for 'mich' both in Hadiya and Yem. Herbal experts make test of colour by smashing leaf remedy between palms calling the name of the patient. If the preparation turns orange red, it is concluded that the ailment is 'mich' and more remedy administred to the patient. In further experience, some plant species that were used medicinally were found to be avoided or feared in Hadiya area are used as medicinal in Yem area. For instance, *Arisaema* spp. named as ('hemeshesa' in Hadiya) and ('zawunewa' in Yem) to mean 'enset of snake' in both cases are avoided from any touch in Hadiya while they are used in Yem as medicinal. Similarly, in Hadiya area, some plants species that were avoided and not used for medicinal purpose are now used as new medicinal candidate. For example, *Vernonia myriantha* which was considered to cause hemorroids and avoided to touch or even sit beneath its shade in the past in the 4 districts of Hadiya is recently accepted to be highly medicinal for treating fresh wound and wound healing while it is known to be long used for the same wound healing in Yem.

There were also some MPs that have special symbolism. In this regard, in Hadiya 'duqusha' = *Drymaria cordata* and 'hechura' = *Kalanchoe* sp. are considered as symbols of reconciliation and making peace while 'seda' = *Pennisetum clandestinum* in Hadiya is considered a symbol of blessing and object of prayer to God by family and community elders during Holidays and social gatherings. Brides and bridegrooms are let sit on lawnry of it and blessed for expanding in family and for prosperous future of them. Another species, *Bersama abyssinica* is considered a tree of tricks of witchcraft and disliked by some people in Yem while it was included as medicinal in Gombora/Hadiya. *Podocarpus falcatus* 'digiba'/'Hujuba' in Hadiya was used to be worshipped and passengers prayed by touching its branches, painting butter and putting fresh grass on its trunk for good luck and peaceful day in their travel.

4.2.3.20 Survey of MPs in the markets of the study districts

A total number of 39 species that are classified in 22 families were observed in the markets of the five districts (Appendix 7). This makes 13% of the MPs inventoried for human and livestock health in the study area. About 24 (62%) of the MPs observed in the market were nutraceutical species that are used as food, spices and home remedies followed by 8 (21%) species as material culture, 5 (13%) species used for medicinal purpose only, of which 3 species were wild and 2 species cultivated, and 2(5%) of species were stimulants (Fig. 23). Among the species used for nutraceutical purpose, *Allium sativum, Aframomum corrorima, Coriandrum saitvum, Nigella sativa* and *Zingiber officinale* were the most widely used species for home remedies. About 36 (92%) of the marketed species were recorded in Hadiya making 17% of the total number of MPs while 22 (56%) of them were in Yem making 9% of the total MPs. On district basis, the respective number of marketed MPs used for human and livestock health in descending order were 28 (29%) and 6 (14%) in Anlemo followed by 22 (10%) and 6 (7%) in Yem, 21 (19%) and 4 (10%) in Gibe, 17 (24%) and 3 (7%) in Duna and 14 (16%) and 3 (6%) in Gombora.

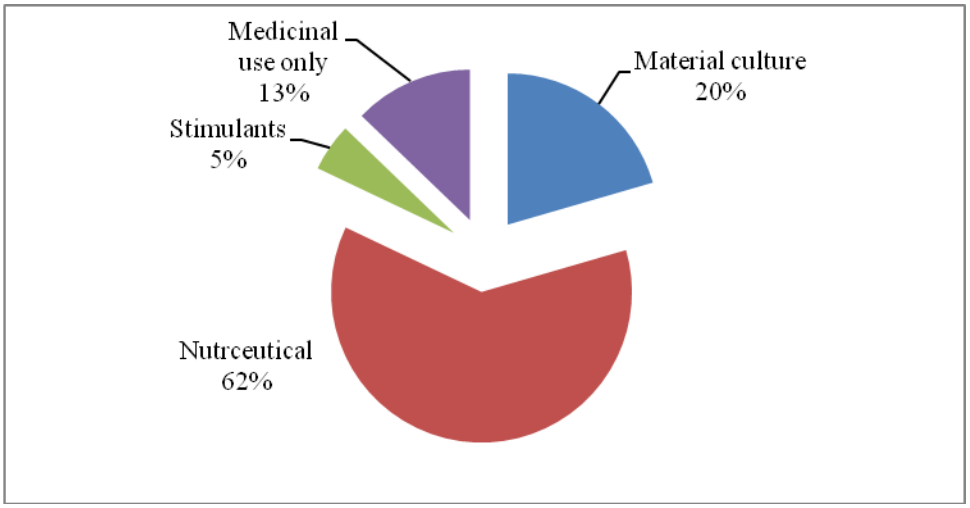


Fig. 23. Percentage of marketed MPs used for different purposes

Regarding the market values of taxa of only medicinal uses, it was observed 3-5 ETB per set for *Ajuga integrifolia*, 5 ETB per root piece for *Echinops kebericho* and 10-15 ETB per piece for *Securidaca longepedunculata*. The prices of seedlings of medicinal taxa were 5 ETB per 4 seedlings *A. integrifolia*, 5 ETB per bundle of seedlings of *E. kebericho*, 5 ETB/stalk of *Cymbopogon citratus*, 10-20 ETB/bundle of *Eucalyptus globulus*, *E. camaldulensis* and *Juniperus procera*, each, 10 ETB/4 seedlings of *Moringa* sp., and 25 ETB/few branches of *Withania somnifera*. The prices of medicinal stimulants was 10-15 ETB/bundle for *Catha edulis*, 3-5 ETB/set for *Nicotiana tabacum* and 2-5 ETB/slice of *N. rustica* leaf bread. Regarding the prices of nutraceutical taxa, there were variations of prices depending on the supply of the products and species of interest as they are circulated from short to long distances. The highest price of nutraceutical taxa was 5 ETB for 2 cloves of *Allium sativum* and *Zingiber officinale*, 1 kubaya/gubaya of *Lens culinaris* and *Pisum sativum* and 3 branches of *Rosmarinus officinalis*, and 3 ETB per 1/2 cup of *Nigella sativa* (Appendix 5). Material goods of medicinal taxa such as products of *Ensete ventricosum*, *Lagenaria siceraria*, *Phoenix reclinata* and *Pennisetum sphacelatum* had prices ranging from 25-35 ETB. Generally, both men and women were observed to be engaged in the small local business of the medicinal items for sustaining ther lives.

In further market observation, there was only one temporary ethnophytomedicinal/herbal vendor that is managed by a healer named Erebo at Homecho market in Gibe District (Fig. 7c). The healer was a local resident, vangelical believer who claims his displays include cures of about 37 benign topical and internal human ailments. Based on participant observation, he receives a good amount of income per market day charging 5-10 birr per remedy and each time he also prays to God in Jesus name to cure the patients' ailments with the remedy he gives that he ends up with an agreement prayer word 'Amen' by the patients and some idly surounding marketers of mainly youngsters.

4.2.3.21 Threats of medicinal plants in the study districts

Based on findings of preference ranking made with ten key informants on 13 threats of the sustainability MPs in each district (Tables 23 and Fig. 24), the three top rank challenges were charcoal extraction, expansion of agricultural land and drought in Anlemo; agricultural expansion, fuelwood and lumber mill in Duna; fuel wood for households and bakeries, local lumbering mill and intensification of *Eucalyptus* species (mainly *Eucalyptus camaldulensis*) for logging as a cash tree in Gibe; charcoal, agricultural encroachment into communal forests and intensification of *Eucalyptus* spp. in Gombora; and unwise harvest, agricultural encroachment to forested lots and grazing were the three top threat factors in a rank order in Yem.

Table 23. Preference ranking of threat factors of MPs in the five districts
(Tl = total, R = rank)

Threat factors	Anlemo		Duna		Gibe		Gombora		Yem	
	Tl	R	Tl	R	Tl	R	Tl	R	Tl	R
Charcoal	47	1	14	13	39	5	43	1	29	6
Encroachment to communal forests	46	2	47	1	40	4	42	2	35	2
Drought	42	3	23	12	20	13	19	13	25	7
Construction	42	3	30	9	22	12	20	12	18	12
Fuel wood for households & bakeries	41	5	46	2	45	1	24	9	16	13
Lumbering/saw mill	38	6	45	3	43	2	36	5	33	4
Grazing	37	7	33	7	31	10	34	7	34	3
Household ustensils	34	8	29	11	28	11	21	11	21	10
Intensification of *Eucalyptus* trees	25	9	35	7	42	3	39	3	19	11
Modernisation	21	10	36	6	35	7	37	4	23	9
Unwise harvest	21	11	37	5	38	6	33	8	39	1
Soil erosion & degradation of land	19	12	30	9	32	9	24	10	32	5
Use of herbicides	18	13	40	4	34	8	36	5	24	8

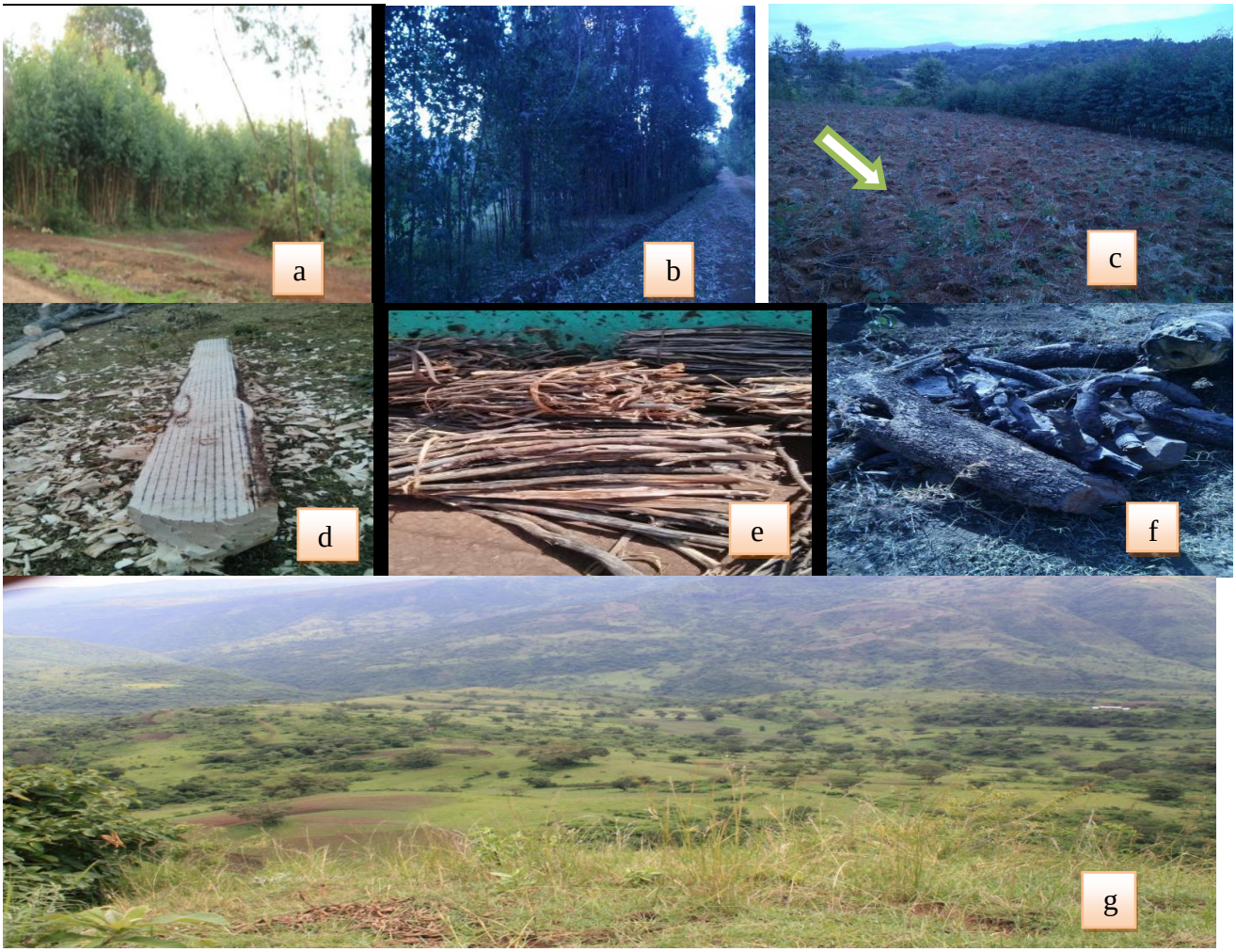


Fig. 24. Pictures of some of the threat factors of MPs; a-c) *Eucalyptus camaldulensis* trees coppices & seedling on a private land lot in AmboroGoynena & Homecho, Gibe District, d) *Croton macrostachyus* fell for lumber -Adeana, Gombora District, e) fuelwood, Homecho -Gibe, f) Charcoal extraction-middle left; g) deforestation for agriculture & charchoal, Gibe valley –Saja, Yem (Photo: Gideon W/M October, 2016; August, 2016)

4.2.3.22 Practices of conservation of MPs in the study area

The outcome of interviews on recommendations of local practices of conservation of the MPs used for human and livestock ailments revealed mainly three conservation options: avoiding destructive harvesting 472 (18%), planting threatened and rare species in communal forests 412 (15%) and in homegardens 364 (14%) (Table 24). Among the various options, three of them were commonly highly recommended in Anlemo, Duna and Gibe districts, namely, avoiding destructive harvest, planting in homegardens and communal forests with ranked proportions of 92 (18%), 75 (15%), and 60 (12%) in Anlemo; 123 (20%), 121 (19%) and 100 (16%) in Duna; 110 (17%), 105 (16%) and 100 (16%) in Gibe, respectively. The most suggested three options in

Gombora in a rank order were planting threatened species in communal forests with 92 (19%) followed by avoid destructive harvest 90 (17%) and plant threatened species in homegardes 80 (15%); and in Yem, avoiding destructive harvesting 61 (14%), planting threatened species in communal forests and establish pilot conservation sites & protect with volunteers 58 (12%) were the three top conservation options.

Table 24. Recommended conservation practices of MP used for human and veterinary ailments

Conservation options	Anlemo		Duna		Gibe		Gombora		Yem		Over all sum	%
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%		
Avoid destructive harvesting	90	18	121	19	110	17	90	17	61	14	472	18
Establish pilot conservation sites & assign volunteers for protection	9	2	21	3	10	2	18	3	58	13	116	4
Establish nurseries for mps	38	8	42	7	32	5	10	2	40	9	162	6
Exclude *Eucalyptus* sp. from indigenous species	58	12	16	3	62	10	50	9	6	1	192	7
Leave onfarm multipurpose spp.	72	14	45	7	60	9	45	8	35	8	257	10
Plant environmentally friendly fast growing species for energy & construction	47	9	31	5	45	7	14	3	47	11	184	7
Plant rare species at home gardens	75	15	123	20	105	16	80	15	54	12	364	14
Plant rare MPs in live fences and communal forests	60	12	100	16	100	16	92	17	60	14	412	15
Protect MPs at sacred & grave yards	10	2	8	1	47	7	50	9	30	7	145	5
Set aside communal grazing lots	19	4	50	8	25	4	39	7	10	2	143	5
Educating about importance of TM	11	2	45	7	32	5	20	4	17	4	125	5
Use manual crop weeding	15	3	21	3	9	1	25	5	25	6	95	4
Total	504	100	623	100	637	100	533	99	443	100	2667	100

cit. = no. of citations

4.2.3.23 Participant Observations of practice of TMPs

The first particinpant observation was made in a local Traditional medicinal clinic owned by a renowned 68 years old local herbalist healer named WoldeMeskel in Yem (Fig. 5 back). He gave his consent to attend his diagnosis and treatment sessions that is formally operational for 2 days a week. A number of patients from different subdistricts of the District and from different Regional States of the country were found in his clinic during participant observation seeking herbal medical attention for different health complaints and consultations. He officially and formally practiced the traditional medication by registering patients' history

by a clerk, records the case of each patient and the amount the patient charged in a patient log. He was observed mixing herbal medication with 'Protestant' prayer. Few patients were also found admitted for different cases in his clinic for days and weeks. Local leaders and residents witness his long time service and wide range of skills. He mentions that he has a shortage of garden for MPs and the species he uses are becoming rare. He further told that he gets his remedies from forests, villages, homegarden and sometines he buys from TM experts in far distances. He suggests establishment of MP garden in the district.

The second participant observation was made on a unique anniversary of 'TMP collection Day on Yem from Mt. Bori which has a peak at 2939 m (Fig. 6 back). The interviewed collector informants told that they collect what is called in Yem "SAMO ETA" which means 'a stored security medicine of year round' (Gideon Woldemariam *et al.*, manuscript). According to informants interviwed, the 'SAMO-ETA' collection anniversary is a very ancient practice that is passed from past generation to the present. During the collection occasion - the following events were observed: i) the agroecology/habitat is a highest peak of the district that is believed locally to harbor medicinal taxa growing in the Mt. have higher healing potential than the same taxa that are found in the lower altitude as well as distinct species that are not found elsewhere locally ii) the strategic position of the Mt. gave chance to the plant species growing on mountain to receive the first radiations of morning sun rise than any other locations helps the Mt. species to be more efficacious against ailments, iii) the collection Date 'Tikimt 17 in E.C. (every October 27th) is a day that is believed to be 'sacred day' in the name of Biblical Martyr St. Stephen according to the religion of Yem who are followers of the dogma of Orthodox Christianity and the plant taxa existing in the Mt. when collected at this date are believed to contain healing potential. Every plant taxa are collected whose parts include mainly leaf and few roots, iv) local people of all ages & gender: men, women and children from near and far subdistricts gather for the collection, children follow their parents mainly fathers as it was observed and attend and learn about the MPs, v) collection of the plant parts is effected in sacks and plastic bags and carried home and sundried, then stored in clean and safe goods as security medicine for year round. Starting sample is added from what was stored into fresh MP product and applied during the cases of human and livestock ailments.

4.2.3.24 Guided transect walk

During guided transect walk made for ethnomedicinal survey, diverse habitats such as homegardens, living fences, sacred and historical sites, farmlands, communal forests fragments, natural forests and plantations of *Eucalyptus* species were observed. In almost all of the study districts, homegardens ('dubo' (Had.), 'gorgu' (Yem)) were known to contain varying number of cultivated and wild MP species. The cultivated medicinal species grown in home gardens were such as *Ajuga integrifolia, Allium sativum, Amaranthus caudatus* (in Gombora), *Annona squamosa* (in Saja-Yem), *Artemisia absinthium, A. annua* (in Gibe), *Carica papaya, Catha edulis*, *Decliptera laxata*, *Echinops kebericho, Ensete ventricosum, Nicotiana rustica, N. tabacum, Ocimum lamiifolium, Persea americana, Phaseolus lunatus*, *Rosmarinus officinalis* and *Ruta chalepensis*. There were also medicinal weeds grown in home gardens such as *Acmella caulirhiza*, *Artemisia abyssinica*, *Leucas martinicensis* and *Physalis peruviana* among others. It was also observed that the Yem people traditionally grow one or two individuals of fig trees (*Ficus sur* and *F. sycomorus*) in homegardens and keep them upto big sizes. This is with a belief that they attract goodluck and moisture for enset homegarden, hence one observes big individuals of the species in almost every house inside enset yard. Similarly, living fences were also found to harbor several MPs among which *Cupressus lusitanica, Euphorbia cotinifolia, E. tirucalli, Erythrina brucei*, *Justicia schimperiana*, *Pycnostachys abyssinica*, *Rhamnus prinoides, Tetradenia riparia* ('benejo'Yem), *Vernonia amygdalina* and *V. myrantha*.

Observation on sacred sites such as Muslim grave yards in Anlemo and Yem (Saja), traditional and religious grave yards of Evangelical and Orthodox Christianity followers in Duna, Gibe, Gombora and Yem and Church compounds of Orthodox Christianity in Gibe and Yem were important reserviors for MPs. Similarly, there was also one historical site in Yem that served as Palace for 12 kings of of Yem that culminated and ended at King Ababogibo which is located in GoruminaHengeri subdistrict This compound interestingly contained large sized indigenous tree species and one exotic one - that include 30 big trunked individuals of *Podocarpus falcatus*, 25 big trunked *Juniperus procera* trees, 200 big trunked *Eucalyptus globulus*, 10 big trunked *Olea*

welwitschii, 2 big trunked *Manilkara butugi*, 30 big trunked *Erythrina brucei*, 6 big trunked *Ficus sycomorus* and 4 big crowned *F. vasta* and a series of *Arundinaria alpina* plantation (Fig. 25).



Fig. 25. Observation of tree stands in Palace of King AbaboGibo at GoruminaHengeri: guard & repair workers & the investigator – left, *Podocarpus* stands - right left, Yem (July, 2016)

4.2.3.25 Focus Group Discussions in the practice of TMPs

The outcome of group discussions showed that people of the study area mainly use the mainstream biomedical health care system for a number of ailments while they use traditional plant based medicine for benign health conditions as well as for ailments that are traditionally thought not to be cured by the mainstream health care system. Those ailments treated by MPs include common cold, abdominal pain, child diarrhea, 'mich', pre-menopause women's ailments and postpartum recovery are almost public domain that every family member mainly mothers collect from homegardens or nearby homestead and apply the remedies for the sick family member or neighbour. Traditional herbal experts are consulted for other more serious sufferings such as 'mich', infant ailments such as sorethroat 'sorqopha'/(Had.)', abdominal pain and flu, 'chabala'(Had.), 'awachifebe?u'(Yem), 'fendana' /(Had.) 'qalicha' ailments (Yem), 'manile' (Had.)/'gognon mero (Yem) /evileye, delivery, hepatitis, cancer and hemorrhoids. Those ailment types for which the biomedical medical system consulted are serious cases can be exemplified by typhoid fever, TB, complicated labour, malaria, family planning, children vaccination, severe diarrhea and accidents. In the case of livestock health, informants indicated incompleteness of mainstream veterinary services that are also mainly located in town centres that are far for remote subdistricts. It was known that mobile veterinary team provide health services to the extent

of remote subdistricts in the cases of fatal and serious cases of outbreaks of epidemics such as lumpy skin disease, foot-mouth-disease, anthrax, trypanosomiasis and blackleg. Informants indicated that they use traditional plant based medicines for livestock ailments such as leech, cough, bloat, diarrhea, delayed placenta, failure of fertility, evileye, ectoparasites, lumpy skin disease, sudden disease. They are also known to use traditional herbal medicines even for more acute cases too, such as anthrax, blackleg, foot-mouth disease and sudden ailment. It was also observed that there were veterinary pharmaceutical drugs packed in strips and in vials displayed on open markets and by non-professional petty traders. For sure, the identities of such drugs are hard to know. In any case, the local people buy such medicines and use them for treating both chronic and acute cases. Locally experienced persons that do not have veterinary training were known to give antibiotic injections for sick animals.

Participants also indicated that the young generation has no interest in use of TMPs. They also assert that use of TMPs are not advised by health extension workers and mainstream health practitioners. In this regard, heads of health offices in the five districts interviewed indicated that they do not have any positive attitude of use of traditional medicinal plants, even they consider it as a bad traditional practice, hence, suggest local people for abandoning it and use western based therapies instead.

4.2.3.26 Transfer of TMP knowledge

The findings of interviews on the of transfer of MPK showed different sources such as close family members (fathers, mothers, grand mothers and fathers, aunts and family-in-laws), friends, neighbors, religious institutes and written pharmacopoeia (Table 25). On overall, the highest cited source social unit of transfer of MPK was father to loved child with 340 (28%) followed by mother to loved child (male /female) 226 (19%) and friends 190 (16%) and neighbors 135 (11%). Regarding the line of transfer at individual district, the highest agreed line was from father to a loved child with 90 (38%) in Duna followed by 85 (35%) in Gibe, 80 (36%) in Gombora, 65 (21%) in Yem and 62 (25%) in Anlemo (Table 25). The next highly cited source of MPK

transfer were mothers and friends with varying proportions of agreements in each district while other sources contributed lesser role as sources of MPK in each district.

Table 25. Transfer of MP knowledge of human ailments in the five districts

Source	Anlemo		Duna		Gibe		Gombora		Yem		All	
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%	Total	%
Aunt	15	6	5	2	6	2	20	9	32	10	78	6
Family-in-law	12	5	5	2	8	3	6	3	15	5	46	4
Father	62	25	90	38	85	35	80	36	65	21	340	28
Friends	45	18	32	13	45	19	40	18	28	9	190	16
Grand father	12	5	8	3	3	1	10	5	25	8	58	5
Grand mother	7	3	12	5	8	3	15	7	26	8	68	6
Mother	45	18	53	22	38	16	30	14	60	19	226	19
Neighbors	35	14	21	9	39	16	15	7	25	8	135	11
Religious institute	10	4	4	2	6	2	2	1	20	6	42	3
Written pharmacopoeia	8	3	9	4	4	2	3	1	8	3	32	3
Total	251	100	239	100	242	100	221	100	314	100	1215	100

cit. = no. of citations

4.2.3.27 Preference Ranking of MPs used for Human ailments in the study area

The analysis of preference ranking revealed the best preferred MPs for treating the most cited human ailments in each of the five districts. The best and least preferred MPs in alphabetic order of the districts were - *Englerina woodfordioides* (epiphytic on *Vernonia amygdalina*) ranked 1st for malaria while *Justicia schimperiana* ranked last in Anlemo (Table 26); *Brucea antidysentrica* ranked 1st for dyspepsia while *Mikaniopsis clematoides* ranked last in Duna (Table 27); *Croton macrostachyus* ranked 1st for stopping bleeding of casual injuries while it was last rank for elephantiasis in Gibe (Table 28); *Allium sativum* ranked 1st for treating pneumonia while it was last rank for abdominal pain in Gombora (Table 29); and *Juniperus procera* ranked 1st for treating common cold while it was last for poor appetite in Yem (Table 30). In each case, the lists of preference species are known to be used as alternative treatments for the respective ailments.

Table 26. Preference ranking of 8 medicinal species used to treat malaria in Anlemo

(8 = highest; 1= least, R = Respondent /Informant in current use)

Species	Informants										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
Englerina woodfordioides	8	7	7	8	6	2	2	6	8	7	61	1
Allium sativum	6	8	6	7	5	6	5	8	7	2	60	2
Ajug integrifolia	7	4	3	6	8	8	4	7	2	4	53	3
Clausena anisata	3	2	4	5	4	7	8	6	5	8	52	4
Ocimum lamiifolium	5	1	8	2	6	5	7	4	3	6	47	5
Croton macrostachyus	4	5	1	4	3	3	6	3	6	8	43	6
Lagenaria siceraria	2	1	3	1	2	4	3	1	1	3	21	7
Justicia schimperiana	1	3	2	3	1	1	1	2	3	1	18	8

Table 27. Preference ranking of 6 species used to treat human dyspepsia in Duna (6 = highest; 1 = least)

Ailment	Informants										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R9		
Brucea antidysentrica	6	5	4	3	6	4	6	5	6	4	49	1
Citrus limon	5	6	5	5	5	5	5	4	3	5	48	2
Ruta chalepensis	4	3	6	6	3	6	2	6	5	6	47	3
Croton macrostachyus	2	4	2	4	4	3	4	3	4	3	33	4
Teclea nobilis	3	1	3	1	1	1	3	1	1	2	17	5
Mikaniopsis clematoides	1	2	1	2	2	2	1	2	1	1	15	6

Table 28. Preference ranking of *Croton macrostachyus* for treating nine human ailments in Gibe

(9 = highest agreement, 1 = least agreement)

Ailment	Informants										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
Bleeding	5	9	6	9	7	9	5	8	7	9	74	1
'Demtoke' *	7	6	9	8	6	7	8	7	5	7	70	2
Abdominal worms	8	7	7	6	9	3	7	9	6	1	63	3
Malaria	6	8	4	5	8	4	9	6	1	3	54	4
Ringworm	4	3	5	7	4	6	2	3	9	6	49	5
Dyspepsia	9	5	3	3	2	1	4	5	3	5	40	6
Headache	3	1	2	3	5	5	6	1	1	8	35	7
Atopic ezcema	2	4	3	1	3	1	3	4	4	2	27	8
Elephantiasis	1	2	1	2	1	2	1	2	3	1	16	9

*'Demtoke' = swelling of whole body parts that may be due to nephritis/hepatitis

Table 29. Preference ranking of *Allium sativum* for treating five human ailments in Gombora (5 = highest; 1 = least)

Ailment	Informants										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
'Mich'	5	4	1	3	5	5	1	4	3	5	36	1
Pneumonia	4	5	2	4	3	4	5	2	2	3	34	2
Bronchitis	2	3	5	2	4	3	3	5	5	1	33	3
Flu	3	2	4	2	1	2	2	3	4	2	25	4
Abdominal pain	1	1	3	1	2	1	4	1	1	3	18	5

Table 30. Preference ranking of *Juniperus procera* treating six human ailments in Yem (6 = highest; 1 = least)

Ailment	Informants										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
Common cold	2	3	5	4	5	6	4	3	4	4	40	1
Malaise	4	5	6	2	4	1	5	5	1	6	39	2
Abdominal pain	6	5	2	1	6	5	1	6	5	1	38	3
Diarrhoea	5	6	4	5	3	3	2	1	6	2	37	4
Hepatitis	3	1	3	6	1	4	6	4	2	3	33	5
Poor appetite	1	2	1	3	2	2	3	2	3	5	24	6

4.2.3.28 Informant Consensus Factor (ICF) of MPs used for human ailments

The results of ICF calculated in each district depicted large average ICF value with the largest value of 0.88 in Duna followed by 0.87 in Gibe, 0.86 in Anlemo, 0.85 in Gombora and 0.75 in Yem (Table 31). Those ailment categories which scored highest values of ICF for each district were; two ailment categories Dermatological ailments (DR) and Sensorial ailments & Headache (SH) scored the same highest ICF values in Anlemo i.e DR ICF 0.91 (treated with 12 species, 126 use reports) and SH ICF 0.91 (treated with 5 species, 44 use reports). DR also scored the highest ICF of 0.95 in Gombora (treated with 8 species, 97 use reports). In Duna and Yem Gastrointestinal & Visceral organs ailments category (GIV) scored the highest ICF values of 0.94 In Duna,(being treated with 35 species, 398 use reports) while in Yem it scored ICF of 0.82 (being treated with 91 species, 506 use reports). The GIV was also highest with regard to number of taxa used treat and number of uses reported in each district (Table 31). In Gibe, there were two categories that scored highest

ICF- Miscellaneous (MISc) ailments ICF 0.91 (with 18 species & 184 use reports), and Respiratory System ailments (RS) (with 19 species & 208 use reports). On the other hand, the lowest ICF values in each district were; for Miscellaneous ailments (MISc) and Musculo-Skeletal ailments (MSK) each 0.82 in Anlemo; Psycho-Spiritual & cultural ailments (PS) 0.81 in Duna; Reproductive & Uro-Genital ailments (RUG) 0.82 in Gibe; RS ailments 0.74 in Gombora and Blood Vascular & Infectious (BVI) 0.67 in Yem.

With regard to specific list of human ailments treated in those categories with the highest ICF values in Anlemo and Gombora; the DR ailments reported in Anlemo includes 10 ailments such as athlete's foot, boil, burns, edema, fresh wound, herpes simplex (mouth 'mich' locally), feet infection, ringworm, *Tinea versicolor* all treated by single species and warts (treated by 5 species) while the same ailment category in Gombora includes five ailments such as fresh wound (treated by 3 species), edema (treated by 3 species), ringworm, dandruff, thorn-puncture infection treated by a single species. Additionally in Anlemo, the SH category that had the same highest ICF value includes 3 ailments such as ear infection, migraine and benign headache each of them managed with a single MP species. In Gibe, the 'MISc' category which scored highest ICF value of 0.91 includes ailments such as 'mich' (treated by 5 species), sudden ailment (treated by 8 species) and fever (treated by 3 species); and RS category which also scored ICF of 0.91in the district includes 9 ailments such as common cold (treated by 8 species), tonsilitis (by 7 species), flu (by 4 species), cough (by 3 species), asthma (by 2 species), acute febrile rheumatism, TB, pneumonia and whooping cough each treated by a single species.

Similarly, the GIV ailments which had the highest ICF value of 0.94 in Duna includes 13 ailments such as abdominal pain (treated by 15 species), dyspepsia (by 6 species), ascariasis (by 4 species), child abdominal upset (by 3 species), helminthiasis (by 2 species), amoebiasis, constipation, diarrhea, gastritis, giardiasis, hemorrhoids, hepatitis, nephritis each treated 1 species while the same ailment category in Yem that had the highest ICF of 0.82 includes 15 ailments such as abdominal pain (treated by 14 species), amoebiasis (by 13 species), child diarrhea & hepatitis (treated by 10 species each), nephritis (by 8 species), diarrhea (by 7

species), hamorroids (by 5 species), taeniasis (by 4 species), ascariasis (by 3 species), dysentry, dispepsia, constipation, poor appetite, vomiting and sudden abdominal pain each treated by a single MP species.

Table 31. Informant Consensus Factor (ICF) of MPs used to treat human ailments

(A = Anlemo, D = Duna, Gb = Gibe, Gm = Gombora, Y = Yem, UR = no. of use reports, spp.= # of species used for treating ailments, BVI = Blood Vascular & Infectious, DR = Dermatological ailments, GIV = Gastrointestinal & Visceral organs ailments, MISc = Miscellaneous ailments, MSK= Musculo-Skeletal ailments, RS = Respiratory System ailments, PS = Psycho-Spiritual & cultural ailments, RUG = Reproductive & Uro-Genital ailments, SH = Sensorial ailments & Headache)

Ailment Category	Anlemo		Duna		Gibe		Gombora		Yem		A	D	G	Gm	Y
	UR	Spp	UR	Spp.	UR	Spp.	UR	Spp.	UR	Spp.	ICF	ICF	ICF	ICF	ICF
BVI	194	30	41	5	138	17	86	15	211	70	0.85	0.90	0.88	0.84	0.67
DR	126	12	62	10	116	19	97	8	207	59	0.91	0.85	0.84	0.95	0.72
GIV	317	42	398	35	410	43	291	37	506	91	0.87	0.94	0.90	0.87	0.82
MISc	131	24	136	14	184	18	201	21	277	54	0.82	0.9	0.91	0.9	0.81
MSK	84	16	92	16	144	21	88	12	114	31	0.82	0.83	0.86	0.87	0.73
PS	42	7	37	8	44	6	25	5	67	18	0.85	0.81	0.88	0.80	0.74
RUG	44	8	8	2	61	12	36	10	97	32	0.84	0.85	0.82	0.74	0.68
RS	149	18	161	18	208	19	119	16	143	30	0.89	0.89	0.91	0.87	0.80
SH	44	5	23	3	43	8	31	5	106	28	0.91	0.91	0.83	0.83	0.74
Average											0.86	0.88	0.87	0.85	0.75

4.2.3.29 Fidelity level, FL(%) of selected MPs for human ailments in the study area

The overall inspection of Fidelity Fevel, FL(%) calculated for each MPs used to treat human ailments in the the nine ailment categories the five districts mostly showed the highest value of 100%. Accordingly, a highest proportion of 117 (54%) species scored FL of 100% in Yem followed by 73 (67%) in Gibe, 59 (68%) in Gombora, 54 (53%) in Anlemo and 42 (58%) in Duna. Similarly, 64 (30%) scored FL 55-90% in Yem followed by 28 (25%) scored 50-86% in Anlemo, 22 (20%) had 50-89% in Gibe, 21 (24(%) had 55-90% in Gombora, 20 (28%) had 50-85% in Duna while those MPs scored below FL of 50% were 35 (16%) in Yem, 16 (16%) in Anlemo, 14 (14%) in Gibe, 10 (14%) in Duna and 7 (8%) in Gombora (results not presented due to big size of the data from each district). Instead, the FL(%) of only some of the MPs from ailment categories

with the highest ICF values are presented in this section and Table 32. Accordingly, in Anlemo species that scored highest FL in the DR category (which scored the highest ICF value) include *Vernonia myriantha* (for fresh wound) FL of 100%, *Euphorbia schimperiana* (for warts) 100%, *Lysimachia ruhmeriana* (for *Tinea versicolor*) 100%.

Similarly in Duna, species which scored the highest FL (%) in the GIV ailments (which had highest ICF) for the district include *Embelia schimperi* (used as vermifuge) FL of 100%, *Stephania abyssinica* (for sudden abdominal pain) 100%, *Momordica foetida* (for sudden abdominal pain) 100% and *Brucea antidysentrica* (for abdominal pain) 100%, *Teclea nobilis* (for dysentry) 69% and *B. antidysentrica* (for dyspepsia) 54%. In Gibe District, species from two categories MISc and RS had the same high ICF - *Securidaca longepedunculata* (for sudden ailment) FL of 100%, *Physalis peruviana* (for sudden ailment) MISc category, and *Achyrospermum schimperi* (for common cold) 100%, *Acmella caulirhiza* (for tonsilitis), *Artemisia abyssinica* (for whooping cough) and *Ocimum lamiifolium* (for tonsilitis) each 46% all RS category.

In Gombora, species that had high FL in DR category (that scored high ICF for the district) were *Carissa spinarum* (for edema), *Ensete ventricosum* /clone'Haywona' (for thorn puncture infection), *Kalanchoe schimperiana* (for edema) and *Vernonia myriantha* (fresh wound) each FL of 100%. In this district, other species that had highest FL in other ailment category were *Englerina woodfordioides* (symbiont on *Vernonia amygdalina*) (for rheumatic pain-MSK), and *Phaseolus lunatus* (for sudden ailment -MISc)) each 100%. In Yem, *Haplocarpha rueppellii* (for abdominal pain) 100%, *Maesa lanceolata* (abdomonal worms) 80%, *Rumex abyssinucus* (for hepatitis) 75%, *Verbena officinalis* (for child diarrhea) 65%, *Brucea antidysentrica* (for abdominal pain & diarrhea) 65% and *Hagenia abyssinica* (for taeniasis) 60%; from other category *Carduus schimperi* (for acute febrile illness - MISc) and *Inula confortiflora* (for sudden ailment - MISc) each 100% in Yem.

Table 32. FL(%) of selected MPs used to treat ailment categories with high ICF values in the study area

1. Anlemo

Species	ailment	Ip	Iu	FL(%)
Solanum incanum.	Ear infection	7	7	100
Pittosporium viridiflorum	migraine	3	3	100
Vernonia myriantha	freshwound	27	27	100
Allium sativum	Ringworm	55	64	86
Nigella sativa	migraine	9	14	64
Cucumis ficifolius	hemmoroids	11	19	57
Carissa spinarum	boil	12	20	57
Aloe sp.	Burns	5	11	46

2. Duna

Species	ailment	Ip	Iu	FL(%)
Embelia schimperi	vermifuge	10	10	100
Eucalyptus globulus	flu	13	13	100
Momordica foetida	abdominal pain	5	5	100
Stephania abyssinica	abdominal pain	18	18	100
Rumex abyssinicus	hepatitis	21	28	75
Teclea nobilis	dysentry	9	13	69
Brucea abyssinica	dispepsia	21	40	54

3. Gibe

Species	ailment	Ip	Iu	FL(%)
Achyrospermum schimperi	common cold	9	9	100
Acmella caulirhiza	tonsilitis	21	21	100
Artemisia abyssinica	Whooping cough	5	5	100
B. antidysentrica	sudden ailemnt	22	22	100
Cynoglossum lanceolatum	sudden fever	7	7	100
Physalis peruviana	sudden pain	11	11	100
Securidaca longepedunculata	sudden ailment	23	23	100

4. Gombora

Species	ailment	Ip	Iu	FL(%)
Amaranthus caudatus	'mich'	5	5	100
C. spinarum	edema	5	5	100
Englerina woodfordioides	rheumatic pain	15	15	100
Ensete ventricosum /'heywona'	thorn puncture infection	4	4	100
Phaseolus lunatus	sudden ailment	17	17	100
Kalanchoe schimperina	edema	7	7	100
V. myriantha	freshwound	25	25	100

5. Yem

Species	ailment	Ip	Iu	FL(%)
Haplocarpha rueppellii	abdominal pain	40	40	100
Maesa lanceolata	abdonimal worms	13	16	80
E. schimperi	abdoninal worms	12	16	75
R. abyssinicus	hepatitis	24	32	75
Verbena officinalis	child diarrhea	12	18	65
B. antidysentrica	sudden abdominal pain	9	14	64
Hagenia abyssinica	taeniasis	17	28	60

4.2.3.30 Use Values (UV), Relative Importance Indices (RI) and Use Diversity (UD) indices of selected MPs in the study area

Use value index (UV) and Relative Importance index (RI) were calculated based on 12 main use categories for the whole medicinal taxa out of which only 10 species with highest UV and RI along their Use Diversity Values (*H'*) and Use Evenness (*J'*) indices are presented in Tables 33-37. Accordingly, three species with the top use values (UV) in each district were; *Croton macrostachyus* (3.45) followed by *Allium sativum* (1.77) and *Citrus limon* (1.36) in Anlemo; *C. macrostachyus* (1.54) followed by *Hagenia abyssinica* (1.45) and *Vernonia amygdalina* (1.12) in Duna; *C. macrostachyus* (2.25) followed by *A. sativum* (1.34) and *V. amygdalina* (1.27) in Gibe; *C. macrostachyus* (2.18) followed by *Ensete ventricosum* ('Gishir') and *Nicotiana tabacum* each (1.35) in Gombora; and *Juniperus procera* (3.55) followed by *C. macrostachyus* (2.55) and *Buddleja polystachya* (1.64) in Yem. On the other hand, those species scored the least UV in each district were; *Crotaria spinosa* and *Verbascum sinaiticum* each 0.04 in Anlemo; *Plantago major* 0.04, *Haplocarpha rueppellii, Lagenaria abyssinica, Impatiens ethiopica* each 0.05 in Duna; *Commelinia imberbis, Gnidia involucrata* and *Lippia adoensis* var. *adoensis* each 0.04 in Gibe; *Artemisia annua* and *Cyphostemma cyphopetalum* 0.05 each in Gombora, and *Bersama abyssinica, Canarina eminii, Cynoglossum amplifolium, Erucastrum arabicum* and *Pycnostachys eminii* each 0.03 in Yem (list not given in the Tables).

Based on the analysis of RI, three MPs with the top RI values in each district were; *Croton macrostachyus* (2.00) followed by *Eucalyptus globulus* and *Juniperus procera each* (1.90) in Anlemo; *Cordia africana* (2.00) followed by *C. macrotachyus* and *E. globulus* each (1.78) in Duna; *C. macrostachyus* (2.00) followed by *E. globulus* (1.55) and *Allium sativum* (1.38) in Gibe; *C. macrostachyus* (2.00) followed by *Syzygium guineense* subsp. *guineense* (1.98) and *Podocarpus falcatus* (1.64) in Gombora; *Juniperus procera* (2.00) followed by *C. macrostachyus* and *Sysygium guineense* subsp. *guineense* each (1.78) in Yem (Tables 39-43). On the other hand, MPs with the least RI scores in each district were *Ajuga integrifolia* 0.33, *Dymaria cordata* and *Verbascum sinaiticum* each scored RI of 0.35 in Anlemo; *Coriandrum sativum* 0.22 in Duna; *Artemisia absinthium, A. abyssinica* and *Commelinia imberbis* each 0.20 in Gibe; *A. annua* 0.22, *Cyphostemma*

cyphopetalum and *Laggera tomentosa* 0.34 each in Gombora, and *Verbena officinalis* 0.23 and *Verbascum sinaiticum* 0.28 in Yem (list not given in the Table).

Table 33. UV, RI, UD & UE of selected MPs with the highest indices in Anlemo

(A = no. of informants cited the sp. for human medicine; B = no. of informants cited the sp. for livestock medicine; C = A+B, D = total no. of use citations of the sp.; E = Use value; F = no. of use categories; G = Relative Imprtance (RI), H = overall use diversity (UD = *H'*); I = overall use evenness (UE = *J'*)

Species	A	B	C	D	E	F	G	H	I
Croton macrostachyus	65	20	85	317	3.45	8	2.00	1.89	0.91
Allium sativum	69	5	74	163	1.77	4	1.19	-	-
Citrus limon	55	-	55	125	1.36	5	0.86	-	-
Vernonia amygdalina	14	13	27	119	1.29	7	1.45	1.77	0.99
Juniperus procera	7	-	7	54	1.00	8	1.90	2.04	0.98
Premna schimperi	7	12	19	90	0.98	8	1.42	1.28	0.59
Nicotiana tabacum	25	21	46	88	0.96	4	0.93	-	-
Ocimum lamiifolium	61	-	61	80	0.87	3	0.85	-	-
Olea europaea. subsp. *cuspidata*	14	-	14	75	0.80	7	1.68	1.87	0.96
Eucalyptus globulus	10	-	10	77	0.80	8	1.90	2.05	0.99
Hagenia abyssinica	14	-	14	62	0.70	7	1.49	1.55	0.80
Teclea nobilis	12	-	12	66	0.70	6	1.13	1.50	0.84
Maesa lanceolata	6	8	14	57	0.60	6	1.13	1.60	0.89
Ensete ventricosum	7	-	7	51	0.55	7	1.83	1.78	0.99

Table 34. UV, RI, UD & UE of selected MPs with the highest indices in Duna

Species	A	B	C	D	E	F	G	H	I
Acacia abyssinica	-	5	5	26	0.22	7	1.20	1.57	0.87
Albizia schimperiana	3	8	11	41	0.33	6	0.87	1.46	0.91
Calpunia aurea	-	25	25	82	0.64	5	0.82	1.82	0.93
Clausena anisata	11	7	18	49	0.38	5	0.92	1.66	0.93
Cordia africana	3	5	8	42	0.45	10	2.00	2.17	0.90
Croton macrostachyus	26	15	41	180	1.54	8	1.78	1.87	0.90
Eucalyptus globulus	13	-	13	71	0.89	8	1.78	1.91	0.92
Hagenia abyssinica	42	9	51	159	1.45	7	0.84	1.89	0.97
Ensete ventricosum /clone'gishir'/	11	9	20	107	0.94	6	1.21	1.77	0.99
Millettia ferruginea	11	3	14	75	0.59	6	0.98	1.78	0.99
Olinia rochetiana	16	-	16	41	0.33	4	0.87	1.26	0.78
Teclea nobilis	13	-	13	41	0.34	4	0.98	1.35	0.80
Vernonia amygdalina	27	-	27	142	1.12	6	0.98	1.93	0.99
Allium sativum	43	-	43	86	0.67	2	0.54	-	-

Table 35. UV, RI, UD & UE of selected MPs with the highest indices in Gibe

Species	A	B	C	D	E	F	G	H	I
Croton macrostachyus	95	30	125	390	3.31	8	2.00	1.63	0.79
Allium sativum	69	10	79	158	1.34	2	1.38	-	-
Teclea nobilis	17	-	17	27	1.33	6	0.63	1.15	0.64
Vernonia amygdalina	51	-	51	150	1.27	6	1.10	1.79	0.92
Eucalyptus globulus	17	4	21	106	1.00	8	1.55	1.83	0.91
Citrus limon	58	-	58	114	0.97	4	1.02	-	-
Nicotiana tabacum	17	30	47	96	0.81	3	0.60	-	-
Clausena anisata	28	8	36	83	0.70	5	0.92	1.34	0.75
Eucalyptus camaldulensis	3	-	3	16	0.63	7	0.98	1.89	0.87
Albizia schimperiana	-	13	21	73	0.62	5	0.82	1.51	0.84
Prunus africana	8	5	13	60	0.51	5	0.82	1.60	1.00
Syzygium guineense subsp. *guineense*	9	-	9	54	0.46	8	1.35	2.05	0.99
Olea europaea subsp. *cuspidata*	8	-	8	43	0.36	7	1.10	1.76	0.90
Olea welwitschii	6	3	9	35	0.30	6	1.01	1.59	0.89

Table 36. UV, RI, UD & UE of selected MPs with the highest indices in Gombora

Species	A	B	C	D	E	F	G	H	I
Croton macrostachyus	43	12	54	203	2.18	8	2.00	1.84	0.88
Ensete ventricosum	10	9	19	126	1.35	6	1.51	1.64	0.93
Nicotiana tabacum	9	58	67	126	1.35	3	0.66	-	-
Vernonia myriantha	25	-	25	13	1.24	6	1.04	1.66	0.96
Vernonia amygdalina	28	-	28	97	1.04	6	1.08	1.69	0.95
Manilkara butugi	13	4	17	83	0.89	8	1.62	1.96	0.94
Securidaca longepedunculata	31	18	59	71	0.76	3	0.66	-	-
Clausena anisata	13	6	19	61	0.66	5	1.01	1.52	0.94
Podocarpus falcatus	9	-	9	58	0.62	7	1.64	1.94	1.00
Eucalyptus camaldulensis	9	-	9	57	0.61	7	1.81	1.94	1.00
Ocotea kenyensis	5	4	9	57	0.61	7	1.57	1.94	1.00
Euclea racemosa subsp. *schimperi*	5	7	12	54	0.58	6	1.18	1.73	0.96
Sapium ellipticum	-	8	8	48	0.52	7	1.49	1.94	0.99
Syzygium guineese subsp. *guineese*	-	5	5	42	0.45	9	1.98	2.19	0.99

Table 37. UV, RI, UD & UE of selected MPs with the highest indices in Yem

Species	A	B	C	D	E	F	G	H	I
Juniperus procera	61	3	64	259	3.55	7	2	1.88	0.96
Croton macrostachyus	31	9	40	184	2.55	8	1.78	1.99	0.94
Buddleja polystachya	20	7	27	118	1.64	6	1.27	1.67	0.93
Calpurnia aurea	-	24	24	99	1.36	6	1.31	1.82	0.93
Hagenia abyssinica	25	-	25	92	1.23	6	1.40	1.68	0.94
Erythrina brucei	13	4	17	87	1.16	6	1.36	1.86	0.96
Clematis longicauda	21	7	28	84	1.10	6	1.40	0.43	0.24
Podocarpus falcatus	7	6	13	84	1.07	6	1.58	1.70	0.97
Allium sativum	36	-	36	78	1.06	3	0.75	-	-
Cordia africana	5	5	10	70	1.01	5	1.40	1.75	0.98
Premna schimperi	8	9	17	69	1.00	7	1.45	1.99	0.95
Olea europaea subsp. *cuspidata*	12		12	66	0.96	6	1.27	1.79	1.00
Prunus africana	11		11	63	0.91	5	1.17	1.65	0.92
Gardenia ternifolia	8	3	11	58	0.84	8	1.64	1.88	0.90
Syzygium guineese subsp. *guineense*	3	4	7	54	0.78	8	1.78	1.86	0.89

4.2.3.31 Use Diversity Values of MP species in the study area

The overall 301 medicinal species 237 species in Yem and 209 species in Hadiya provided 11 additional use values to the local communities. The use values were apiculture, construction, energy (fuel wood & charcoal), farming & household tools, fence, food and wild edibles, forage, ritual & cultural, shade and maintenance of soil and environment. In each district, the highest number of 115 (54%), 106 (91%), 105 (88%), 83 (79%) and 56 (64%) of taxa in Yem, Anlemo, Gibe, Gombora and Duna, respectively were known to provide 3 or more additional use values to the local communities (Fig. 26).

The proportion of the medicinal taxa that provided more added values in rank order of the districts and in rank order of additional use values were; soil & environment 186 (78%), forage 108 (45%), energy 55 (23%), farming & household tools 52 (21%) and construction 34 (14%) in Yem; soil & environment 101 (85%), forage 51 (41%), energy 36 (29%), shade 35 (28%), construction 23 (18%) and farming & household tools 18 (14%) in Gibe; soil & environment 82 (71%), forage 50 (41%), energy 35 (29%), farming & household tools 23 (19%) and construction 14 (11%) in Anlemo; soil & environment 68 (64%), forage 38 (36%), energy 36

(34%), construction 24 (22%) and farming & household tools 20 (19%) in Gombora; and soil & environment 63 (73%), forage 30 (34%), energy 21 (24%), farming & household tools 19 (21%) and construction 9 (10%) in Duna (Fig. 26). Other use categories in each district were provided with lesser proportions but important additional livelihood services to the local communities in each district.

Moreover, Use Diversity (UD) and Use Equitability (UE) values calculated for selected multipurpose medicinal taxa in the five districts showed that; *Eucalyptus globulus* (UD = 2.05**,** UE = 0.99) followed by *Croton macrostachyus* (UD = 1.89, UE = 0.91) and *Olea europaea* subsp. *cuspidata* (UD = 1.87, UE=0.96) in Anlemo (Table 33); *Cordia africana* (UD = 2.17, UE = 0.90) followed by *Vernonia amygdalina* (UD = 1.93, UE = 0.99) and *Eucalyptus globulus* (UD = 1.91, UE=0.92) in Duna (Table 34); *Syzygium guineese* subsp. *guineense* (UD = 2.05, UE = 0.99) followed by *Eucalyptus camaldulensis* (UD = 1.89, UE = 0.87) and *E. globulus* (UD = 1.83, UE = 0.91) in Gibe (Table 35); *S. guineense* subsp. *geuineense* (UD = 2.19, UE = 0.99) followed by *E. camaldulensis.*, *Ocotea kenyensis*, *Podocarpus falcatus* and *Sapium ellipticum* each (UD = 1.94, UE = 1.00 for the 1st three, 0.99 for the last) in Gombora (Table 36); and *C. macrostachyus* (UD = 1.99, UE = 0.90) and *Premna schimperi* (UD = 1.99, UE = 0.95) followed by *Juniperus procera* (UD = 1.88, UE = 0.0.96) in Yem (Table 37).

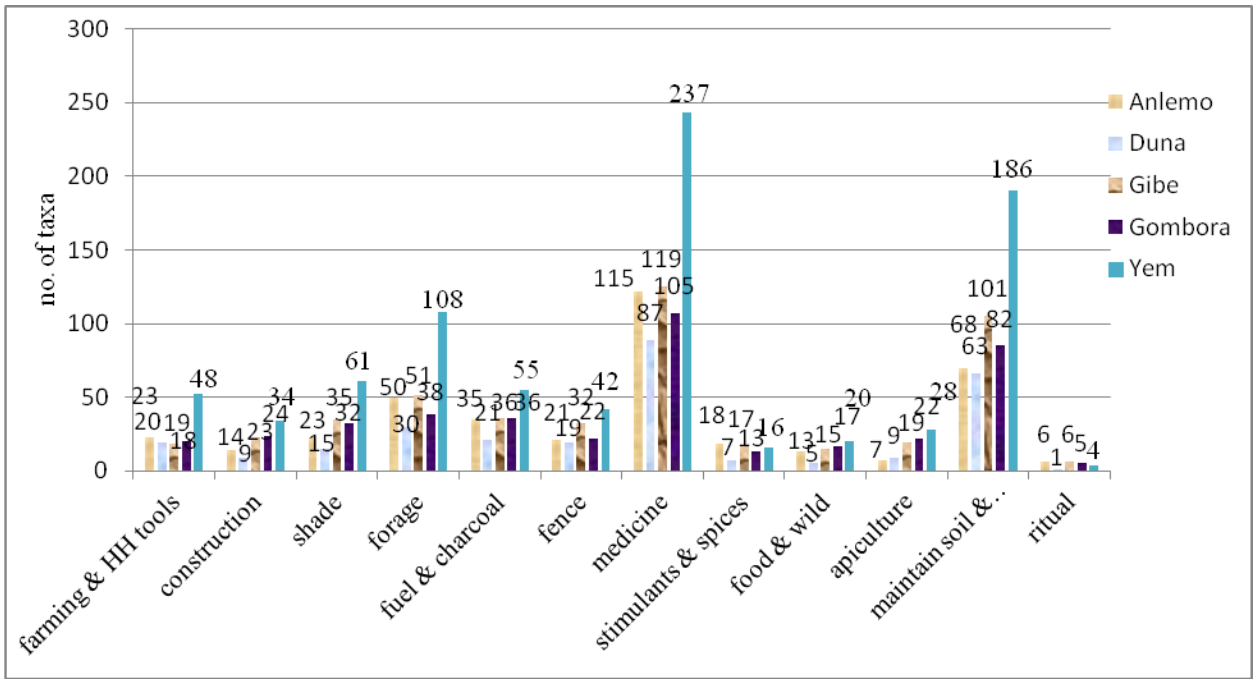


Fig. 26. Proportions of MPs in the 12 use categories

4.2.3.32 Direct Matrix ranking of the MPs for human health with multiple uses

The exercise of direct matrix ranking (DMR) on 10 multipurpose indigenous MPs revealed species that are under threat due to pressure of diverse uses in the five districts are presented in (Tables 38-42). Accordingly, *Acacia sieberiana*, *Juniperus procera* and *Hagenia abyssinica*, were locally threatened species in rank of 1st,-3rd, respectively by activities of fuel wood and construction in Anlemo (Table 38); *Cordia africana*, *Croton macrostachyus*, and *Hagenia abyssinica* and *Juniperus procera* were locally threatened ranking 1-3 for fuel wood and construction in Duna (Table 39); *Croton macrostachyus*, *Olea europaea* subsp. *cuspidata*, and *Olea welwitschii* and *Prunus africana* were the most utilized and threatened species ranking of 1-3 by activities of fuel wood and construction in Gibe (Table 40); *Cordia africana*, *Podocarpus falcatus* and *Manilkara butugi* were the most threatened species ranking 1-3 by activities of fuel wood and construction in Gombora (Table 41), and *Cordia africana*, *Juniperus procera* and *Podocarpus falcatus* were species locally threatened ranking 1-3 by activities of fuel wood, construction and lumbering in Yem (Table 42).

Table 38. Average DMR score of 10 informants on 10 multipurpose species in Anlemo

A = furniture, farming & hh tools, B = fodder, C = fuel wood, D = charcoal, E = construction, F = lumbering

Species	A	B	C	D	E	F	Total	Rank
Acacia sieberiana	2	3	5	5	3	2	18	1
Arundinaria alpina	2	4	3	1	5	1	14	6
Croton macrostachyus	3	1	5	1	2	4	13	7
Erythrina brucei	1	2	3	1	3	3	12	8
Eucalyptus camadulensis	1	1	5	1	5	4	16	5
Eucalyptus globulus	1	1	5	1	5	3	15	3
Hagenia abyssinica	1	1	5	2	2	5	15	3
Juniperus procera	2	4	5	1	5	3	18	1
Olea europaea subsp. *cuspidata*	3	2	5	1	4	1	13	7
Teclea nobilis	4	4	3	1	1	1	10	9
Total	18	27	44	15	35	27		
Rank	5	3	1	6	2	3		

Table 39. Average DMR score of 10 multipurpose species in Duna

Species	A	B	C	D	E	F	Total	Rank
Acacia abyssinica	4	2	5	4	3	2	20	6
Albizia schimperiana	1	1	5	2	3	2	14	8
Cordia africana	5	5	5	3	5	5	28	1
Croton macrostachyus	4	5	5	3	3	5	25	2
Dombeya torrida	1	1	4	2	2	2	12	10
Erythrina brucei	2	3	2	1	2	3	13	9
Eucalyptus globulus	4	5	5	1	5	3	23	5
Hagenia abyssinica	3	4	5	3	4	5	24	3
Juniperus procera	4	5	5	1	5	4	24	3
Millettia ferruginea	1	1	5	2	3	1	13	9
Olinia rochetiana	2	1	5	2	4	1	15	7
Total	31	33	51	24	39	33		
Rank	7	4	1	6	2	5		

Table 40. Average DMR of 10 multipurpose medicinal species in Gibe

Species	A	B	C	D	E	F	Total	Rank
Apodytes dimidiata	3	3	5	2	4	3	20	7
Balanites aegyptiaca	1	1	5	5	3	1	16	10
Croton macrostachyus	4	5	4	4	3	5	25	1
Eucalyptus globulus	3	4	5	1	5	2	20	5
Eucalyptus camaldulensis	4	3	5	1	5	2	20	5
Olea capensis subsp. *macrocarpa*	2	4	5	2	4	2	19	8
Olea europaea subsp. *cuspidata*	4	5	5	3	4	2	23	2
Olea welwitschii	5	3	5	2	4	2	21	3
Prunus africana	2	4	5	2	4	4	21	3
Syzygium guineense subsp. *guineense*	2	3	5	2	5	1	18	8
Total	30	35	49	24	41	24		
Rank	4	3	1	5	2	5		

Table 41. Average DMR of 10 multipurpose MPs in Gombora

Use pressure category	A	B	C	D	E	F	Total	Rank
Balanites aegyptiaca	2	2	5	5	3	2	19	7
Combretum collinum	3	3	5	5	3	2	21	5
Cordia africana	5	5	5	3	5	5	29	1
Croton macrostachyus	3	4	4	3	3	5	19	7
Eucalyptus camaldulensis	3	4	5	2	5	4	20	4
Ficus vasta	2	3	3	3	2	5	18	9
Manilkara butugi	4	5	4	4	5	4	26	3
Ocotea kenyensis	3	3	5	3	5	3	21	5
Olea welwitschii	4	4	5	2	4	3	22	4
Podocarpus falcatus	5	5	5	3	5	5	28	2
Total	34	38	46	33	40	38		
Rank	5	3	1	6	2	3		

Table 42. Average DMR of 12 multipurpose tree species in Yem

Use pressure category	A	B	C	D	E	F	Total	Rank
Cordia africana	5	5	5	3	5	5	28	1
Croton macrostachyus	3	1	3	2	3	5	17	9
Erythrina brucei	1	1	2	2	3	2	11	11
Gardenia ternifolia	3	3	5	5	3	2	21	6
Hagenia abyssinica	3	2	5	4	4	4	22	4
Hypericum quartinianum	2	2	5	4	3	1	17	9
Juniperus procera	3	4	5	3	5	5	25	2
Olea europaea subsp. *cuspidata*	3	3	4	3	3	2	18	8
Olinia rochetiana	1	3	5	4	4	3	20	7
Podocarpus falcatus	5	4	5	2	5	5	26	3
Premna schimperi	2	3	4	4	3	1	17	9
Syzygium guineese subsp. *guineense*	3	3	4	3	5	4	22	4
Total	34	34	52	39	46	39		
Rank	5	5	1	3	2	3		

4.2.3.33 Indigenous knowledge of MPs used for human health

4.2.3.33.1 Back ground of Informants

The general socioeconomic profile of the informants of each district is presented in Table 43. Of the overall total of 501 of informants sampled, the biggest proportion of informants sampled in a rank order was 128 (26%) from Duna followed by 119 (24%) in Gibe, 93 (19%) in Gombora, 92 (18%) in Anlemo and 69 (14%) in Yem. Socio-economic and location variables used for hypothesis testing were gender, age, marital status, religion, education, informant category, agroecology, subdistrict and district. Regarding overall proportions of categorical variables, gender had 277 (55%) for male and 224 (45%) female; categories of age were 208 (42%) for old age (>= 50 years old), 153(31%) were middle age (31-49 years old) while 140 (28%) were young agers (18-30 years old); religion comprised of 338 (68%) Evangelicals (Protestants), 66 (13%) Orthodox & Catholic (few in number) and 97 (19%) Muslims; categories of education were 187 (37%) noneducated, 285 (57%) elementary complete and 29 (6%) highschool & above; based on MPK, 399 (80%)

were general inform(>=5ants while 102 (20%) were key informants; based on agroecology 214 (43%) were middle landers, 178 (36%) lowland dwellers while 109 (22%) were high landers.

Table 43. Backgrounds of informants, socioeconomic and agroecological variables (Cath. = Catholic, highland = 2300-2629 m; midland = 2001-2299 m; lowland = 1500-2000 m as.l. no. = number)

Variable	Category	Anlemo		Duna		Gibe		Gombora		Yem		Over all	
		no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
Gender	male	54	59	68	53	65	55	52	56	38	55	277	55
	female	38	41	60	47	54	45	41	44	31	45	224	45
	total	92	100	128	100	119	100	93	100	69	100	501	100
Age	young (18-35)	29	32	44	34	31	26	24	26	12	17	140	28
	middle (36-50)	24	26	40	31	33	28	37	40	19	28	153	31
	old 0)	39	42	44	34	55	46	32	34	38	55	208	42
	total	92	100	128	100	119	100	93	100	69	100	501	100
Marriage	single	9	10	19	15	16	13	12	15	10	14	66	13
	married	83	90	109	85	103	87	81	87	59	86	435	87
	total	92	100	128	100	119	100	93	102	69	100	501	100
Religion	Evangelical	13	14	117	91	115	97	91	98	2	3	338	67
	Orthodox(+Cath.)	2	2	11	9	4	3	2	2	51	74	70	14
	Muslim	77	84	-	-	-	-	-	-	16	23	93	19
	total	92	100	128	100	119	100	93	100	69	100	501	100
Education	noneducated	26	28	46	36	50	42	30	32	36	52	188	38
	elementary (1-8)	63	68	72	56	64	54	57	61	28	41	284	57
	highschool & above (>=9)	3	3	10	8	5	4	6	6	5	7	29	6
	total	92	100	128	100	119	100	93	100	69	100	501	100
Informant category	general	72	78	108	84	99	83	73	78	47	68	399	80
	key	20	22	20	16	20	17	20	22	22	32	102	20
	total	92	100	128	100	119	100	93	100	69	100	501	100
Agroecology	highland	21	23	70	55	-	-	-	-	18	26	109	22
	midland	29	32	58	45	65	55	43	46	19	28	214	43
	Lowland	42	46	-	-	54	45	50	54	32	46	178	36
	total	92	100	128	100	119	100	93	100	69	100	501	100

4.2.3.33.2 Emic Categories of the natural environment in Hadiya

The Hadiya have generations old tradition of classifying natural resources around them in a general and specific level of hierarchies. Terms such as ‘her ulla’ designates the world, the earth while ‘her wo?o’ designates the ‘aquatic environment’. The term ‘ulla’ also designates the terrestrial environment that includes

different features of landscapes such as ‘duna’ = mountain, ‘letebira’= plateau, ‘cheba’ = valley, ‘balle’= gorge and ‘dirifa’ = gully. The lithosphere is termed as ’ullimura’ while its surface is classified as ‘kina’ = rock /rocky parent material and the pedological part such as ‘kata’ = broken rocks, ‘sheshera’ = sand and ‘bucha’ = soil. Based agroclimatic factors (moisture & heat) ‘ulla’ can be classified as ‘ineqora’ = the highland, ‘hensewa’ = the middle land and ‘qale?a’ =the lowland. The landscapes can be expressed in terms of presence of ‘Mutano’ = the plants such as natural forests, plantations of introduced/exotic species, usable, managed, unmanaged, abandoned and unusable lands and surface fresh water systems. Based on the natural vegetation cover, landscapes are classified into; ‘doma’ – the forest, ‘dubo’ = the bush, and ‘hitula’ = the grasslands. ‘Udma?a’ is a noncultivable land that doesn’t support human settlement. Managed landscape is classified into; ‘abulla/wit-ulla’ = farm land, ‘geru-ulla’ = fallow, ‘dichi?l-woro’ = spot in terraced closure by earth and living fence by outskirt of home garden, ‘dubo’/garo?o = home garden which is protected by ‘ota’ = live/dry fence, and ‘nefera/jofora’ = front yard of home. Some features of landscapes of the study areas is given in Fig. 27.

Informants in Hadiya area were found to categorise plant species based on actual uses such as medicinal use. If a species is used for some remedy they assign it as good/useful if they do not use it locally they assign it as useless/bad. Regarding the use, the Hadiya have old traditional use of plants for healing and recovering from ailments/‘jabo’/. There is a folklore that is commonly known as ‘qar be-manchi qerarbe?i haqi he?oyo’ – which is translated as ‘a man without relatives and a plant/tree without medicine never exists’. Human disease is termed as ‘mani-tiso/jabo’ while livestock diseases are termed as ‘dinat-tiso/jabo’.

In Hadiya, ailments are generally classified based on either anatomical parts ailed; maternity related such as ‘godapisa’/abortion,; spiritual types such as ‘manile’/’gojano’/evil eye ailment, ‘ganela’/evil spirit ailment, ‘alchena’/sterility; or miscellaneous types that are difficult to categorise such as ‘mich’ and ‘chebela’. This is also true for the case of livestock ailments. Some livestock ailments are not called by direct name for fear not induce its recurrence due to severity of the disease, for instance, ‘tinticho’/anthrax called as ‘hefecha’. Ailments are then named either with a single word, or folkbinomially with two words together - mixing the

ailed body part/'oracho'/ and the ailment type. Examples of singe word diseases are 'suqo?o' = TB, 'shinqa' = asthma, 'semaga' = tonsillitis, 'adite' = diarrhea, 'demuma' = headache. Examples of binomial naming of ailments include; 'mur tiso'/mu?l tiso' = nephritis, 'wademunch tiso/wademuncho/'= rainbow disease that actually is hepatitis. Classification of plants /'mutano' sieze a rank of kingdom as the top rank under which different growth forms such as 'hite'/grasses, 'herefa'/herbs/weeds, 'heqa'/tree and 'tuda'/climbers are categories. Folktaxonomic levels below the rank kingdom are at generic specific and subspecific levels. In this regard, the Hadiya names of most of the species documented in this study have one-to-one equivalent with botanical species while in some cases there were overdifferentiation at generic level and underdifferentiation at underspecific level like 'variety'. Examples of overdifferentaited taxa include five landraces of enset (*Ensete ventricosum*) such as 'Astera','Agade', 'Gishir', 'Heywona', 'Meqe?lwesa' and 'Qiniwar' (Appendix 4) that are considered as independent species. The underdifferentiated taxa are exemplified by *Teclea nobilis* and *Vepris dainellii* which are differentiated at genus level same species from the same family Rutaceae but designated as male gender and female gender, respectively.

Naming the MPs used to treat human and livestock ailments /disorders is done folkbinomially by connecting the ailed body part/'oracho'/or type of ailment /'jabo/tiso' as a prefix that is followed by 'qerare'/medicine. For instance, 'illitis qerare' = a medicine of eye disease/conjunctivitis, 'wademunch qerare' = a medicine of hepatitis, 'demu?m qerare' = a medicine of headache. The choice and use of MPs follows taste, aroma and local accessibility of the species. The term 'qerare'/medicine literally originates from a fact that 'medicinally used plants possess bitter in taste', for example, *Ajuga integrifolia, Hagenia abyssinica, Ocimum lamiifolium, Ruta chalepensis, Teclea nobilis, Vernonia amygdalina* all possess bitter taste and all of them are used as medicinal. Some aromatic species also include *Artemesia ansinthium, Coriandrum sativum, Eucalyptus spp., Ruta chalepensis* among others. "The medicinal plants/'tisqerare' are gathered from different sources /land use types such as 'dubo' = homegarden, 'ota'= living fence, 'haqoro' = forest, 'ineqora'= highland, 'qale?a/bereha' = lowland/semi-desert, sometimes from 'mera' = market and 'qera?l mana' = from healers.

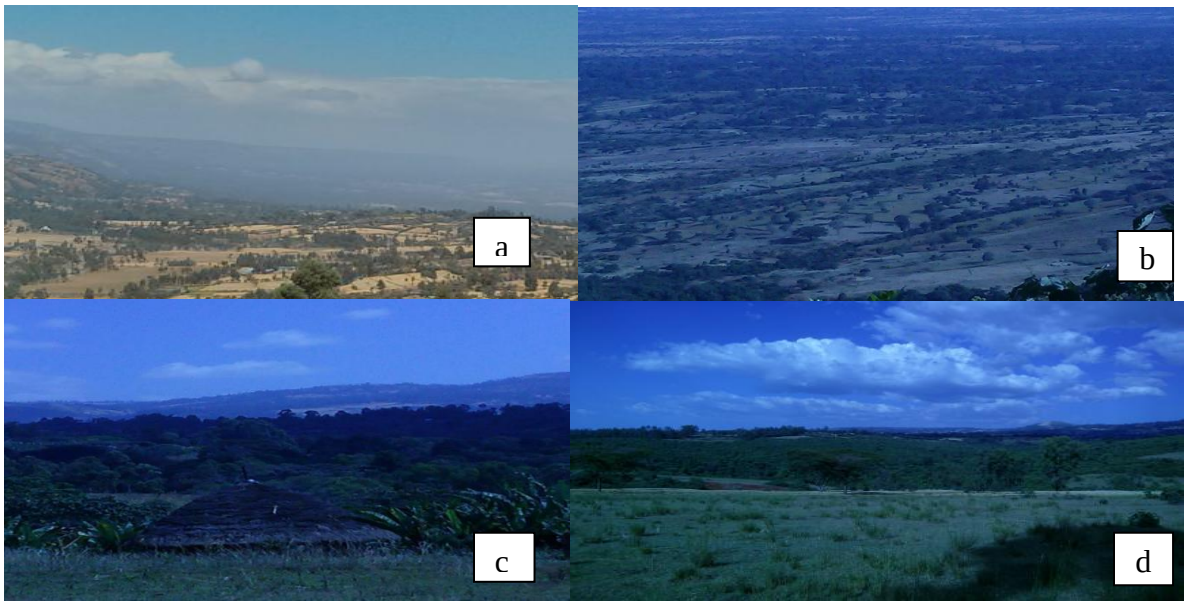


Fig. 27. Some landscape features of districts of Hadiya: a) emergent *Eucalyptus* stand dominated village Debub Fonko-Anlemo; b) woodland with cultivation& grazing fields near Gibe valley & c) forested yard near villages in Gibe. d) Communal forest of Barewa near Habicho - Gombora (Photo Gideon WM, October, 2016)

4.2.3.33.3 Emic Categorisation of the natural environment in Yem

The Yem also have tradition of classifying the natural environment and its resources in their vicinity. They classify different landscapes of the earth as 'kuma' = mountain, 'golo' = plateau, 'gowu' = valley, 'she?ka' = gully. The soil = 'U?a' is classified into different types: 'shu?a-shu?a' = rocky soil, 'futu' = sandy soil, 'she?a u?a = ferric soil, 'kera u?a' = black clay soil. Seasons are classified as 'yeshu' = summer, 'bega' = autumn, 'mera' = spring and winter. Based agroecological categorisation that is based on altitude and climate follows 'kuma' = highland, 'kochoda' = middle land and 'zebo' = lowland /or desert. Different types of vegetation distributed along landscape can be classified as 'bu?ru' = forest, 'bochu' = bush, 'kuwa' = grass land, 'gorgu' = homegarden and 'oja' = fence and 'buloni' farm. Based on growth forms plants are classified as 'akma i?o' = big tree, 'gero i?o' = small tree, 'so?ra' = herb/weed and 'kuwa' = grass.

The Yem call ailments/diseases as 'mero'. They broadly classify diseases as human 'asuni mero' and livestock ailments 'miyani mero'. In Yem, the ailments are classified similar to the case of Hadiya based on either anatomical parts ailed and spiritual types such as evil spirit/'manguza', evil eye /'manguza'/'gognon', sterility /'konun tishu', 'risbala'; or miscellaneous types that are difficult to categorise such as sudden febrile

ailment/‘mich’, ‘be?u’ and seasonal feet swelling ailment ‘awachifebe?u’. This is also true for the case of livestock ailments. In Yem, illnesses are named as in the case of Hadiya with a single word or with a folkbinomial connecting ailing body part and/or type of disease treated. For instance, ‘zewun-mero’ - ‘zewu’ = snake and ‘mero’ = ailment, together mean ailment of snake bite; ‘tetni mero’ = ‘tet’ = head and ‘mero’ = medicine, together means headache; ‘kan mero’= ‘kan’ = dog, ‘mero’ = disease - together (disease of mad dog/rabies). The medicine = ‘mero’ which is added after the ailment name such as ‘kanmero-eta/ = medicine of rabies, ‘ketini-eta mero = medicine of abdominal pain; ‘tetini mero eta’ = medicine of headache, …, so on. As in the case of Hadiya, the MPs that are recorded in this study had one to one Yem names equivalent to scientificspecies while a few of them were overdifferentiated at variety level and still a few underdifferentiated at genus level. Examples of overdifferentaited taxa include five landraces of enset (*Ensete ventricosum*) such as ‘Anchiro’, ‘Asu’, ‘Gomoruwa’, ‘Kerona’ and ‘Kinkiso’ (Appendix 6) that are considered as independent species. There was also a case one epiphytic species, *Englerina woodfordioides* that grows on different woody species which is locally considered as distinct species such as ‘tigna buzo’ = one grows on *Vernonia myriantha*, ‘tigna atebiyo’= one grows on *Justicia schiperiana*, ‘ertu hegemsa’ = one grows on *Calpurnia aurea*, ‘ertu etecha’ = one grows on *Dodonaea angustifolia*. The medicinal quality and preference of this species determined based on the host species. Example underdifferentiated taxa is two species of the same genus: *Triumfetta rhomboidea* /’meshikekesa’ and *T. tomentosa* ‘herkekesa’ that are considered distinct species but designated as male and female gender. Some photos of landscape features of Yem are given in Fig. 28

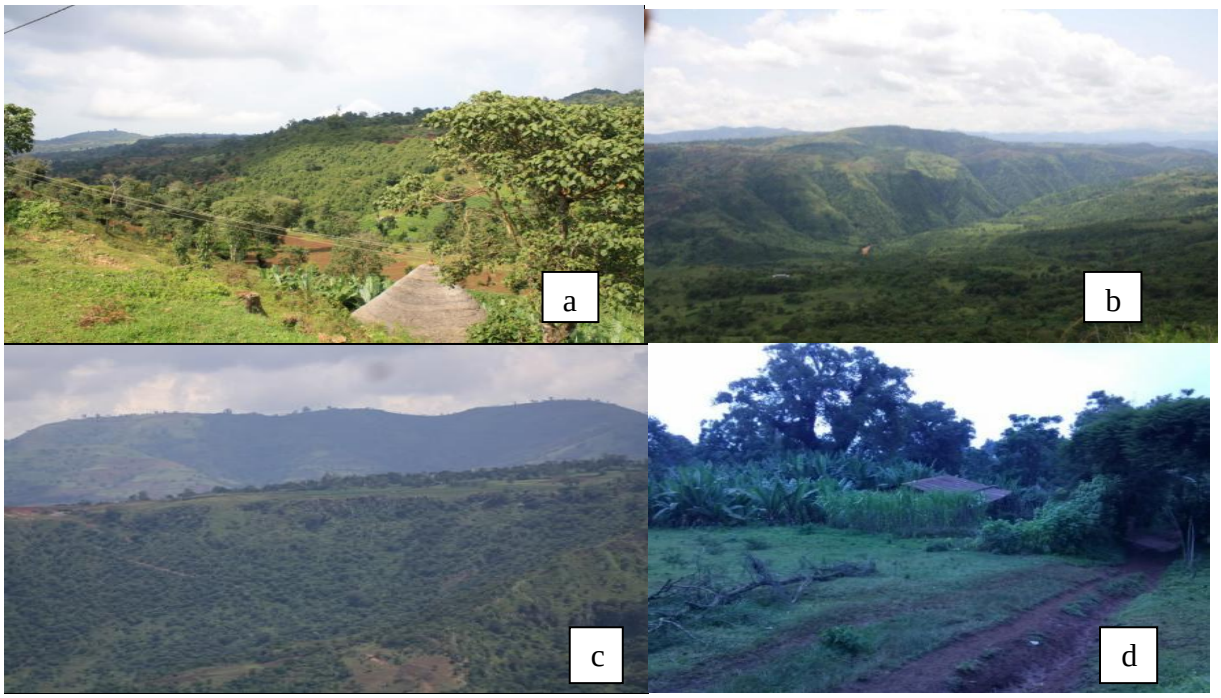


Fig. 29. Some landscape features of Yem District; a) a village at GoruminaHengeri subdistrict, b) woodland vegetation at valley of Gibe River Saja subdistrict, c) Bori Mt. & its vicinity, d) a village at Fofzuriya sbdistrict – all in Yem (Photo by Gideon WM, August 2016)

4.2.3.34 Similarity of human ailments reported in among the study area

Sorenson's Coefficient of Similarity calculated (Table 44) showed that highest similarity of 49% human ailments was found between Hadiya and Yem. On district basis, the highest similarity of 72% human ailments between Anlemo and Duna followed by 45% between Anlemo and Gombora, 41% between Anlemo and Gibe, and Anlemo and Gombora each, 37% between Gibe and Duna, 36% between Duna and Gombora , 32% between Gombora and Yem, 31% between Gibe and Yem and the least similarity of 25% between Duna and Yem.

Table 44. Sorenson's Coefficient of Similarity of human ailments in the study area

	Hadiya	Yem	Anlemo	Duna	Gibe	Gombora
Hadiya	1					
Yem	0.49	1				
Anlemo	-	0.37	1			
Duna	-	0.25	0.72	1		
Gibe	-	0.31	0.41	0.37	1	
Gombora	-	0.32	0.45	0.36	0.41	1

4.2.3.35 Similarity of MP used for human ailments in the study area

Sorenson Coefficient (Ss) calculated showed about 56% of similarity of MPs used for human health between Hadiya and Yem. On district basis, the highest similarity of 64% was observed between Gibe and Gombora followed by 60% between Gibe and Yem, 56% between Gibe and Anlemo, 52% between Anlemo and Gombora, 51% between Anlemo and Duna, 49% between Duna and Yem, 46% between Duna and Gibe, 44% between Duna and Gombora, 43% between Anlemo and Yem and the least similarity was 25% between Gombora and Yem (Table 45).

Table 45. Sorenson's Similarity(Ss) of MPs used for human ailments in the study area

	Hadiya	Anlemo	Duna	Gibe	Gombora	Yem
Hadiya	1					
Anlemo	-	1				
Duna	-	0.51	1			
Gibe	-	0.56	0.46	1		
Gombora	-	0.52	0.44	0.64	1	
Yem	0.56	0.43	0.49	0.60	0.25	1

4.2.3.36 Comparison of number of human ailments reported and MPs used

Based on output of paired *t*-test, there was a significant difference (at œ = 0.01) between the mean number of MPs. and the number of ailments treated in each of the five districts. The highest mean number of 4.74 taxa treated a mean number of 2.59 human ailments (each MPs treating 1.83 ailments) in Yem while the least mean number of 2.87 taxa treated a mean number of 1.87 ailments (each MP treated 1.53 ailments) in Gombora (Table 46). In another expression, the mean number of MPs that treated a single ailment in a rank order of the district was 1.97 in Anlemo followed by 1.83 in Yem, 1.77 in Duna, 1.76 in Gibe and 1.53 in Gombora. The respective mean number of taxa and corresponding mean number of ailments treated in a rank order of the districts was 4.74 ±6.90 and 2.59±3.77, $t(79) = 5.56$, $p < 0.001$ in Yem followed by 4.29±5.24 and 2.17±2.32, $t(44) = 4.22$, $p < 0.001$ in Anlemo, 4.00±4.60 and 2.27±1.99, $t(47) = 3.77$, $p < 0.001$ in Gibe, 3.49±3.78 and 1.97±1.99 , $t(34) = 3.74$, $p < 0.001$ in Duna, 2.87±3.04 and 1.87±1.76, $t(45) = 3.82$, $p < 0.001$ in Gombora. Pearson's correlation showed there were strong correlations between the number of ailments reported and the

number of taxa used to treat them in each district with respective with r values of $r = 0.89$, 0.83, 0.82, 0.86 and 0.89 in Anlemo, Duna, Gibe, Gombora and Yem, respectively, each with a significance of $p < 0.001$.

Table 46. Summary of mean number of MP and corresponding mean # of ailment treated by the taxa & correlation of them in the five district

District	#of families	Mean # of MPs	Corresponding Mean # of ailment treated	*t*	DF	*P* value	Pearson's *r*	*P* value
Anlemo	45	4.29±5.24	2.17±2.31	-4.22	44	0.00	0.89	0.00
Duna	35	3.49±3.78	1.97±1.99	-3.74	34	0.00	0.83	0.00
Gibe	48	4.00±4.60	2.27±1.99	3.77	47	0.00	0.82	0.00
Gombora	46	2.87±3.04	1.87±1.76	-3.82	45	0.00	0.86	0.00
Yem	80	4.74±6.91	2.59±3.77	-5.56	79	0.00	0.89	0.00

4.2.3.37 Statistical tests on MPK of human health and socioeconomic and site variables

The results of statistical tests between MPK and different variables considered showed both significant and nonsignificant results that are highlighed in Table 47. The detail results of each variable against MPK are provided in next sections.

Table 47. Summary statistical significance of MPK of human ailments and socioecononic and site variables

Variable	a/b	Hadiya	Yem	Anlemo	Duna	Gibe	Gombora
Gender	-	a	a	ns	a	a	ns
Marriage	-	a	ns	a	b	a	a
Religion	-	a	ns	ns	b	b	ns
Education	-	ns	ns	ns	ns	ns	ns
Agroecology	-	-	b	ns	ns	ns	ns
Informant category	-	a	a	a	a	a	a
Age	-	a	ns	a	ns	a	b
Ethnicity	a	-	-	-	-	-	-
Five Districts	a	-	-	-	-	-	-
20 subdistricts	a	-	-	-	-	-	-

a = significant at 0.01, b = significant at 0.05, ns = not significant

4.2.3.37.1 MPK of human ailments between informants of Hadiya and Yem ethnic groups

There was a significant difference in the mean number of MPs cited for human ailments between Hadiya (with respect to the four districts) and Yem ethnic groups, $t(499) = 4.42$, $p < 0.001$. The *mean*(±*SD*) of MPs known by the Yem was 13.40±10.41Yem while that of Hadiya was 10.35±4.57.

4.2.3.37.2 MPK of human ailments among the informants of the five districts

There was a significant difference in mean number of MPs cited by informants in the five districts, $F(4, 496) = 6.98$, $p < 0.001$. The highest mean number of MPs were known by the informants of Yem while the least number of MPs were mentioned by informants of Anlemo. The respective mean(±SD) of MPs known in rank a order of the districts was 14.51±1.90 in Yem followed by 10.97±4.74 in Gibe, 10.39±4.43 in Duna, 10.33±4.90 in Gombora and 9.79±4.73 in Anlemo, (Table 48). Post hoc multiple comparison using Games-Howell method for unequal samples indicated that the significance was between Anlemo–Yem $MD = -4.71$, $SE = 1.51$, $p = 0.021$.

Table 48. One-way ANOVA of MPK of human medicine among informants of the study area

ANOVA					
MPK					
	SS	*df*	MS	*F*	Sig.
Between Groups	1071.33	4	267.83	6.98	.000
Within Groups	19034.38	496	38.38		
Total	20105.71	500			

4.2.3.37.3 Principal component analysis of human MPK among the five districts

Principal components analysis conducted to assess the similarity of informants of the study area based on MPK showed that the first component (PCA1) accounted for 37.32% of the variance and the second component for 23.34% of the variance explained and both components explained 61% of the total variance explained (Table 49). The PCA grouped the informants of the five districts in PCA1 (Anlemo, Gombora and Yem) and PCA2 (Duna and Gibe). On rotated component loadings, Anlemo, Gombora and Yem informants have high positive loadings in PCA1 (Anlemo = 0.824, Gombora = 0.762 and Yem = 0.628) while Gibe has positive loading (0.70) on PC2 and Duna has a high negative loading of -0.85 on this axis as displayed on the PCA biplot (Table 50 & Fig. 29). Observation of the correlation matrix showed a fairly high positive correlation of 0.48 between Anlemo and Gombora followed by 0.34 between Anlemo and Yem, 0.28 between Gombora and Yem and 0.27 between Gibe and Gombora. On the other hand, a weak negative correlation of -0.24 was observed between Duna and Gibe and -0.10 between Duna and Gombora (Table not given).

Table 49. Importance components of PCA in human MPK between informants of the study area

Component	Eigenvalues		
	Total	% of Variance	Cum %
PCA1	1.87	37.33	37.33
PCA2	1.17	23.34	60.66

Table 50. Loadings of component matrix of PCA of MPK of informants of the study area

Rotated Component Matrix

	Component	
	1	2
Anlemo	.824	
Duna	.123	-.845
Gibe	.289	.700
Gombora	.762	.234
Yem	.638	

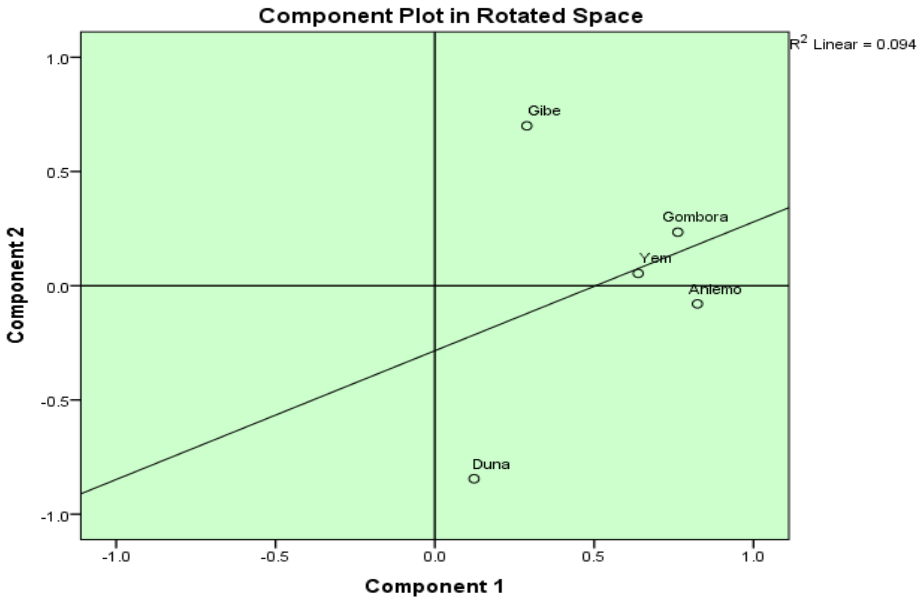


Fig. 29. Biplot of PCA showing correlation of human MPK of informants

4.2.3.37.4 MPK of human aliments among the informants of 20 subdistricts

There was a significant difference in mean number of MPK of human ailments between informants of the 20 study subdistricts, $F(19, 481) = 3.99$, $p < 0.001$ (Table 51). The highest mean±SD of 21.78±16.78 MPk was recorded in Gorumina-Hengeri subdistrict of Yem while the least mean MPK of 8.82±2.34 was recorded in Arara (Hadiya). The next larger mean MPK 12.82±5.59 was recorded in FofaZuriya (Yem), 12.61±12.57 in Saja-Laften (Yem), 12.12±6.24 Adeana (Hadiya).

Table 51. ANOVA of MPK of human health between 20 study subdistricts
(MS = mean square, SS = sum of squares)

ANOVA					
MPK	SS	*df*	MS	*F*	Sig.
Between Groups	2738.542	19	144.134	3.99	.000
Within Groups	17367.171	481	36.106		
Total	20105.713	500			

4.2.3.37.5 Gender and MPK of human ailments in the five districts

There was a significant difference in mean number of MPK between male and female in Hadiya (the four districts combined) $t(430) = 3.07$, $p = 0.008$; in Duna $t(120.5) = 1.98$, $p = 0.048$, Gibe $t(117) = 2.78$, $p = 0.01$; and in Yem $t(67) = 3.15$, $p = 0.002$. The highest MPK *mean±SD* 18.34±14.15 for male and 9.81±5.68 for female were recorded in Yem followed by male 12.05±5.13 and female 9.69±3.92 in Gibe, male 11.10±5.01 and female 9.58±3.54 in Duna and male 10.70±4.96 and female 9.39±3.90. On the other hand, there was no a significant difference in gender and MPK, $t(90) = 0.27$, $p = 0.78$) in Anlemo and $t(91) = 1.62$, $p = 0.11$ in Gombora. The mean (±SD) of MPs known by male gender was 11.06±5.34 while that of female was 9.41±4.17 in Gombora. In Anlemo, the same value of statistic for male was 9.91±4.99 and that of female was 9.63±4.41.

4.2.3.37.6 Marriage and MPK of human ailments in the five districts

There was a significant difference MPK between married and single informants in Hadiya (four districts combined) $t(430) = 4.66$, $p = 0.001$; in Anlemo $t(90)= 2.78$, $p = 0.01$; in Duna $t(126) = 2.42$, $p = 0.02$; in Gibe $t(117) = 2.89$, $p < 0.001$; and in Gombora $t(20.33) = 3.04$, $p = 0.006$. The mean (±*SD*) MPK of married

and single informants in descending order were 11.46±4.82 and 7.88±2.78 in Gibe; 10.73±4.47 and 8.42±3.72 in Duna; 10.73±5.03 and 7.67±2.90 in Gombora; 10.49±4.62 and 7.52±2.99 in Hadiya; and 10.23±4.75 and 5.78±4.75 in Anlemo. On the other hand, there was no a significant difference in MPK between married and single informants in Yem, $t(67) = 0.14$, $p = 0.89$; married scored a little higher *mean±SD* of 14.59±11.95 and single 14.00±12.21.

4.2.3.37.7 Religion and human MPK in the five districts

There was a significant difference in MPK between religious groups of Hadiya (four districts combined) $F(2,429) = 5.82$, $p = 0.003$ (Table 52). Post hoc analysis showed that the significant difference was between Evangelical vs Muslim ($p = 0.046$), and Orthodox and muslim pairs ($p = 0.046$). The Orthodox knew the highest mean (±SD) MPK 13.75±4.43, Evangelicals 10.07±4.34, and Muslim 9.56±4.45. On separate district basis, there was also significant difference between groups in Duna, $t(126) = 2.41$, $p = 0.016$ and Gibe, $t(117) = 2.3.0$, $p = 0.02$ and Orthodox believers knew more MPs *mean±SD* of 16.25±7.18 than Evangelicals who knew 10.79±4.58 in Gibe; and Orthodox believers knew more mean of 13.45±5.71 than Evangelicals 10.10±4.21 in Duna. However, there was no a significant difference in religion and MPK in Anlemo, $t(91) = 0.06$, $p = 0.25$ and in Yem, $t(66) = 1.63$, $p = 0.66$; Muslims knew 11.51±0.71 and Evangelicals knew 11.23±6.09 in Anlemo; and Orthodox knew 8.35±3.14 and Muslims 6.88±3.60 in Yem. Religion was not important in Gombora because the informants were all followers of a single religion i.e Evangelicals.

Table 52. Oneway ANOVA of religion vs MPK in Hadiya

	Sum of Squares	*df*	Mean Square	*F*	*Sig.*
Between Groups	236.640	2	118.320	5.824	.003
Within Groups	8715.247	429	20.315		
Total	8951.887	431			

4.2.3.37.8 Informant category and MPK of human ailments

There was a significant difference in MPK between key and general informants of the study area; $t(430)=21.19$, $p = 0.002$ in Hadiya (four districts combined); $t(27.77) = 12.06$, $p < 0.001$ in Anlemo; $t(28.89)$

=11.28, $p < 0.001$ in Duna; $t(117)$ =12.95, $p < 0.001$ in Gibe; $t(117) = 10.41$, $p < 0.001$ in Gombora; and $t(67) = 4.28$, $p < 0.001$ in Yem. The key informants of Yem knew the highest mean of 22.50±15.16 MPs while a least mean number of 16.99±4.02 were known by Hadiya. Similarly, the general informants of Yem knew the highest of 10.77±7.73 MPs while those of Anlemo knew a least mean of 7.79±2.73 MPs. The respective *mean±SD* of MPK known by key and general informants in the rest of districts in a rank order were 19.05±3.69 and 9.34±2.92 in Gibe; 17.95±3.31 and 8.89±2.95 in Duna; 17.20±4.42 and 8.45±2.98 in Gombora, and general informants of 8.57±2.97.

4.2.3.37.9 Agroecology and human MPK in the five districts

There was a significant difference in MPK between informants of the three agroecologies in Yem, $F(2,66) = 4.08$, $p = 0.021$. The midlanders knew the highest *mean±SD* of 20.84±16.81 followed by lowlanders 12.60±12.57 and highlanders 11.80±5.07 in Yem (Table 53); A post-hoc test using Hochberg method for unequal samples showed that the significant difference was between midlanders and highlanders pairs $MD = 8.23$, $p = 0.02$ in the Yem. However, there was no a significant difference in mean between informants of the rest of four districts; $F(3,89) = 1.46$, $p = 0.23$ in Anlemo; $t(126) = 1.71$, $p = 0.92$ in Duna; $t(117) = 0.44$, $p = 0.082$ in Gibe; and $t(91)$ =1.82, p = 0.071 in Gombora.

Table 53. One-way ANOVA of MPK of human health between informants of different agroecologies

(BG = between groups, WG = within groups, MS= measqure, SS= sum of squares)

District	Group statistics				ANOVA					
	category	N	Mean	SD		SS	*df*	MS	*F*	*Sig.*
Anlemo	Lowland	21	9.67	4.49	B G	99.94	3	33.31	1.46	.23
	Midland	29	10.14	5.58	WG	2034.02	89	22.85		
	Highland	42	9.62	4.31	Total	2133.96	92			
Yem	Lowland	18	12.61	12.57						
	Midland	19	20.84	16.81	BG	1059.57	2	529.78	4.08	0.021
	Highland	32	11.81	5.07	WG	8567.68	66	129.81		
	Total	69	14.51	11.90	Total	9627.25	68			

4.2.3.37.10 Age and human MPK in the five districts

The results showed both significant and nonsignificant results between age and human MPK in the study sites

(Table 54). A significant difference in MPK was observed Hadiya (four districts combined) $F(2,429) = 19.42$, $p < 0.001$; older aged had highest MPK the mean (±SD) being 11.57±5.04 followed by middle age 9.91±4.05 and young 8.39±3.07. Significant difference in MPK was also observed among the age groups in Anlemo $F(3,89) = 7.14$, $p < 0.001$; in Gibe $F(2,116) = 6.18$, $p < 0.003$ and in Gombora $F(2,90) = 3.65$, $p < 0.03$. The respective mean (±SD) MPK among the old, middle age and young informants were 12.27±5.38, 10.97±3.79 and 8.68±3.56 in Gibe; 11.81±4.95, 10.35±5.27 and 8.33±3.53 in Gombora; and 11.74±5.26, 9.54±4.06 and 7.38±3.20 in Anlemo (a post hoc comparison showed that the significance was between the young and old agers, $MD = 4.05$, $p = 0.01$) (Table not given). On the other hand, the nonsignificant results of age and MPK were observed in Duna, $F(2,125) = 2.29$, $p = 0.11$ and Yem $F(2,66) = 1.18$, $p = 0.32$

Table 54. One -way ANOVA of MPK among different age groups in the study area
(N = no. of informants, B = between groups, W = within groups, MS meansquare, SS = sum of squares)

Site	Group statistics				ANOVA				
	Category	N	Mean	SD		SS	*df*	*MS*	*F*	*Sig.*
Hadiya	Young	128	8.39	3.07	B G	743.017	2	371.5	19.42	0.000
	Middle age	135	9.91	4.05	W G	8208.87	429	19.135		
	Old	169	11.57	5.04	Total	8951.88	431			
Yem	Young	12	12.25	11.31	B G	331.53	2	165.76	1.18	0.32
	Middleage	18	18.11	17.01	W G	9295.72	66	140.84		
	Old	39	13.54	8.84	Total	9627.26				
Anlemo	Young	29	7.38	3.2	BG	413.74	3	137.91	7.14	0.000
	Middleage	24	9.54	4.06	WG	1720.22	89	19.33		
	Old	39	11.74	5.27	Total	2133.96	92			
Duna	Young	44	9.43	4.4	BG	88.48	2	44.24	2.29	0.105
	Middleage	40	10.3	4.06	WG	2407.99	125	19.26		
	Old	44	11.43	4.66	Total	2496.47	127			
Gibe	Young	31	8.68	3.56	BG	256.27	2	128.14	6.18	0.003
	Middleage	33	11	3.79	WG	2404.65	116	20.73		
	Old	55	12.3	5.38	Total	2660.92	118			
Gombora	Young	24	8.33	3.53	BG	166.03	2	83.01	3.65	0.03
	Middleage	37	10.35	5.27	WG	2044.64	90	22.72		
	Old	32	11.81	4.95	Total	2210.67	92			

4.2.3.37.11 Education of informants and human MPK in the study area

The results showed that there was no a significant difference in MPK and level of education in the study area;

$F(2, 429) = 1.40$, $p = 0.25$ in Hadiya, $F(2, 66) = 0.23$, $p = 0.80$ in Yem; $F(2, 89) = 1.62$, $p = 0.19$ in Anlemo; $F(2, 125) = 1.87$, $p = 0.16$ in Duna; $F(2, 116) = 2.42$, $p = 0.09$ in Gibe; and $F(2, 90) = 0.41$, $p = 0.67$ in Gombora (Table 55).

Table 55. One-way ANOVA of MPK among informants of different level of education in the area
(BG = between group; N = number of informants, WG = within group, MS = mean square)

Site		Group	statistics			ANOVA				
	Category	N	*M*	*SD*		*SS*	*df*	*MS*	*F*	*Sig.*
Hadiya	nonducated	152	10.59	4.91	B G	58.228	2	29.11	1.404	0.247
	Elementary	257	9.81	4.27	WG	8893.659	429	20.73		
	Highschool & above	23	10.22	4.55	Total	8951.887	431			
Yem	nonducated	34	13.91	12.80	B G	65.98	2	32.99	0.23	0.797
	Elementary	29	14.59	11.30	WG	9561.27	66	144.9		
	Highschool & above	6	17.5	11.10	Total	9627.25	69			
Anlemo	nonducated	26	10.42	4.45	B G	110.18	3	36.73	1.62	0.191
	Elementary	63	9.57	4.94	WG	2023.77	89	22.74		
	Highschool & Above	3	9.00	2.65	Total	2133.96	92			
Duna	nonducated	46	10.54	4.78	BG	72.58	2	36.29	1.87	0.158
	Elementary	72	9.96	3.80	WG	2423.89	125	19.39		
	Highschool & above	10	12.80	6.43	Total	2496.47	127			
Gibe	nonducated	50	11.80	5.59	B G	106.49	2	53.24	2.42	0.09
	Elementary	64	10.61	3.93	WG	2554.43	116	22.02		
	Highschool & above	5	7.40	3.65	Total	2660.92	118			
Gombora	nonducated	30	10.40	4.52	B G	19.93	2	9.97	0.41	0.70
	Elementary	57	10.10	5.12	WG	2190.74	90	24.34		
	Highschool & above	6	12.00	5.18	Total	2210.67	92			

4.2.3.37.12 Gender and Conservation of MPs for human ailments

Chi square test of association showed both significant and nonsignificant outcomes in the five study districts with regard to gender and tendency of conservation of MPs. Accordingly, there was a significant association in gender and conservation of MP in Hadiya, $\chi^2(1) = 5.10$, $p < 0.024$; Yem, $\chi^2(1) = 9.06$, $p = 0.003$; and Anlemo, $\chi^2(1) = 47.67$, $p < 0.001$. However, the test of association was not significantly different between male and female in Duna, Gibe and Gombora Districts with the values $\chi^2(1) = 0.50$, $p = 0.58$, $\chi^2(1) = 9.06$, $p = 0.30$ and $\chi^2(1) = 1.30$, $p = 0.25$, respectively.

4.2.3.37.13 Age and conservation of MP for human ailments

The association of age and MP conservation was also showed variable statististical significances among the five districts. A statistically significant association was observed in Hadiya (four districts combined) $\chi^2(2) = 6.33$, $p < 0.031$ and Yem $\chi^2(2) = 17.48$, $p < 0.001$. Separate analysis in the four districts showed that age and MP conservation had significant association in Anlemo $\chi^2(2) = 33.409$, $p < 0.001$ and Gibe $\chi^2(2) = 8.94$, $p = 0.01$. On the other hand, the association of age and MP conservation was not significant in Duna and Gombora with the values $\chi^2(2) = 0.25$, $p = 0.88$ and $\chi^2(2) = 0.25$, $p = 0.88$, respectively.

4.2.4 Results of of MPs used for livestock ailments in the study area

4.2.4.1 Use and diversity of EVMPs

The results showed a total of 156 species that are used to treat a total number of 74 livestock ailments and health conditions in the study area (Appendix 5 & 6). The species are classified in 136 genera and 73 families. There were 3 landraces/clones of enset ‘elewa’ (Yem), ‘gishir’ (Had) and ‘meqe?l wesa (Had)/’asu’/ (Yem) that are used to treat livestock health conditions. Out of the total, 103 species that are classified in 99 genera and 59 families were used to treat 61 livestock ailments and conditions in Hadiya while 89 species that are classified in 81 genera 49 families were used to treat 45 livestock ailments in Yem. The respective number of EVMPs and ailments reported in the four districts of Hadiya by rank were 49 and 36 in Gombora followed by 46 and 37 in Duna, 42 and 32 in Anlemo, and 40 and 33 in Gibe (Fig. 30).

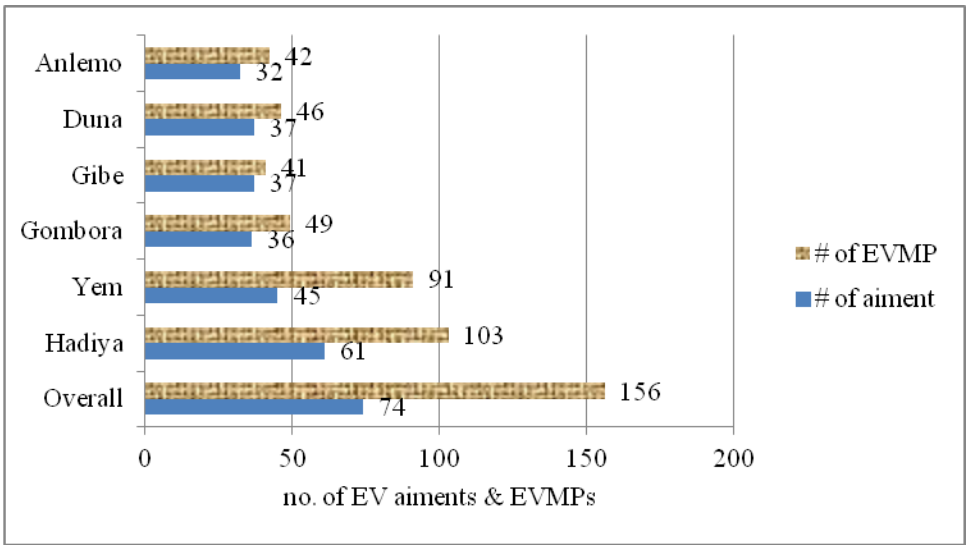


Fig. 30. The number of livestock ailments and EVMPs used
(percentages in the text are based on individual district)

Further taxonomic analysis on the abundance of EVMPs in medicinal families showed that Fabaceae was the most cited with 11 (10%) in Hadiya while this family was 6 (7%) in Yem. The number of EVMPs contained in this family in the four districts of Hadiya by rank were 7 (17%) in Anlemo followed by 5 (11%) in Duna, 3 (8%) in Gibe and 3 (6%) in Gombora. The next family rich in EVMPs was Solanaceae 7 (7%) in Hadiya and 6 (7%) in Yem. Asteraceae had 7 (7%) in Hadiya and 7 (8%) EVMPs in Yem. Lamiaceae had 6 (7%) species in Yem while Poaceae had 6 (13%) species in Duna. Similarly, Solanaceae was another family which contributed for 3 or more EVMPs commonly in four of districts in a rank order of followed by 5 (14%) Anlemo, 4 (10%) in Gibe and Solanceae each 3 (7%) in Gibe. Other families with more than a single EVMPs by rank were; Euphorbiaceae and Lamiaceae each 3 (7%) species again in Duna; Euphorbiaceae and Musaceae each 3 (8%) species in Anlemo and Gibe; Lamiaceae, Euphorbiaceae and Boraginaceae each 3 (6%) species in Gombora (Fig. 31).

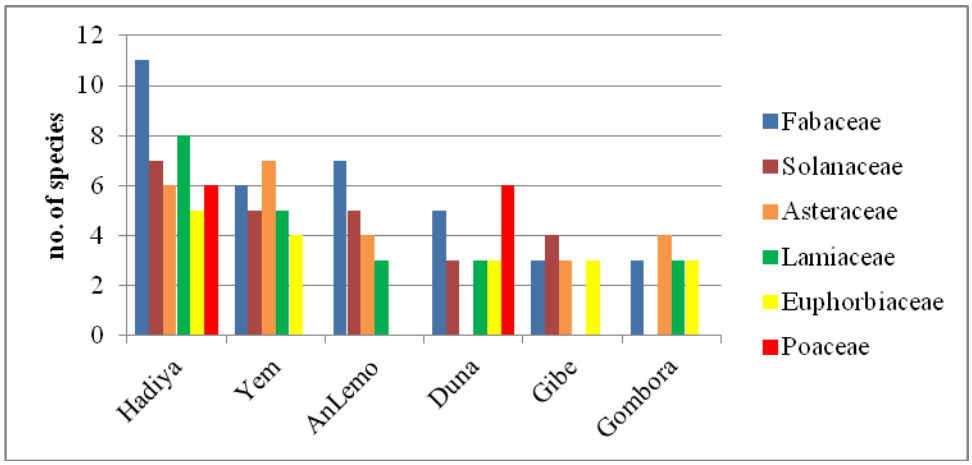


Fig. 31. EVMPs families with more than a single species

4.2.4.2 Habit of EVMPs used in the study area

Based on results the highest cited habit of EVMPs was shrub in both Hadiya and Yem with 53 (30%) and 31 (35%), respectively (Table 56). The next highest cited habit was herb with 51 (29%) in Hadiya and 25 (28%) in Yem. With the same trend, shrubs were the dominant habit of EVMPs in three of the four districts of Hadiya with the highest report of 15 (37%) in Anlemo and 15 (30%) in Gombora, and 12 (30%) in Gibe while herbs were the most used lifeform in Duna with 18 (39%) taxa. Herbs were the second highest used habit in Anlemo with 13 (32%) and 10 (25%) in Gibe while tree was the second most used habit in Gombora with 14 (29%) and shrubs 11 (24%) taxa in Duna.

Table 56. Habit of EVMPs used in the study area

(C = Climber (woody), CH = Climber(herbaceous), H = Herb, T/S = Tree/Shrub, T = Tree)

Habit	Hadiya		Yem		Anlemo		Duna		Gibe		Gombora	
	freq.		freq.	%	freq.	%	freq.	%	freq.	%	freq.	%
C	12	7	4	4	2	5	2	4	3	8	5	10
CH	7	4	6	7	1	2	3	7	2	5	1	2
H	51	29	25	28	13	32	18	39	10	25	10	20
S	53	30	31	35	15	37	11	24	12	30	15	31
T/S	12	7	7	8	3	7	2	4	3	8	4	8
T	41	23	16	18	7	17	10	22	10	25	14	29
Total	176	100	89	100	41	100	46	100	40	100	49	100

4.2.4.3 Number and type of livestock ailments recorded in the study area

Livestock ailments mostly mentioned during freelisting were of cattle, equines, goats and sheep while only a single case of poultry i.e Newcastle sickness (Appendix 5). The three top cited livestock ailments in each district were; anthrax 73 (15%) followed by blackleg 48 (10%) and abdominal worms 28 (6%) in Yem; abdominal pain 23 (8%) followed by sudden ailment 22 (8%) and evil eye 19 (7%) in Anlemo; sudden ailment 41 (9%) followed by diarrhoea 36 (8%) and choking 34 (7%) in Duna; sudden disease 53 (13%) followed by pasture bloat 42 (11%) and choking 41 (10%) in Gibe; sudden ailment 42 (11%) followed by choking 36 (10%) and blackleg 21 (6%) in Gombora.

4.2.4.4 Sign and symptoms of livestock ailments in the study area

About of 26 sign and symptoms of livestock ailments were listed during interviews (Table 57). On overall the highest cited sign and symptoms were failure to eat 159 (7%) followed by sleeping longer 145 (7%), parasite egg on faeces/dung and tear flow each 132 (6%). Three highest cited sign and symptom in each district were long sleeping 50 (7%) followed by cough 40 (8%) and erection of hair 35 (7%) in Anlemo; isolate & standalone 35 (8%) followed by failure of feeding 34 (8%) and abrupt breathing 32 (7%) in Duna; failure to eat and fail to regurgitate cud each 40 (9%) followed by abrupt breathing 35 (8%) and erection of hair 34 (8%) in Gibe; isolate & stand alone 45 (11%) followed by abdominal bloat 42 (10%) and failure of feeding 40 (10%) in Gombora; and flow of tear 29 (9%) followed by erection of hair and limping each 23 (7%) in Yem.

Table 57. Signs and symptoms of livestock ailments in the study area
(cit. = no. of citations, TL = overall total)

Symptoms	Anlemo		Duna		Gibe		Gombora		Yem		TL	%
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%		
Abrupt breathing	12	3	32	7	35	8	11	3	21	6	111	5
Abdominal bloat	9	2	20	5	14	3	42	10	8	2	93	4
Bleeding nose & mouth	10	2	14	3	17	4	15	4	9	3	65	3
Blood on excreta	25	5	10	2	15	3	20	5	8	2	78	4
Blood in milk	-	-	-	-	-	-	-	-	16	5	16	1
Cough	40	8	14	3	18	4	10	2	20	6	102	5
Erection of hair	35	7	17	4	34	8	19	5	23	7	128	6

Symptoms	Anlemo		Duna		Gibe		Gombora		Yem		TL	%
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%		
Fail to eat	27	6	34	8	40	9	40	10	18	5	159	7
Long sleeping	50	11	31	7	29	7	20	5	15	4	145	7
Fail to regurgitate cud	22	5	17	4	40	9	22	5	5	1	106	5
Fever	8	2	7	2	11	3	5	1	-	-	31	1
Flow of tear	7	1	27	6	32	7	37	9	29	9	132	6
Isolate & stand alone	18	4	35	8	10	2	45	11	8	2	106	5
Limping	8	2	-	-	12	3	15	4	23	7	58	3
Poor appetite	19	4	12	3	12	3	19	5	15	4	77	4
Salivate, runny nose	21	4	15	3	6	1	8	2	3	1	53	2
Shivering	11	2	11	3	9	2	5	1	5	1	41	2
Skinniness	25	5	6	1	21	5	12	3	20	6	100	5
Sneezing	9	2	9	2	10	2	6	1	5	1	39	2
Sore feet	8	2	10	2	10	2	7	2	6	2	41	2
Sore mouth	10	2	14	3	20	5	9	2	11	3	64	3
Stomach growl	14	3	24	6	30	7	17	4	-	-	85	4
Swellings	30	6	22	5	15	3	9	2	10	3	86	4
Unable to move	22	5	13	3	10	2	10	2	6	2	61	3
Worm eggs on faeces	24	5	21	5	31	7	35	9	21	6	132	6
Total	481	100	434	100	500	100	460	100	305	91	2135	100

4.2.4.5 The number of livestock ailments treated by EVMPs

Based on results, more than 50% of the livestock ailments were reportedly managed by a single medicinal taxon while the rest of them were known to be treated by concoction of medicinal taxa. Accordingly, the proportions of ailments treated by a single EVMP by rank were 26 (89%) in Anlemo followed by 24 (67%) in Gombora, 23 (51%) in Yem, 22 (59%) in Duna and 21 (64%) in Gibe. On the other hand, the number of ailments treated by concoction of EVMPs in each district by rank were 22 (49%) in Yem followed by 15 (41%) in Duna, 12 (36%) in Gibe and 12 (33%) in Gombora and 6 (19%) in Anlemo. Among ailments treated by combination of taxa were abdominal pain treated by the highest number of 16 (11%) species and black leg 11 (8%) in Yem followed by evil eye treated by 6 (11%) and constipation by 4 (8%) in Anlemo, sudden ailment and pasture bloat each by 6 (8%) in Gibe, choking and African horse disease each treated by 5 (8%) in Duna, and sudden ailment and choking each by 5 (8%) in Gombora.

4.2.4.6 Number of EVMPs used to treat livestock ailments

The findings showed that most of the EVMPs were reportedly used to treat a single ailment while smaller proportions of them were known to treat more than a single ailment in the five districts. The proportion of EVMPs used to treat single ailment in rank order of the districts were 70 (79%) in Yem followed by 41 (86%) in Gombora, 36 (88%) in Anlemo, 35 (77%) in Duna and 33 (77%) in Gibe while those taxa treated multiple of livestock ailments in order of rank were again 19 (21%) in Yem followed by 11 (23%) in Duna, 10 (23%) in Gibe, 8 (14%) in Gombora and 6 (12%) in Anlemo (Table 58). Those EVMPs used to treat multiple of ailments in each district were *Nicotiana tabacum* and *Withania somnifera* each 3 (6%) in Anlemo; *Nicotiana tabacum*, *Croton macrostachyus*, *Asparagus africanus*, *Momordica foetida*, *Ricinus communis* and *Sida schimperiana* each 3 (5%) in Duna; *Croton macrostachyus* 5 (8%) and *Nicotiana tabacum* 4 (7%) in Gibe; *Nicotiana tabacum* 5 (8%) and *Clerodendrum myricoides* 3 (5%) in Gombora, and *C. myricoides* 5 (5%), *Lobelia giberroa*, *Maesa lanceolata*., *Clematis longicauda* and *Rubia cordifolia* each 3 (3%) in Yem (Table 59). Photos of some commonly used EVMPs are given in Fig. 32.

Table 58. Number of EVMPs used to treat >=2 livestock ailments in the study area
(ail. =no. of ailments treated by the taxon)

Species	Anlemo		Duna		Gibe		Gombora		Yem	
	ail.	%	ail.	%	ail.	%	ail.	%	ail.	%
Nicotiana tabacum	3	6	3	5	4	7	5	8	-	-
Withania somnifera	3	6.	-	-	-	-	-	-	-	-
Calpurnia aurea	-	-	-	-	-	-	-	-	5	4
Clerodendrum myricoides	2	4	-	-	2	4	3	5	2	2
Croton macrostachyus	2	4	2	3	5	9	-	-	-	-
Cucumis ficifolius	2	4	-	-	-	-	-	-	-	-
Asparagus africanus	-	-	3	5	2	4	-	-	-	-
Lobelia giberroa	-	-	-	-	-	-	-	-	3	3
Maesa lanceolata	-	-	-	-	-	-	-	-	3	3
Momordica foetida	-	-	3	5	2	4	-	-	-	-
Nicotiana rustica	-	-	-	-	2	4	-	-	-	-
Ricinus communis	-	-	3	5	-	-	-	-	-	-
Clematis longicauda	-	-	-	-	-	-	-	-	3	3
Sida schimperiana	-	-	3	5	-	-	-	-	-	-
Rubia cordifolia	-	-	-	-	-	-	-	-	3	3

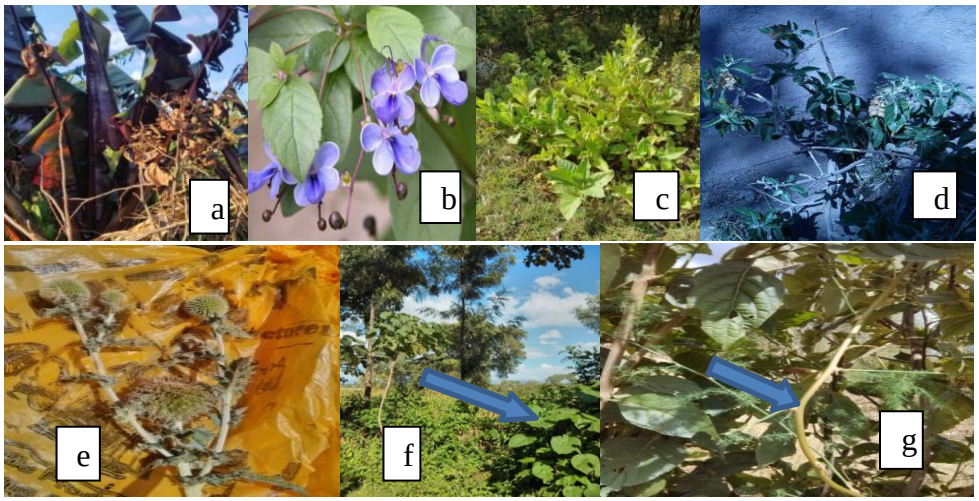


Fig.32. Photos of some commonly used EVMPs a) *Ensete ventrcosum* (meqe?l wesa(Had)/Asu(Yem), b) *Clerodendrum myricoides*, c) *Nicotiana tabacum*, d) *Withania somnifera* e) *Echinops kebericho*, f) *Croton macrostachyus*, g) *Asparagus africanus*. (Photo by Gideon WM, October, 2016)

4.2.4.7 Parts of EVMPs used for livestock remedies

The findings showed that about 15 different parts EVMP parts were reportedly employed for management of livestock health in the study areas (Table 59). On overall, the most used part was leaf with a proportion of 173 (44%) followed by root 84 (21%), stem bark 31 (8%) and shoottip 26 (7%), and the least used parts were seed 8 (2.03%), rhizome and wood each 1 (0.25%). In all the districts leaf was the most used part followed by root. The proportions of leaf by rank in the districts was 57 (48%) in Yem followed by 32 (53) in Anlemo, 30 (43%) in Gombora, and 27 (39%) in Duna and 27 (36%) in Gibe. Other parts were also reported important but with small frequencies.

Table 59. Parts EVMPs used for treating animal ailments in the study area

Part used	Anlemo		Duna		Gibe		Gombora		Yem		Overall cit.	%
	*cit.	%	cit.	%	cit.	%	cit.	%	cit.	%		
Leaf	32	53	29	41	27	35	30	43	57	48	173	44
Root	10	17	15	22	14	18	16	23	29	24	84	21
Stem bark	3	5	3	4	11	14	11	16	3	3	31	8
Shoot tip	1	2	8	12	7	9	2	3	10	8	28	7
Fruit	5	8	3	4	4	5	2	3	9	8	23	6
Whole part	3	5	3	4	2	3	1	1	4	3	13	3
Stem	1	2	4	6	5	7	2	3	2	2	14	4
Bulb	3	5	1	1	1	1	-	-	-	-	5	1
Corm	-	-	2	3	2	3	2	3	2	2	8	2
Latex	-	-	-	-	1	1	-	-	-	-	1	0.25
Pseudostem	-	-	1	1	1	1	-	-	1	1	3	1
Root bark	-	-	1	1	-	-	2	3	-	-	3	1
Seed	2	3	1	1	3	4	-	-	2	2	8	2
Wood	-	-	-	-	-	-	1	1	-	-	1	0.25
Rhizome	-	-	-	-	-	-	-	-	1	1	1	0.25
Total	60	100	69	100	78	100	69	100	120	100	398	100

*cit. = # of citations

4.2.4.8 State of livestock remedy preparation

Results showed that an overall of 367 (92%) remedies of veterinary ailments were prepared from fresh material while 19 (5%) from fresh/dry and 12 (3%) from dry plant materials (Fig. 33). Similarly, the fresh remedies were predominantly used in a rank order districts with 116 (97%) in Yem followed by 70 (90%) in Gibe, 67 (97%) in Gombora, 65 (92%) in Duna and 49 (82%) in Anlemo. The fresh/dry remedies constituted the next highest of 7 (12%) in Anlemo followed by 4 (5%) in Gibe and 4 (3%) in Yem, 2 (3%) in Duna and Gombora each while the dry remedies constituted the remaining fewer proportion in Anlemo, Duna and Gibe, but lacking in Gombora and Yem.

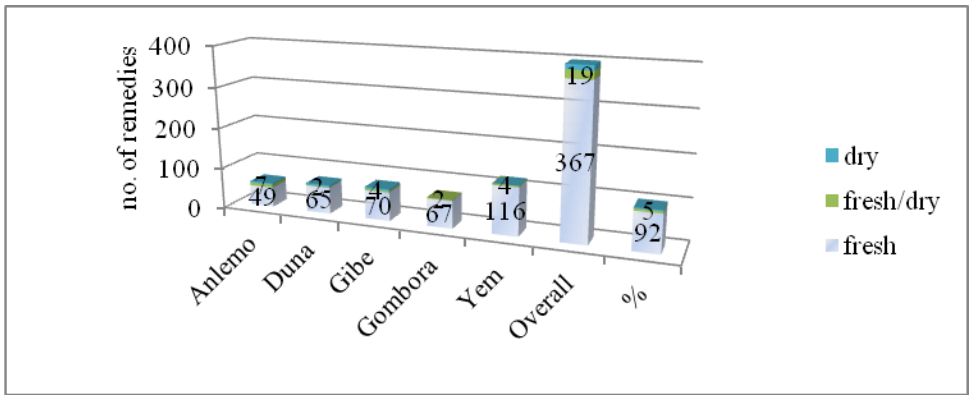


Fig. 33. State of remedies for livestock ailments

4.2.4.9 Methods of preparation of EVMPs

It was found that the local people prepare herbal remedies using different methods (Fig. 34). On overall, maceration was the most commonly used method of remedy preparation of veterinary ailments with citations of 231 (59%) followed by decoction 30 (8%), juice 18 (5%) and infusion 12 (3%). With the same trend, maceration was the most used method in each district in a rank order of 60 (50%) in Yem followed by 47 (68%) in Duna, 45 (75%) in Anlemo, 42 (61%) in Gombora and 37 (49%) in Gibe. Infusion was the next commonly used method in each district in a rank order of 36 (30%) in Yem followed by 17 (25%) in Gombora, 15 (22%) in Anlemo, 11(14%) in Gibe, 8 (13%) in Anlemo

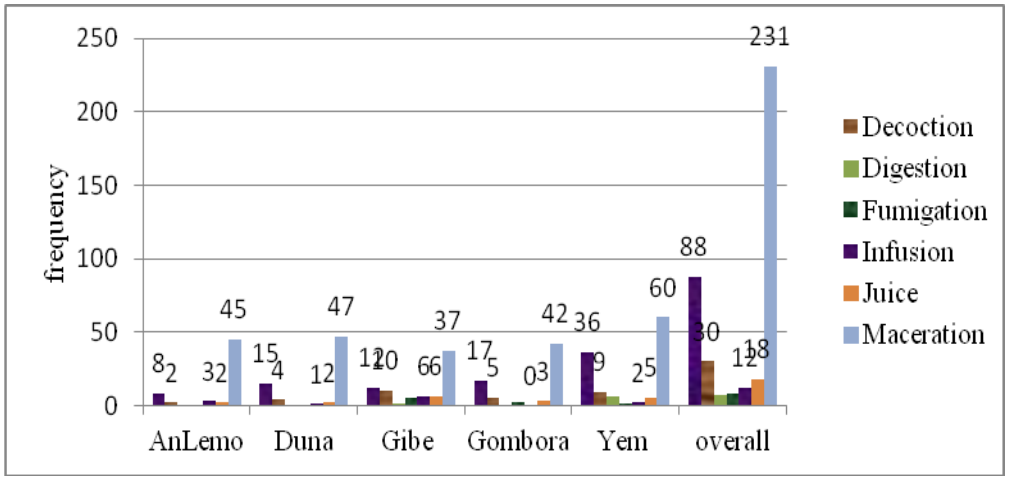


Fig. 34. Method of preparation of EVMP remedies

4.2.4.10 Route of application of EV herbal remedies

Based on results, local people used to apply herbal remedies through different animal body parts and conditions. On ovrall, the highest cited route was via oral route i.e. 272 (68%) followed by dermal 75 (19%) and nasal route 33 (8%) (Table 60). With the same trend, oral route was the most cited route in all districts in a rank order of 86 (72%) in Yem followed by 48 (71%) in Gombora, 47 (68%) in Duna and 47 (60%) in Gibe, and 44 (73%) in Anlemo. The next most used route in each district was dermal application in a rank order of again 30 (25%) in Yem followed by 14 (18%) in Gibe, 12 (17%) in Duna, 9 (15%) in Anlemo and 8 (12%) in Gombora while other routes constituted the remaining fewer proportions of routes in each district.

Table 60. Route of application of EVMP remedies in the study area (cit= # of citations)

	Anlemo		Duna		Gibe		Gombora		Yem			
Route	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%	Overall	%
Oral	44	73	47	68	47	60	48	71	86	72	272	69
Dermal	9	15	12	17	14	17	10	13	30	25	75	19
Nasal	5	8	8	12	10	14	8	12	2	2	33	8
Ocular	1	2	1	1	1	2	2	3	2	2	7	2
Genital	1	2	-	-	3	5	1	1	-	-	5	1
Fumigation	-	-	3	4	3	5	-	-	-	-	6	2
Total	60	100	71	100	78	100	69	100	120	100	398	100

4.2.4.11 Mode of application of EVMP remedies

The communities of the study areas were known to apply herbal preparations in different modes (Table 61). On overall, the most reported mode of application was drenching with a proportion of 247 (62%) followed by paint 49 (12%) and drip via nose 21 (5%). In districts separately also, drenching was the highest cited mode of administration in a rank order of 86 (72%) in Yem followed by 46 (61%) in Gombora, 40 (58%) in Duna, 38 (63%) in Anlemo and 37 (54%) in Gibe. Painting was the next most used mode of remedy application with the highest being 18 (15%) in Yem followed by 10 (14%) in Duna and 10 (13%) in Gibe, 6 (10%) in Anlemo and 5 (7%) in Gombora while the remaining modes constituted the rest of fewer proportions.

Table 61. Mode of application of EVMP remedies in the study area

Mode	Anlemo		Duna		Gibe		Gombora		Yem		Overall	
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%
Drenching	38	63	40	58	46	61	37	54	86	72	247	62
Paint	6	10	10	14	10	13	5	7	18	15	49	12
Wash	5	8	1	1	3	4	-	-	3	0	12	3
Drip via nose	3	5	5	7	7	9	6	9	-	-	21	5
Feed/forage	1	2	3	4	1	1	2	3	3	3	10	3
Drip on eye	1	2	1	1	1	1	1	1	3	3	7	2
Inhale	2	3	1	1	1	1	5	7	-	-	9	2
Blow	1	2	2	3	2	3	3	4	-	-	8	2
Touch the location with	1	2	-	-	-	-	1	1	2	2	4	1
Fumigate	-	-	1	1	3	4	2	3	-	-	6	2
Poultice	-	-	2	3	-	-	1	1	2	2	5	1
Swallow	1	2	1	1	-	-	-	-	-	-	2	1
Tie	1	2	2	3	-	-	-	-	-	-	3	1
Amulet	-	-	2	1	2	3	-	-	-	-	4	1
Feed bulk/slice	-	-	-	-	-	-	3	4	3	2	6	2
Hold in mouth	-	-	-	-	-	-	3	4	-	-	3	1
Insert	-	-	-	-	2	3	-	-	-	-	2	1
Total	60	100	71	100	78	100	69	100	120	100	398	100

cit.= no. of citations

4.2.4.12 Ingredients added to plant preparations of livestock ailments

There were only few number of additives reported to be used along animal remedies in the five districts. Some of the commonly added ingredients reported in the five districts were salt lick /'bole', salt and dough.

4.2.4.13. Dosage of EVMPs in the studyarea

The local herbal practitioners and owners of livestock in the study areas indicated that they use some measurement objects to regulate dosage of livestock phytoremedies (Table 62). In the districts, the highest cited local measurements of remedies in rank order were jug/'bule' 49 (41%) in Yem followed by litre/jug 28 (39%) in Duna, meka/jug 27 (35%) in Gibe and 20 (29%) in Gombora, and estimation 18 (30%) in Anlemo. The frequency application of EVMP preparations varied from once to 3-5 days and rarely until the case improves for those remedies thought to be safe for the animal.

Table 62. Dose of EVMP remedies (H,Y = Hadiya,Yem)

Traditional measurement tool	Anlemo # of remedies	%	Duna #of remedies	%	Gibe # of remedies	%	Gombora # of remedies	%	Yem # of remedies	%
Handful	10	17	10	14	15	19	18	26	20	17
Meka/jug/'bule'(H,Y)	15	25	28	39	27	35	20	29	49	41
Burchuko/kubaya/gubaya (H,Y)	10	17	12	17	15	19	11	16	20	17
Drop	7	12	9	13	10	13	10	14	6	5
Estimation	18	30	12	17	11	14	10	14	25	21
Total	60	100	71	100	78	100	69	100	120	100

4.2.4.14 Source of EVMPs in the five districts

Overall analysis on the source of EVMP showed that the highest proportion was obtained from wild 185 (69%) followed by semi-cultivated 50 (19%) and cultivated 32 (12%) (Table 63). With a similar trend, the wild source was dominant in each district proportions of 33 (79%), 35 (76%), 31 (74%) 40 (82%) and 76 (85%) in Anlemo, Duna, Gibe Gombora and Yem, respectively. The cultivated/wild and cultivation supplied minor proportions in each district.

Table 63. Source of EVMPs in the study area (cit. = no. of citations)

Source	Anlemo		Duna		Gibe		Gombora		Yem		Overall	
	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%	cit.	%
Cultivated	7	17	5	11	8	19	4	8	8	9	32	12
Semicultivated	2	5	6	13	3	7	5	10	5	6	50	19
Wild	33	79	35	76	31	74	40	82	76	85	185	69

4.2.4.15 Habitat distribution of MPs used for livestock ailments

It was found that the MPs used for the livestock ailments were distributed in 13 different types of habitats (Fig. 35). Forest patches were the predominant repositories of EVMPs in a rank order of the 46 (52%) in Yem followed by 23 (49%) in Gombora, 15 (36%) in Anlemo and 15 (38%) in Gibe while living fence was the dominant habitat for a biggest proportion of 12 (27%) taxa in Duna. Living fence was the next dominant habitat of EVMPs with the highest of 10 (24%) in Anlemo followed by 8 (18%) in Gibe and 8 (20%) in

Gombora while in Duna home garden 5 (11%) and fallow 10 (11%) in Yem. Other habitats of EVMPs had varying proportions of records in the study districts.

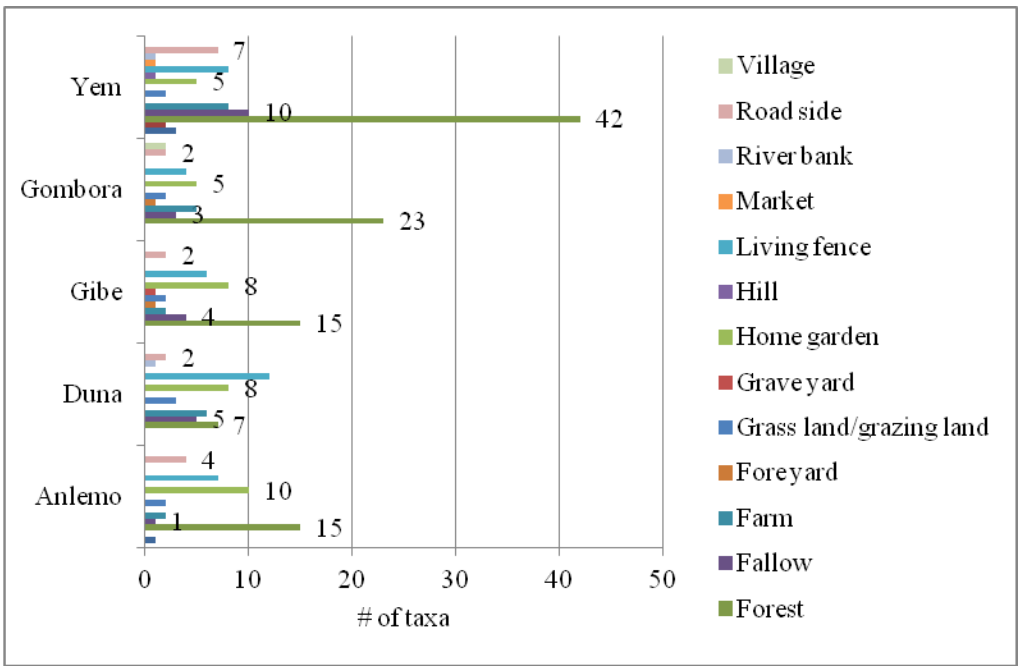


Fig. 35. Habitat diversity of EVMPs used for livestock ailments (Market = anthropogenic habitat)

4.2.4.16 Accessibility of EVMPs in the five districts

Based on informants interviews and field observation, the accessibility MPs was grouped in three status/levels of accessibility; very common, common and locally rare in each district. In all districts, the highest number of EVMP taxa were in 'common' category the highest record of 39 (43%) taxa in Yem followed by 24 (49%) in Gombora, 20 (43%) in Duna and 20 (47%) in Gibe and 17 (41%) in Anlemo (Fig. 36). The next bigger proportion of EVMP taxa were in 'very common' status with the highest of 27(30%) taxa in Yem followed by 12 (28%) in Gibe, 11 (22%) in Gombora, 10 (22%) in Duna and 9 (21%) in Anlemo. The EVMP taxa in 'rare' status were again highest in Yem with 24 (27%) taxa followed by 16 (38%) in Anlemo and 16 (35%) in Duna, 11 (26%) in Gibe and 14 (29%) in Gombora. Regarding list of species in each status group, species in 'very common' status in all district include *Albizia schimperiana*, *Buddleja polstachya*, *Carissa spinarum*, *Calpurnia aurea*, *Croton macrostyachyus*, *Clutia abyssinica*, *Erythrina brucei*, *Momordica foetida* and *Cyathula*

cylinderica. On the other hand, 'locally rare' EVMPs in most districts include *Agarista salicifolia, Asparagus africanus, Caylusea abyssinica, Echinops kebericho, Cucumis ficifolius, Crinum abyssinicum, Englerina woodfordioides, Inula confetiflora, Securidaca longepedunculata, Stereospermum kunthianum, Millettia ferruginea* and *Lysimachia ruhmeriana.*

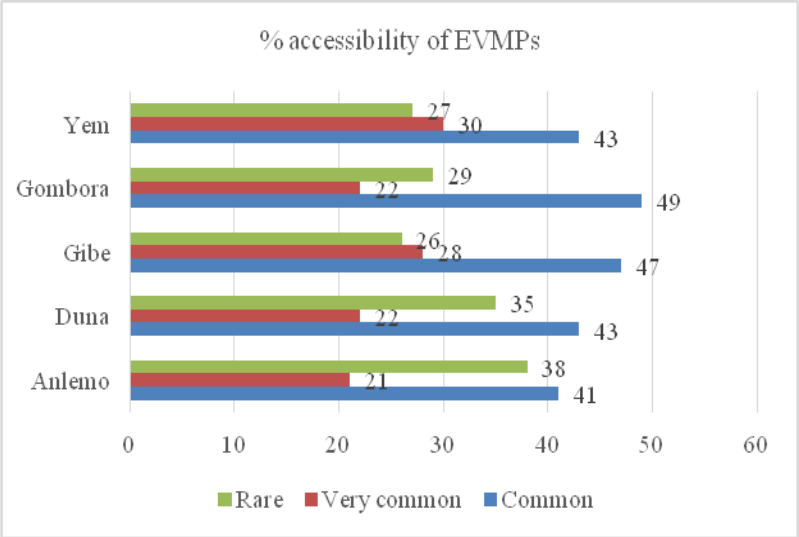


Fig. 36. Accessibility level of ETVMPs

4.3.17 Preference Ranking of EVMPs

The preference ranking of EVPMs that had high citations during freelisting was assessed using ten key informants in each district (Tables 64-68). Accordingly, the 1st and last ranked EVMPs used for treating the ailments of importance in each district were; *Croton macrostachyus* was 1st while *Gouania longispicata* was 5th for treating pasture bloat in Anlemo (Table 64); *Crinum abyssinicum* was 1st while *Clausena anisata* was 5th for sudden ailment in Duna (Table 65); *C. macrostachyus* was 1st (as it was in Anlemo) while *Senecio hadiensis* was 6th for treating pasture bloat in Gibe (Table 66); *Nicotiana tabacum* was ranked 1st for leech infestation while 5th for epizootic lymphangitis /of horse in Gombora (Table 67), and *Lobelia giberroa* was 1st while *Premna schimperi* was 6th /last ranked for treating livestock anthrax in Yem (Table 68).

Table 64. PR of five EVMPs used to treat pasture bloat of cattle in Anlemo

Species	Informants										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
Croton macrostachyus	5	4	3	5	3	4	2	5	4	5	40	1
Nicotiana rustica	4	5	1	3	5	1	5	4	5	4	37	2
Verbascum sinaiticum	2	3	5	4	4	5	3	3	3	1	33	3
Erythrina brucei	1	2	4	2	2	3	1	2	2	3	22	4
Gouania longispicata	3	1	2	1	1	2	4	1	1	1	17	5

Table 65. PR of five EVMPs used to treat sudden ailment in Duna

Species	Informants										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
Crinum abyssinicum	5	4	4	3	5	5	4	4	5	4	43	1
Momordica foetida	4	5	5	5	4	3	3	5	3	5	42	2
Echinops kebericho	2	3	1	2	3	4	5	2	4	3	29	3
Stephania abyssinica	3	1	3	4	1	1	2	1	1	2	19	4
Clausena anisata	1	2	2	1	3	2	1	3	2	1	18	5

Table 66. PR of five MPs for treating pasture bloat of cattle in Gibe

Species	Informants										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
Croton macrostachyus	6	5	6	4	6	6	6	5	5	4	53	1
Echinops kebericho	5	6	5	6	5	5	4	6	4	6	52	2
Momordica foetida	4	3	4	5	3	4	3	4	6	5	41	3
Rumex nepalensis	3	4	3	3	4	3	4	3	3	3	33	4
Helinus mystacinus	2	1	2	1	2	1	2	2	2	1	16	5
Senecio hadiensis	1	2	1	2	1	2	1	1	1	2	14	6

Table 67. PR of *Nicotiana tabacum* for treating 5 livestock ailments in Gombora

Ailment type	Informants										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
Leech	3	5	4	5	5	1	5	3	2	5	38	1
Sudden ailment	4	3	1	3	4	5	3	5	1	4	33	2
Flu /sheep, goat	2	2	5	2	1	4	2	4	5	2	29	3
Lumpy skin disease	5	4	3	1	3	2	1	2	3	1	25	4
Epozootic lymphangitis / horse	1	1	1	4	2	3	4	1	4	3	24	5

Table 68. PR of six EVMPs used to treat anthrax in Yem

Species	Informants										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
Lobelia giberroa	6	3	5	6	3	6	5	6	4	6	50	1
Inula confertiflora	2	4	6	4	5	3	6	5	6	5	46	2
Hypericum quartinianum	4	6	4	3	2	5	3	4	3	4	38	3
Olinia rochetiana	3	5	1	5	4	1	1	1	5	3	29	4
Buddleja polystachya	5	2	3	1	4	3	4	2	1	2	27	5
Premna schimperi	1	1	2	2	1	3	2	3	2	1	18	6

R = respondents

4.2.4.18 Direct Matrix Ranking (DMR) of multipurpose EVMPs

The direct matrix ranking performed with ten key informants on ten multipurpose EVMPs revealed the taxa that are threatened by list of utilitarian factors in the study districts (Tables 69-73). Accordingly, *Acacia sieberiana*, *Croton macrostachyus* and *Ehretia cymosa* were the first three indigenous EVMPs threatened by activities of fuel wood, construction, fodder, furniture, and farming & household tools besides the medicinal use in Anlemo (Table 69); *Cordia africana, Croton macrostachyus* and *Acacia abyssinica* were the most threatened EVMPs by activities of fuel wood extraction, construction, fodder and charcoal in Duna (Table 70); *C. macrostachyus* followed by *Prunus africana* and *Ilex mitis* threatened by by activities of fuel wood, construction, furniture, farming & household tools on top of medicinal use in Gibe (Table 71); *C. africana* and *Manilkara butugi* followed by *Syzygium guineense* subsp. *guineense* were the top three EVMPs threatened by activities of fuel wood, construction, furniture, ~~and~~ farming & household tools in Gombora (Table 72); *C. africana* followed by *Juniperus procera* and *P. africana* were found to be the top three top EVM taxa threatened by fuel wood, charcoal, furniture, household & farming tools in Yem (Table 73).

Table 69. Average Direct Matrix Ranking (ADMR) of ten mulpipurpose EVMPs in Anlemo

A = furniture, farming & hh tools, B = fodder, C = fuel wood, D = charcoal, E = construction, F = lumbering, G = medicine

Species	A	B	C	D	E	F	Total	Rank
Acacia sieberiana	3	5	5	5	2	1	21	1
Agarista salicifolia	2	1	5	4	2	1	15	6
Buddleja polystachya	1	1	4	2	2	1	11	10
Calpunia aurea	4	1	5	2	3	1	16	4
Clausena anisata	1	4	4	1	3	1	14	8
Croton macrostachyus	4	1	5	2	5	3	20	2
Ehretia cymosa	5	2	5	2	3	2	19	3
Maesa lanceolata	1	4	5	2	2	1	15	6
Olinia rochetiana	2	2	4	3	4	1	16	4
Vernonia amygdalina	1	5	4	1	1	1	13	9
Total	24	26	46	24	27	13		
Rank	5	3	1	5	2	6		

Table 70. ADMR of ten mulpipurpose EVMPs in Duna

Species	A	B	C	D	E	F	Total	Rank
Acacia abyssinica	3	4	5	5	3	2	22	3
Agarista salicifolia	2	1	5	4	2	1	15	9
Albizia schimperiana	2	1	4	2	3	1	13	10
Calpunia aurea	5	1	5	3	4	1	19	5
Clausena anisata	2	5	5	2	2	1	17	6
Croton macrostachyus	5	1	5	4	4	5	24	2
Cordia africana	5	4	5	2	5	5	26	1
Hagenia abyssinica	4	1	5	2	4	5	21	4
Maesa lanceolata	1	5	5	2	2	1	16	8
Millettia ferruginea	2	5	5	2	3	1	18	6
Total	31	28	49	28	32	23		
Rank	3	4	1	4	2	6		

Table 71. ADMR of ten mulpipurpose EVMPs in Gibe

Species	A	B	C	D	E	F	Total	Rank
Albizia schimperiana	2	1	3	2	2	1	11	10
Apodytes dimidiata	3	3	4	3	4	4	21	4
Calpurnia aurea	5	1	5	2	4	1	18	6
Clausena anisata	2	5	5	1	3	1	17	8
Croton macrostachyus	5	1	5	3	5	5	24	1
Euphorbia abyssinica	3	1	1	1	3	4	13	9
Ilex mitis	3	2	5	4	5	3	22	3
Maesa lanceolata	2	5	5	3	2	1	18	6
Olea welwitschii	3	1	5	4	4	3	20	5
Prunus africana	4	3	5	3	4	4	23	2
Total	32	24	43	27	36	28		
Rank	3	6	1	5	2	4		

Table 72. ADMR of ten mulpipurpose EVMPs in Gombora

Species	A	B	C	D	E	F	Total	Rank
Canthium oligocarpum	3	3	4	5	4	1	20	9
Combretum collinum	3	4	5	5	2	2	21	7
Cordia africana	5	4	5	5	5	5	29	1
Croton macrostachyus	4	1	5	3	4	4	21	7
Dodonaea angustifolia	3	2	5	5	4	1	20	9
Ehretia cymosa	5	3	4	4	4	2	22	6
Manilkara butugi	5	4	5	4	5	5	28	2
Ocotea kenyensis	5	3	5	3	5	4	25	5
Sapium ellipticum	4	4	5	3	5	5	26	4
Syzigium guineese subsp. *guineese*	5	3	5	5	5	4	27	3
Total	42	32	48	42	43	33		
Rank	3	6	1	4	2	5		

Table 73. ADMR of ten multipurpose EVMPs in Yem

Species	A	B	C	D	E	F	Total	Rank
Celtis africana	4	4	5	4	3	2	22	5
Cordia africana	5	5	5	3	5	5	28	1
Croton macrostachyus	5	1	4	2	3	4	19	7
Dodonaea angustifolia	3	1	5	5	3	1	18	8
Ehretia cymosa	3	3	4	3	3	2	18	8
Juniperus procera	5	1	5	3	5	5	24	2
Maytenus addat	2	4	4	5	2	1	18	8
Premna schimperi	3	4	4	5	4	1	21	6
Prunus africana	4	4	5	3	5	3	24	3
Stereospermum kunthianum	3	4	5	5	3	3	23	4
Total	37	31	46	38	36	27		
Rank	3	5	1	2	4	6		

4.2.4.19 Informant Consensus Factor (ICF) of EVMPs

The ICF values calculated for seven EV ailment categories (of the 74 EV ailments reported in this study) are presented in Table 74. The average ICF values of EV ailment categories in a rank order of the districts were; 0.87 in Duna followed by 0.84 in Gombora, 0.83 in Gibe, 0.82 in Anlemo and 0.73 in Yem. Ailment categories with the highest ICF values in a rank order of the districts were; 0.92 (treated by 4 species, 40 use reports) for RUG in Duna followed by 0.90 for MSMis in Gibe (treated by 11 species, 99 use reports) and in Gombora (treated by 11 taxa, 93 use reports), 0.87 for GIV in Anlemo (treared by 18 species, 130 use reports), and 0.78 for PS in Yem (treated by 10 species, 42 use reports). On the other hand, EV ailment categories with the least ICF values in ascending rank order of the districts were; 0.66 for BVI in Yem followed by 0.74 for BVI in Anlemo, 0.75 for PS in Gibe and BVI in Gombora, and 0.81 for MSMis in Gibe.

Focusing on the specific EV ailments in those categories with the highest ICF values in each dsitrict, the RUG ailments in Duna include 4 ailments such as babesiosis, delayed placenta, failure of milk and mastitis each treated by a single species. Similarly, the MSMis in Gibe and Gombora includes 6 ailments such as eye ailment/conjunctivitis, horse sudden ailment, sudden cattle ailment (treated by 6 species), fracture, sun stroke of young animals and general health each treated by a single species. GIV ailments that scored the highest ICF

value in Anlemo includes 8 ailments such as abdominal pain (treated by 4 taxa), constipation (by 3 taxa), diarrhea (by 3 taxa), abdominal worms (by 2 taxa), 'tef' straw bloat (by 2 taxa), leech, grain bloat and pasture bloat (each by 1 taxon); and PS ailments that scored the highest ICF value in Yem include 5 ailments such as evil eye (of calves, milk cattle and cubs of goats and sheep), hate of calf, cattle boycott milking (totally treated by 7 taxa), and 'Risbala'= an ailment locally linked with bad sprit & believed to be caused by sudden hovering of eagle over goats/animals from sky treated by 2 species.

Table 74. ICF values of EVMPs in 7 ailment categories in the study area

(A = Anlemo, D = Duna, G = Gibe, Gm = Gombora, Y = Yem, UR = -# of use reports, Spp. = # of taxa used for the ailments, BVI = Blood vascular & infectious ailments category, DR = Dermatological ailments, GIV= Gastrointestinal & visceral organs, MSMis = Musculo-skeletal, sensory & miscellaneous ailments such as sudden ailment that are not clearly defined, PS = Psycho-spiritual ailments, RUG=Reproductive & urogenital ailments, RS = Respiratory system ailments)

Ailment Category	Anlemo		Duna		Gibe		Gombora		Yem		A	D	G	Gm	Y
	UR	Spp	UR	Spp.	UR	Spp.	UR	Spp.	UR	Spp.	ICF	ICF	ICF	ICF	ICF
BVI	34	9	58	11	36	8	47	12	170	58	0.74	0.82	0.80	0.76	0.66
DR	22	4	78	10	24	4	46	5	64	18	0.86	0.88	0.87	0.87	0.73
GIV	130	18	141	19	109	19	85	21	119	30	0.87	0.87	0.83	0.76	0.75
MSMis	45	9	86	17	98	11	93	11	44	11	0.82	0.81	0.90	0.89	0.77
PS	35	7	9	2	13	4	16	3	42	10	0.81	0.88	0.75	0.86	0.78
RUG	18	4	40	4	21	3	22	4	39	10	0.82	0.92	0.89	0.85	0.76
RS	22	3	48	6	89	16	62	9	44	15	0.85	0.89	0.76	0.87	0.67
Average											0.82	0.87	0.83	0.84	0.73

4.2.4.20 Fidelity Level, FL (%) of EVMPs

Based on the finding of FL, most of the EVMPs scored FL of 100% in each district. Accordingly, a highest number of 73 species in Yem followed by 43 species in Gombora, all the 40 species in Gibe, 38 species in Duna scored FL of 100% and 34 species in Anlemo scored FL of 100%. On the other hand, 12 species scored FL between 50-73% in Yem followed by 6 species between 50-77% in Anlemo, 5 species FL of 50-70% in Gombora and 4 species between 50-70% in Duna while 4 species in Duna and Yem, and a single species in Gombora and Anlemo scored FL <50% (results not presented due to large size).

Species that got highest healing potential and the categories with highest ICF values in each district are presented in Table 75. Accordingly, *Nicotiana tabacum* (against leech - GIV), *Croton macrostachyus* (against pasture bloat - MSMis) and *Premna schimperi* (against ascariasis - GIV), *Withania somnifera* (against abdominal worms - GIV) had FL of 100% in Anlemo; *Ensete venteicosum* /clone 'Meqe?lwesa- (for delayed placenta) and *Kalanchoe schimperiana* (for mastitis) both RUG gained FL 100%; *Asparagus africanus* (as galactogogue) 46% in Duna; *Cucumis ficifolius* (against sudden ailment -MSMis), *Securidaca longepedunculata* (against sudden ailment - MSMis) and *Momordica foetida* (against sudden ailment) each scored FL of 100% in Gibe; *Asparagus africanus* (for general health - MSMis), *M. foetioda*, *Securidaca longepedunculata* (for sudden ailment -MSMis), *E. ventricosum*/ clone 'gishir' (for fracture - MSMis), *Fuerstia africana* (against conjunctivitis -MSMis), each scored FL of 100% in Gombora; and *Acanthus eminens*, *Drymaria cordata* and *Englerina woodfordioides* (symbiont on *Vernonia myriantha*) (all for evil eye) FL 100% in PS category, *Haplocarpha rueppellii* (for general health -MSMis) FL 100%, *Crinum abyssinicum* (against sudden ailment - MSMis) scored FL of 64% in Yem.

Table 75. Fidelity level, FL(%) of highest cited species for livestock ailments in the study area

1. Anlemo

Species	ailment	Ip	Iu	FL (%)
Calpurnia aurea	ticks	10	10	100
Echinops kebericho	sudden disease	12	12	100
Withania somnifera	abdominal worms	5	5	100
Croton macrotachyus	pasture bloat	12	12	100
Nicotiana tabacum	leech	11	11	100
Premna schimperi.	ascariasis	10	13	77

2. Duna

Species	ailment	Ip	Iu	FL(%)
Asparagus africanus	galactogogue	14	14	100
Clerodendrum myricoides	retain conception	25	25	100
Crinum abyssinicum.	sudden disease	14	14	100
Ensete ventricosum (Meqe?l wesa)	delayed placenta	23	23	100
Kalanchoe schimperiana	mastitis	13	23	57
Echinops kebericho	sudden disease	17	38	45

3. Gibe

Species	ailment	Ip	Iu	FL(%)
Clerodendrum myricoides	retain conception	15	15	100
Ensete ventricosum (‘meqe?lwesa wesa)	Delayed placenta	15	15	100
Securidaca longepedunculata	sudden disease	16	16	100
Asparagus africanus	sudden disease	17	17	100
Nicotiana tabacum	leech	13	13	100

4. Gombora

Species	ailment	Ip	Iu	FL(%)
Mormordica foetida	sudden disease	17	17	100
E. ventricosum (‘gishir’)	fracture	15	15	100
Lysimachia ruhmeriana	chocking	13	13	100
Securidaca longepedunculta	sudden disease	18	18	100
Echinops kebericho	sudden disease	10	14	71
Nicotiana tabacum	lumpy skin disease	18	58	31

5. Yem

Species	ailment	Ip	Iu	FL(%)
Acanthus eminens	evileye	4	4	100
Haplocarpha rueppellii	general health	15	15	100
Drymaria cordata.	hafe of calf	3	3	100
Englerina woodfordioides	evileye	3	3	100
Periploca linearifolum	evileye	10	14	71
Crinum abyssinicum	Sudden disease	9	14	64
Lobelia giberroa	Anthrax	9	21	43

4.2.4.21 Similarity of EVMPs in the five districts

The Sorenson's Coefficient (Ss) showed about 36% of similarity in EVMPs between Hadiya (four districts combined) and Yem (Table 76). Further similarity of EVMPs calculated among the five study districts showed that Anlemo and Gibe districts have the highest similarity of 68% in EVMPs followed by 63% between Anlemo and Duna, 53% between Gibe and Gombora, 50% between Anlemo and Gombora while modest similarity of 41% was observed between Anlemo and Yem, 37% between Duna and Yem, 33% between Duna and Gibe, and Gombora and Yem each. The least similarity of 29% was observed between Gombora and Duna.

Table 76. Sorenson's Coefficient of Similarity calculated for EVMPs among the study sites

	Hadiya	Anlemo	Duna	Gibe	Gombora	Yem
Hadiya	1					
Anlemo	-	1				
Duna	-	0.63	1			
Gibe	-	0.68	0.33	1		
Gombora	-	0.50	0.29	0.53	1	
Yem	0.36	0.41	0.37	0.35	0.33	1

4.2.4.23 Statistical tests of EVMPK and socioeconomic variables

The results of statistical tests between EVMPK and different socioeconomic variables considered showed both significant and nonsignificant results that are highlighed in Table 77. The detail results of each variable against EVMPK are provided in next sections.

Table 77. Statistical significance of EVMPK and socioeconomic and site variables

Variable	a/b	Hadiya	Yem	Anlemo	Duna	Gibe	Gombora
Gender	-	b	a	ns	a	a	a
Marriage	-	a	ns	b	ns	ns	a
Religion	-	a	ns	ns	ns	a	ns
Education	-	ns	ns	ns	ns	a	ns
Age	-	a	ns	a	ns	a	b
Informant category	-	a	a	a	a	a	a
Agroecology	-	-	a	ns	ns	ns	ns
Ethnicity (Hadiya & Yem)	a	-	-	-	-	-	-
Five Districts	a	-	-	-	-	-	-
20 subdistricts	a	-	-	-	-	-	-

a = significant at 0.01, b = significant at 0.05, ns = not significant

4.2.4.23.1 Ethnicity (Hadiya and Yem) and EVMPK of informants

There was a significance difference in EVMPK among informants of Hadiya and Yem, $t(499) = 6.16$, $p < 0.001$, the *mean* & *SD* were 8.16±3.55 for Yem while it was 6.09±2.39 for Hadiya. A more variation in EVMPK was observed among informants of Yem than in Hadiya.

4.2.4.23.2 EVMPK between informants of the five districts

There was a significant difference in EVMPK between informants of the five study districts $F(4,497) = 21.60$, $p < 0.001$ (Table 78). The mean & SD of EVMPK of informants in each district in a rank order were 8.16±3.56 in Yem followed by 6.71±2.90 in Gombora, 6.65±1.76 in Anlemo, 6.49±2.20 in Gibe and 4.86±2.13 in Duna. Postoc test was significant among all pairs ($p < 0.001$) (except not significant in Anlemo-Gombora pair (p =1.00).

Table 78. One-Way ANOVA of EVMPK among informants of the five districts
(BG = between groups, WG = withingroups, MS = meansquares, SS = sum of squares)

Site	N	mean	SD	ANOVA				
Anlemo	92	6.65	1.76		*SS*	*df*	*MS*	*F*	*Sig.*
Duna	128	4.86	2.13	BG	533.29	4	133.32	21.60	.000
Gibe	119	6.49	2.20	WG	3062.16	496	6.17		
Gombora	93	6.71	2.90	Total	3595.45	500			
Yem	69	8.16	3.56						
Total	501	6.38	2.68						

4.2.4.23.3 EVMPK among informants of 20 subdistricts of the five districts

There was also a significant difference in EVMPK between informants of the 20 study subdistricts $F(19,481) = 6.52$, $p < 0.001$ (Table not given due to big size). Homogeneity of variances was not met ($p < 0.001$), post-hoc comparison revealed significant mean differences among some pairs of the 20 subdistricts.

4.2.4.23.4 Gender and EMPK of informants of the five districts

There was both significant and nonsignificant difference in EVMPK in gender in the study area. Significant difference in EVMPK between male and female was in Hadiya (four districts combined) $t(430) = 6.56$, $p = 0.04$; in Yem $t(68) = 3.28$, $p < 0.001$; in Duna $t(126) = 5.49$ $p < 0.001$; in Gibe $t(117) = 4.32$, $p < 0.001$;

and in Gombora $t(88) = 2.62$, $p = 0.01$. Male had higher EVMPK in each case, the highest *mean±SD* for male being (8.98±3.63) and female (6.41±2.70) in Yem followed by male (7.38±2.87) and female (5.85±2.73) in Gombora; male (7.22±2.25) and female (5.61±1.79) in Gibe; male 6.74±2.41 and female 5.28±2.13 in Hadiya, and male (5.74±2.9) and female (3.87±1.38) in Duna. However, there was not a significant difference in EVMPK in gender in Anlemo $t(90) = 0.99$, $p = 0.33$ male (*mean±SD* 6.84±1.82) and female (6.45±1.65).

4.2.4.23.5 Marriage and EVMK of informants of the five districts

There was a significant difference in EVMPK in between married and single. Significant difference was in Hadiya $t(430) = 2.64$, $p = 0.007$; and Anlemo $t(90) = 2.45$, $p = 0.02$. The respective mean & SD of EVMPs known by married and single informants were 6.21±2.46, and 5.30±1.73 in Hadiya; 6.81±1.78 and 5.33±0.50 in Anlemo. However, there was no significant difference in Duna $t(127) = 0.50$, $p = 0.61$; in Gibe $t(117) = 0.48$, $p = 0.285$; and in Yem $t(67) = 0.82$, $p = 0.41$. Married informants had the higher *mean & SD* (6.89±3.05) and single informants (5.50±1.38) in Gombora; and married (6.81±1.78) and single (5.33±0.50) in Anlemo. On the outher hand, married had high mean (8.31±3.49) and single (7.30±3.97) in Yem, married (6.57±2.24) and single (5.94±1.87) in Gibe; married 6.21±2.46, single 5.30±1.73 in Hadiya and married (4.90±2.15) and single (4.63±2.03) in Duna.

4.2.4.23.6 Informant category and EVMPK of informants of the five districts

There was a significant difference in EVMPK between the key and general informants in Hadiya $t(430) = 13.53$, $p < 0.001$; in Yem $t(68) = 6.19$, $p < 0.001$; and in the four districts of Hadiya separately - in Anlemo $t(28.24) = 5.09$, $p < 0.001$; in Duna $t(127) = 3.03$, $p = 0.006$; in Gibe $t(24.96) = 9.29$, $p < 0.001$; and in Gombora $t(91) = 11.50$, $p < 0.001$. The respective mean & SD of EMPK among key and general informants in a rank order of the districts was 11.27±3.26 and 6.70±2.64 in Yem followed by 10.95±2.30 and 5.55±1.72 in Gombora, 9.85±1.84 and 5.81±1.56 in Gibe, 8.84±2.66 and 5.47±1.83 in Hadiya, 8.30±1.66 and 6.21±1.50 in Anlemo, and 6.25±2.26 and 4.60±2.01 in Duna.

4.2.4.23.7 Religion and EVMPK of informants of the five districts

There was a significant difference in EVMPK between religious groups in Hadiya $F(2,429) = 6.99$, $p = 0.001$; and Gibe $t(117) = 2.57$, $p = 0.01$; the higher *mean* &*SD* was for Orthodox 9.25±2.21 and Evangelicals 5.88±2.48 in Gibe; and for Orthodox 7.56±2.98, for Muslim 6.69±1.35 and Evangelicals 6.39±2.14 in Hadiya. However, there was no a significant difference in MPK between religious groups in the rest of three districts (except Gombora District which had a single religious group); $t(88) = 0.53$, $p = 0.6$ in Anlemo; $t(10.91) = 1.32$, $p = 0.021$ in Duna; and $t(65) = 1.59$, $p = 0.12$ in Yem.

4.2.4.23.8 Age and EVMPK of informants of the five districts

There was a significant difference in EVMPK of age groups in Hadiya (four districts combined) $F(2,429) = 10.19$, $p < 0.001$; in Anlemo $F(3,89) = 6.24$, $p = 0.001$; Gibe $F(3,116) = 5.91$, $p = 0.001$ and Gombora $F(2,90) = 3.75$, $p = 0.02$ (Table 79). The old agers had highest EVMPK with the respective *mean* & *SD* for old, middle agers and young were 7.08±1.97, 6.50±1.71 and 6.24±1.35 in Anlemo; 7.07±2.38, 6.24±2.06 and 5.71±1.71 in Gibe; 6.71±2.89, 6.43±2.96 and 5.75±2.01 in Gombora; 6.69±2.40, 5.91, and 5.48±1.86 in Hadiya. A post hoc comparison showed that the difference was significant between young and old age, $MD = 2.00$, $p = 0.015$ in Anlemo, $MD = 3.13$, $p = 0.012$ in Gibe and $MD = 1.19$, $p = 0.003$ in Gombora and $MD = 1.21$, $p < 0.001$. However, there was no a significant difference in EVMPK of the three age groups in Duna, $F(2,125) = 1.15$, $p = 0.32$ and Yem, $F(2, 66) = 1.41$, $p = 0.25$.

Table 79. One-Way ANOVA of ages and EVMPK of informants in the study area (BG=between groups, WG=within groups)

Site		*Sum of Squares*	*df*	*Mean Square*	*F*	Sig.
Hadiya	BG	112.58	2	56.289	10.194	0.000
	WG	2368.9	429	5.522		
Yem	BG	35.13	2	17.56	1.41	0.25
	WG	824.12	67	12.49		
Anlemo	BG	56.39	2	18.81	6.24	0.001
	WG	268.08	89	3.01		
Duna	BG	10.3	2	5.13	1.14	0.325
	WG	567.17	125	4.54		
Gibe	BG	81.31	2	27.1	5.91	0.001
	WG	532.16	116	4.59		
Gombora	BG	59.58	2	29.79	3.76	0.027
	WG	713.58	90	7.93		

4.2.4.23.9 Education and EVMPK of informants of the five districts

There was a significant difference in EVMPK between levels of education only in Gibe District, $F(2, 116) = 4.10$, $p = 0.008$; noneducated had highest *mean* & *SD* 6.72±2.51 followed by elementary 6.44±1.93 and high school & above 4.80±1.48. Level of education didn't show a significant difference in EVMPK in Hadiya $F(2, 429) = 0.53$), $p = 0.665$; in Yem $F(2, 66) = 0.13$, $p = 0.13$; in Anlemo $t(87) = 1.36$, $p = 0.17$ (two categories of education, 3rd category highschool & above had only n=3 hence neglected); in Duna $F(2, 125) = 0.14$, $p = 0.86$; and in Gombora $F(2, 90) = 0.16$, $p = 0.85$ (Table 80).

Table 80. One-Way ANOVA of education and EVMPK among informants of the area (BG = between groups, WG = within groups)

Site		Sum of Squares	*df*	Mean Square	*F*	*Sig.*
Hadiya	BG	9.104	3	3.035	0.525	0.665
	WG	2472.375	428	5.777		
Yem	BG	3.31	2	1.66	0.13	0.88
	WG	855.93	66	12.97		
Duna	BG	1.37	2	0.69	0.15	0.862
	WG	576.1	125	4.61		
Gibe	BG	58.84	2	19.61	4.1	0.008
	WG	554.63	117	4.78		
Gombora	BG	2.67	2	1.35	0.16	0.854
	WG	770.46	90	8.56		

4.2.4.23.10 Agroecology and EVMPK among informants of 20 subdistricts of the five districts

There was a significant difference in EVMPK among informants of three agroecologies $F(2, 66) = 5.13$, $p = 0.008$ in Yem, the *mean±SD* was 6.78±3.52 for lowlanders, 10.16±4.34 for midlanders and 7.75±2.48 highlanders. Post-hoc comparison revealed that difference in means was significant in pairs of midlanders with highland $MD = 2.41$, $p = 0.046$ and midlanders with lowlanders $MD = 3.38$, $p = 0.009$. However, there was not a significant variation in agroecologies $F(3, 89) = 5.61$, $p = 0.001$ mean low land 6.33, midlan 6.45 and highland 6.98 in Anlemo; $t(126) = 0.59$, $p = 0.55$ in Gibe -midlanders mean 4.98±2.19 and highlanders 4.76±2.08; $t(117) = -0.44$, $p = 0.65$ in Duna lowlanders mean 6.33±2.36, and midlanders mean 6.56±2.06, and $t(91) = 1.41$, $p = 0.16$ in Gombora lowlanders mean 7.10±3.11 and midlanders 6.26±2.58.

CHAPTER FIVE

5. DISCUSSION, CONCLUSION and RECOMMENDATIONS

5.1 Discussion

5.1.1 Floristic Diversity of the Vegetation of the study area

The overall count of 468 species recored from all quadrtas laid in the five districts showed one of the highest inventrories made so far in the country. The high floristic diversity may be attributed to the predominant preferential sampling from protected microsites where human and livestock impacts are more or less avoided. The overall floristic richness was higher in Hadiya (four districts combined) than in Yem while Yem showed highest richness of species than the four districts of Hadiya separately indicating that Yem has higher floristic richness at district level. However, the overall floristic diversity and evenness was higher in Yem than that of Hadiya. This trend of floristic diversity and evenness was not consistent on district basis. The overall diversity and evenness indices were highest in Gibe followed by Gombora, Duna, Yem, and the least overall floristic diversity and evenness in Anlemo. The species richness was higher in Hadiya than in Yem indicating the importance the remnant vegetation and different land uses of each of the four study districts in Hadiya represent different agroecologies and microsites that contributed to more species that were not common among the districts. The diversity and evenness of the vegetation of current study are comparable to some other reports from dry afromontane forest patches such as Gideon Woldemariam *et al.* (2016) for Kumuli forest in Yem (H' = 2.97, J' = 0.60) and Haileab Zegeye *et al.* (2011) TaraGedam forest (H' = 2.98, J' = 0.65) from Taragedam forest north Ethiopia, which might be attributed to similar climatic factors and human interference effects commonly evident in the Dry evergreen Afromtane and Grassland Complex of the country.

The composite floristic richness of 468 species documented in current study is both comparable and superior to other studies reported across afromontane regions of the country. Studies done in the

afromontane forests and grasslands of central Ethiopia such as Zerihun Woldu (1980) in Wolmera, Sebesebe Demissew (1988) in Menagesha Suba, Tamrat Bekele (1994) in Chilimo were the earlier ecological works that came up with inventory of fewer species in the region laid basis for further studies. A study by Gideon Woldemariam *et al.* (2016) on a closed natural forest patch of Kumuli in Yem Special District identified about 133 woody plant species, Mesfin Belete and Tamiru Demsis (2018) reported 114 species from central Ethiopia, Dodola, Tenna Regassa (2016) reported 415 species in west Shewa, Abiyot Berhanu (2017) 212 species in Awi Nothwest Ethiopia, Mamo Kebede *et al*. (2013) 240 species from afromontane forest of Wendogenet, Abate Ayalew *et al*. (2006) 174 species in north Ethiopia, Wello, Mekonen Biru (2003) 177 species from Gurage Massifs and else where Adane Girma (2011) 321 species from north and south Nandi in Kenya, east Africa. This variation in the findings may be explained by the purpose of the study, distances between the study areas and heterogeneniety of the sites that inturn is attributed to microclimatic and physical factors that dictate floristic richness of vegetation. The 18 (3%) endemic species with different threat categories and a single newly recorded species of *Rubus* sampled in Gibe in the present areas is comparable to 17 species by Mesfin Belete and Tamiru Demsis (2018) but higher than 13 endemic species reported by Ensermu Kelbessa and Teshome Sormessa (2014) reported from Bonga moist montane forest, but inferior to 43 in Chelia, Jibat & Chilimo (Tenna Regassa, 2016). In anycase, the endemism indicates the importance of the vegetation patches of of the study area and alerts of conservation of such species.

Relatively high abundance 96 families of plants recorded in the current investigation follows 104 families reported from west Shewa (Tenna Regassa, 2016) but superior to other reports across afromontane Ethiopia such as 79 families from Awi areas (Abiyot Berhanu, 2017), 57 families (Mesfin Belete and Tamiru Demsis, 2018), elsewhere 94 families (Adane Girma, 2011). In terms of species richness, Asteraceae was the dominant family with the highest number species recored in Yem followed by Duna, Gibe and Gombora while with the least number of species in this family was recorded in Anlemo. Fabaceae was the next species rich family with the highest number species recorded in Yem followed Gibe, Gombora and Anlemo;

Poaceae was also rich in species the highest number recorded in Yem followed Gombora, Gibe and Anlemo while the least number of species in this family was recorded in Duna. The dominance of families Asteraceae followed by Fabaceae can be explained by their high success and species richness in the plant world. Other study by Tenna Regassa (2016) also reported the dominance of Asteraceae with 42 species, Fabaceae 21 species and Poaceae 19 species; Asteraceae 18 species and Fabaceae 13 species Abiyot Berhanu (2017). Adane Girma (2011) also reported 24 species for Asteraceae and dominance of Rubiaceae 21 species and Euphorbiaceae 15 species in east Africa. The dominance of families Asteraceae, followed by Acanthaceae and Lamiaceaae was also reported by Mesfin Belete and Tamiru Demsis (2018).

The overall floristic diversity (*H'*) and evenness (*J'*) based on species frequency was a little higher in Yem than that of Hadiya indicating dominance of few species. District based overall floristic diversity and evenness were rather highest in Gibe followed by Gombora and Duna indicating better distribution of species. The diversity indices of current finding are comparable to some other reports from dry afromontane forest patches such as Gideon Woldemariam *et al*. (2016) for Kumuli forest in Yem ($H' = 2.97, J' = 0.60$) and Haileab Zegeye *et al.* (2011) ($H' = 2.98, J' = 0.65$) from Taragedam forest north Ethiopia.

The dominance of herb lifeform in Hadiya and Yem as well as Duna, Gibe and Gombora might be attributed to disturbance regime that allows regeneration for herbs while the dominance of shrubs in Anlemo might be attributed to grazing effect, rainfall pattern and other disturbance related factors. Denslow (1980) substantiates that communities in patch areas with disturbance of large scale clearings are most diverse in species as open light conditions increase diversity of herbaceous species in particular.

Over 50% floristic similarity of Hadiya and Yem, and the highest floristic similarity among the four districts of Hadiya can is explained by proximity of phytogeographical locations and similar environmental factors such altitudinal gradients and climatic factors such as similar rainfall pattern and temperature ranges which dictate distribution and types of floristic species. According to Müller-Dumbois and Ellenberg (1974) whenever two sites have a similarity of least 25%, they can be considered floristically similar. The

similarity of the flora with medicinal taxa in the current investigation were compared with retrieved data from ecological works conducted in other parts of the country (Table 81). Higher floristic similarity of 31% was observed with the dry afromontane forest of Biteyu at the Gurage Massifs (Mekonnen Biru, 2003) followed by 29% with a moist montane forest of Belete forest in the southwest Ethiopia (Kiflay Gebrehiwot & Kitesa Hundera, 2014), 26% with Wondogenet forest in the southern Ethiopia (Mamo Kebede *et al*., 2013), 24% with west Shewa afromontane highland forests (Tenna Regassa, 2016) and the least similarity of 22% with southwestern moist montane forest of Geba at Yayu Biosphere Reserve. A higher percentage of floristic commonality of the current study area with forests of Biteyu and Wondogenet forests might be attributed to similar altitudinal, rainfall distribution and temperature patterns shared in the same Dry evergreen Afromontane forest and Grassland Complex that allow growth of similar species. The similarity with moist forest of Belete forest and a least similarity of Geba forest of Yayu might be attributed to their difference in rainfall ranges, however, as they exist in the same Afromontane region they share considerable number of afromontane tree species which have wide range of geographical and ecological amplitudes (White, 1983). In a broader context, the vegetation type/s of the present study area is characteristised by the Dry evergreen Afromontane Forest and Grassland Complex (Friis *et al*., 2010).

Table 81. Sorenson's Similaity of species between current study area & some other study areas in Ethiopia (N = no. of spp., a = no. of spp. common to both sites)

Study Locations	N	a	Ss	1-Ss	Reference
Biteyu Forest	177	76	0.31	0.69	Mekonen Biru (2003)
Chelia,Dendi, Jibat areas	415	163	0.24	0.76	Tenna Regassa (2016)
Geba Forest	111	59	0.22	0.88	Gideon Woldemariam (2005)
Wondogenet Forest	240	93	0.26	0.74	Mamo Kebede *et al*. (2013)
Belete Forest	157	81	0.29	0.71	Kiflay Gebrehiwot & Kitesa Hundera (2014)
Hadiya & Yem area	468				current study

5.1.2 Classification and Ordination

Classification of plant communities based on patterns and trends in response to their environment is

essential in ecosystem management practices to maintain sustainability (Mucina, 1997). In this regard, multivariate analysis provides useful information on the underlying environmental drivers of species distribution, as species that live together have both similar as well as variable environmental requirements for their existence. In the present study, community 1 had highest species richness while community 2 had least species richness in Hadiya. This is based on the fact that community 1 included wide range of altitudes and large number of quadrats in Hadiya which gives chance to existence of more number of MPs. Similarly in Yem, community 3 had highest species richness while community 2 had least pecies richness that might be attributed to the extent of human and animal disturbance in sample microsites. By contrast to diversity and evenness indices based on species frequency, the diversity and evenness indices based on cover-abundance of species were higher among the plant communities identified in both sites. This might be attributed to uniformy distributed cover-abundance values of species in the quadrats and subjective preferential sampling of quadrats mainly in protected communal forest patches, sacred sites such as church compounds, grave yards, living fences, fore and back yards of homes from which human and animal disturbances are avoided. Large diversity and evenness indice show that sites of samples are less exposed to human and animal disturbances (DeJong, 1975). Other studies also reported high diversity and evenness of plant communities such as Mekonnen Biru (2003) from Biteyu forest, Berhabu Kebede (2010) from Gedo forest and Ermias Lulekal (2014) from Dense forest all dry evergreen afromontane forests.

Canonical Correspondence Analysis (CCA) is a useful ordination method that is used to simultaneously relate species data with environmental factors (ter Braak, 1986; Zhang and Thas, 2016). CCA shows the difference in vegetation patterns under the influence of environmental variables by interrelating with different types of reciprocal averaging with multiple regression techniques together (ter Braak, 1986). In the present investigation, the CCA results depicted that the constrained ordination (i.e. the constraint of the environmental factors in the species abundance) could explain a total inertia of 1.20 (25%) in Yem and 0.40 (12%) in Hadiya. The importance of components constrained axes showed that the primary separation of quadrats in ordination space was accounted for mainly by CCA1 and CCA2, was significant and explained

76% of the total variation in Yem, and in Hadiya both axes were significant and explained 78% of total variation.

Monte Carlo test showed that altitude, slope and aspect have significant effect while disturbance has not significant effect in the distribution of the plant communities in Hadiya. All the four environmental factors have significant effect on the distribution of the plant communities in Yem. According to literature, both topographic natural factors and human activities influence the distribution of plant communities at small and large scales. Environmental factors such as topography, climate, edaphic factors, slope and aspect of solar radiation as well as human disturbances are major factors that dictate the distribution of plant communities containing MPs (Zerihun Woldu *et al.*, 1989; Friis, 1992). Topographic factors such as altitude, slope and aspect are environmental factors that are responsiblle for ecological diversity (Oldfather *et al.*, 2016). They shape local climate through local hydrologic processes such as runoff water at steep and evaporates more readily at higher temperature and less available slopes in the thin soil. Altitudinal gradient is known to have influence on diversity of lifeform of plant communities with greater influences on the spatial distributions of the plant community diversity. Reports on the effect of altitude on lifeforms show that perennial herbs are tended to grow well at higher altitude, while annual herbs tended to thrive at the middle latitude and lower altitude (Xu *et al.*, 2017; Naud Lucy *et al.*, 2019). The influence of aspect also is explained in the literature that north-facing slopes receive lower solar radiation flux density, resulting in lower evapotranspiration rates and significant difference in soil properties resulting in high vegetation cover and plant diversity (Sternberg, and Shoshany, 2001; Kutiel and Lavee, 2013; Zeng *et al.*, 2014). Similarly, reports also indicate that disturbances by human activities affect distribution of plant communities (Feoli, *et al.* 2003; Linderman *et al.*, 2006; Zheng *et al.*, 2013; Li *et al.*, 2017; Caroline *et al.*, 2018; Musciano *et al.*, 2018).

5.1.3 Ethnobotanical Results of MPs in Hadiya and Yem

5.1.3.1 Overall Diversity of MPs used for Human and Livestock ailments

The high overall diversity of 301 TMPs used for treating human and livestock ailments recorded from current study area shows the high dependence of local communities on the local plant resources which led to the existence of high MPK among the study societies that passed down through generations. It clearly shows that the biological resources of TMPs are playing important role in maintaining health care of human and livestock by complementing the mainstream health care system. The higher number of MPs reported for human ailments than that of livestock indicates more prevalence of human ailments and the importance given to human health than the latter. The highest diversity of MPs inventoried in Yem than in Hadiya might be attributed to more dependence of the community on plant remedies and in part due to relative floristic richness of Yem Special District. District based diversity, Gibe had the highest diversity of MPs followed by Anlemo and Gombora while the least diversity of MPs was Duna which might similarly be attributed to degradation of natural vegetation cover compared to rest of districts and in part less prevalence of human ailments. Vandebroek *et al*. (2004) speculated that the richness of plant biodiversity would imply the highest degree of plant knowledge and inferred from their results that social factors such as family history of practicing traditional medicine, play an important role in the transmission, and hence continuity, of medicinal plant knowledge.

The number of ethnomedicinal species recorded for human and livestock uses in this study is bigger compared to similar ethnobotanical studies in different cultures across the country and elsewhere. A study from Meinit, Bench and Sheko -Southwest Ethiopa reported 124 MPs (71 species from Sheko, 51 Meinit, 35 Bench people) (Miruste Giday, 2007), 124 medicinal species reported from Kafa southwest Ethiopia (Tesfaye Awas, 2007); 230 medicinal plant species from ManaAngetu-Bale that were used for treatment of human and livestock ailments: 181 species for human medicine, 27 species for livestock medicine and 22 for both (Ermias Lulekal *et al.,* 2008); 121 species reported from two districts of Erob and Gulomeheda Districts -Tigray, North Ethiopia that were used to treat human and livestock (Tadesse Beyene, 2015). The current finding is a little closer elsewhere with that of Thomas (2008) who reported 345 species that used in traditional medicine from TIPNIS and 340 species from Quechua, Yuracaré and Trinitario Communities in

the Andes and Amazon Regions of Bolivia. Zank *et al*. (2015) inventoried 192 species of MPs from three locations in Brazilian semi-arid region (153 species from Macaúba, 132 species from Cacimbas and 101 species from Maracujá).

5.1.3.2 Diversity and abundance of MPs in the plant communities

The MPs in the quadrats of Yem had higher diversity and evenness than Hadiya. However, the MP diversity and evenness were higher in the separate districts of Hadiya was higher in Gombora, Anlemo, Gibe and Duna indicating better distribution of MPs species. Mirutse Giday (2007) also reported variation in diversity and evenness of MPs among Sheko, Meinit and Bench. In the present study, over 50% of MPs that were enlisted during interviews were encountered in the quadrats of Yem and Gombora indicating a fairly good status of MPs available in the wild habitats while lower percentage of MPs were in the quadrats of Gibe, Duna and Anlemo districts may be in part that the MPs are locally threatened in the wild habitats as a result of human activities such as agricultural expansion, deforestation and grazing and in part the informants are less knowledgeable in free listing of MPs from the wild.

The plant communities identified in Hadiya and Yem had varying richness in MPs. In Hadiya, Community 1 had the highest MP richness among the communities that might be attributed to the largest number of quadrats that also included different microsites. However, it also contained high number of MPs that had low synoptic values may indicate they are rare in the quadrats. On the other hand, Community 2 had both least MPs richness and least number of species that are rare in the quadrats that is situated in eastern side of Gibe valley. In this community, *Securidaca longepedunculata* is among the locally rare species that is highly medicinally sought species for its root bark. *Combretum molle* is also among the most highly fragile species in community 2 that is sought species for its high quality of charcoal compared to other species and sold with a high price over 500 in ETB per quintal locally.

In Yem, the three communities had almost close MP richness which might be due to closer number of sample quadrats they contained. However, community 3 had a highest number of 25 MPs with the least

synoptic values that is situated in western part of Gibe that indicates their rarity in the quadrats. The medicinal species such as *Embelia schimperi, Prunus africana* and *Rubia cordifolia* in *community* 1; *Clematis longicauda, Clerodendrum myricoides* and *Englerina woodfordioides* in community 2, and *Gardenia ternifolia, Stereospermum kuntianum* and *Tragia doryodes* in community were found rare in the quadrats. There fore, the indicated species in both study sites are of high conservation concerns.

5.1.3.3 Diversity, abundance and habit of MPs reported for human ailments

The high diversity of 278 MPs that were used to treat 166 human ailments in the current study indicates that the local people have rich MPK and they are dependent on TMPs for reasons of their accessibility, cultural acceptance and efficacy compared to the biomedical health care system. The higher number of MPs reported for human ailments in Yem than in Hadiya may partly indicate the Yem have more MPK, cultural preference of TMPs and in part due to existence of better floristic cover that is rich in MP which can be positively correlated to the use of TMPs for treating ailments. On the other hand, the lesser number of MPs reported in the four districts of Hadiya compared to Yem might be due to the fact that the local people visit formal biomedical practitioners/clinics than the Yem people do.

The present study inventoried bigger number of species, genera and families than some similar studies conducted in the country. For instance, Miruste Giday (2007) has reported 124 medicinal species classified in 104 genera and 51 families from Sheko, Meinit and Bench people in the southwest of Ethiopia; 71 species (classified in 63 genera and 33 families) in Sheko, 51 species (in 45 genera and 27 families) from Meinit and 35 species (in 34 genera and 25 families) from Bench. However, the number of species, genera and families at separate district level in Anlemo, Duna, Gibe and Gombora in the present study are less than 135 species (classified in 128 genera and 71 families) reported from Ankober District North Ethiopia by Ermias Lulekal (2014), while that of Yem District in current study was superior compared to the same author. Other studies from neighboring locations to current study include a study by Mathewos Agize *et al.* (2013) who reported 178 medicinal plant species for human ailments from districts of Loma and Gena Bosa, Dawro Zone. Similarly, Melese Maryo *et al.* (2015) reported 145 species used for human ailments in

Kembatta Tembaro Zone, Southern Ethiopia. Tena Regassa (2016) also reported 172 medicinal species from western Shewa of which 161 species from Jibat District, 157 species from Chelia and 156 species from Dendi. Comparable to present study, 204 species used by the highland Tzeltal and Tzotzil (Casagrande, 2002); as few as 59 species from Himalayan forest, Pakistan in thesis report of Adnan (Adenan, 2011); 368 MPs used by the Maonan tradition, from Huanjiang County, southwest China (Hong *et al.*, 2015); 231 MPs were reported from Western Uganda (Asiimwea *et al.*, 2014); 168 MP taxa used to treat 99 health disorders in Zacatecas state, Mexico (Reimers *et al.*, 2018). Also, about 87 species with medicinal uses were cited for Macedonia region, Northern Greece (Tsioutsiou *et al.*, 2019) indicating the use of TMPs in health care in the developed world, too.

In all the five districts, few MP families such as Asteraceae, Alliaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Rutaceae and Solanaceae were reported used to treat more than a single ailment while taxa from most of the families recorded treated a single health problem. Species belonging to family Asteraceae were found to treat the highest number of health problems in Hadiya and Yem, and in the four districts of Hadiya separately that is attributed to the rich secondary compounds it contains that are used for treating ailments and higher number of species it contains among the plant world. A number of taxa from Asteraceae are culturally known to have efficacy against ailments based on long experience and trial error. Asteraceae is also a worldwide family with 25,000 species and 1000 genera with a big number of taxa known to possess rich content of secondary metabolites such as steroids, terpenes and alkaloids that are used as anti-inflammatory, analgesic anantipyretic and antioxidant agents as proven in research works (Desmarchelier & WittingSchaus, 2000; Sílvia *et al.*, 2015).

The dominance of the families mentioned in the current study is in agreement with other works in the counry that indicated the families contain highly diverse taxa of medicinal species (Mesfin Tadeasse, 2004; Tigist Wondimu *et al.*, 2007; Miruste Giday, 2007; Tilahun Teklehaymanot & Mirutse Giday 2007; Moravec *et al.*, 2014; Melese Maryo *et al.*, 2015; Tadesse Beyene, 2015; Tenna Regassa, 2016; Ahmed Biya *et al.*, 2017). Other studies from overseas that came up with dominance of Asteraceae among others

include Asiimwea *et al.* (2014) from western Uganda; Hong *et al.* (2015) from southeast China; Hassan *et al.* (2017) from Pakistan; Axiotis *et al.* (2018) from north Macedonia, Greece; Reimers *et al.* (2018) from Zacatecas state, Mexico.

The dominance of use of herbs for human ailments in Yem and Hadiya, and in the four districts of Hadiya separately may be attributed to their distribution and availability in each district in diverse habitats including those that are disturbed and devoid of woody species. This finding corroborates with similar studies in other parts of Ethiopia which reported highest utilisation of herbaceous lifeform for phytotherapies (Mirutse Giday, 2007; Ermias Lulekal, 2014; Tadesse Beyene, 2015; Tenna Regassa, 2016). In disagreement with the present finding, Tabuti *et al.* (2003) and Maroyi (2011) reported dominance of shrubs in MPs utilized among tribals in Uganda.

5.1.3.4 Source, habitat and accessibility of MPs reported for human ailments

The greater proportion of MPs used for human health reported was from the wild sources in Yem and Hadiya, and the four districts of Hadiya separately shows people of the study area are dependent on the wild plant resources for maintaining health care and supporting other livelihood needs. However, the wild grown taxa are not managed by local people as the cultivated ones, hence, they are prone to direct and indirect threat factors such as overexploitation, grazing, lack of information about status of species collected from the wild, lack of concern and awareness about importance MPs in the wild and other natural factors such as drought. Literature also show that wild-harvested MPs are threatened by an ever-rising rural human population coupled behind agricultural expansion and growing interest on herbal products (Castle *et al.*, 2013; Rakotoarivelo *et al.*, 2015). On the other hand, eventhough the cultivated species contribute smaller proportion of the source of MPs, they play huge role in selfmedication as home remedies in all study sites. The cultivated MPs can be obtained from homegardens or some times purchased from markets. Such species include *Allium sativum, Coriandrum sativum, Ruta chalepensis* and *Zingiber officinale* that play three folds of roles: medicinal, food and economic values to families while *Artemisia absinthium, Dicliptera laxata, Eucalyptus globulus, Nicotiana tabacum* and *Ocimum lamiifolium* play medicinal values

to selfmedication of families.

Remnant forests as *in situ* natural sites, are important habitat for the wild MPs in Anlemo, Gibe, Gombora and Yem while homegarden is predominant habitat in Duna where MPs are grown as weeds as well as deliberately planted medicinally popular species. On the other hand, the higher importance of homegarden as habitat may indicate the resultant impact of habitat destruction, fragmentation and loss of native species from the wild. Basically, homegardens are good refuges as *ex situ* conservation and management sites for those threatened and rare species in the wild and the cultivated MPs too (Zemede Asfaw, 2001). The current finding regarding source and habitat of MPs for human uses is in agreement with other studies conducted in different parts of Ethiopia (Mirutse Giday, 2007; Tesfaye Awas, 2007; Ermias Lulekal, 2014; Tadesse Beyene, 2015), and elsewhere from Madagascar by Reazafindraib *et al*. (2013).

Over 65-75% of the MPs freelisted in each district were in the accessibility category of 'common' and 'very common' indicating that their local availability in close vicinity that can be obtained short period of time (for instance within 5-10-30 minutes) whenever needed. On the other hand, about 1/3rd of the MPs designated as locally in 'rare' status in each district are ones suffered overexploitation due to their local importance and destruction of their habitat. Such species include *Asparagus africanus* and *Cucumis ficifolius* (in Duna, Gibe & Gombora), *Englerina woodfordioides* (in Duna, Gibe and Gombora and Yem) *Haplocarpha rueppellii* and *Inula confertiflora* (in Yem), *Securidaca longepedunculata* (in Gibe, Gombora & Yem). According to Schippmann *et al*. (2002), rare species which have narrow geographic distribution, habitat specificity and of small population sizes are more fragile than species of any other pattern. Therefore, prioritizing conservation efforts for rare species in this finding is highly suggested.

5.1.3.5 Number, type and sign & symptoms of human ailments and MPs used

The findings on overall ailments reported showed that abdominal pain, acute febrile illness, arthritis, dyspepsia, 'awachifebe?u'/'danifurutu', hepatitis, malaria, 'mich' and tonsillitis were the most cited human ailments from the five districts. The root causes of the ailments are culturally linked to disharmony with

God and causes from evil spirit, curses from paternal parents and locally respected people due to wrong doing while the biomedical causes are linked to biological and nonbiological agents such as microbial and parasitic infections, poor hygienic food and water that are related to low standard of living, changes in weather and climate, unsafe working physical environment. Similar findings have been reported from other parts of the country (Tadesse Beyene, 2015; Tenna Regassa, 2016), and Rakotoarivelo *et al.* (2015) from Madagascar.

Results showed healers, family heads and patients themselves traditionally diagnose different ailments by using diverse physical sign and symptoms. Among the diverse sign and symptoms, ones that had highest reports in each district were - fatigue in Anlemo; headache in Duna; cough in Gibe; inability to move in Gombora, and abdominal pain in Yem. Local healers in particular observe the physical sign and symptoms of the patient to comeup with the ailment type the patient suffers from and prepare the right MP remedy. The expertise is based on longterm experience and experimentation they developed. The sign and symptoms are also used post application of phyotoremedies in indication that the drug has acted on the ailment agent. The biomedical practioners also use sign and symptoms during history of patients but support the diagnosis later by laboratory examinations. However, the traditional diagnosis methods and modern medical diagnosis usually do not have a direct one-to-one correspondence with discrete diseases within the biomedical system (Vandebrook, 2008). One of the the criticisms of traditional diagnosis and use of MP for treating human ailments may be wrong diagnosis of ailments by only physical inspection of the patient and administering phytoremedies. In fact, some acute ailments might be fatal, hence, seeking biomedical attention side by side is advisable. There are other ethnobotanical studies which reported use of traditional sign and symptoms in the treatment of human ailments (Mirutse Giday, 2007; Ermias Lulekal *et al.*, 2008; Tadesse Beyene, 2015).

The findings showed that over half (58-71%) of the human ailments in all districts were known to be treated by a single taxon while the smaller proportion of them were known to be treated with two or more taxa. The fact that a single ailment might be treated with different therapeutic species might be based on high

morbidity of the ailments in the localities, use of different species depending on local availability of therapeutic species and variation in knowledge of therapeutic species in different study areas. This was evident from the interviews that the informants from different localities freelisted different medicinal taxa for the same case depending on their personal knowledge and local importance of taxa. Kokwaro (1976) also indicated that local utilization of phytoremedies varies from species to species, from disease to disease, from place to place and from person to person. Species used to treat multiples of ailments in the study area might be based on their popularity at local and national level. In Hadiya area, such species whether cultivated or wild are locally recognized as 'medicine for 12 ailments' to indicate the popularity of the species to treat different aiment types. The survey further showed that most healers of Yem and few of them from Hadiya area use concoction of MPs for a single health problem. This might be due to the level of expertise among the healers in part and in part due to the belief that multiple therapy could promote healing potential of the phytoremedy and helps the clients to have trust on healers. The use of concoction of MPs for a single case is in agreement with a report by Bussmann and Sharon (2006) who showed healers use concoction of several species for treating a single case among indigenous communities of northern Peru. According to literature, the use of multiple therapeutic species for a single case is thought to have a synergistic antagonistic pharmacological agents within themselves that work together in a dynamic way to produce therapeutic efficacy with minimum side effects (Tiwari and Rao, 2002; Ebong *et al.*, 2008). Rasoanaivo *et al.* (2011) also indicated that extracts of multiple plant species may have an immunomodulatory effect improving immune functions and some plant constituents may attenuate/reduce the sideeffects of others. The use of multiple of therapeutic species for a single health case and vice-versa in the current study is in agreement with other studies reported across the coutry such as Dawit Abebe and Ahadu Ayehu (1993), Byafers Tamene (2000), Tadesse Beyene (2015) and elsewhere from Bangladesh, Nigeria, Peru and Uganda (Hossan *et al.*, 2010; Luziatelli *et al.*, 2010; Rahmatullah *et al.*, 2010; Tabuti *et al.*, 2010; Maroyi, 2011; Ouhaddou *et al.*, 2014; Ofuegbe and Adedapo, 2015).

5.1.3.6 Parts and state of MPs used to treat human ailments

Based on the findings, almost all parts of the MPs are known to be employed for treating human ailments. In particular, overall leaf was the most used part in all districts variably followed by root, fruit and shoot tip. The explanation for the widespread use of leaf may be with a thought it contains healing substances, its ease for collection and its availability for most seasons of the year. Moreover, leaf is a photosynthetic organ where secondary bioactive molecules that are used for treating ailments are synthesised (Tugume *et al.*, 2016). Likewise, the usage of roots for considerable number of preparations might be attributed to the fact that it is a sink for synthesised metabolites that are medicinally important**.** The root is also favoured because it is protected parts from physical damages and even when leaf is shed or withered they stay alive keeping active molecules inside and its availability throughout the year and traditionally considered to be source of strong medicine (Mahwasane *et al*., 2013). However, unwise and nonsustainable harvest of root poses strong threat on the mother plant especially for those species that are under different status of vulnerability for overexploitation unless they are brought under proper management (Cunningham, 2001). Other studies with similar findings on use of leaf and root as the most widely used plant parts across the country are Mirutse Giday *et al.* (2009), Moravec *et al.* (2014), Ermias Lulekal (2014), Tadesse Beyene (2015) and Bussmann and Sharon (2006) and Maroyi (2011) in Nhema, Uganda.

The highest use of fresh MP remedies for human health in all study sites might be in part due to the availability of the species in any desired time, and partly the availability of some volatile bioactive compounds in the fresh remedies to bring the desired effect. In those dry plant materials other than seeds such as leaf and bark may lose their volatile oils and other compounds during the process of inappropriate drying and storage as they might be prone for fungal and pest attack and photobleaching, hence, may lose efficacy. Of course, for those species whose access is difficult and dependent on seasonal variation, securing dry remedies might be alternative provided that the storage goods are ones that do not lead to perishing. Other studies in agreement with this findings include Miruste Giday (2007), Ermias Lulekal

(2014), Tenna Regassa (2016) and from elsewhere Bussmann and Sharon (2006),Tugume *et al*. (2016) and Opio *et al*. (2018).

5.1.3.7 Methods of preparation, composition of MP remedies, diluents used, route of application, mode of application of plant remedies for human ailments

The findings showed different methods of preparation that are preceded by grinding or pounding of the remedy for a number of MPs parts to increase surface area so that extraction will be efficient by solvent to help extraction of biologically active compounds. Among the different methods of preparation, maceration was the highest cited method in all study sites. With maceration, the mixture of the damp solid material is pressed then is strained, and the combined liquids are clarified by decantation or filtration after standing (Handa *et al*., 2008). Elsewhere Ouhaddou *et al*. (2014) reported maceration of plant remedy in cane alcohol among with the honey or oil were used to obtain usable component. Maceration was also reported as a major method of remedy preparation in Keffi, Nigeria (Mowobi *et al*., 2016). In disagreement with this finding, decoction was the most common method of preparation of phytoremedy reported in other parts of Ethiopia include those of Ermias Lulekal (2014) and Tadesse Beyene (2015).

The findings showed that a number of MPs remedies in all study area employ about 26 different types of additives. The explanation for the use of additives is to increase the efficacy of the remedies used, to mask the disgusting smell and taste of the phytoremedies orally and reduce side effects of the remedies. Tugume *et al*. (2016) substantiates that additives enhance extraction of bioactive molecules during remedy preparation and believed to minimize discomfort, improve taste and reduce adverse effects such as vomiting and diarrhoea. This finding is in agreement with similar studies that reported use of additives to herbal remedies such as Kalayu Mesfin *et al*. (2013) and Tadesse Beyene (2015) and in overseas Napagoda *et al*. (2018) in Gampaha District, Sri Lanka and Ouhaddou *et al*. (2014) in Morocco.

The investigation revealed that the MP remedies for human ailments applied through oral route in all study districts. The explanation for oral application is that ailments are more of internal organs and the remdies

are prepared in solution form, hence, the remedy can reach sooner to the target ailing site and show the desired action. This finding is in agreement with similar studies reported in Ethiopia (Ermias Lulekal, 2014; Melese Maryo, 2015; Tadesse Beyene, 2015; Tenna Regassa, 2016) and in Africa (Maroyi, 2011; Tugume *et al*., 2016; Opio *et al*., 2018), in Philipinnes in Asia (Tantengco *et al*., 2018). Drinking was the most dominant mode of application as most remedies were prepared in the form of solution in all the districts and most of the phytoremedies being dissolved by water as diluent for preparation. The use of dilutants is to release the bioactive compounds contained in the herbal remedies by the power of solvent mainly the water potential. This finding is in agreement with Kalayu Mesfin *et al*. (2013), Opio *et al*. (2017) and Tantengco *et al*. (2018).

The preparation and application of the herbal remedies had some traditional and religious beliefs and taboos in both Hadya and Yem cultures. Beliefs, norms and taboos are parts ofTM that make this system of medicine different from the mainstream health system. A similar finding was reported by Mirutse Giday and Tilahun Teklehaymnot (2009) and Getnet Chekole *et al*. (2015).

5.1.3.8 Dosage, side effects and inconvenience and antidotes of human MPs

Results showed that the communities of the study areas use various local and traditional measuring objects and estimation of amount of phytoremedies in specified duration of time that lack standard. It was also found that local herbal experts are aware of the side effects of remedies and they administer the remedies based on age, physical condition of the patient and time of pregnancy of the patients. The absence of standard dosages of phytoremedies is where skepticism as well as allegations raised against traditional herbal remedies by mainstream health practitioners and educated people. Another allegation is related to lack of asceptic standards of the herbal samples and the equipment used for preparation and management of the remedies (Matotoka and Masoko, 2017) which should be brought to scrutiny for conducting phytochemical standards of the phytoremedies. Lack of standard dosages in herbal remedies was also reported by Mirutse Giday (2007), Ermias Lulekal *et al*. (2008) and Tadesse Beyene (2015).

The results showed that most of the MPs remedies reported in the study area were without observable side effects while few of them are said to incur some side effects. The main side effects reported include among others diarrhea, nausea and vomiting. According to informants' experience, the side effects like diarrhea is acceptable and indication of assimilation of the remedy to yield the desired outcome. For instance, the remedy prepared from *Hagenia abyssinica* for taeniasis severely results in severe diarrhea as the remedy assimilates and empties the alimentary canal along with the worms. For those who use this remedy, taking in a small amount is advisable. Moreover, patients need to be sure to prepare the necessary antidotes before intake of the remedy to minimize the side effect. The diarrhea is also considered a number of old age people as cleansing the body to maintain healthy condition. Other species that induce diarrhea include *Croton macrostachyus* and *Crepis rueppellii*. Remedies from some species such as *Ajuga integrifolia*, *Aloe* sp. and *Teclea nobilis* might induce vomiting before the remedy assimilates. Some remedies from species such as *Cucumis ficifolius* and *Gnidia glauca* are reported to be fatal, even for physically strong patients in taking in excess amount, hence only little amount is used. The local communities were known to use different antidotes for reversing the side effects posed by some medicinal species. The first measure is staying at rest at home from work and journey. Healers oftentimes know the consequent sideeffects and advise clients/patients to prepare antidotes before hand and use them when effects of and symptoms of side effects start. The finding of current study corroborates with other studies from other cultural groups across the country (Mirutse Giday, 2007; Ermias Lulekal, 2014; Tadesse Beyene, 2015).

5.1.3.9 Marketability of the MPs used for human & livestock health

Ehnobotanical observation of markets is important to identify species under threat and to address the issues of overexploitation (Cunningham, 2001). Market observation of current study revealed that most of the wild grown MPs freelisted during interviews in the districts of Hadiya were not marketed except those cultivated species that have nutraceutical uses indicating that the local people get them from their vicinities and local herbal experts, and in part considering that trade of MPs couldn't generate attractive income. Similar

observation was found from the markets of Yem in indication that selling of MPs is taboo in the culture, hence, local people obtain herbal remedies either by visiting local herbal experts or resorting to natural habitats to obtain them. The observation of seedlings of few rare medicinal species sold in almost all of the markets of Hadiya area during rainy season is encouraging which indicates that local markets are dispenseries for conservation the MPs in loss/threat and develop practice of *ex situ* conservation in homegarden and living fences. Among the few MPs sold, *Securidaca longepedunculata* and *Withania somnifera* are locally threatened species that need attention of conservation.

On the other hand, the nutraceutical MPs observed in abundance in all the markets are most important for home remedies, as food and spices. Such species have a commonly saying in Hadiya 'godabina goda-genshina qerare' that is translated as 'a fill for stomach/hunger and a remedy for sickness' in indication of dual purposes of the species. The nutraceutical species are means of economic activity for considerable number of families both for men and women and they were found to gain some income that helps them earn life from the sale. However, the term nutraceutical comprises nutritionally or medicinally enhanced foods and manipulated by pharma and biotech companies with health benefits which has gotten high attention in the developed world (Agrawal, 2009). The absence of ethnomedicinal vendors except a single vendor only in Gibe District in the current study may indicate in part absence of renowned herbal specialists in each case and in part the herbal vendors might be confined locally in the villages other than the market. Other ethnobotanical reports on marketability MPs in Ethiopia include that of Kloos (1978), Hareya Fassil (2005), Abiyu Eniyew *et al*. (2013), Ermias Lulekal (2014), Getnet Chekole *et al*. (2015), Debela Hunde *et al.* (2015), Melese Maryo (2015) and Tadesse Beyene (2015). Elsewhere, Sher *et al.* (2011) also reported as few as 22 medicinal species in indicating gatherers have very little marketing skills and are often not aware of the high market value and sell with low prices. In disagreement to present finding, Casagrande (2002) reported active sale of herbal products from local vendor in Tzeltal Mexico. Shanley and Luz (2003) also reported active sale of about 200 medicinal herbs, shrubs, and trees in shops, on curbsides for both minor and serious ailments for a significant portion of the region's population mainly the poor at Ver-

o-Peso market, Belém - eastern Amazonia. Amiri and Joharch (2012) also reported more than 600 herbalist shops trading natural medicinal products and 269 medicinal plant species belonging to 88 families in the Mashhad markets in Iran. Ofori *et al.* (2012) also reported marketability of about 160 MPs in Ghana and over 100 species becoming scarce or unavailable due to the high demand.

5.1.3.10 Threats to MPs and perceived conservation options

Based on the outcome of preference ranking, the top perceived threat factors to the loss of the MPs in all districts in common among others were agricultural expansion and charcoal & fuel wood extraction in woody species. Drought is another natural factor that occurs as a result of climate change with consequent erratic rainfall distribution leading to withering away and death of species annual as herbaceous lifeform as well as seedlings of woody. Generally, the country's TMPs and that of the study areas faced serious threat of sustainability primarily due to human-induced destruction of habitat as a result of land use pressure for agriculture and livestock grazing (Ensermu Kelbessa *et al.*, 1992). In agreement with the finding of current study, there are also other studies across the country that reported similar threats of MPs (Endashaw Bekele, 2007; Mirutse Giday, 2007; EtanaTolassa, 2007; Ermias Lulekal *et al*., 2008; Kalayu Mesfin *et al*., 2013; Mohammed Adefa and Seyoum Getaneh, 2013; Balcha Abera, 2014; Debela Hunde *et al*., 2015; Ermias Lulekal, 2015; Gonfa Kewessa *et al*., 2015; Tadesse Birhanu *et al*., 2015; Atinafu Kebede *et al*., 2017; Gemedi Abdela *et al*., 2018; Seble WoldeYohannis *et al*., 2018). Similary, studies from overseas with similar findings include that of Maonan people in China (Hong *et al*., 2015), Colombia (Cadena-González *et al*., 2013), Savina *et al*. (2014) from lower Pakistan (Hassan *et al*., 2017). Regarding locally perceived conservation options, overall avoiding destructive harvesting, planting rare species in communal forests and homegardens, planting alternative environmentally friendly species for energy and construction, leaving multipurpose species amid of farm were the foremost recommended ones. The present finding is in agreement with other studies across the country and elsewhere (WHO *et al*., 1993; Etana Tolosa, 2007; Romesh *et al*., 2011; Kalayu Mesfin *et al*., 2013; Debela Hunde *et al*., 2015; Ermias Lulekal, 2014; Tilahun Tolossa and Moa Megersa, 2018).

5. 1.3.11 Guided transect walk, Focus Group Discussions and Participant observation

During local guided transect walk, landscape managements such as home gardens, living fences, agricultural fields, grazing fields, some protected communal enclosures, few historic sites/sacred sites, patches of *Eucalyptus* plantations and few protected natural forests were observed. These are important repository sites for the genepool of threatened and other plant diversity in general and MPs in particular. Another observation was on recent tendency of local people mainly in Gibe and Gombora on intensification of eucalypt plantations on parts of their farmlands and edges of farms that harbor native species for generating cash. These species are debated as a blessing and curse paradoxes of their uses and environmental damages they incur as a result of pumping much ground water and allelopatic effects on indigenous undergrowths (Mesfin Abebe and Wubalem Tadesse, 2014). The negative impacts of eucalypt on undergrowths has been theorized among environmentalists. However, some domestic studies reported absence of negative impacts on native undegrowths (Michelsen *et al.*, 1996; Feyera Senbeta *et al*., 2002). On the other hand, reports from overseas showed allelopathic impacts of the species on undegrowths (El-Rokiek and Eid, 2009; Sasikumar *et al.*, 2009; Becerra *et al.*, 2018). Replacement of indigenous trees and shrubs by exotic tree species mainly *Eucalyptus globulus* was also observed in Debark landscape, Ethiopia (Belay Tefera *et al*., 2014).

The outcome of group discussion showed that the local people use both the government provided mainstream health care system and TMPs side by side for managing their health care. The finding of the discussion showed that benign and chronic ailments are first treated with MPs and by the mainstream biomedical system if no progress found while the biomedical health care is sought for acute cases. The TMPs are observed to be preferred for number of cases where the mainstream health care is not believed to be effective and satisfactory, and when there is shortage of money to pay for the biomedical services. This indicates that both the TMPs and biomedical system are employed for improving human and livestock health. This finding is in agreement with the finding of Brandão *et al.*, (2005) among people of Brazil and Graz *et. al*. (2011) in Latin America. However, Bussmann *et al.* (2007) indicated the tendency of use of

pharmaceutical medicine plays a larger role when compared to the use of MPs with a belief that this medical system is faster and more effective in Anticona in El Porvenir, Peru.

The discussions showed that the veterinary health problems are also managed by both EVMPs and modern veterinary medicine. However, findings showed that the mainstream veterinary clinics are not available at the extent of remote subdistricts being confined to substations at far locations. Hence, the local people need to commute long distances to the substations to consult vet professionals if they can be helped. During the discussions, informants indicated team of vet practioners campaign to subdistricts when there is incidence of outbreak of some livestock ailments. The shortage of well established veterinary system is compensated by non-professional petty traders who sell veterinary pharmaceutical drugs whose quality and standards are nor verified in open markets and villages in in the form of injection vials, and tablets what they call it 'chalk'. The drugs are given to ailing animals with high dose once by owners of the livestock or by self skilled experts in neigbors. Such practices should be brought to surveillance for preventing intrude of counterfeit and expired veterinary pharmaceuticals.

Group discussions also revealed that the younger generation has no interest in use of TMPs considering it as backward practice and non-scientific and tend to use the formal health services. The finding also showed that the local people are discouraged by mainstream biomedical practitioners and health extension workers not to use TMPs, rather they advise them to consult the former**.** In line to this, the finding of independent interviews with the heads of health offices in the five districts revealed that none of the district health officers acknowledge the use of TMPs and the practices of herbal practioners. They further asserted that the society uses traditional herbal medicine by their own, and they teach them not use TMPs and its practices considering a harmful and bad practice, their efficacy is not scientifically proved and doses are not standardised and have a number of unspecified side effects. Such negative attitudes to practices and use of TMPs by the mainstream medical practitioners and younger generation need to be averted since the TMPs contribute a lot in maintenance of public health. This can be resolved by justifying the efficacy and safety of

TMPs through phytochemical screening and clinical trial of phytoremedies in collaboration between both systems of health care. WHO Regional Office of Africa (2003) underlines existence of challenges of the integration of TM into national health care systems due to factors such as lack of political recognition of TM, lack of regulatory and legal frameworks for practice of TM, inadequate protection of IPRs and biodiversity, denial of the role of TM practices for health care, lack of mechanisms for registration of TM, inadequate data on scientific and clinical validation of TMs. Therefore, this needs commitments of all stakeholders that link to societal health system work in collaboration to enhance and utilise the benefits gained from use of TMPs in health care.

From participant observation of a local herbalist healer's traditional clinic in Yem, it was learnt that the TMPs and associated knowledge is locally valued and this system of medicine complements the mainsream health system while the traditional practioner is making good income for his services. However, it still tasks collaboration of practioners of the mainstream health system and other parties to assist the TM pratitioners by training about issues of safety and asceptic techniques, ethics and responsibilies on the services rendered to the populace, and also evaluate and monitor quality of the services. Participant observation the unique anniversary occassion of MP Collection Day /the 'SAMO-ETA' day of Yem culture that is held at Mt. Bori shows the existence of deeprooted and generation old traditional practice and knowledge of utilizing MP resources for managing health care of both human and livestock. The important finding from this cultural event shows the mixing together of culture, religion, agroecology and science together for safeguarding health care system and improving life standard.

The cultural aspect of this occasion is that this generations old practice and belief is unique of its kind across the country and even it might be limited to exceptional geographic location/s of the world. The religious dimension of the occasion is that the Yem are predominantly followers of Orthodox religion and October 27th (Tikimt 17) is a sacred day to martyr St. Stephen (Kidus Estifanos) of Holy Bible and it is believed that every herbals collected on that day is traditionally believed to have healing potential for ailments of human and livestock. Regarding the agroecological aspect of the occasion, the mountainous

landscape favours evolution of MPs species with distict distribution ranges than elsewhere. The other point the informants indicated is that the site receives the first beams of solar radiations as the Mt. is altitudinally legend in Yem and close territories about 2939 m and the society believe that this helps the plant species of the Mt. Bori to make medicinal products which has coincidence with with the scientific fact. Based on these rationals, the local people use the 'SAMO-ETA' MP collected and stored as recipe for treating and curing almost about 179 different ailments of human and livestock. This festival is unique of its kind across Ethiopia that is handed over from past to present. Therefore, safeguarding and strengthening of this unique traditional practice of collection of 'SAMO-ETA' that links nature and health care development and *in situ* conservation of the plant biota is highly suggested.

There are few reports around the world on traditional ritual and semi-religious festivals related to wellbeing of communities. For instance, in Balkan Orthodox religion related festival of celebrating St. George Day, people used to go would go out in the fields before sunrise into forests and gardens and pick different plants and flowers used for rituals, magical purposes and to assure fertility and wellbeing (Terzić, *et al*., 2015). Rana *et al*. (2016) reports existence of strong traditions, cultural activities, beliefs, taboos, totems, performing religious rituals related to medicinal uses of plants among tribal communities in Districts of Banswara and Dungarpur, India. In Chinese tribal culture, medicinal market is underwent during the Dragon Boat Festival in Jianghua County, Hunan Province (Luo *et al*., 2018).

5.1.3.12 Outcome of Preference Ranking, Informant Consensus Factor, Fidelity Level, Use values and Relative importance and candidacy MPs for development of phytoremedies

The quantitative tools used such as PR, ICF, FL, UV and RI showed that the study area have high diversity of MPs that have highest popularity and cultural agreement among the communities that can be candidates for further phytochemical analyses and clinical trials for standardising their employment in health system and development of drugs when possible. The TM uses of the species in preference of this finding has also been reported medicinal by studies in the country. For instance, *Englerina woodfordioides* (Samuel Zerabruk and Gidey Yirga, 2012; Muluken Wubetu *et al.*, 2017), *Allium sativum* (Fisseha Mesfin *et al*.,

2009; Alemayehu Kefalew *et al*., 2015; Muluken Wubetu *et al*., 2017), *Brucea antidysentrica* (Behailu Etana, 2010; Samuel Zerabruk and Gidey Yirga, 2012; Muluken Wubetu *et al*., 2017), *Croton macrostachyus* (Behailu Etana, 2010; Mengistu Gebrehiywet, 2010; Fiseha Mesfin *et al*., 2014).

The highest ICF values obtained for dermatological ailments ICF 0.91 in Anlemo and 0.94 in Gombora, and sensorial ailments & headache 0.91 also in Anlemo; gastrointestinal & visceral organs ailments 0.94 in Duna and 0.82 in Yem; miscellaneous ailments and respiratory ailments 0.91 each in Gibe indicate existence of high agreement among informants on the prevalent ailments and MPs used to manage them. High ICF values indicate the prevalence of the ailments mentioned in the categories and high dependence of local people on the MPs that are available in the local flora (Lin *et al*., 2002; Heinrich *et al*., 2009; Andrade-Cetto and Heinrich, 2011; Madikizela *et al*., 2012). High ICF value is known to be very useful in the selection of specific plants for further search of bioactive compounds (Cotton 1996; Heinrich *et al*., 2009). The high prevalence of the ailments in the identified categories in each district might be attributed to poor hygienic living conditions such as absence of enough water and sanitizing agents for washing topical body parts, lack of sanitation and living along with domestic animals, consuming of raw/uncooked meat, lack of sanitation of dishes and improper management of prepared food, local climate favouring vectors such as flies, lack of balanced diet, lack of awareness and poverty. According to Prüss-Üstün *et al*. (2008) the ailments associated with poor sanitation are particularly correlated with poverty and infancy which accounts for about 10% of the global burden of disease.

The high ICF of dermatological ailments in Anlemo and Gombora in the present study conforms with the prevalence of such disoders among rural societies of Ethiopia who make use species such as *Acokanthera schimperi* and *Euclea schimperi* (Tsige Gebre-Mariam *et al*., 2006). Elsewhere, dermatological disorders such as abscesses, acne, burns, boils, incisions, ringworm, rashes, shingles, sores, wounds and warts were treated by 47 plant species (35 families) mainly from Fabaceae (eight species) in northern Maputaland, South Africa (De Wet *et al*., 2013), the same types of ailments were also reported to be managed with 30

botanical families mainly Euphorbiaceae and Asteraceae in Keffi, Nigeria (Mowobi *et al.*, 2016). Umair *et al.* (2017) also indicated high ICF of dermatological disorders from Hafizabad district, Punjab-Pakistan. With regard to the high ICF of gastrointestinal and visceral organ ailments in Duna and Yem Districts, there are some reports in agreement this finding from nationwise and overseas. For instance, Belachew Garedew and Dagne Abebe (2018) reported the high prevalence of gastrointestinal parasitic diseases in Yeki District, Southwest Ethiopia. Bussmann and Sharon (2006) also indicated that internal organs disorders (of liver, gallbladder, diarrhea, colic) were the most commonly treated medical conditions in norther Peru. Asiimwe *et al.* (2014) also reported a high ICF for gastrointestinal disorders treated with the highest number of species (127) in western Uganda. Umair *et al.* (2017) also found a high ICF for gastrointestinal disorders from Hafizabad district, Punjab-Pakistan. Reimers *et al.* (2018) also reported high ICF for gastrointestinal illnesses in Zacatecas state, Mexico.

The high ICF of musculosktal ailments in Gibe district in the present finding is in agreement elsewhere with the report of prevalence musculoskeletal disorders in Navarra in Brazil and management of them mainly with taxa from Asteraceae, Lamiaceae and Rosaceae (Cavero and Calvo, 2015). Song *et al.* (2014) also reported a high ICF (0.98) for musculo-skeletal disorders that are treated by 49 taxa in Gayasan National Park, Korea. Malik *et al.* (2015) also found that Musculosketal ailments to have the highest use category of (44%) treated by 142 plants taxa.

In the present finding a number of MPs have gotten high healing potential for human ailments in the five districts. According to literature, high FL values of numerous species may indicate that the informants had a tendency to rely on one specific plant species for treating one specific ailment than for several different ailments i.e. when a species treats a single ailment, and low FL values show that plants are used for a wide range of ailments/different purposes (Andrade-Cetto and Heinrich, 2011; Tangjitman *et al.*, 2015; Teixidor-Toneu *et al.*, 2016; Ducusin, 2017). Basically, species with the highest FL values are known to possess highest healing potential of ailments and they are considered as model plants that can be employed

for further phyotochemical investigation (Trotter and Logan, 1986; Heinrich *et al.*, 1998; Hassan-Abdella *et al.*, 2013).

The high use values of species in the present study indicate that they are most important, best known and most utilized by the local people. Use Value is a quantitative tool that measures types of uses and relative cultural importance associated with particular species (Vendruscolo and Mentz, 2006). A high UV of plants also indicates their abundance in a specific study area and their consistent use for the treatment of various ailments and high usage reported by the number of informants shows that the plant is well recognized by the local inhabitants and is well utilized in ethomedicinal purposes (Phillips and Gentry, 1993a; Kayani *et al.*, 2014). More importantly, the taxa that are used over and over again are more likely to be biologically active (Trotter and Logan, 1986). On the other hand, plant with low UVs may not be necessarily less important. It may reflect the unawareness of people of that area and lack of understanding of proper use of medicinal flora (Camou-Guerrero *et al.*, 2008). With a similar trend to UV, few species scored the highest relative importance index (RI) in all districts indicating the usefulness of the MPs in possession of pharmacological properties (Bennett and Prance, 2000).

5.1.3.13 Use Diversity of MP species

In addition to providing affordable health care, most of the medicinal taxa in all districts were known to provide a number of additional biodiversity use values to the local communities. More than 50% of the taxa in all districts were known to provide 3 or more additional uses. Among the 12 use categories of medicinal taxa in all districts, the maintenance of soil and climate which is a regulating service of biodiversity had the highest proportion of taxa. The next use categories with big proportions of medicinal taxa in all districts were farming and house hold tools, construction, extraction of fuel wood and charcoal, fence and forage. According to literature, the multipurpose MPs serve a wide range of economic, sociocultural, and in underpinning the major ecosystem services: namely the provisioning of materials and goods, regulating,

cultural and supporting services that are important for the livelihood of local people (Thomas and Million Bekele, 2002; Millennium Ecosystem Assessment, 2005; Belay Tefera *et al.*, 2014).

The multipurpose MPs existing in the forest and agroforestry ecosystems of both Hadiya and Yem play a grand role in the ecosystem services. Among these services, their roles is in maintenance of soil and climate was a category high use reports next to the medicinal role of the multipurpose species. The landscape of both Hadiya and Yem have a number of tributary rivers that drain into Gibe river which is playing role in generating the biggest megavolts of power to the fast growing economy of Ethiopia. As the vegetation cover in general and MP species in particular dwindle from the sites, the volume of these rivers getting shrinked or completely dried during the dry season. Moreover, summer rain could carry big volume of soil from upstream into the river that leads to siltation of the hydroeclectric dams of the river. Literature show that about 1.9 billion tons of soil is lost annually from the Ethiopian highlands into big rivers of the country by rainwater erosion owing to degradation of vegetation cover as a whole and multipurpose species in particular (Thomas and Million Bekele, 2002). Moreover, these species among others serve as sink for carbon, maintain hydrological cycle and fight climate change, lessen the impact of rainfall allowing water to percolate, prevent siltation of dams and lakes (Thomas and Million Bekele, 2002). Forage is another important value of themultipurpose MPs that contribute cruicial role in livestock production (Thomas and Million Bekele, 2002; UNDP Ethiopia, 2017). Multipurpose species also provide shade tree coffee plants, homegardens, improvement of soil fertility and reduction erosion, firewood, and honey production (UNDP Ethiopia, 2017). The multipupose species are also the main sources of construction materials for both rural as well as urban communities. The annual demand for construction wood is estimated to be 2.10 - 4.20 million m^3 (Thomas and Million Bekele, 2002). Regarding resources of energy, multipurpose species provide materials for fuelwood and charcoal mainly for the rural community of the study areas. It is estimated that woody species provide about 78% of all energy consumption for the rural households in the country with annual average consumption of 1 m^3 per capita (Thomas and Million Bekele, 2002).

From the analysis of direct matrix ranking, it was found tht the multipurpose MPs in the study area are threatened by different livelihood activities other than the medicinal values. Such threatening activities include agricultural expansion and nonsustainable utility values such as farming and household tools, construction, extraction of fuel wood and charcoal, and forage obiously threaten these important native taxa in each district. Therefore, it is important to monitor the impacts of such utility services, educate local communities on sustainable harvesting practices and cultivation of such species are some of the conservation measures suggested. Meanwhile, the local people of the five study districts developed practices of cultivation of the exotic multipurpose medicinal species of *Eucalyptus camaldulensis* and *E. globulus*. The species are highly valued in that they grow and incrcease biomass fastly in almost every land uses with little management compared to the native species and provide wide range of utility services and economic values. Equally important, it needs to give due attention for cultivation of some fast growing native species that have no environmental impact.

5. 1.3.14 Emic Catagories of the natural resources in Hadiya and Yem

Both the Hadiya and Yem people have rich indigenous/traditional knowledge of classifying natural environment and its resources around them from a general more inclusive level to specific level of hierarchies. The emic classification of plants and illnesses is likely to show some differences from those used by a botanist (etic categories) as was done by Sutherland (2000). In both cultures, plants are grouped into different emic categories based on attributes such as medicinal and other use values. Literature shows that local people classify nature not only from utilitarian point of view, but also for cognitive, or intellectual purposes guided in essence by abstract thinking, a distinctly and uniquely human attribute (Morris, 1984; Kujawska *et al*., 2017). Folk names/vernacular names of the plants used in both sociocultral groups reflect the historical development of plant use in the region and help to establish taxonomic information of the local plant biodiversity at the national datatabase.

Naming of folk plant taxa in both Hadiya and Yem follows designation with a single word that can be associated with some attribute of the plant, or it makes use of folk binomial/compound expressions of parallel syntactic composition as indicated by Hunn and French (1984). Such names indicate that the taxon so named is subordinate to the taxon named by the head constituent of the name which is analogous to the botanical binomial nomemclature (Atran *et al.*, 1997). The folk Hadiya and Yem names of the MPs in current study had one-to-one equivance with the standard taxonomic naming at specific level while few of them were overdifferentiated, and still a few of them underdifferentiated as found by Berlin *et al.* (1966) and Berlin (1992). Moreover, folk namings of plants in both Yem and Hadiya generally follows kinds of gender (male/female), ecology, taste, domestic and wild animals as indicated by Zemede Asfaw and Mesfin Tadesse (2001). Generally, the emic ecological knowledge/indigenous knowledge in collaboration with etic knowledge in both traditions play important role for sustainable utilisation of natural resource, managing the threats posed against them and protecting and conserving them using indigenous knowledge and reconciling the emic and etic knowledge for the sustenability of the scarce natural resources for the future generation and ensuring sustainable development (Martin, 1995).

5. 1.3.15 Transfer of knowledge of MPs used for human and animal ailments

The findings depicted that the overall social unit of transfer of MPK maintains vertical line of transfer from parents mainly fathers and mothers to a loved child either male or female with secrecy. This trend of MPK transfer was consistent in the five districts. However, in some cases the MPK diffuses through different horizontal lines, too. The disguised transfer of MPK is prone to loss and distortion when the vertical line breaks. This finding was in agreement with similar other domestic studies (Gonfa Kewessa *et al.*, 2015; Getnet Chekole *et al.*, 2015: Tadesse Birhanu *et al.*, 2015). Elsewhere, Reyes-García *et al.* (2009) indicated that cultural transmission of knowledge MPK occurs through vertical paths (from parents), horizontal paths (among age-peers) and oblique paths (from older generations).

5. 1.3.16 Similarity of human ailments reported among the study sites

The least similarity of human ailments reported between Hadiya and Yem as well as between the four districts Hadiya and Yem might be due to difference in prevalence of human ailments, difference in attitude of protection of ailments, cultural variation, individual difference of knowledge about prevalent ailments among informants. On the other hand, the highest similarity of human ailments reported between allopatric districts of Anlemo and Duna Districts can be explained by similar cultural origin, relatively similar free listing abilitity of ailments by informants and altitudinal similarity between their subdistricts that favor prevalence of some ailments in common.

The highest similarity of MPs between Gibe and Gombora in the current finding might be due to cultural and geographical closeness of both such that they share similar vegetation distribution. Gombora is a recently established district taking some subdistricts from Gibe and Soro Districts, and the community of both share many social issues including markets. The similarity of Gibe and Yem can also be explained by adjacent location of the two disricts so that diffusion of MPK will be evident and chorological similarity of their vegetation in middle and lowlands. The similarity of Gibe and Anlemo that are allopatric to each other might be due to similar etheir ethnic background and more or less similarity in plant community distribution between them. The least similarity of MP between Gombora and Yem might be due to their isolation by natural frontier Gibe River and cultural dissimilarity of both. The grouping of Anlemo, Gombora and Yem districts into PCA1 all with positive loadings might be due to their closer sample size and similar distribution of MPK among informants and that of Duna and Gibe in PCA2 with negative and positive loadings to each other by PCA might also be due to their large sample size but difference in distribution of MPK among informants. In fact, the informants of the four districts of Hadiya had close mean MPK to each other which were smaller than that of Yem.

Comparison of the MPs used in this investigation with other close and far phytogeographical sites across the country (Table 82) showed more than 50% similarity with Western Shewa (Chelia, Dendi & Jibat areas) (Tenna Regassa, 2016) followed by 41% similarity with Ankober North Shewa (Ermias Lulekal, 2014) and

Kembata Tembaro in Southern Central Ethiopia (Melese Maryo *et al.*, 2015) and least similarity of 33% was observed with Erob and Gulomeheda in north Ethiopia (Tadesse Beyene, 2015). The reasons for observed varying levels similarity of MP species among the different groups might be extent of similarity in floristic diversity, traditional use of MPs available for treating human and livestock ailments and local people of the different regions are dependent on TMPs for maintaining their health care.

Table 82. Sorenson's Similarity of MPs for human ailments with other geographic regions of the country

(N = no. of species reported, a = species common to current study area with other sites)

Site	N	a	Ss	References
Ankober	135	66	0.41	Ermias Lulekal (2014)
Chelia, Dendi& Jibat	172	103	0.52	Tenna Regassa (2016)
Kembata & Tembaro	145	65	0.41	Melese Maryo *et al.* (2015)
Erob & Gulomeheda	121	46	0.33	Tadesse Beyene (2015)
Hadiya & Yem	278			current

5.1.3.17 Comparison of number of human ailments reported and MPs used to treat them in the five districts

The significant difference in mean number of human ailments and MP taxa used to treat them in each of the five districts in all districts shows that more than a single taxon were used to treat a single ailment. This inturn indicates that the local people of all study areas have rich MPK and they use them for management of human ailments. In disagreement with this finding, Tadesse Beyene (2015) reported nonsignificant difference on mean number of ailments treated by the MPs among the people of two districts from north Ethiopia which might indicate less abundance of MPs in that region.

5.1.3.18 Comparison of MPK and the effects of different socio-economic and location variables

The significant difference in MPK between informants of Hadiya (combination of the four districts) and Yem Special District might be due to intercultural differences between the two such that the plants can be differently perceived. It might also stem from the fact that Yem is richer in the diversity of the medicinal taxa recorded than the Hadiya area. The knowledge of MPs and skills of using them varies from community to community following intracultural and sociodemographic differences, differential access to forest landscapes (Quinlan and Quinlan, 2007; Mathez-Stiefel and Vandebroek, 2012; Díaz-Reviriego *et al.*, 2016; Saynes-Vásquez *et al.*, 2016). Casagrande (2002) indicaed that social organization, individual cognition, and random processes in cultural transmission shape the flow of information, and knowledge about many

MPs. This finding is in agreement with other works across the country that reported significant difference of MPK among different cultural groups (Mirutse Giday 2007; Tadesse Beyene, 2015), and elsewhere from West Africa (Sop *et al.*, 2012). The significant difference in MPk of human health between informants of the five districts separately and among those of the 20 study subdistricts might be due to individual difference in MPK of both expert healers and general informants, availability medicinal species in close vicinity and geographical separation of the sites from each other leading to variation in knowledge of healing plants. Toledo *et al.* (2007) substantiates that the knowledge and practice associated with the collection and uses of plants vary within any culture because of the abundance and quality of species, geography of the region, origin of the plants, residence of the people, social status, and relationships within the community. Sop *et al.* (2012) also speculates MPK knowledge might depend on individual's locality while Kunwar *et al.* (2018) indicated that cultural divergence, varied accessibility, physiographic heterogeneity, and biodiversity uniqueness that attribute for variation in MPK.

The significant difference in MPK observed between male and female informants of Hadiya and Yem; Duna, Gibe might be attributed mainly to difference in occupation i.e. males spend outside home in duties near forests such as farming, herding, clearing, collecting, and managing landscape so that they get greater exposure to knowledge of indigenous usefulplant species whereas females stay at home for family management, cooking, caring, preparing family needs collect useful plants from homegarden and homestead. This is in agreement with reports of Hareya Fassil (2005) and Tadesse Beyene (2015), and elsewhere Reyes-García *et al.* (2010). On the other hand, the insignificant difference in MPK between male and female in Anlemo and Gombora might be related to ther fact that females learn about public common knowledge from husbands and neighbours, or due to chance factor. In agreement with this finding other reports also showed that common MPK tends to be fairly consistent because people tend to share remedies that they have used and that were effective (Hopkins, 2009; Sop *et al.*, 2012; Doyle *et al.* (2017). Other reports also showed that women had greater MPK than men (Voeks and Leony , 2004; Almeida, 2012; Ouhaddou *et al.*, 2014; Hammadi *et al.*, 2015).

The larger MPK by married than single informants in Hadiya (four districts combined), and in the four districts of Hadiya separately might be explained by the fact that the married have always concern about the wellbeing of their family members, and feel more responsibility and are keen to learn from neighbors, workmates and friends. This finding is in agreement with other reports that showed married people have a broad knowledge of MPs while single persons use few MP (Ceolin *et al*., 2011; Reazafindraib *et al*., 2013). On the other hand, the insignificant difference in MPK between single and married inYem might be in that MPK is a commom knowledge for married and single. The single may equally learn about commom MPK from parents and neighbors and society as a whole. The larger MPK by key informants than general informants in all might be in that the former have accumulated and acquired more MPK from different sources. Moreover, experts/key informants always seek to know more by observing healing potentials of new MPs on their clients/patients for accumulating more skill and attract more clients and get more income. However, there were general informants who could listout greater number of MPs in some of the districts. Variation in MPK can arise from specialization which is related to social relations and identities and individual motivation and experience (Mathez-Stiefel and Vandebroek, 2012; Díaz-Reviriego *et al*., 2016).

The significant difference in MPK between the religious groups in Hadiya might arise from the inclusion of Gombora district whose informants are all Evangelical believers for knowledge test and in part difference in religious groups of Duna and Gibe. The significant difference in MPK beween Evangelical and Orthodox believers in Duna and Gibe might be due to individual differences in MPK of members of religious groups, or due to chance factor. The insignificant difference in MPK beween Evangelical and Muslim believers in Anlemo and Orthodox and Muslim in Yem might be in that peoples' perception and cultural beliefs may/not have significant influence on their preference of source of health care. All religions practiced in the five distrits permit the use of MPs to cure illnesses besides their belief in faith healing depending on doctrine of their religion. In agreement with this finding, Gadisa Demie *et al*. (2018) indicated that religion had no association with the health seeking behaviour among indigenous people around Dire Sheikh Hussein

heritage site of South-eastern Ethiopia. The findings of this study is partly in agreement with the findings of Tadesse Beyene (2015) among Orthodox and Catholic religion followers in north Ethiopia, and elsewhere Hopkins (2009) from Mexico that showed insignificant difference in medicinal plant competence scores between people of different faiths Catholic, Evangelical and Jihova followers.

The explanation for the fact that key informants knew more than the general informants in all sites might be attributed to specialisation of the herbal knowledge, personal interest as well as curiosity to know more species for professional application. Key informants seek to know more medicinal species in order to gain more income from their clients and know more to maintain their social status and reputation among other healers. This finding is in agreement with a study by Tenna Regassa (2016) in West Shewa Districts.

Regarding the effect of agroecologies, it is evident that the traditional climate based agroecologies present marked differences in vegetation, soil types, demographic characteristics, economic activities, and cultural traits in highlands, midlands and low lands. In the current finding, agroecology against MPK was significant in Yem only and the midlanders knew more MPs which might be due to floristic richness of the ecology in the midlands and aggregation of informants with more MPK. However, absence of effect of agroecology on MPK in Hadiya, Anlemo, Duna, Gibe and Gombora might be due to existence of migration, communication and sharing of MPK among inhabitants of the different agroecologies. According to Kunwar *et al.* (2018), the knowledge of plant collection and use is strongly associated with the cultural heritage whereas the ecogeographical condition influences the ways in which plants are collected and used. The larger MPK by older age groups in Hadiya and Yem, and the four districts of Hadiya might be attributed to the fact that MPK is accumulated by older members through the lifetime experiences from different sources of knowledge and interaction with the environment while the young agers had lower MPK due to combination of factors such as shorter life experience, absence of source of knowledge, lack of interest in TM and modernisation. According to Quinlan and Quinlan (2007), the effects of modernization on traditional knowledge is that it avoids consumer behavior of people from their natal communities by

increasing in consumer items instead of those traditionally used among a particular culture. Hammadi *et al*. (2015) also noted a loss of information on MPs which is explained by the distrust of belief in traditional medicine by some people particularly the young. This finding is in agreement with similar studies in other parts of the country (Hareya Fassil, 2005; Mengistu Gebrehiwot, 2010; Balcha Abera, 2014; Tenna Regassa, 2016) and else where Phillips and Gentry, 1993a; Ayantunde *et al.*, 2008; Hopkin, 2009; Quinlan and Quinlan, 2007; Sop *et al.*, 2012; Ouhaddou *et al*., 2014; Tugume *et al.*, 2016; Doyle *et al.*, 2017). On the other hand, the absence of difference in MPK between age groups in Duna (p = 0.11) and Yem (p = 0.32) may be attributed to cultural factors that MPK is a public domain atleast for non-expert /laypeople who equally share a common knowledge among all ages, or it might be due to chance.

The insignificant difference in education and MPK Hadiya and Yem, and in the four districts of Hadiya separately might indicate that both noneducated and those who went to school for some level of education tend to use TMPs for health care. Mathez-Stiefel and Vandebroek (2012) found that there was no influence of education in MPK among two communities from Peru and Bolivia. In disagreement with current finding, Tadesse Beyene (2015) found out that education has effect on MPK indicating educated people tend to use modern medicine and have less MPK. In line with this, Quinlan and Quinlan (2007), Hopkin (2009) and Ouhaddou *et al*., (2014) found out that there is a negative relationship between MPK and education.

5.1.3.19 Association of gender, age and conservation of MPs

The existence of tendency of males in conservation of MPs than females in Hadiya and Yem , and Anlemo and Yem might be related to differences in occupation such that males stay away from home in the forests and farms enabling to possess more knowledge about useful plant species, and the more knowledge about the plant biota, the more care and tendency of conservation of medicinal plants. The significant result in Hadiya might be due to informants from Anlemo, or it might be due to chance factor as the results are non-significant for Duna, Gibe and Gombora which might indicate that both male and females equally use MPs and have similar tendency for conservation of MPs. The more tendency of older people in MP conservation

in Hadiya and Yem, and in Anlemo and Gibe might be due to acculturation of MPK among the modern generation which distrusts use of TMPs and tends to use modern mainstream medicine and neglect conservation of MPs. However, in the case of Yem the significant difference in age and conservation of MPs is a conflicting outcome as there was no significant difference in age and MPK in the district earlier in this study in the light of congruence of MPK and conservation of MPs, this might be might be due to chance factor. The absence of dependence between age and conservation of MPs in Duna and Gombora might be in that all age groups more or less equally know useful plants and concerned about conservation of them, or it might be due to chance factor.

5.1.4 Diversity of Ethnoveterinary MPs in Hadiya and Yem

The current investigation revealed relatively high diversity of (156) species that are used for traditionally managing 74 livestock ailments in Hadiya and Yem. This shows that the community of the study area are dependent on EVMPs that are available in their vicinities for managing livestock ailments. As the mainstream veterinary services are not well established in the study area and the whole country while the EVMPs are the most accessible and affordable means of veterinary health that help harnessing the popential of this important biodiversity. Higher number of livestock ailments and EVMPs reported from Hadiya (four districts combined) compared to livestock ailments and EVMPs in Yem might be in that informant of each district have fewer uncommon livestock ailments and EVMPs that add to aggregate combined in Hadiya. On district basis, the number of livestock ailments reported were higher in Gombora, that of Duna and Yem were comparable, and of Anlemo and Gibe Districts were lowest. However, the number of EVMPs reported in the four districts of Hadiya were lower than in that of Yem indicating higher diversity and more EVMPK in Yem than the four districts. Similar to the present findings, EVMPs were reportedly contribute in safeguarding primary health care of livestock in other sociocultures across Ethiopia such as in Borena (Teshale Sori *et al*., 2004), in Meinit, Sheko and Bench (Mirutse Giday, 2007), in Ankober (Ermias Lulekal, 2014). Comparably, more studies from other parts of the country include 74 EVMP species for treating 22 different livestock ailments in 4 districts of Jimma Zone Ethiopia(Yared Yigezu *et al*., 2014); 51

EVMPs used for 33 ailments (Ermias Luleka *et al.*, 2014), 23 EVMP species treating 24 ailments in Erob and 29 species for 18 animal ailments in Gulomeheda, north Ethiopia (Tadesse Beyene, 2015), 34 EVMP species against 20 livestock ailments from Enarj Enawga District, Amhara Ethiopia (Yihenew Simegniew *et al.*, 2018). Elsewhere, Rittera *et al.* (2012) found out 56 plants from Corales island Brazil; Tabuti *et al.* (2003) reported the use of 38 plant species in Bulamogi, Uganda; Abbasi *et al.* (2013) reported 89 botanical taxa from districts of the Lesser Himalayas of Pakistan.

Fabaceae was EVMP rich family in both Hadiya and Yem with higher abundance in Hadiya than in Yem. Fabaceae was also important family with varying number of EV species in the four districts of Hadiya separately while Asteraceae was important in 4 districts - in Anlemo, Gibe, Gombora and Yem, and Solanaceae was also important family in 4 districts - Anlemo, Duna, Gibe and Yem. This indicates that the species under these families have highest abundance, higher familiarity and long lived local importance for healing veterinary ailments among each of the local communities under study. The finding of current study is in agreement with Yared Yigezu *et al.* (2014), Yihenew Simegnew *et al.* (2018) across the nation, and worldwide Bessada *et al.* (2015), Parthiban *et al.* (2016) and Tugume *et al.* (2016). Abbasi *et al.* (2013) also quoted the abundance of taxa of Poaceae in Lesser Himalayas on top of families in mention in current study.

5.1.4.1 Habit, Ailments reported, EVMPs and sign and symptom of veterinary ailments in the five Districts

The highest cited habit of EVMPs was shrub in both Hadiya and Yem, and Anlemo, Gibe and Gombora while herb was the most cited habit in Duna indicating that there is good distribution of medicinal shrubs in the four districts while they are less abundant in Duna, hence herbs are mostly applied for ethnoveterinary use. This finding is in agreement elsewhere with reports of Tabuti *et al.* (2003) in Uganda and Hassan-Abdallah *et al.* (2013) in Djibuti, and Yihenew Simegnew *et al.* (2018) who reported domination of herb in Enarj Enawga District, Amhara Region. In disagreement with the current finding, Yared Yigezu *et al.* (2014) reported trees as dominant lifeform in Jimma Zone.

The findings of most prevalent ailments in the five districts showed that sudden ailment was the most cited in Anlemo, Duna, Gibe and Gombora; choking in Duna, Gibe and Gombora; abdominal pain and evil eye in Anlemo; diarrhoea in Duna; black leg in Gombora and Yem; pasture bloat in Gibe; anthrax and abdominal worms in Yem. This indicates that parasitic, microbial and other causes of ailments deteriorate the livestock production impacting the economy of people of the study area. Other studies also reported the prevalence of a number of same veterinary ailments such as Endalew Amenu (2007) from Ejaji West Shewa, Gebremedin Romha *et al*. (2015) from southern Ethiopia and Teka Feyera *et al*. (2017) from Fafan, Eastern Ethiopia. There are also similar reports from elsewhere on the prevalence of EV ailments from North West Province of South Africa (Van der Merwe *et al.*, 2001) and from India (Banumath and Vaseeharan, 2015; Rastogi *et al.*, 2015).

Based on results, few EV ailments were reportedly treated by different species such as abdominal pain and black leg in Yem, evil eye and constipation in Anlemo, choking and African horse ailment in Duna, sudden ailment and pasture bloat in Gibe, sudden disease and choking in Gombora. Conversely, EVMPs were used to treat multiple of ailments. The explanation for the use of concoction of species for a single veterinary case might be to the expectation of synergistic effect of bioactive compounds contained in the phytomedicine working together in a dynamic way to produce therapeutic efficacy with minimum side effects (Tiwari and Rao, 2002; Ebong *et al.*, 2008; Tugume, *et al.*, 2016). In the case of a single therapeutic species used for multiple ailments may at first lie on the fact that different informants use varied species for the same EV ailments. Moreover, popular species may contain a number bioactive compounds that can act on wide range pathogenic agents with a single or repeated doses. Other reports with similar findings include Bussmann and Sharon (2006), Mayori (2013) and Ouhaddou *et al*. (2014). On the other hand, the use of a single EVMP to treat several ailments is probably attributed to presence of many metabolites in one particular plant and also the fact that the same molecule can be active against different pathogens (Tugume *et al.*, 2016).

Sign and symptoms of EV ailments listed by the informants of the study area are physically observed on livestock that are very important in diagnosing the type of ailment and treatment to be done to the animal. This is also true other cultures that native veterinary practitioners who traditionally diagnose veterinary ailments based on signs and symptoms are consulted to examine the animal and prescribe some medicine (Piyadasa, 1994; Tadjbakhsh, 1994; Ole-Miaron, 2003). Ole-Miaron (2003) reported that the knowledge of diagnosing animal health issues acquired through observation, palpation and auscultation of sick livestock which evolved into an ethnodiagnosis procedure to the Maasai traditional bioprospecting skills. Toyang *et al*. (2007) also indicated that diagnosis is often carried out by using the senses of taste, touch, smell, sight as well as involvement of supernatural methods such as consulting spirits, oracles or divination. Animal sicknesses can also be detected temporally by season based traditional knowledge (Ole-Miaron, 2003).

5.1.4.2 Parts of EVMPs used and state of remedies prepared for treating livestock ailments

Leaf was the top cited and utilized part for management of EV cases in all the districts. The explanation for high utilisation of leaf could be attributed to their ease of obtaining them in large quantities in most seasons compared to the other plant parts. They are sites for synthesis of bioactive compounds such as tannins and other alkaloids that fight against illnesses (Passalacqua *et al*., 2007). This finding corroborates with similar studies across the country such as Yared Yigezu *et al*. (2014) and Tadesse Birhanu *et al*. (2015) and elsewhere Rittera *et al*. (2012) from Corales Island Brazil and Tariq *et al*. (2014) from Sulaiman Range, Pakistan. However, the current finding disagrees with Tabuti *et al*. (2003), Ermias Lulekal (2014) and Yihenew Simegniew *et al*. (2018) who reported the dominance of roots that might be based on their existence even in a disturbed habitat and dry seasons too. The dmoninant use of fresh EV remedies in all districts might be with the fact they can be accessed easily of in close proximity and with the thought of containing rich healing material than dried remedies. This finding is in agreement with reports by Tadesse Birhanu *et al*. (2015) from Wolega and Busman and Sharon (2006) from Northern Peru who also report use of fresh EV remedies.

5.1.4.3 Method of preparation, route & mode of administration, ingredients added and dosage, source and habitat of herbal EVMPs

The most commonly used method of EVMP remedy preparation was maceration by the fact that most of the herbaceous and fresh preparations are cold extracted without any damage and wastage of the bioactive components. Maceration was also reported as one method of remedy preparation by Kamoga (2010) in Uganda, Rittera *et al.* (2012) in Corales Island, Brazil, Ouhaddou *et al*. (2014) in Morocco and Tsobou *et al*. (2016) in Cameroon. However, infusion and decoction were reported as the dominant ethnoveterinary remedy preparation methods by Teshale Sori *et al*. (2004), Tabuti *et al*. (2003) and Bussmann and Sharon (2006). Oral application of remedy was the highest cited route mainly by drenching the remedies. Drenching by mouth is used for dissolved remedies that are dissolved by water. Water helps to release the active component directly sending enough amount of bioactive compound to target ailment sites such as the gastrointestinal and blood vascular system so that faster reaction of the remedy against ailing agent is achieved. Among the few most reported additives for livesock remedies, salt and mineral saltlick were known to be used in all districts which is said to curb harmful effect and/or increase the efficacy the remedy applied (Jabbar *et al.*, 2006; Hassan *et al.*, 2014). This finding is in agreement with other reports such as Dawit Abebe and Ahadu Ayehu (1993), Teshale Sori *et al*. (2004) and Tadesse Birhanu *et al*. (2015), Guluma Kitata *et al*. (2017) and elsewhere Parthiban *et al.* (2016) from Tamil Nadu India.

Dosage of EVMP remedies is known to be determined by livestock owners and herbalists depending on the degree the ailment, age, size, body condition of the animal and frequency of application. Smaller sized local goods are used for calves and young angulates while bigger objects are used for large sized livesock such as cattle and equines. The dosages in general are non-standard, however, local people do their best to minimise the sideffect of the remedies. Local people know that excessive quantities of EVMPs can be deadly for the animal. For example, Firaol Tamiru *et al*. (2013) indicated that more than half tuber of *Crinum abyssinicum* and over dosage of *Calpurnia aurea* for internal parasites can kill the ainimal. The collection of most of the EVMPs remedies from the wild unmanaged sources in each district is unreliable and may pose vulnerability to species of scarce status due to overexploitation. In agreement with this

fidings, other studies such as Behailu Etana (2010) from Jima Zone and elsewhere Yousafzai *et al*. (2010) from Marghazar valley, Pakistan and Hassan *et al*. (2014) from Malak Valley Pakistan reported wild collection of EVMPs. The findings of about 14 habitats of EVMPs with varying status in each district shows the importance of diverse landuse system as refuge for the veterinary health resources. Similar study from elsewhere by Parthiban *et al*. (2016) reported diverse habitats from where the ethnoveterinary medicinal plants collected in Tamil Nadu, India.

5.1.4.4 Preference ranking, Informant Consensus Factor and Fidelity Level of EVMPs

These tools helped to identify EVMPs that have highest cultural importance that lead to further pharmacological analyses. The best preferred species in each district were - *Croton macrostachyus* for abdominal bloat of cattle in Anlemo and Gibe; *Crinum abyssinicum* for sudden ailment in Duna; *Nicotiana tabacum* for leech in Gombora and *Lobelia giberroa* for anthrax in Yem. The EV medicinal uses of the species in preference of current study were also reported in other cultures; *Croton macrostachyus* is used for abdominal bloat and *N. tabacum* for blackleg in Jimma Zone (Yared Yigezu *et al*, 2014); *Lobelia giberroa* for lumpy skin disease was reported in Jibat and Dendi District Oromia (Tenna Regasa, 2016); *Crinum abyssinicum* for swelling of skin diseases by Mersha Ashagre (2011) and for internal parasites by Firaol Tamiru *et al*. (2013). Phytochemical screening of on *N. tabacum* also showed that it contains active component- called pyridine, 3-(1-methyl-2-pyrrolidinyl)-(S) that might have a broad spectrum antimicrobial activities against biofilm forming uropathogens (Gemechu Ameya *et al*., 2017).

Livestock ailment categories such as gastrointestinal ailments in Anlemo; reproductive & urogenital ailments in Duna; musculoskeletal, sensory & miscellaneous ailments in Gibe, Gombora and Yem were ailment categories with the highest ICF values indicating high informant agreement and the informants use few EVMPs for managing the health conditions. High ICF values are also obtained when only one or a few plant species are reported to be used by a high proportion of informants to treat a particular ailment, whereas low ICF values indicate that informants disagree over which plant to use (Heinrich *et al.*, 1998, Gazeano *et al*., 2005). High ICF values can thus be used to pinpoint particularly interesting species for the

search of bioactive compounds (Canales *et al.*, 2005). In agreement with current finding from Anlemo, a high ICF (0.71) was reported for gastrointestinal problems in Ankober (Ermias Lulekal *et al.*, 2014) and from elsewhere digestive problems scored highest ICF (0.61) among local community from India (Bhuvaneshwar and Kumar, 2013) and stomach disorders by Jamila and Mostafa (2014) and Remna *et al.* (2017) in Morocco.

The Fidelity Level (FL) conducted showed a number of EVMPs with high healing potential in each district. Literature indicate that plants species that are used repetitively among local communities score high FL and such species are more likely to possess biologically active compounds, hence, have good healing potential against the specific ailments in mention and considered as potential candidates for further pharmacological investigations and deserve priority attention (Trotter and Logan,1986; Hassan-Abdelah *et al.*, 2013).

The multipurpose EVMPs identified by direct matrix were most threatened species by extraction of fuelwood and charcoal, construction, fodder, furniture and farming & household tools. Therefore, these species need to be included under interdisciplinary local consrvation schemes to ensure sustainable utilization of their products by the local communities. Similarly, the threats of multipurpose EVMPs were also reported from west Oromia (Tadesse Berhanu *et al.* 2014), south Ethiopia (Gebremedin Romha *et al.*, 2015) and Pakistan Indus region (Mussarat *et al.*, 2014).

5.1.4.5 Similarity of EVMPs used in the five districts

The highest similarity of EVMPs between the districts might be attributed to their similarity in agroecology, EVMPK, morbidity of ailments and availability of medicinal taxa in common. On the other hand, the least similarity observed between between Duna and Gombora that are from the same Hadiya might be difference in morbidity and availability of least number of EV medicinal taxa. Moreover, the least similarity of EVMPs between Hadiya and Yem might be attributed to availability of EVMPs, cultural difference and individual difference among informants who listed out the species.

Comparison of the EVMPs diversity of the present study area with other parts the dry afromontane region (Table 84) showed the largest similarity with west Shewa (Tenna Regassa, 2016) followed by north central north Ethiopia (Ermias Lulekal, 2014) might be attributed to closeness of climatic and topographic factors and existence of more or less similar floristic cover in common for use of similar EVMPs. On the other hand, the least similarity of the EVMPs with north west Ethiopia (Ayehu Mengesha and Debeb Dese, 2018) and with North Ethiopia (Tadesse Beyene, 2015) might be the distance between the sites, cultural variation and difference in floristic composition.

Table 83. Sorenson's Similarity (Ss) of EVMPs in the study areas with other studies

(N = no. of EVMPs, a = no. of taxa common to each pair of sites, b = no. of taxa recorded in current sites only, c = no.of taxa ecorded in each of the four sites)

Area	N	a	Ss	References
Ankober	49	26	0.34	Ermias Lulekal (2014)
Chelia, Dendi & Jibat	97	42	0.50	Tenna Regassa (2016)
Erob & Golumeheda	46	15	0.17	Tadesse Beyene (2015)
Gonder Zuria	68	20	0.24	Ayehu Mengesha and Debeb Dese (2018)
Hadiya & Yem	156			current

5.1.4.6 Comparison of EVMPK and socioeconomic and location variables

The significant difference in EVMPK between Yem and the Hadiya might be attributed to chance factor since their means are not far from each other. Of course, both ethnic groups have cultural difference as well as difference in availability of EVMPs. With a similar trend, the informants of the five districts as well as those of the 20 study subdistricts had significant difference in EVMPK which might be attributed to the difference in their geographic location and agroecological gradient which might dictate the distribution and availability of EVMPs and associated knowledge of it among informants of the study subdistricts. In agreement to this finding, there was difference in MPK among Bench, Meinit and Sheko ethnic groups in the southwest Ethiopia (Mirutse Giday, 2007), between Koore and Maasai in east Africa (Caudell *et al*., 2017). However, Tadesse Beyene (2015) showed absence of significant difference in MPK between Erob and Golumeda districts north Ethiopia.

The significant difference in EVMPK between male and female in Hadiya and Yem, Gibe, Gombora and Duna might be due to occupational difference in that men oftentimes spend outside homestead in different land uses and know more useful MPs plants than women who know most from homegardens and villages. On the other hand, the nonsignificant difference in EVMPK between male and female in Anlemo might be explained either by chance factor, or women might have equal responsibility of managing animals by acquiring knowledge from husbands, neighbours and friends. There are other reports in the country in agrrement with both significant and nonsignificant findings. Mirutse Giday (2007), Ermias Lulekal (2014), Yihenew Simegniew *et al*. (2018) and from elsewhere among Koore ethnic group Caudell *et al*. (2017) reported that males are more knowledgeable in EVMPs than females while Tadesse Beyene (2015) and Tenna Regassa (2016) and elsewhere with that of González *et al*. (2011) in western Spain and Monteiro *et al*. (2011) in Amazonian Briazil reported nonsignificant difference in gender and EVMPK.

The significant difference between married and single informants (married informants knew more mean EVMP than single) in Hadiya, in Anlemo and Gombora may be attributed to possession of livestock property and sense of responsibility of management of livestock health by married than single. The significant difference in Hadiya may be due to responses of both Anlemo and Gonbora districts which are sigificant. The explanation for the signicant findings might be due to chance factor, or lack of livestock ownership that may lead to lack of concern about EVMPK. In line with this, Harvey (2013) showed that Massai girls are known to take a greater role in livestock care after marriage as they are often taught by their husbands about EVMP uses. In agreement with this finding, Tadesse Beyene (2015) in north Ethiopia also reported a significant difference between male and female. The nonsignifnicant difference in EVMPK between married and single in Duna, Gibe and Yem may indicate that the single might get knowedge from their parents and other sources. The explanation for the fact that key informants knew more than the general informants in all sites is similar to the of MPK of human health and might be attributed to specialisation of the herbal knowledge, personal interest as well as curiosity to know more species for professional application. Key informants seek to know more medicinal species in order to gain more

income from their clients and know more to maintain their social status and reputation among other healers. This finding is in agreement with a study by Tenna Regassa (2016) in West Shewa Districts.

The explanation for that Orthodox religion followers in Hadiya and Gibe knew relatively more EVMPs might be attributed to chance factor whereas the nonsignificant difference in religious groups among Evangelicals, Muslims and Orthodox believers in Anlemo, Duna and Yem might be local availability of MPs and dependence of both religious groups on traditional herbal remedies for livestock health. The explanation for that old agers had more EVMPK in Hadiya; in Anlemo, Gibe and Gombora which might be the fact that older people have accumulated more MPK by experimentation and experience since long time when modern medical system not expanded. Similar findings were reported by Tenna Regassa (2016) and Yihenew Simegniew *et al*. (2018). Elsewhere Ouhaddou *et al*. (2014) from Uganda & Tariq *et al*. (2014) from Pakistan have also reported similar findings. On the other hand, the absence of significant difference in EVMPK among age groups in Duna and Yem might due to chance factor, or might be linked with that the EVMPK is a public domain in which all age groups share it among them. In agreement with the finding of Yem elsewhere from experience of Zapotec children in Mesoamerica were known to gain a great deal of traditional knowledge through engagement in adult work activities such as weeding and gathering, fetching medicinal plants, caring for animals, ancestral inheritance, inter-cultural diffusion and interaction with the natural environment (Hanazaki *et al.*, 2013; Saslis-Lagoudakis *et al.*, 2014).

The explanation for the finding that noneducated knew more in Gibe may be that the educated social group show less interest of using EVMPs tending to modern veterinary medicine which may lead to have less EVPK. This finding is in aegreement with Ouhaddou *et al*. (2014). However, the explanation for the absence of influence of education on EVMPK in Hadiya, Anlemo, Duna, Gombora and Yem might be from the fact that those who had to some level of education were partly engaged in farming livestock rearing and forest related activities such as extraction of tools and medicines, generally they have plant relationships. The fact that midlanders in Yem knew more EVMPs in Yem is also similar to that of MPK of human health and might be due to floristic richness of the ecology in the midlands which might be

correlated aggregation of informants with more EVMPK. However, absence of effect of agroecology on EVMPK in Hadiya, Anlemo, Duna, Gibe and Gombora might be due to existence of communication and sharing of EVMPK among informants similar cultural origin from the three or two agroecologies be attributed to diffusion of MPK following amog the inhabitants of the different agroecologies. According to Kunwar *et al.* (2018), the knowledge of plant collection and use is strongly associated with the cultural heritage whereas the ecogeographical condition influences the ways in which plants are collected and used.

5.2. CONCLUSION

The current investigation documented 468 species in the study area with reports of 359 in Hadiya and 326 in Yem, and in the four districts of Hadiya separately 229, 206, 132 and 117 species in Gibe, Gombora, Duna and Anlemo Districts, respectively indicating the patches of forests and different land uses serve as reservoirs for high diversity of useful plant species. However, the actual distribution of MPs in the plant communities was nearly half of the MPs freelisted during interview with informants both in Hadiya and Yem, and Gombora while it was about one fourth in that of Gibe, Anlemo and Duna Districts indicating that the MPs are becoming rare in the surrounding remnant vegetation patches and different land uses. This entails the need for intervention of threatening factors of medicinal and useful plant biodiversity. The findings of ordination of species and environmental data of the five districts revealed that altitude, slope, aspect and disturbance were variably determinants of the diversity of the plant communities containing MPs.

The present investigation is the first hand in-depth ethnomedicinal investigation made in the two ethnic groups: Hadiya that represents Cushetic language family and Yem Special District which represents Omotic language family in Ethiopia. The work discovered a high number of 301 species with a district contribution of 237 species in Yem and 209 species in Hadiya, and with district contribution of 119, 115, 105 and 86 in Gibe, Gombora, Anlemo and Duna, respectively indicating a high dependence of local people on plant biodiversity for maintaining both human and livestock health. In each district, the highest number of human ailments and MPs used for managing them were reported than that of veterinary ailments and corresponding EVMPs. A number of TMPs were employed for both human and livestock ailments owing the their popularity and similarity of ailments treated.

The information obtained from the study area may be useful to other researchers in the fields of ethnobotany, taxonomy and pharmacology. It could also provide a database for the selection of widely used MPs for searching bioactive compounds to treat both human and livestock ailments. A considerable

number of MPs reported in this work are also used as alternative health care resources among other cultures across the country, and also in overseas, still some of them were empirically proved *in vitro* and *in vivo* animal assays to have healing potentials for different ailments. Some of MPs are novel phytoremedial inclusions to the national database of genetic resources in the development of the health sector and need further scientific efforts of confirmation of their pharmacological compounds.

The local people still have ambivalent perception of relating ailments to be caused as a result of disharmony with God, curses of close parents mainly fathers and culturally reputable and respected persons for wrong doing and evil spirit besides the biomedical causes and effects of etiology of ailments. It was found that the TMPs are used side by side with the biomedical health services for maintaining both human and livestock health. The TMPs are locally used from viewpoint of cultural trust, their efficaccy against a lot ailments as they are tested through long experiences of trial and error and inherited from forefathers, economic reasons and availability of the TMPs. In this regard, it was found that the nonexpert local people have practice and rich MPK of self medication using a range of MPs commonly used in home remedies. The herbal experts by and large are known to provide traditional medical services beyond the knowledge of nonexpert local people.

Participant observation made in the TMPs clinic, the mass TMP collection event of 'SAMO-ETA' in the culture of Yem and the market TMP vendor in Gibe (Hadiya) show proof of local acceptance of TMPs for managing human and livestock health in the study districts. Regardless of acceptance of TMPs by the local communities, interviews made and overall observation showed that there is still a negative attitude by the biomedical practitioners towards the utilisation of TMPs. This calls for the balance in utilisation of both systems of medicine as they target maintenance of human and livestock health. Rather, working in collaboration on the issues of efficacy, safety and filter candidate species is important for development of health care as a whole. Local people of the study districts, specially traditional experts diagnose human and livestock ailments using physical conditions by visual observation of abnormal manifestations on body of a sick person or animal for administering medicinal remedies. However, since some of these signs and

symptoms are common to different ailment types which may mislead and result in fatality, attention of biomedical care should be sought for safety.

Among the plant families with MPs, Asteraceae, Fabaceae and Lamiaceae contained the highest number of ethnomedicinal species used for both human and veterinary ailments in each district owing to their successful distribution with big number of taxa and possession of active principles that fight ailments. Most of the MPs used for human and livestock health are collected from diverse wild habitats such as homegardens, living fences, edges of farms, farms, fallows, roadsides, sacred sites such as church compounds and grave yards, communal forests and protected forests that are important repositories for TMPs.

The current investigation depicted that the transfer of MPK of human and livestock among TM experts followed mainly vertical transfer among close kinship from either paternal or maternal source and other horizontal sources such as friends and religious institutions. The findings of market observations showed that almost all of the MPs collected from the wild for managing both human and livestock health issues were not marketed indicating that they are obtained locally when they are needed in the cases of the rest of four distrcts. In the case of Yem, interviews showed that selling of MPs in open market is taboo in that culture. Most plant species encountered during market surveys were rather nutraceutical species that played prominent roles both as food and self administered home remedies for commonly known ailments of human and livestock. The investigation revealed that the communities of each of the study districts possess deep insider's local ecological knowledge of categorising natural resources in their environment, and deep traditional knowledge of plant genetic resources that are used in managing human and livestock ailments and conditions. Except two folklore sayings recorded in Hadiya that refer to MPs uses, none were mentioned during interviews which may indicate tendency of erosion of the MPK in the study areas due to modernization related reasons. The PR, ICF, FL(%), UV and RI indices in the present study could reveal a number of culturally important and popular MPs that are locally employed in traditional health care with suggestion of further pharmacological studies for development of therapeutic products. PR revealed that

Englerina woodfordioides (epiphytic on *Vernonia amygdalina*) treating malaria in Anlemo; *Brucea antidysentrica* for dyspepsia in Duna; *Croton macrostachyus* for stopping bleeding of casual injuries in Gibe; *Allium sativum* for pneumonia in Gombora; and *Juniperus procera* for common cold in Yem were the most preferred taxa for human health. The ICF of MPs used for dermatological ailments and sensorial ailments and headache in Anlemo; gastrointestinal and visceral organ ailments in Duna and Yem; miscellaneous ailments and respiratory ailments in Gibe; dermatological ailments in Gombora had highest values indicating high agreement among informants on prevalence of ailments and efficacy of the MPs in each category suggesting further pharmacological test for the safety MPs. Similarly, the high FL (%) values of the MPs indicate healing potential of the MP in the categories suggesting further pharmacological tests of those species with high FL (%). The high ICF of EVM ailment categories for gastrointestinal ailments in Anlemo; reproductive and urogenital ailments in Duna; musculoskeletal, sensory and miscellaneous ailments in Gibe, Gombora and Yem indicate the efficacy the MPs in each category. The high FL (%) of the MPs in the ailment categories suggest further phytochemical screening for existence of bioactive compounds.

The findings showed that there are a number of multipurpose medicinal taxa that support the local people with fulfiling livelihood besides their medicinal role. However, the findings of UV, UD and DMR indicated that such use pressure on MPs might lead to threat of sustainability of the existing native multipurpose medicinal taxa. Those use pressure such as overexploitation, non-sustainable and destructive harversting, extraction of charcoal, fuelwood, fodder, construction and timber extraction constrained the multipurpose species. Such species among others include *Croton macrostachyus* in all districts, *Crodia africana* in Duna and Yem, *Juniperus procera* in Anlemo and Yem, *Acacia sieberiana* in Anlemo, *Hagenia abyssinica* in Duna, *Olea europaea* subsp. *cuspidata*, *Podocarpus falcatus* and *Manilkara butugi* in Gombora, *Prunus africana* and *Stereospermum kunthianum* in Yem are the most vulnerable ones. Hence, this investigation emphasizes the need for urgent implementation of conservation measures. due to non-sustainable utilization unless urgent management strategies are implemented.

With a similar development, the outputs of focus group discussions on the threats of MPs revealed that human activities such as expansion of agricultural land for fulfilling livelihood, overharvesting of rare species, intensification of exotic species such as *Eucalyptus* spp. in pocket lots where indigenous species survive could have negative effects their regeneration due to domination and allelopathic effect. Therefore, eucalypt lots and indigenous species need separate manangement.

The findings showed socioeconomic factors such as ethnicity, gender, marriage, informant category/level of expertise on TMs, age, and location factors such as district location, subdistrict location and agroecology differently affect MPK of human and livestock health in all districts. Religion, education (except in EVMK in Gibe) and agroecology (except in human MPK in Yem) were not affecting factors for TMPK. This was both in accepting and and rejection of the hypotheses set in this thesis. The findings of this investigation showed that the local people of the study areas still have rich knowledge of MPs and the ecology of the study areas harboured considerable number of healing plants with multiple of uses regardless of intense human pressure posed against them. However, there are human induced and natural factors which threaten both the indigenous knowledge and the plant genetic resources. In particular, the study areas have high human population pressure of utilising MPs for livelihood reasons in nonsustainable manner. The fact that most healing plants are collected from the wild makes the problem more complex. Unless the current pressure against the biota and the indigenous knowledge is averted, consequent losses are inevitable in the near future.

5.3 RECOMMENDATIONS

Based on findings of current investigation, the following points are recommended for implementation by the investigator depending on the access of financial facility and other parties such as universities and EBI;

1) Conducting phytochemical screening and clinical trials of the MPs with high informant consensus and FL (%) for human health such as *Carduus schimperi, Englerina woodfordioides, Haplocarpha rueppellii, Inula confortiflora, Lysimachia ruhmeriana, Physalis peruviana, Securidaca longepedunculata, Verbena officinalis* and *Vernonia myriantha*, and for livestock health such as *Asparagus africanus, Crinum abyssinicum, Hypericum quartinianum, Lobelia giberroa, Mormordica foetida* aad *Premna schimperi* for evaluating their efficacy and safety for further uses.

2) Clearing negative attitudes against use MPs, educating people about the importance and congruence of MPs with modern medicine is of great importance and encourage conservation of both especially among the young generation.

3) The traditional and the mainstream health practitioners need to acknowledge their medical practices as recommemded by WHO since their objective is providing health service to the the society. In this regard, the contribution of TMPs to the health care of the society should be acknowledged and supported by collaborative researches with ethnobotanists, pharmacists, chemists and physicians to evaluate and validate the usage of traditional medicinal plants with the modern scientific methods and innovative techniques for the development of health sector.

4) All concerned parties such as the EBI and higher leaning institutions such as Wachemo University, Wolaita Sodo University, Addis Ababa University, local district administrations and NGOs need to work in the agenda of conservation of the indigenous knowledge and MPs in the health development strategy to secure the wealth of MP in hand in the study area.

5) Conduct investigations on regeneration biology and propagation of the most most exploited such as *Croton macrostachyus*, rare and locally threatened multipurpose species such as *Balanites aegyptiaca,*

Combretum molle, Juniperus procera, Manilkara butugi, Ocotea kenyensis, Podocarpus falcatus, Prunus africana and Seciuridaca longepedunculata for conservation.

6) Creating community-based MP conservation initiatives for threatened species by promoting other activities that the local people can benefit directly and indirectly such as carbon trading, searching for grassroot funds for cultivation, establishing nursery sites especially where water is not limiting, creating opportunities of getting wages somehow so that people develop interest in the activities, give technical assistances and evaluate the progress,

7) Setting aside *in situ* and *ex -situ* conservation sites for the species under threat. In this regard, the cultural 'healing Mt. Bori' in Yem Special District is an ideal place for conservation of MPs. Therefore, recognition the unique culture and the site associated with culture needs to be brought into conservation programmes by EBI and other NGOs. The existing exotic plantations of the Mt. should be removed via logging to give better opportunity for indigenous MP species instead. Moreover, all parties involved in stewardship of the MPs and associated indigenous knowledge need to devise workable strategy for conservation of these important natural heritages. There should also be financial commitments from donors working in conservation of Mountain biodiversity and others, and the commitments government decision making bodies in effecting conservation,

8) Conduct further ethnobotanical studies on wild edible and other useful plant species in each district,

9) Investigate the impact of *Eucalyptus* spp. on the indigenous species and identify management sites for it, and identify equally useful multipurpose indigenous such as *Cordia africana*, or even exotic species such as *Grevillea robusta* that may not have harmful effects on the native species and the environment.

10) Creating awareness of on-farm conservation of the relic multipurpose MP species that can be easily conserved on farm without completely eradicating them, therefore, giving guidance to farmers who own the land lots,

11) Research Projects with themes of climate change adaptability and restoration of the vegetation cover and useful plant biodiversity of the country are suggested to consider the restoration and conservation of

vegetation of Yem and Hadiya for their ecosystem services they contribute for development activities around the study area. The landscapes of both sites are also sources for a number of tributary streams and rivers that drain into Omo Gibe River that plays a pivotal role as a backbone of generation of the pollution free energy/electricity from its No. 1-5 dams for the nation's development and foreign exchange earnings. Such water sources include Gombora River in Gombora District, Hendosha, Ha?a, Ameka in Gibe District, Dogosa River between Hadiya and Gurage; Derbu, Ozewa and Dawuna Rivers from Bori Mt. and other highlands Yem. However, the volume of these rivers is highly dwindled losing some of tributary streams and smaller rivers are dried as a result of degradation of forest vegetation cover in the region. Therefore, efforts restoration of vegetation cover especially along the watersheds of each tributary river is of urgent call for intedesciplinary integrated biodiversity and natural resources conservation schemes to maintain level of water bodies that drain to the most important Omo Gibe River to achieve the mega-projects and development of the country as a whole.

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Appendix 1. List of species collected from sample quadrats of of the five districts
(C-W = woody climber, C-H = herbaceous climber, H = herb, S = shrub, T = tree, T/S = tree/shrub, '?' = a symbol used for glottal sound)

No.	Botanical name	Family	Hadiya/Yem/Oromo name	Habit	Sample Code
1	*Acacai lahai* Steud. & Hochest. ex Benth.	Fabaceae	Lafto (O)	T	GW565
2	*Acacia abyssinica* Hochst. ex Benth.	Fabaceae	HensewGirara (H)	T	GW09
3	*Acacia brevispica* Harms	Fabaceae	Gemema (Y)	S?	GW320
4	*Acacia dealbata* Link	Fabaceae	Beha?lheqa (H)	T	GW149
5	*Acacia negrii* Pic. Serm.	Fabaceae	Gu?a (H),Ezu (Y)	T	GW165
6	*Acacia oerfota* (Forssk.) Schweinf.	Fabaceae	Girara (H)	T	GW10
7	*Acacia polyacantha* Willd.subsp. *campylacantha* Brenan	Fabaceae	Bate Girara (H)	T	GW02
8	*Acacia seyal* Del.	Fabaceae	WachoGirara (H)	T	GW27, 215
9	*Acacia sieberiana* DC.	Fabaceae	Gerbe Girara (H)	T	GW01
10	*Acalypha fruiticosa* Forssk.	Euphorbiceae	Dobi labahrefa, Doqonu (Y)	S	GW54, 124
11	*Acalypha psilostachya* Hochst.	Euphorbiceae	Dobiherefa (H)	H/S	GW158.
12	*Acalypha racemosa* Baill.	Euphorbiaceae	Doqonu (O)	H/S	GW139
13	*Acanthus eminens* C. B. Clarke	Acanthaceae	Ashwala (H),Zarquwa (Y)	S	GW38, 11
14	*Acanthus polystachius* Del.	Acantaceae	Kogna (Y)	S	GW625
15	*Acanthus sennii* Chiov.	Acanthaceae	Ashwala (H)	S	GW21
16	*Achyranthus aspera* L.	Amaranthaceae	AjarDono?o (H),Za?no (Y)	H	GW191, 664
17	*Achyrospermum schimperi* (Hochst. ex Briq.) Perkins	Lamiaceae	Hedormata (H),Sufiya (Y)	H	GW90, 07
18	*Acmella caulirhiza* Del.	Apiaceae	Odo (Y)	H	GW83
19	*Adiantum capilus-veneris* L.	Adiantaceae	QorichaSididu (O)	H	GW208
20	*Ageratum conyzoides* L.	Asteraceae	Geqisa (H)	H	GW75, 440
21	*Agrocharis incognita* (Norman) Heyw. & Jury	Apiaceae	Za?no (Y)	H	GW573
22	*Agrocharis melananthai* Hochst.	Apiaceae	Za?no (Y)	H	GW471
23	*Ajuga integrifolia* Buch. -Hem. ex D. Don	Lamiaceae	Anamura (H)Tenecho (Y)	H	GW93, 97
24	*Ajuga* sp.	Lamiaceae	La?lAnamura (H)	H	GW91
25	*Alchemilla fischeri* Engl.	Rosaceae	DunHerefa (H)	H	Gm357
26	*Alchemilla pedata*A. Rich.	Rosaceae	Danifofa (Y)	H	GW61, 64, 357
27	*Alectra sessiliflora* (Vahl) Kuntze	Scrophulariaceae	Adu'n wesa (Y)	H	GW562
28	*Allophylus abyssinicus* (Hochst.) Radlk.	Sapindaceae	Abera (H)	T	GW261
29	*Aloe* sp.	Aloaceae	Genenoèo (H)	H	GW12, 581
30	*Amaranthus hybridus* L.	Amaranthaceae	She?aSianuwa (Y),Gude (H)	H	GW156

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31	*Amaranthus spinosus* L.	Amaranthaceae	Sianuwa (Y)	H	GW303
32	*Ampelosissus bonbycina* (Bak.) Planch.	Vitaceae	Iderefa (O)	C-W	GW170
33	*Andropogon abyssinica* Fresen.	Poaceae	Lambuda (H),Gabja (Y)	H	GW172, 15
34	*Aningeria adolfi-frederici* (Engl.) Robyns & Gilbert	Sapotaceae	She?a (H),Qerero (O)	T	GW296
35	*Anthospermum herbaceum* L.f.	Rubiaceae	Durbo/Nojo (Y)	H	GW279, 673
36	*Apodytes dimidiata* E.Mey. ex Arn.	Icacinaceae	Mewa (H)	T	GW362, 460
37	*Arisaema schimperanum* Schott	Araceae	Hemeshesa (H),Zewunewa (Y)	H	GW110
38	*Arthraxon micans* (Nees) Hochst.	Poaceae	Shashahite (H),Durbo (Y)	H	GW291
39	*Arthraxon quartinianus* (A. Rich.) Nash	Poaceae	Shashahite (H)	H	GW178
40	*Arthropteris monocarpa* (Cordem) C. Chr.	Davalliaceae	Ontoto (H)	H	GW192
41	*Arundinaria alpina K. Schum.* K. Schum.	Poaceae	Lema (H)Wosha (Y)	T/S	GW43, 34
42	*Asparagus setaceus* (Kunth) Jessop	Asparagaceae	Hundufana (H),Keshelzona (Y)	S	GW658
43	*Asparagus africanus Lam.* Lam.	Asparagaceae	Hundufana (H),Keshelzona (Y)	S	GW05, 274
44	*Aspilia africana* (Pers.) C.D. Adams	Asteraceae	Tego (H),Ha?mu (Y)	H/S	GW192, 247, 586
45	*Asplenium aethiopicum* (Burm.f.) Bech.	Aspleniaceae	Ontoto (H)	H	GW369, 248
46	*Asplenium friesiorum* C. Chr.	Aspeliniaceae	Ontoto (H)	H	GW85
47	*Balanites aegyptiaca* (L.) Del.	Balanitaceae	Bedeno (H)	T	GW118
48	*Becium obovatum* (Mey. ex Benth.) N.E. Br.	Lamiacaeae		H	GW193
49	*Berkheya speckeana* Oliv.	Asteraceae	Heluta (H)	H	GW06
50	*Bersama abyssinica* Fresen.	Melianthaceae	Koreqa (H)	S	GW206, 87
51	*Berula erecta* (Huds.) Coville	Apiaceae	FezaDemsa (Y)	H	GW256, 658
52	*Bidens macroptera* (Sch.Bip. ex Chiov.) Mesfin	Asteraceae	Ede'e (Y)	H	GW674
53	*Bidens pilosa* L.	Asteraceae	MentaAlebo (H)	H	GW289, 414
54	*Bidens prestinaria* (Sch. Bip.) Cufod.	Asteraceae	Ede?e (H)	H	GW35
55	*Bothriocline schimperi* Oliv.& Hiern ex Benth.	Asteraceae	Zemu (Y)	S	GW658, GW101
56	*Brachiaria brizantha* (A. Rich.) Stapf	Poaceae	Wo'l soqido (H)	H	GW163
57	*Brachiaria jubata* (Fig. & De Not.) Stapf	Poaceae	Wo'l soqido (H)	H	GW356
58	*Bridelia micrantha* (Hochst.) Baill.	Euphorbiceae	Dengechacha (H),MukeJeldesa (O)	T/S	GW201
59	*Brucea antidysentrica* J.F. Mill.	Simaroubaceae	Chironta (H),Tolo (Y)	S	GW59
60	*Brugmansia arborea* (L.) Lagerheim	Solanaceae	Turumbfita (H)	S	GW211
61	*Bulbostylis abortira* (Steu.) C.B. Clarke	Juncaceae	Wicbidara (H),Amergeda (Y)	H	GW58
62	*Caesalpinia decapetala* (Roth) Alston	Fabaceae	Gorta (H),Qorat i(O)	S	GW339, 40
63	*Calpurnia aurea.* (Ait.) Benth.	Fabaceae	Sena (H), Zimsa (Y)	S	GW50
64	*Canthium oligocarpum* Hiern	Rubiaceae	Fugegarewa/Mikekicho (H)	T/S	GW182, 615
65	*Capsicum frutescens* L.	Quad	Mitmito (H), Ziga (Y)	H	GW91
66	*Cardiospermum halicacabum* L.	Sapindaceae		C-H	GW76

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67	*Carduus schimperi* Sch. Bip.	Asteraceae	Sote?e (H), Asewa (Y)	H	GW88, 479
68	*Carex chlorosaccus* C. B. Clarke	Poaceae	Lenda (H)	H	GW170
69	*Casmiroa edulis* La Llave	Quad	Kazmira (H)	G	GW35
70	*Cassipourea malosana* (Baker) Alston	Rhizophoraceae	Loko?o (H)	T/S	GW204
71	*Celtis africana* Burm.f.	Ulmaceae	Qeme?haqa (H),Wa?ya (Y)	T	GW319
72	*Centella asiatica* (L.) Urban	Apiaceae	Odo (Y)	H	GW190
73	*Cheilanthes farinosa* (Fossk.) Kaulf.	Siphonopteridaceae	Ontoto?O (H)	H	GW345
74	*Cheilanthes multifida* (Sw.) Sw.	Siphonopteridaceae	Biska (Y)	H	GW209
75	*Chinopodium ambrosoides* L.	Chinopodiaceae	Mika (Y)	H	GW310
76	*Chionanthes mildbraedii* (Gilg & Schellenb.) Stearn	Oleaceae	Kinbecha (H)	T/S	GW701
77	*Chloris pycnothrix* Trin.	Poaceae	Qaleqorto?O (H),Te?lbeta (Y)	H	GW171
78	*Cirsium vulgare* (Savi.) Ten.	Asteraceae	Haluta (H),Tuzgu (Y)	H	GW05
79	*Cissampelos pareira* L.	Menspermaceae	FeleHuma (H),Meshkatemteko (Y)	C-H	GW276
80	*Cissus populnea* Guill. & Perr.	Vitaceae	Iderefa (O)	C-H	GW338
81	*Clematis hirsuta* Perr. & Guill.	Ranunculaceae	Segu (H)	C	GW431
82	*Clematis longicauda* Steud. ex A. Rich.	Ranunculaceae	Fida (H),Segu (Y)	C-W	GW34, 250
83	*Clematis simensis* Fresen.	Ranunculaceae	Segu (H)	C	GW426
84	*Clerodendrum myricoides* (Hochst.) Vatke	Lamiaceae	Heniga (H),Mignmignu (Y)	S	GW30, 197
85	*Clerodendrum* sp. (umbellatum?)	Lamiacaeae	QaleiHaniga (H)	S	GW213
86	*Clutia abyssinica* Jaub. & Spach.	Euphorbiceae	Shumtige?e (H), Nagna (Y)	S	GW271, 138
87	*Clutia lanceolata* Forssk.	Euphorbiceae	Shumtige?e (H)	S	GW25
88	*Coccinia abyssinica* (Lam.) Cogn.	Cucurbitaceae	AJu (Y)	C-H	GW89
89	*Combretum Collinum* Fresen.	Combretaceae	Mentich Habule (H)	T/S	GW214, 437
90	*Combretum molle* R. Br. ex G. Donn.	Combretaceae	Gonch Habule (H)	T/S	GW212, 299
91	*Combretum paniculaum* Vent.	Combretaceae		C-W	GW298
92	*Commelinia africana* L.	Commelinaceae	Badullutunta (Y)	Y	GW91
93	*Commelinia diffusa* Burm.f.	Commelinaceae	ChefLutunta (H)	H	GW67
94	*Commelinia imberbis* Ehremb ex Hassk.	Commelinaceae	Lutunta (H)	H	GW243, 257
95	*Commelinia latifolia* Hochst. ex A. Rich.	Commeliniaceae	Lutunta(H)	H	GW579
96	*Convolvulus kilimandschari* Engl.	Convolvulaceae	Herenda (H),Ku?reniEta (Y)	C-H	GW22, 135
97	*Conyza pyrrhopppapa* Sch.Bip. ex A.Rich.	Asteraceae		S	GW400
98	*Conyza schimperi* Sch. Bip. ex A. Rich	Asteraceae		S	GW269, 111
99	*Conyza* sp.	Asteraceae		H	GW430
100	*Conyza steudii* Sch. Bip. ex A. Rich	Asteraceae		H	GW123
101	*Conyza sumatrensis* (Retz.) E. H. Walker.	Asteraceae		H	GW448
102	*Cordia africana Lam.* Lam.	Boraginaceae	Kerewaza (Y)	T	GW453

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103	*Crassocephalum cripidioides* (Benth.) S. Moore	Asteraceae	Wic Hesbeta (H)	H	GW121
104	*Crassocephalum macropappum* (Sch. Bip. ex A. Rich.) S. Moore	Asteraceae	Dado Hesbeta (H)	H	GW362
105	*Crassocephalum rubens* (Juss.) S. Moore	Asteraceae		H	GW402
106	*Craterostigma plantaginarum* Hochst.	Scrophulariaceae		H	GW645
107	*Crepis rueppellii Sch.Bip.* Sch. Bip.	Asteraceae	Qintabo (Y)	H	GW703
108	*Crepis schultzii* (Hochst. ex A. Rich.) Vatke	Asteraceae		H	GW41
109	*Crotalaria impressa* Nees ex Walp.	Fabaceae	Dage?lgite'e (H)	H	GW149
110	*Crotalaria incana* L.	Fabaceae	Dage?lgite'e (H)	S	GW03, 570
111	*Crotalaria rosenii* (Pax.) Milne-Redh.ex Polhill	Fabaceae	Dage?lgite'e (H)	S	GW16, 178
112	*Crotalaria* sp.	Fabaceae		C-H	GW149
113	*Croton macrostachyus*. Del.	Euphorbiceae	Mesena (H), Woshkela (Y)	T	GW05
114	*Cupressus lusitanica* Mill.	Cupressaceae	Ferenj Homa (H)	T	GW04
115	*Cuscuta* sp.	Cuscutaceae		H	GW106
116	*Cussonia ostinii* Chiov.	Araliaceae		T	GW235
117	*Cyathula cylinderica* Moq.	Amaranthaceae	Beraba/Qecheba (H), umo (Y)	H	GW87, 579
118	*Cyathula polycephala* Bak.	Amaranthaceae	Umo (Y)	H	GW239
119	*Cycnium tubulosum* (L.f..) Engl.	Scrophulariaceae		H	GW637
120	*Cynanchum abyssinicum* Decne	Aslepiadaceae	Adulala (H)	H	GW73
121	*Cynodon dactylonn* (L.) Pers.	Poaceae	Qorto?o (H)	H	GW621
122	*Cynoglossum amplifolium* Hochst ex A. Dc. in DC.	Boraginaceae	Ajar qecheba (H)	H	GW168, 147
123	*Cynoglosum lanceolatum* Forssk.	Boraginaceae	Ajar Qecheba (H)	H	GW229, 648
124	*Cyperus assimilis* Steud.	Cyperaceae	Bidara (H), Che?ra (Y)	H	GW299
125	*Cyperus brevifolius* (Rottb.) Hassk.	Poaceae		H	GW66
126	*Cyperus distans* L. f.	Cyperaceae	Bidara (H),Che?ra (Y)	H	GW181
127	*Cyperus dives* Del.	Cyperaceae	Bidara (H), Che?ra (Y)	H	GW189
128	*Cyperus rotundus* L.	Cyperaceae	Bidara (H)	H	GW67
129	*Cyphostemma adenocaule* Desc. ex Willd & Drummond	Vitaceae	Lalo?o (H)	C-H	GW198
130	*Cyphostemma cyphopetalum* (Fresen.) Desc. ex Wild & Drummond	Vitaceae	Lal?o (H)	C-H	GW105
131	*Cyphostemma pannosum* Vollesen	Vitaceae	Iderefa (O)	C-H	GW151
132	*Dalbergia lactea* Vatke	Fabaceae	Felesena(H)	S	GW63, 502
133	*Datura stramonium* L.	Solanaceae	Mechara(H)	H	GW376, 454
134	*Desmodium repandum* (Vahl) DC.	Fabaceae	HedorOtongola (H), Afey (Y)	H	GW291
135	*Dichrostachys cinerea* (L.) Wight & Arn.	Fabaceae	Qertefa (H)	T/S	GW222
136	*Dicliptera laxata C.B. Clarke* C.B. Clarke	Acanthaceae	Omoro (H)	H	GW319
137	*Dicrocephalia integrifolia* (L. f.) Kuntze	Asteraceae	Dubi Herefa (H)	H	GW271, 705
138	*Digitaria abyssinica* (Hochst. ex A. Rich.) Stapf	Poaceae	Wereda (H), Duma (Y)	H	GW238

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139	*Digitaria ciliaris* (Retz.) Koel.	Poaceae	Wodeduma (Y)	H	GW63, 137
140	*Digitaria velutina* . (Forssk.) P. Beauv.	Poaceae	Wodeduma (Y)	H	GW532
141	*Dipsacus pinnatifidus* Steud. ex A. Rich.	Dipsacaceae	Hororamo (H)	H	GW31
142	*Discopodium penninervium* Hochst.	Solanaceae	Meraro?o (H)	S	GW119, 06
143	*Dissotis senegambiensis* (Guill. & Perr.) Triana	Melastomataceae		H	GW308, 656 GW175
144	*Dodonaea angustifolia* L. f.	Sapindaceae	Kitkita (H)	S	GW62, 410
145	*Dombeya torrida* (J.F. Gmel.) P. Bamps	Sterculiaceae	Jana (H)	T	GW13
146	*Dovyalis abyssinica* (A. Rich.) Warb.	Flacoutiaceae	Hegela (H)	S	GW75
147	*Dregea schimperi* (Decne.) Bullock	Asclepediaceae	Adulala (H)	C-W	GW124 GW424
148	*Drougetia iners* (Forssk.) Schweinf.	Urticaceae	Dobilabahrefa (H)	H	GW02, 627
149	*Drymaria cordata* (L.) Schultes	Caryphyllaceae	Duqusha (H)	H	GW90
150	*Drynaria volkensii* Hieron.	Polypodiaceae	Hecho?o (H)	H	GW653
151	*Duranta erecta* L.	Verbenaceae	Utam Bitena (H)	S	GW275
152	*Dyschoriste multicaulis* (A. Rich.) O. Kuntze	Acanthaceae	Ul Qecheba (H)	S	GW662
153	*Dyschoriste nagchana* (Nees) Bennett	Acanthaceae	Ul Qecheba (H)	H	GW61
154	*Dyschoriste radicans* Nees	Acanthaceae	Ul Qecheba (H)	H	GW71
155	*Echinops hispidus* Fresen.	Asteraceae	Ajar Haluta (H)	H	GW284
156	*Ehretia cymosa* Thonn.	Boraginaceae	Ulaga (H)	T/S	GW47
157	*Ekebergia capensis Sparrm.* Sparrm.	Meliaceae	Olola (H)	T	GW210, 02
158	*Elaeodendron buchananii* (Loes.) Loes.	Celastraceae	Wetembereda (H)	T/S	GW139
159	*Embelia schimperi Vatke* Vatke	Myrsinaceae	Qenqa (H)	S	GW10,12
160	*Englerina woodfordioides* (Schweinf.) M. Gilbert	Loranthanceae		S	GW161,167
161	*Entada africana* Guill. & Perr.	Fabaceae	MandeChilala (H)	T	GW206, 246
162	*Eragrotis olivacea* K. Schum.	Poaceae	Mure?e (H)	H	GW318
163	*Eragrotis paniciformis*(A. Br.) Steud	Poaceae	Mure?e (H)	H	GW30
164	*Eragrotis papposa* Nees	Paoceae	Mure?e (H)	H	GW355
165	*Erica arborea* L.	Ericaceae	Sate?e (H), Heyeyu (Y)	S	GW163, 20
166	*Eriosema jurionianum* Staner & De Craene	Fabaceae		H	Uncoded
167	*Eriosema monatum* Bak. f.	Fabaceae		H	GW13
168	*Erythrina abyssinica* Lam. ex DC.	Poaceae	Wolensu (O)	T	GW235
169	*Erythrina brucei Schweinf.* Schweinf.	Fabaceae	Wora?a (H), Kocho (Y)	T	GW208,282
170	*Erythrococa trichogyne* (Muell. Arg.) Prain	Euphorbiceae	Bu?a (H)	S	GW74,200
171	*Eucalyptus camaldulensis* Dehnh	Myrtaceae	Kehser barzafa (H)	T	GW213
172	*Eucalyptus citriodora* Hook.	Myrtaceae	Wonjbarzafa (H)	T	GW221
173	*Eucalyptus globulus* Labill	Myrtaceae	Qedal Barzafa (H), Forobarzaf (Y)	T	GW255
174	*Euclea racemosa* Murr. subsp. *schimperi* (A. DC.) White	Ebenaceae	Megara (H)	S	GW320, 291

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175	*Euphorbia abyssinica Gmel* Gmel.	Euphorbiceae	Adama (H), Akma (Y)	T	GW272, 170
176	*Euphorbia cotnifolia* L.	Euphorbiceae		S	GW326
177	*Euphorbia prostrata* Ait.	Euphorbiceae	Adamherefa (H)	H	GW202
178	*Euphorbia schimeriana*	Euphorbiceae	Gendela (H), Binebish (Y)	S	GW27, 717
179	*Faurea speciosa Welw.* Welw.	Proteaceae	Ankulusa, Duru?mHaqa (H)	T/S	GW213, 76
180	*Ficus ingens* (Miq.) Miq.	Moraceae	Qonda?la (H)	T	GW196
181	*Ficus sur* Forssk.	Moraceae	Oda?a (H),Teya (H)	T	GW114, 364
182	*Ficus exasperata* Vahl	Moraceae	Buch Hufancho (H)	T	GW202
183	*Ficus ovata* Vahl	Moraceae	Qonda?la (H), Odo (Y)	T	GW196
184	*Ficus sycomorus* L.	Moraceae	Oda?a (H), Teya (Y)	T	GW128
185	*Ficus thonningii* Blume	Moraceae	DimboChuka (H)	T	GW08
186	*Ficus vasta* Forssk.	Moraceae	Qilto?o (H)	T	GW96,225
187	*Flacourtia indica* (Burm. F) Merr.	Flacourtiaceae	Hegela (H)	T/S	GW128
188	*Flemingia grahamiana* Wight & Arn.	Fabaceae		S	GW421
189	*Flueggea virosa* (Willd.) Voigt.	Euphorbiaceae		S	GW261
190	*Fuerstia africana* T.C.E. Fr.	Lamiaceae	HaliGomenja (H), Muneta (Y)	H	GW116, 325
191	*Galiniera saxifraga* (Hochst.) Bridson	Rubiaceae	Gendeqa (H)	H	GW113
192	*Galinsoga parviflora* Cav.	Asteraceae	GutichaH)	H	GW128
193	*Galinsoga quadriradiata* Ruiz & Pavon	Asteraceae	Geqisa(H)	H	GW130
194	*Galium simense* Fresen.	Rubiaceae	Wic Qecheba(H),Ahicha(Y)	H	GW281
195	*Gardenia ternifolia.* Schumach. & Thonn.	Rubiaceae	Gambelu/Ankulusa	T/S	GW65, 226
196	Geranium aculeolatum Oliv.	Geraniaceae	UlliHerefa(H)	H	GW349
197	*Gerbera viridifolium* (DC.) Sch. Bip.	Asteraceae	Guffifiita(H)	H	GW273
198	*Gloriosa superba/multicaulis* Y	Amaryllidaceae		H	GW472
199	*Glycine wightii* (Wight & Arn.) Verdc.	Fabaceae	Nekeshilo(Y)	CH	GW629
200	*Gnaphalum rubiflorum* Hilliard	Asteraceae	Os hata(H)	H	GW17
201	*Gnidia involucrata* Steud. ex A. Rich.	Thymelaeaceae	Wic Olewa(H)	H	GW118
202	*Gnidia glauca* (Fresen.) Gilg	Thymelaeaceae	Olewa(H),Aluwo(Y)	S	GW21
203	*Gomphocarpus purpurascens* A. Rich.	Asclepiadaceae		H/S	GW571
204	*Gouania longispicata Engl.* Engl.	Rhamnaceae	Herira(H)	S	GW32, 332
205	*Grewia ferruginea* Hochst. ex A. Rich.	Tiliaceae	Togene(H)	T/S	GW84, 284
206	*Grewia velutina* (Forssk.) Vahl	Tiliaceae	Heruresha(H)	S	GW311
207	*Guizotia scabra* (Vis.) Chiov.	Asteraceae	Jela(H)	H	GW337, 210
208	*Hagenia abyssinica* (Bruce) G.F. Gmel.	Rosaceae	Suto(H),Ofa(Y)	T	GW258
209	*Halleria lucida* L.	Schrophularicaeae		S	GW54
210	*Haplocarpha pueppellii* (Sch. Bip.) Beauv.	Asteraceae	Fecheqe(H),Taseta(Y)	H	GW492
211	*Haplocarpha schimperi* (Sch. Bip.) Beauv.	Asteraceae	Fecheqe(H),Taseta(Y)	H	GW113

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212	*Helichrysum foetidum* (L.) Moenech.	Asteraceae		H	GW639,117
213	*Helichrysum forsskahlii* (J. F. Gmel.) Hilliard & Burtt	Asteraceae		H	GW665
214	*Helichrysum globosum* A. Rich.	Asteraceae		H	GW617
215	*Helichrysum schimperi* (Sch. Bip. Ex A. Rich.) Moeser	Asteraceae	Apso(Y)	S	GW148, 32
216	*Helichrysum stenopterum* DC.	Asteraceae		H	GW36
217	*Helinus mystacinus* (Ait.) E, Mey. ex Steud.	Rhamnaceae	Homecho(H), Idigagura(O)	S	GW102, 412
218	*Hibiscus berberidifolius* A. Rich.	Malvaceae	Borara(H),Kesa(Y)	S	GW181.
219	*Hibiscus macranthus* Hochst. ex A. Rich.	Malvaceae	Borara(H)	S	GW385
220	*Hibiscus vitifolius* L.	Malvaceae	Kesa(Y)	C	GW17
221	*Hippocratia africana* (Willd.) Loes.	Celastraceae	Morkera(H)	C	GW21
222	*Hippocratia goetzei* Loes.	Celastraceae	Morkera(H)	C-W	GW293
223	*Holothrix ucifolia* (Rchb.f.) Rchb.f.	Orchidaceae		H	GW98
224	*Hydrocotyle manii* Hook.f.	Apiaceae	Herefa(H)	H	GW53
225	*Hygrophila schulli* (Hamilt.) M. R. & S. M. Almeida	Acantaceae	Haluta(Girmita(H)	H	GW18
226	*Hyparrhenia hirta* (L.) Stapf	Poaceae	Borosa(H)	H	GW347
227	*Hyparrhenia rufa* (Nees) Stapf	Poaceae	Borosa(H)	H	GW19
228	*Hypericum annulatum* Morris	Hypericaceae	Geremba(H)	T/S	GW249
229	*Hypericum peplidifolium* A. Rich.	Hypericaceae		H	GW683
230	*Hypericum quartinianum*. A. Rich.	Hypericaceae	Geremba(H),Arinshesho(Y)	T/S	GW13
231	*Hypericum revolutum* Vahl	Hypericaceae	Fa?ya(Y)	T/S	GW60
232	*Hypoestes forskoalii* (Vahl) R. Br.	Acanthaceae	Eriya (H)	H	GW142
233	*Hypoestes triflora* (Forssk.) Roem. & Schult.	Acanthaceae	Eriya (H)	H	GW137, 586
234	*Ilex mitis (L.) Raldk*. (L.) Radlk.	Aquifoliaceae	Ashminqa(H),Botewa(Y)	T	GW381, 611
235	*Impatiens ethiopica* Grey-Wilson	Balsaminaceae	Doche?e(H)	H	GW130, 478
236	*Impatiens rothii* Hook.f.	Balsaminaceae	Ako(Y)	H	GW587
237	*Indigofera arrecta* (Hochst. ex A. Rich.)	Fabaceae	Chihurbata(H)	S	GW23
238	*Indigofera spicata* Forssk.	Fabaceae	Chihurbata(H)	S	GW153
239	*Inula paniculata* (Klatt) Burtt-Davy	Asteraceae	Gufgabala(H)	H	GW375
240	*Isglossa somalensis* Lindau	Acanthaceae		H	GW713
241	*Isodon ramosissimus* (Hook. F.) Codd	Lamiaceae		H	GW536
242	*Jacaranda mimosifolia* D. Don	Bignonaceae	Jakaranda(H)	T	GW374
243	*Jasminum abyssinicum* Hochst. ex DC.	Oleaceae	Tonsa(H),Gemdu(Y)	C-W	GW76
244	*Jasminum fluminense* Vell.	Oleaceae	Tonsa(H)	C-W	GM25
245	*Juncus dregeanus* Kunth	Juncaceae		H	GW78
246	*Juniperus procera* Hochst. ex Endl.	Cupressaceae	Homa(H),Arkewa(Y)	T	GW180
247	*Justicia heterocarpa* T. Anders.	Acanthaceae	Eriya (H)	H	GW364

No.	Botanical name	Family	Hadiya/Yem/Oromo name	Habit	Sample Code
248	*Justicia schimperiana*	Acanthaceae	Tumunga(H),Atebiyo(Y)	S	GW689
249	*Kalanchoe densiflora* Rolfe var. densiflora (Forssk.) Pers.	Crassulaceae	Henchura(H)(Orange fl)	H	GW l37
250	*Kalanchoe petitiana* A. Rich. var. petitiana	Crassulaceae	Henchura(H)	H	GW175b
251	*Kalanchoe schimperiana* A. Rich.	Crassulaceae	Gebali Henchura(H)	H	GW77
252	*Kohautia platyphylla* (K. Schum.) Bremek.	Rubiaceae		H	GW640
253	*Kosteletzkya adoensis* (Hochst. ex A. Rich.) Mast.	Malvaceae	Ul Borara(H)	H	GW21
254	*Lactuca inermis* Forssk.	Asteraceae	Gendela(H)	H	GW67
255	*Lagenaria abyssinica* (Hook.f.) C.F. Jeffrey	Cucurbitaceae	Umdumbusha(H),Gengana(Y)	C-H	GW664
256	*Laggera crispata* (Vahl) Hepper & Wood	Asteraceae	WichBobe?e(H),Gufufa(Y)	H	GW555
257	*Laggera tomentosa* (Sch. Bip. ex A. Rich.) Oliv. & Hiern.	Asteraceae	WichBobe?e(H),Gufufa(Y)	H	GW558
258	*Landolphia buchannanii* (Hall.f.) Stapf	Apocynaceae	Homba(H),Agega(Y)	C-W	GW215
259	*Lantana trifolia* L.	Verbenaceae	Boraboma(Y)	S	GW17
260	*Launaea intybacea* (Jacq.) Beauv.	Asteraceae	Ul gendela(H)	H	GW103, 709
261	*Leonotis ocymifolia* (Burm. f) Iwarsson	Lamiaceae	Hororamo(H)	S	GW23
262	*Leptadenia hastata* (Pers.) Decne.	Asclepediaceae	Tubu(Y)	C	GW87
263	*Leucas martinicensis* (Jacq.) R. Br.	Lamiaceae	Meri(Y)	H	GW70,GW582
264	*Leucas calostachys Oliv*.Oliv.	Lamiaceae	Qibetora(H)	S	GW73
265	*Linum trigynum* L.	Linaceae	KesiMororo(Y)	H	GW716
266	*Lippia adoensis* Hochst. ex Walp.	Verbenaceae	Ateda(H),Shasha(H)	S	GW36, 37
267	*Lobelia giberroa* Hemsl.	Campanulaceeae	Boyondena(H),Umri(Y)	S	GW578
268	*Loxogramme abyssinica* (Baker) M. G. Price	Polypodiaceae	Biska(Y)	H	GW202
269	*Lycopodium clavatum* L.	Lycopodiaceae?	IyoApso(Y)	H	GW247
270	*Lysimachia ruhmeriana Vatke* Vatke	Primulaceae	Uli sereta(H)	H	GW195
271	*Macaranga capensis* (Baill.) Sim a (Pax) Friis & Gilbert	Euphorbiceae	Odecho(H)	S	GW176
272	*Maesa lanceolata.* Forssk.	Myrsinaceae	Kowada(H),Tegewa(Y)	T/S	GW256, 04
273	*Malva parvifolia* Hojer	Malvaceae	Nosa(Y)	H	GW35
274	*Manilkara butugi Chiov*. Chiov.	Sapotaceae	Lega(H)	T	GW199
275	*Maytenus addat* (Loes.) Sebsebe	Celastraceae	Chirantata(H),Ma?ra(Y)	T/S	GW161
276	*Maytenus arbutifolia (*A. Rich.) Wilczek	Celastraceae	Jonge?e(H),Sona(Y)	S	GW127, 614
277	*Maytenus gracilipes* (Welw. Ex Oliv.) Exell subsp. arguta (Loes.) Sebsebe	Celastraceae	Jonge(H),Tuluma(Y)	S	GW170
278	*Maytenus senegalensis* (Lam.) Exell	Celastraceae	Feretkesa(H),Bonsona(Y)	T/S	GW314
279	*Melia azedarach* L.	Meliaceae	Nima(H)	T/S	GW104
280	*Melinis repens*(Will.) Zizka	Poaceae	Serethite(H),wajo(O)	H	GW449
281	*Microglossa pyrifolia* (Lam.) Kuntze	Asteraceae	Se?a(H),Etnisuqeru(Y)	S	GW68, 07, 317
282	*Mikaniopsis clematoides* Milne-Redh	Asteraceae	Bukuke(H)	C-H	GW24, 608, 265

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283	*Millettia ferruginea* (Hochst.) Bak.	Fabaceae	Hengeda(H),Kesha(Y)	T	GW66, 21
284	*Mimulopsis solmsii* Schweinf.	Acanthaceae		H	GW92, 140,169
285	*Mimusops kummel* A. DC.	Sapotaceae	Dogoena(H)	T	GW217
286	*Minuartia filifolia* (Forssk.) Mattf.	Schrophularicaeae		H	GW50,663
287	*Momordica foetida Schumach.* Schumach	Cucubitaceae	Hameshesa(H),Wojimiya(Y)	C-H	GW713,
288	*Myrsine africana.* L.	Myrsinaceae	Getema (H),Futuwa (Y)	S	GW183
289	*Nicotiana tobaccum* L.	Solanaceae	Temba?a (H),Tumako (Y)	H	GW266
290	*Nuxia congesta.*R. Br.ex Fresen.	Loganiaceae	Bitena (H),Shiǹga (Y)	T/S	GW344, 20
291	*Ocimum basilicum* L.	Lamiaceae	Gimenja (H)	H	GW236, 276
292	*Ocimum lamiifolium* Hochst. ex Benth.	Lamicaeae	Damekesa (H)	S	GW31
293	*Ocimum urticifolium* Roth	Lamiaceae	Lael Gimenja (H)	S	GW16
294	*Ocotea kenyensis* (Chiov.) Robyns & Wilczek	Lauraceae	Shewa (H)	T	GW19
295	*Olea welwitschi* (Knobl.) Gilg & Schellenb.	Oleaceae	Sigeda (H)	T	GW185
296	*Olea capensis* L. subsp. *macrocarpa* (C.A. Wright) Verdc.	Oleaceae	Onema (H), Zija (Y)	T	GW03
297	*Olea europaea* L. subsp. *cuspidata* (Wall. ex G. Don) Cif.	Oleaceae	Wera (H),Buna(Y)	T	GW618
298	*Olinia rochetiana.* A. Juss.	Oliniaceae	Guna(H),Fegegu (Y)	T	GW74
299	*Oncoba spinosa* Forssk.	Flacourtiaceae	Akuku (O),Kuka (H)	T/S	GW17
300	*Oplismenus burmannii* (Retz.) P. Beauv.	Poaceae	Sheshehite (Y)	H	GW65
301	*Oplismenus hirtellus* (L.) P. Beauv.	Poaceae		H	GW349
302	*Oreosyce africana* Hook. f.	Cucurbitaceae	Ke?uaju (Y)	C-H	GW619
303	*Orobanche minor* Smit	Orobanchaceae	Adu?nwesa(H),Herko(Y)	H	GW647
304	*Osyris quadripartita* Decn.	Santalaceae	Karo(H),Mekekuma(H)	S	GW210,288
305	*Otostegia tomentosa* A. Rich. subsp. *ambigens* (Chiov.) Sebald	Lamiaceae	Forodebese(Y)	H	GW218
306	*Oxalis latifolia* Kunth	Oxalidaceae	Silketa(Y)	H	GW707
307	*Oxalis obliquifolia* A. Rich.	Oxalidaceae	Silketa(Y)	H	GW645
308	*Oxalis radicosa* A. Rich.	Oxalidaceae	Silketa(Y)	H	GW152 , 18
309	*Oxyanthus speciosus* DC. subsp. *stenocarpus* (K. Schum.) Bridson	Rubiaceae	MentichGendeqa(H),Wetekibo(Y)	T/S	GW11
310	*Ozoroa insignis* Del. subsp. *insignis*	Anacardiaceae	Bisho?o(H)	T/S	GW203
311	*Panicum hochstetteri* Steud.	Poaceae	Wajo(Y)	H	GW530
312	*Panicum maximum* Jacq.	Poaceae	Shashahite(H)	H	GW147
313	*Panicum pusillum* Hook. f.	Poaceae	Dabayhite(H),Mergaanuta(O)	H	GW541
314	*Paspalum scrobiculatum* L.	Poaceae	Wo?lsoqido(H)	H	GW112
315	*Passiflora edulis* Sims	Passifloraceae	Fashinturusa(H)	C-H	GW204, 700
316	*Pavetta abyssinica* Fresen.	Rubiaceae	Wetekibo(Y)	T/S	GW151, 418
317	*Pavetta oliveriana* Hiern	Rubiaceae	Wetekibo(Y)	S	GW418

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318	*Pavonia schimperiana* Hochst. ex A.Rich.	Malvaceae		S	GW710
319	*Pavonia urens Cav*.Cav.	Malvaceae	Wich Borara(H)	S	GW35,718
320	*Pellaea viridis* (Forssk.) Prantl.	Adiantaceae	Ontoto?o(H)	H	GW141
321	*Pellaea* sp.	Adiantaceae	Ontoto(H)	H	GW64
322	*Pennisetum clandestinum* Chiov.	Poaceae	Seda(H),Geda(Y)	H	GW118
323	*Pennisetum sphacelatum* (Nees) Th. Dur. & Schinz	Poaceae	Migira(H/O)Gufa(H),Fesha(Y)	H	GW545
324	*Pennisetum thunbergii* Kunth	Poaceae	Wishmigira(H)	H	GW542
325	*Pennisetum trachyphyllum* Pilg.	Poaceae	Shasha?a(H)	H	GW281
326	*Pennisetum villosum* Fresen.	Poaceae	QaleWishmigira(H)	H	GW663
327	*Pentas lanceolata* (Forssk.) Defl. subsp. *quartiniana* (A. Rich.) Verdc.	Rubiaceae	Webeta(H)	S	GW138, 444
328	*Pentas schimperiana* (A. Rich.) Vatke subsp. *schimperiana*	Rubiaceae	Wobeta(H)	S	GW156, 510
329	*Peperomia abyssinica* Miq.	Piperaceae		H	GW217
330	*Periploca linearifolium* Quart-Dill. & A. Rich.	Asclepediaceae	Adulalla(H/O),Tubu(Y)	C-W	GW55, 36
331	*Persicaria nepalensis* (Meisin.) Myabe	olygoniaceae	Kukusibocha(H)	H	GW584
332	*Phaseolus vulgaris* L.	Fabaceae	Boloqe?e(H)	H	GW22
333	*Phaulopsis imbricata* (Forssk.) Sweet subsp. *imbricata*	Acanthaceae	Uli qecheba(H)	H	GW72, 408
334	*Phoenix reclinata Jacq.* Jacq.	Arecaceae	Dimbaba(H),Deya)Y),Meti(O)	S	GW105,626
335	*Phragmanthera macrosolen* (A. Rich. M.) Gilbert	Loranthanceae	ErtuWedesa(O)	S	GW117,317
336	*Phyllanthus pseudoniruri* Muell. Arg.	Euphorbiaceae		S	GW232
337	*Phyllanthus rotundifolius* Willd.?	Euphorbiaceae		H	GW231
338	*Physalis peruviana*.L.	Solanaceae	Onjoro(H),Timatim(Y)	H	GW43, 607
339	*Phytolacca dodecandra* L.'Hérit	Phytolaccaceae	Hanja(H),Andode(Y)	S	GW688
340	*Piliostigma thonnninghii* (Schumach.) Milne-Redh	Fabaceae	Hurbo(H),Lulu(O)	T/S	GW209, 128
341	*Pittosporium viridiflorum* Sims	Pittosporaceae	Qesha(H),Toshu(Y)	H	GW568
342	*Plantago lanceolata* L.	Plantaginaceae	WishAlebo(H),Buriyo(Y)	H	GW57, 649
343	*Plantago major* L.	Plantaginaceae	Dumniburiyo(Y)	H	GW09, 649
344	*Plectocephalus varians* (A. Rich.) C.Jeffrey ex.Cufod.	Asteraceae	Ul Hata(H)	H	GW463,GW 271
345	*Plectranthus sylvestris* Gürke	Lamiaceae	Michqerare(H)	H	GWf94
346	*Plectranthus lactiflorus* (Vatke) Agnew	Lamiaceae	Be?uneta(Y)	H	GW346
347	*Plectranthus lanuginosus* (Hochst. ex Benth.) Agnew	Lamiaceae	Be?uneta(Y)	H	GW274
348	*Plectranthus marrubatus*J. K. Morson	Lamiaceae	Dumnizero(Y)	H	GW709
349	*Plectranthus ornatus* Codd	Lamiaceae	Dumnizero(Y)	H	GW100
350	*Plectranthus punctatus* (L.f.) L'Hér.	Lamiaceae	Data(H)	H	GW34, 483
351	*Pleopeltis macrocarpa* (Willd.) Kaulf	Polypodiaceae	Ontoto?O(H),Biska(Y)	H	GW238
352	*Poa annua* L.	Poaceae	Tafearemamo?o(H)	H	GW58

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353	*Podocarpus falcatus* (Thunb.) R. B. ex Mirb.	Podocarpaceae	Digiba(H),Gedewa(Y)	T	GW101, 613
354	*Polygala albida* Schinz subsp. stanleyana (Chod.) Paiva	Polygalaceae		H	GW18
355	*Polyscias fulva* (Hiern.) Harms	Araliaceae	Bolfe(H),(Y)	T	GW172
356	*Polystachya bennetiana* Rchb.f.	Orchidaceae	Koshma(Y)	H	GW218a
357	*Polystachya rivae* Schweinf.	Orchidaceae	Koshma(Y)	H	GW130
358	*Premna schimperi Engl.* Engl.	Lamiaceae	Totenke(H)Wagnara(Y)	T/S	GW49, 413
359	*Protea gaguedi* J. F. Gmel.	Proteaceae	Burebuke(Y)	T	GW462
360	*Prunus africana.* (Hook. f.) Kalkm	Rosaceae	Arara(H),Ona(Y)	T	GW213
361	*Pseudarthria hookeri* Wight & Arn.	Fabaceae		S	GW311
362	*Pseudocarum eminii* (Engl.) H. Wolff.	Apiaceae		S	GW216a
363	*Pseudognaphalum richardianum* (Cufod.) Hilliard & Burtt	Asteraceae		H	GW652
364	*Psidum guajava* L.	Myrtaceae	Zaytuni(O)	T/S	GW442
365	*Psydrax parvifolia* (Afz.) Bridson	Rubiaceae	Ililquba(H)	S	GW251
366	*Psydrax schimperiana* (A. Rich.) Bridson subsp. schimperiana	Rubiaceae	Ililquba(H)	T/S	GW89
367	*Pteridium aquilinum* (L.) Kuhn	Dennistaedtiaceae	Ontoto?o(H),Biska(Y)	H	GW172
368	*Pterolobium stellantum* (Forssk.) Brenan	Fabaceae	Chergosa(H),Gegema(Y)	S	GW37
369	*Pycnotachys eminii* Gürke	Lamiaceae	Tombora(H),Ke?nzero(Y)	S	GW287, 144
370	*Rhamnus prinoides* L'Hérit.	Rhamnaceae	Gesho?o(H),Gesho(Y)	S	GW39, 20
371	*Rhamnus staddo* A. Rich.	Rhamnaceae	Wato?O(H),Wacha(Y)	T/S	GW85, 197
372	*Rhiocissus tridentata* (L. f.) Wild & Drummond	Vitaceae	Lalo?o(H)Lalu(O)	C/W	GW264, 318
373	*Rhus natalensis* Krass	Anacardiaceae	Qemo?o(H),Kamo(Y),Tatesa(O)	T/S	GW214
374	*Rhyncosia erythreae* Schweinf.	Fabaceae		H	GW417
375	*Ritchiea albersii* Gilg.	Capparidaceae	Hesbeta(H)	S	GW103
376	*Rosa abyssinica* Lindley	Rosaceae	Goqe(H),Garona(Y)	S	GW312, 610
377	*Rothmannia urcelliformis* (Hiern.) Robyns	Rubiaceae		S	GW163
378	*Rubia cordifolia* L.	Rubiaceae	Haro(H),Kerachicha(Y)	C-H	GW205
379	*Rubus apetalus* Poir.	Rosaceae	Danegora(H),Ke?u(Y)	S	GW252
380	*Rubus rosifolius* Sm.	Rosaceae	Kereke?u(Y)	S	GW218
381	*Rubus* sp.	Rosaceae	Chigora(H)	S	GW10
382	*Rubus steudneri Schweinf.* Schweinf.	Rosaceae	Danegora(H),Ke?u(Y)	S	GW374, 31
383	*Rumex abyssinicus* Jacq.	polygoniaceae	Shisho(H),Ferefeku(Y)	H	GW11, 491
384	*Rumex nervosus* Vahl	Polygoniaceae	She?luta(Y)	H	GW567
385	*Rytigynia neglecta* (Hiern.) Robyns var. *neglecta*	Rubiaceae	Garewa(H),Ke?unbuna(H)	S	GW86, 451
386	*Salvia nilotica* Jacq.	Verbenaceae	Okota(H),Okta(Y)	H	GW365
387	*Sanicula-elata* Buch-Ham. ex D.Don	Apiaceae	Danifofa(Y)	H	GW105, 189

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388	*Sapium elliptium* (Krauss) Pax	Euporbiceae	Badewacho/Sheqema(H),Bosoqa(Y)	T	GW98
389	*Satureja abyssinica* (Benth.) Briq.	Lamiaceae	Be?uneta(Y)	H	GW66, 141
390	*Satureja paradoxa* (Vatke) Engl. ex Seybold	Lamiaceae	Data(H),Hore(Y)	H	GW115
391	*Scadoxus multiflorus* (Matyn) Raf.	Amaryllidaceae	Zobone(O)	H	GW624
392	*Schrebera alata* (Hochst.) Welw.	Oleaceae	Lobaqa(H),Orewa(Y)	T	GW201, 612
393	*Scolopia theifolia* Gilg	Flacourtiaceae	Gimqesha?a(H)	S	GW44
394	*Securidaca longepedunculata* Fresen.	Polygalaceae	Muke/Aymela(H),Ameli(Y)	S	GW201
395	*Selaginella* sp.	Lycopodiaceae?		H	GW48
396	*Senecio tamoides* DC.	Asteraceae	Hayborsa(H)	S	GW259
397	*Senecio* sp.	Asteraceae	2016 Yem	H	GW684
398	*Senecio rogazii* Chiov.	Asteraceae		H	GW537
399	*Senna septemtrionalis* (Viv.) Irwin & Barneby	Fabaceae	Checho?o(H),BunsAshtuza(Y)	S	GW51
400	*Senna didymobotra* (Fresen.) Irwin & Barneby	Fabaceae	Checho?o(H)	S	GW69
401	*Senecio tamoides* (Bolle) Lock	Fabaceae	Checho?o(H)	S	GW220
402	*Shefflera abyssica* (Hochst. ex A. Rich.) Harms	Araliaceae	Getema(H),Dega(Y)	T	GW116
403	*Sida alba* L.	Malvaceae	Keraba(O)	S	GW677
404	*Sida rhombifolia* L.	Malvaceae	Ulborara(H)	S	GW129
405	*Sida schimperiana* Hochst. ex A. Rich.	Malvaceae	Jejogota(H),Keja(Y)	S	GW315
406	*Sideroxylon oxyacanthum* Baill.	Sapotaceae	Feretkesa(H)	S	GW435
407	*Smilax aspera* L.	Smilacaceae	Hobemeda(H),Kowa(Y)	C	GW136
408	*Snowdenia polystachya* (Fresen) Pilg.	Poaceae	Muja(H),Bo?ha(Y)	H	GW228
409	*Solanecio gigas* (Vatke) C. Jeffrey	Asteraceae	Tombosena(H)(Domorisa(Y)	S	GW258
410	*Solanum anguivi* Lam.	Solanaceae	WidLorawa(H),Gemekewa(Y)	S	GW602
411	*Solanum marginatum* L. f.	Solanaceae	Ajar Loro?o(H),Foroamemu(Y)	S	GW20, 46
412	*Solanum nigrum* L.	Solanaceae	Deme?e(H),Ereto(Y)	H	GW13
413	*Solanum villosum* Mill.	Solanaceae	OdamDeme?e(H),Ke?unereto(Y)	H	GW52, 621
414	*Solenostemon aurtani* (Briq.) J.K. Morton	Lamiaceae		H	GW184, 711
415	*Sonchus bipontini* Oli. & Hiern.	Asteraceae	TetemoGendela(H),Gogma(Y)	H	GW347
416	*Spermacoce pusilla* Wall.	Rubiaceae	Seyo(Y)	H	GW654
417	*Sporobolus africanus* (Poir.) Robyns & Tournay	Poaceae	Ke?unNejo(Y), MureJeldesa(O)	H	GW106
418	*Sporobolus agrostoides* Chiov.	Poaceae	Ke?unNejo(Y), MureJeldesa(O)	H	GW267
419	Sp x (Asteraceae/small shrub/Duna	Asteraceae		H/S	GW25
420	Spx (Fabaceae)	Fabaceae	Haqo'lsen(H)	S	GW57
421	Spx (loda H)	?	LodaH)	C	GW195
422	Sp. Lamiaceae	Lamiacaeae		H	GW51
423	*Stachys aculeolatum* Hook. f.	Lamiaceae		H	GW31

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424	*Stegnogramma pozoi* (Lagasca) K. Iwatsuki	Thylipteridaceae		H	GW216
425	*Stephania abyssinica* (Dillon & A. Rich.) Walp	Menispermaceae	Huma(H),Temteko(Y)	C-H	GW59
426	*Stereospermum kunthianum Cham.*Cham.	Bignonaceae	Bisho?o(H),Botoro(O)	T	GW294
427	*Swertia abyssinica* Hochst.	Gentianaceae	Zeraro(H),Forofiga(Y)	H	GW08, 642
428	*Syzygium guineens*e (Willd.) DC. subsp. *guineense*	Myrtaceae	Dubana(H),Shewu(Y)	T/S	GW244, 859
429	*Syzygium guineese* (Willd.) DC. subsp. *macrocarpa* (Engl.) F. White	Myrtaceae	Goto?o(H)Gotu(O)	T	GW291
430	*Taccazea conferta* N.E. Br.	Asclepiadaceae	Dolmencha(Y) ,Tubu(Y)	C	GW652
431	*Tagetes minuta* L.	Asteraceae	Bobe?e(H)	H	GW60, 650
432	*Teclea nobilis Del.* Del.	Rutaceae	Ta?a(H),Meku(Y)	S	GW84
433	*Tectaria gemmifera* (Fée) Alston	Tectariaceae	Ontto(H),Biska(Y)o	H	GW81
434	*Tephrosia interrupta* Hochst. & Steud. ex Engl.	Fabaceae		S	GW191
435	*Terminalia brownii* Fresen.	Combretaceae	Debeqa(H),Dedensa(O)	T	GW208
436	*Tetrapogon cenchriformis* (A.Rich.) Clayton	Poaceae		H	GW532
437	*Thalictrum rhynchocarpum* Dil. & A. Rich.	Ranunculaceae	Shotesa(Y)	H	GW107
438	*Thelypteris confluens* (Thunb.) C.V.Morton	Siphonopteridaceae	Ontoto(H),Biska(Y)	H	GWx2
439	*Themeda triandra* Forssk.	Poaceae		H	GW171
440	*Thunbergia alata* Boj. ex Sims	Acanthaceae	Uli Fida(H)	C-H	GW78
441	*Thunbergia ruspoli* Lindau	Acanthaceae		H	GW376
442	*Tiliacora funifera* Oliv.	Menspermaceae	Chu?na(H)	C-W	GW10
443	*Toddalia asiatica* (L.) Lam.	Rutaceae	Sego(H),Keregora(Y)	S	GW330
444	*Torilis arvensis* (Hudson) Link	Apiaceae		H	GW216
445	*Tragia brevipes* Pax	Euphorbiceae	Lael Dobo(H),Misketa(Y)	H	GW346
446	*Tragia dryodes* M. Gilbert	Euphorbiaceae	Misketa(Y),Geldu(O)	C	GW297
447	*Trema orientalis* L. Bl.	Ulmaceae		T	GW207
448	*Trichilia volkensii* Gurke	Meliaceae	Abera(H)	T	GW26
449	*Trichocladus ellipticus* Eckl. & Zehn.	Hamamelidaceae	Qeberbuya (H)	S	GW227
450	*Trichodesma zeylanicum* (Burn. f.) R. Br.	Boraginaceae	Qale qecheba/stingy	H	G207
451	*Trifolium polystachyum* Fresen.	Fabaceae	Gerenbongo(Y), Sidisa(O)	H	GW262
452	*Triumfetta rhomboidea* Jacq.	Tiliaceae	Borara(H)	S	GW379
453	*Triumfetta tomentosa* Boj.	Malvaceae	Borara(H)	S	GW165
454	*Ubelinia kigesiensis*\	Rubiaceae	Aremamo (H)	H	GW327
455	*Urochloa panicoides* P. Beauv.	Poaceae	Chefhite(H)	H	GW117
456	*Vangueria apiculata* K. Schum.	Rubiaceae	Loqo?o(H),Bururi(O)	T/S	GW368
457	*Vepris dainelli* (Pic.Serm.) Kokwaro	Rutaceae	Mentich Taea(H)	T/S	GW164
458	*Verbascum sinaiticum.*Benth.	Schrophularicaeae	Doboqo(H)	H	GW41a
459	*Verbena officinalis* L.	Verbenaceae		H	GW149
460	*Vernonia amygdalina* Del.	Asteraceae	Heba(H),Suqeru(Y)	T/S	Gm252

No.	Botanical name	Family	Hadiya/Yem/Oromo name	Habit	Sample Code
461	*Vernonia bipontini* Duna	Asteraceae		S	GW622
462	*Vernonia hochstetteri* Sch. Bip. ex Walp.	Asteraceae	Wic Soyoma(H)	S	GW141, 259
463	*Vernonia ischnophylla* Muschl.	Asteraceae	Agega(H)	S	GW25
464	*Vernonia karaguensis* Oliv. & Hiern.	Asteraceae		S	GW405
465	*Vernonia myriantha* Hook. f.	Asteraceae	Barewa(H),Buzo(Y)	S	GW02
466	*Vernonia wellastonii* S. Moore	Asteraceae	Hemach Se?a(H)	S	GW08,135
467	*Veronica abyssinica* Fresen.	Schrophularicaeae		H	GW129
468	*Vicia sativa* L. var. *angustifolia*	Fabaceae	Chimishira(H),Kesfi?a(Y)	H	GW583

Appendix 2. Synoptic table of Plant communities in Hadiya

(only species with values >= 1.20 are given in each community)

Species	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Podocarpus falcatus	**3.05**	0.00	0.50	1.00	0.00
Croton macrostachyus	**2.95**	4.40	4.00	1.27	0.57
Syzygium guineense subsp. *guineense*	**2.93**	2.00	0.00	0.33	0.00
Olinia rochetiana	**2.40**	0.00	0.00	0.00	0.29
Eucalyptus camaldulensis	**2.20**	0.00	0.50	3.00	1.00
Calpurnia aurea	**2.18**	0.00	0.00	0.20	0.00
Achyrospermum schimperi	**2.10**	0.00	0.00	0.13	1.19
Albizia schimperiana	**2.08**	0.00	0.00	0.00	0.00
Digitaria abyssinica	**1.88**	0.00	0.92	0.00	0.52
Vernonia myriantha	**1.63**	0.00	1.25	1.00	1.10
Arthraxon micans	**1.53**	0.00	0.42	0.00	0.00
Bersama abyssinica	**1.45**	0.00	0.00	0.00	0.29
Rytigynia neglecta	**1.43**	2.80	2.17	0.13	1.24
Digitaria velutina	**1.40**	0.00	1.58	0.00	0.00
Rubus steudneri	**1.38**	0.00	0.00	0.87	0.05
Senna septemtrionalis	**1.38**	0.00	0.00	0.00	0.00
Toddalia asiatica	**1.30**	0.00	2.75	0.00	0.00
Dodonaea angustifolia	0.65	**7.40**	1.00	0.67	0.00
Euclea racemosa susp. *schimperi*	1.33	**7.40**	0.58	0.53	0.05
Hyparrhenia hirta	0.05	**5.60**	0.00	0.00	0.00
Myrsine africana	0.88	**5.40**	0.00	0.33	1.10
Senna petersiana	0.00	**4.60**	0.00	0.00	0.00
Croton macrostachyus	2.95	**4.40**	4.00	1.27	0.57
Combretum molle	0.13	**4.20**	0.00	0.00	0.00
Rhyncosia viscosa	0.00	**4.20**	0.00	0.00	0.00
Hypericum quartinianum	0.38	**4.00**	0.17	0.00	0.05
Combretum collinum	0.00	**3.80**	0.00	0.00	0.00
Faurea speciosa	0.08	**3.60**	0.00	0.00	0.00
Entada africana	0.05	**2.80**	0.00	0.00	0.00
Ficus vasta	0.23	**2.80**	0.00	0.93	0.00
Rytigynia neglecta	1.43	**2.80**	2.17	0.13	1.24
Terminalia brownii	0.00	**2.60**	0.00	0.00	0.00
Clutia abyssinica	0.15	**2.40**	0.42	0.60	0.71
Dachrostachys cinerea	0.00	**2.40**	0.00	0.00	0.00
Syzygium guineense susp. *macrocarpum*	0.85	**2.40**	0.00	0.40	0.00
Vernonia amygdalina	0.23	**2.40**	0.00	0.00	0.14
Balanites aegyptiaca	0.00	**2.20**	0.00	0.00	0.00
Stereospermum kunthianum	0.00	**2.00**	0.00	0.00	0.00

Species	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Syzygium guineense susp. *guineense*	2.93	**2.00**	0.00	0.33	0.00
Themeda triandra	0.40	**1.80**	0.00	1.20	0.00
Rhus natalensis	0.33	**1.40**	0.83	0.33	0.76
Solanum incanum	0.93	**1.40**	0.58	0.53	0.00
Vangueria volkensii	0.35	**1.40**	0.00	0.00	0.00
Acacia sayal	0.00	**1.20**	2.50	0.20	0.00
Pterolobium stelantum	0.45	0.00	**4.42**	1.07	0.00
Acacia abyssinica	0.25	0.00	**4.42**	1.93	0.00
Cynodon dactylon	0.30	0.00	**4.17**	0.80	0.19
Croton macrostachyus	2.95	7.40	**4.00**	1.27	0.57
Carissa spinarum	1.18	2.40	**3.25**	2.33	0.00
Premna schimperi	0.70	0.00	**3.25**	0.87	0.00
Toddalia asiatica	1.30	2.40	**2.75**	0.00	0.00
Acacia sieberiana	0.00	0.00	**2.75**	0.00	0.00
Acacia sayal	0.00	0.00	**2.50**	0.20	0.00
Rytigynia neglecta	1.43	2.80	**2.17**	0.13	1.24
Pennisetum sphaecelatum	0.60	0.00	**2.08**	1.67	0.29
Acacia polyacantha	0.00	0.00	**2.08**	0.93	0.00
Dischoriste multicaulis	0.25	0.00	**1.67**	0.20	0.43
Digitaria velutina	1.40	2.80	**1.58**	0.00	0.00
Leucas martinescens	0.15	0.00	**1.50**	0.00	0.00
Flacourtia indica	0.03	0.00	**1.33**	0.67	0.00
Vernonia myriantha	1.63	3.80	**1.25**	1.00	1.10
Jasminum abyssinicum	0.40	0.00	**1.25**	0.00	0.95
Eucalyptus camaldulensis	2.20	4.60	0.50	**3.00**	1.00
Carissa spinarum	1.18	2.40	3.25	**2.33**	0.00
Acacia abyssinica	0.25	0.00	4.42	**1.93**	0.00
Pennisetum sphaecelatum	0.60	0.00	2.08	**1.67**	0.29
Croton macrostachyus	2.95	7.40	4.00	**1.27**	0.57
Eucalyptus citriodora	0.78	0.40	0.00	**1.27**	0.00
Eucalyptus globulus	0.00	0.00	0.00	0.00	**3.10**
Hypericum annulatum	0.13	0.00	0.00	0.00	**2.86**
Lippia adoensis	0.10	0.00	1.00	0.00	**2.00**
Acanthus senii	0.00	0.00	0.00	0.00	**1.67**
Leucas calostachys	0.48	0.00	0.75	0.33	**1.52**
Hypoestes forskaollii	0.38	0.00	0.17	0.00	**1.52**
Maytenus arbutifolia	0.60	0.00	0.83	0.80	**1.24**
Rytigynia neglecta	1.43	2.80	2.17	0.13	**1.24**

Apendix 3. Synoptic table of species in plant communities in Yem

(only species with values >= 1.20 are given in each community)

Species	Cluster 1	Cluster 2	Cluster 3
Juniperus procera	**6.22**	1.25	0.00
Syzygium guineense subsp. *guineense*	**4.00**	0.63	2.08
Podoocarpus falcatus	**3.44**	1.63	0.00
Osyris quadripartita	**2.44**	0.63	1.08
Olea capensis subsp. *macrocarpa*	**2.33**	0.25	0.00
Pteridium aquilinum	**2.22**	0.00	0.23
Olinia rochetiana	**2.22**	1.13	0.00
Myrsine africana	**2.11**	0.00	0.00
Ilex mitis	**2.00**	0.75	0.00
Euphorbia abyssinica	**1.89**	0.00	0.46
Hypericum quartinianum	**1.89**	0.00	0.46
Acanthus eminens	**1.78**	0.38	0.00
Apodites dimidiata	**1.56**	1.00	0.08
Erica arborea	**1.33**	0.00	0.00
Carissa spinarum	**1.22**	0.38	1.54
Clutia abyssinica	**1.22**	0.88	0.00
Schefflera abyssinica	**1.22**	0.75	0.00
Cynodon dactyon	1.11	**3.50**	1.62
Ficus sur	0.56	**2.75**	0.46
Hagenia abyssinica	0.56	**2.75**	0.00
Vernnonia myriantha	0.89	**2.63**	0.15
Ekebergia capensis	0.89	**2.50**	0.15
Erytrina brucei	0.00	**2.50**	0.00
Croton macrostachyus	1.11	**2.25**	1.38
Rubus steudneri	1.11	**2.25**	0.00
Arundinaria alpina	0.00	**2.13**	0.00
Maesa lanceolata	1.11	**1.88**	0.00
Taccazea conferta	0.22	**1.75**	0.00
Podocarpus falcatus	3.44	**1.63**	0.00
Andropogon abyssinica	0.11	**1.50**	0.00
Calpurnia aurea	0.00	**1.50**	0.38
Bersama abyssinica	1.11	**1.38**	0.54
Pennisetum thunbergi	1.00	**1.38**	0.00
Carduus schimperi	0.00	**1.38**	0.00
Juniperus procera	6.22	**1.25**	0.00
Momordica foetida	0.22	**1.25**	0.00
Brucea antidysentrica	0.11	**1.25**	0.00
Phytolacca dodecandra	0.00	**1.25**	0.00

Species	Cluster 1	Cluster 2	Cluster 3
Combretum molle	0.00	0.00	**2.23**
Acanthus polystachius	0.00	0.88	**2.15**
Syzygium guineense subsp. *macrocarpum*	4.00	0.63	**2.08**
Sapium ellipticum	0.00	0.00	**1.92**
Dodonaea angustifolia	0.22	0.00	**1.77**
Ficus vasta	0.00	0.00	**1.77**
Premna schimperi	0.00	0.00	**1.77**
Solanum incanum	0.00	0.13	**1.69**
Cynodon dactylon	1.11	3.50	**1.62**
Carissa spinarum	1.22	0.38	**1.54**
Croton macrostachyus	1.11	2.25	**1.38**
Dyschoriste multicaulis	0.00	0.00	**1.31**
Rhiocissus tridentata	0.00	0.00	**1.31**
Helichryssum schimperi	0.78	0.00	**1.23**
Acacia brevispica	0.22	0.00	**1.23**

Appendix 4. List of human ailments and conditions reported in the five districts

(A = Anlemo, D = Duna, G = Gibe, Gm = Gombora, Y = Yem, cit. = citation)

No.	Ailment	Local Hadiya/Yem name	A		D		G		Gm		Y	
			cit.	%	cit.	%	cit.	%	cit.	%	cit.	%
1	Abdominal pain	godabtiso(H)konusato(Y)	74	7	133	14	43	3	108	11	130	8
2	Abdominal bloat	dusima(H)Ketiniketa(Y)	6	1	11	1	18	1	-	-	3	0.18
3	Abdominal worms	godapdequra(H)ketnitowa(Y)	21	2	3	0.33	22	2	-	-	5	0.29
4	Acute rheumatic fever	sorqopa(H)nekelebe?u(Y)	2	0.20	11	1	23	2	49	5	129	8
5	Allergic rashes	sara(Y)	-	-		-	-	-	-	-	12	1
6	Amoebiasis	ameba(H/Y)	8	1	-	-	8	1	8	1	45	3
7	Anaemia	tighofecha/nechima(H)	4	0.40	-	-	-	-	7	1	-	-
8	Anthrax	toka(h)kemar(Y)	-	-	-	-	5	0.38	-	-	69	4
9	Anti-poisoning	merzinimero(Y)	-	-	-	-	-	-	-	-	20	1
10	Aphrodisiac	gonoma(H)	3	0.30	-	-	-	-	-	-	-	-
11	Arthritis	icho?o(H)kecho(Y)	39	4	61	7	51	4	-	-	35	2
12	Ascariasis	henshesha(H)?(Y)	-	-	47	6	-	-	23	2	19	1
13	Asthma	shinqa(H)asma(Y)	13	1.2	14	2	3	0.23	4	0.40	20	1
14	Athletes foot	shokota(H)	2	0.2	-	-	4	0.3	-	-	-	-
15	Atopic eczema	shifite(H)	-	-	-	-	11	1	-	-	-	-
16	Avoidance of disease	jabeoholima(H)	5	1	-	-			-	-	-	-
17	Bad breath	sumbobima(H)	8	1	-	-	2	0.15	-	-	-	-
18	Bad odor fart/flatulence	niboba(H)	3	0.30	6	0.65	-	-	-	-	-	-
19	Belief for Menstrual time	"legu"(O)	-	-	-	-	-	-	-	-	3	0.18
20	Bleeding	xigaulisha(H)ananmaza(Y)	15	1	-	-	18	1	7	0.7	5	0.29
21	Blood diarrhoea	xigadite(H)	3	0.30	-	-	2	0.15	-	-	-	-
22	Blood pressure	xiggifita(H)anantugu(Y)	19	2	11	1	7	1	-	-	10	1
23	Boil	bikirata(H)?(Y)	12	1	3	0.33	-	-	-	-	8	0.47
24	Bone cancer	miqicha(H)meganikanser(Y)	-	-	6	1	3	0.23	-	-	14	1
25	Breast cancer & other swellings	anun tiso(H)	-	-	-	-	-	-	-	-	-	-
26	Bronchitis	oshu(Y)	-	-	-	-	-	-	-	-	5	0.29
27	Burns	shoka(H)	7	10.6	-	-	-	-	-	-	-	-
28	Cancer	kanser(H)	-	-	-	-	-	-	6	1	-	-
29	Chocking	siniqa(H)	2	0.2	2	0.22	8	1	-	-	-	-
30	Cholera	kolera(H)	11	1	-	-	-	-	-	-	-	-
31	Chronic bed patient	kabuno matan(Y)	-	-	-	-	-	-	-	-	3	0.18
32	Chronic leg wound	jenje?na(H)ke?o(Y)	-	-	-	-	8	1	-	-	21	1
33	Chronic nose wound /bat urine/	cishuma(H)k?ra(Y)					5	0.38			9	0.43

Appendix 4. cont'd

34	Chronic scabies /Wichiba/	wiciba/qosha(H)	-	-	7	1	-	-	-	-	-	-
35	Clean womb of postpartum mothers	qe?l ma?na witima(H)	-	-	-	-	-	-	6	1	-	-
36	Common cold	gensha(H)tururu(Y)	48	4	47	5	62	5	37	4	-	-
37	Conjunctivitis	ilitiso(H)afnimero(Y)	3	0.20	-	-	12	1	12	1	26	1
38	Constipation	chirgoka(H)kisha(Y)	5	1	8	1	-	-	13	1	9	1
39	Cough	kuticha(H)oshu(Y)	24	2	12	1	39	3	3	0.30	18	1
40	Dandruff	Forofor(Y)	-	-	-	-	-	-	-	-	10	1
41	Delayed placenta	dasugodapluwa(H)himafara(Y)	3	0.30	-	-	-	-	5	1	-	-
42	Delivery/Postpartum pain	be?u(Y)	-	-	-	-	-	-	-	-	5	0.29
43	Demelanised skin		-	-	-	-	-	-	-	-	1	0.06
44	Dendruff	Boronsha(H)	2	0.20	-	-	3	0.23	4	0.40	-	-
45	Detoxify Euphorbia sp. latex alkaloid on eye		-	-	-	-	-	-	-	-	6	0.35
46	Diarrhea	adite(H)kenicha(Y)	15	1	7	1	39	3	23	2	-	-
47	Dysmenorrhea	adafinimero(Y)	-	-	-	-	-	-	-	-	5	0.29
48	Dyspepsia/adults	qureta(H)busunsu(Y)	50	5	55	6	78	6	48	5	-	-
49	Dyspepsia/ childern	chilluw qureta(H)	-	-	23	3	-	-	-	-	-	-
50	Ear infection	mechaje?e(H)odonmero(Y)	9	1	-	-	7	1	9	1	19	1
51	Early child teeth/Gig	B?rusini ha?ini Ke?u	-	-	-	-	-	-	-	-	2	0.12
52	Earth breath disease	Awachife Be'u /Dani Furutu	-	-	-	-	-	-	-	-	65	4
53	Edema	habdesha(H)mezigishu(Y)	2	0.20	8	1	12	1	22	2.30	14	1
54	Elephantiasis	zube?e(H)ochokita(Y)	-	-	-	-	2	0.15	4	0.40	3	0.18
55	Epilepsy	Irba(Y)	-	-	-	-	-	-	-	-	15	1
56	Epistaxis	senguga(H)sola(Y)	3	0.30	-	-	2	0.15	-	-	12	1
57	Evil epirit	jina(H)manguza(Y)	2	0.20	-	-	-	-	5	1	14	1
58	Evil eye	manile(H)gognon(Y)	20	2	12	1.3	14	1	17	2	36	2
59	Evil spirit (at birth of twins)	manguza(Y)	-	-	-	-	-	-	-	-	3	0.18
60	Excessive bleeding at abortion		19	2	-	-	2	0.22	1	0.10	-	-
61	Eye boil		-	-	-	-	-	-	-	-	2	0.12
62	Feet pain/strain	ochoni mero(Y)	-	-	-	-	-	-	-	-	5	0.29
63	Fertility	meshikamero(Y)	-	-	-	-	-	-	-	-	2	0.12
64	Fever	habuta/iba(H)gugu(Y)	8	1	15	2	27	2	28	3	9	1
65	Flu	gebisa(H)	14	1	13	1	2	0.15	32	3	-	-
66	Food poison/ botulism/	hurbattiso(H)	7	1	3	0.33	6	0.45	-	-	-	-
67	Foot cracking	ochonikalato(Y)	-	-	-	-	-	-	-	-	3	0.18
68	Foot swelling	lokidesha(H)	-	-	4	0.43	3	0.23	-	-	-	-

Appendix 4. cont'd

69	Forgiveness	hafite(H)	-	-	7	1	20	1.5	-	-	-	-
70	Foul flatulence	ni boba(H)suwa(Y)	-	-	-	-	8	1	4	0.40	9	1
71	Fracture	iqemcha(H)mesto(Y)	9	1	11	1	11	1	10	1	11	1
72	Fresh wound	meda(H)adismeza(Y)	12	1	21	2	23	2	45	5	44	23
73	Gastritis	wodano(h)qar(Y)	6	1	6	1	14	1	5	1	12	1
74	General health loss	Qishe?e(H)mero(Y)	3	0.30	-	-	-	-	-	-	15	1
75	General purity	nete?oma(H)	5	1	6	1	-	-	-	-	-	-
76	Giardiasis	jarde?e(H)	3	0.30	13	1	-	-	-	-	-	-
77	Gingivitis	unfesida(H)	10	1	9	1	24	2	-	-	-	-
78	Gland cancer	ganjmusha(H)	7	1	-	-	-	-	5	0.5	-	-
79	Gonorrhea	chopto?o(H)amshisho(Y)	15	1	3	0.33	15	1	5	0.5	53	3
80	Gum infection	sumjabo(H)	5	1	-	-	-	-	-	-	-	-
81	Haemorrhoids	kintarota(H)znga(Y)	28	3	8	1	19	1	8	0.8	30	2
82	Head ache	demuma(H)tetnimero(Y)	10	1	-	-	2	0.15	-	-	-	-
83	Helminthiasis	sutincho(H)fofa(Y)	-	-	-	-	43	3	20	2	23	1
84	Helping labor	gu?o(Y)	-	-	-	-	-	-	-	-	5	0.29
85	Hepatitis	wademuncho(H)amshisho(Y)	29	3	21	2	26	2	11	1.1	58	3
86	Herbal aroma bath	icho?i wobata(H)	-	-	-	-	-		3	0.3	-	-
87	Postpartum mothers recovery	wobata(H)	-	-	-	-	5	0.38	4	0.4	-	-
88	Herpes zoster/simplex	summicha(H)almaze(Y)	8	1	-	-	7	1	-	-	4	0.23
89	Hiccupping	hi?insu(Y)	-	-	-	-	-	-	-	-	2	0.12
90	Hypertension	gifita(H)	-	-	-	-	6	0.45	6	0.6	-	-
91	Impotence	tila(Y)	-	-	-	-	-	-	-	-	10	1
92	Infant abdominal pain	chiluwi godaptiso(H)digabe?usato(Y)	5	1	-	-	14	1	3	0.30	8	0.47
93	infant cough	ciluwkuticha(H)digabe?utururu(Y)	-	-	-	-	-	-	3	0.30	5	0.29
94	infant diarrhoea	ciluw adite(H)digakisha(Y)	-	-	9	1	9	1	18	2	4	0.23
95	Infant flu	ciluw gensha(H)	5	1	-	-	-	-	-	-	-	-
96	Infectious wounds	omera(H)meza(Y)	2	0.2	-	-	-	-	-	-	-	-
97	Influenza	gebisa(H)tururu(Y)	-	-	20	2	-	-	-	-	2	0.12
98	Insanity	julugima(H)nifaso(Y)	7	0.6	5	1	-	-	-	-	4	0.23
99	Insect bite	cimbeqerare(H)?(Y)	3	0.3	-	-	-	4	0.36		5	0.29
100	Leg cancer	ochoni kanser(Y)	-	-	-	-	-	-	-	-	1	0.06
101	Leprosy	kurch(Y)	-	-	-	-	-	-	-	-	2	0.12
102	Lice	tu?a woru(Y)	-	-	-	-	-	-	-	-	5	0.29

Appendix 4. cont'd

103	Magic exercise	gena(H)kofa(Y)	-	-	4	0.43	-	-	-	-	10	1
104	Malaria	Woba(H)koksa(Y)	115	10	-	-	64	5	40	4	-	-
105	Malnourished & stunted children	osisa(H)	-	-	3	0.33	2	0.15	-	-	-	-
106	Mich	micha(H)	7	1	50	5	38	3	65	7	-	-
107	Mich' / 'megagna'	matqesa(H)	36	3	-	-	-	-	-	-	-	-
108	Migraine	sembecha(H)tetnimero(Y)	25	2	-	-	9	1	7	1	11	1
109	Mumps	anku?licho(H)	-	-	3	0.33	2	0.15	-	-	-	-
110	Nausea	leflefato(H)	3	0.30	-	-	3	0.23	-	-	-	-
111	Neck gland cancer	Ganj musha(H)	-	-	-	-	-	-	-	-	2	0.12
112	Nephritis	demtoke (H)	10	1	28	3	15	1	-	-	-	-
113	Night blindness	tunsqoqe(H)	-	-	-	-	3	0.23	5	1	-	-
114	/Nirobiworm bite	laseme(H)	13	1	3	0.33	-	-	-	-	-	-
115	Norm for brides	idayuw suto(H)	2	0.20	-	-	-	-	-	-	-	-
116	Pain of womb post abortion	godapisa(H)	-	-	-	-	7	1	-	-	-	-
117	Pneumonia	sanbamicha(H)kochomero(Y)	5	1	9	1	3	0.23	11	1	6	0.35
118	Poisoned person	merzuniasi(Y)	-	-	-	-	-	-	2	0.20	5	0.29
119	Poor appetite	mun mubeya(Y)	-	-	-	-	-	-	-	-	8	0.47
120	Postpartum recovery	iraniqotima(H)	-	-	-	-	16	1.2	7	1	-	-
121	Postpartum cramping	meshikan be?u(Y)	-	-	-	-	-	-	-	-	3	0.18
122	Postpartum mothers and circumcised children	iran michqrerare(H)	3	0.30	-	-	11	1	-	-	3	0.18
123	STD during coitus		-	-	-	-	-	-	-	-	1	0.06
124	Rabies	gerechuwishjabo(H)kanmero(Y)	11	1	-	-	-	-	3	0.30	-	-
125	Rashes in eye		3	0.20	-	-	-	-	-	-	-	-
126	Repellent	cimbeqerare(H)?(Y)	-	-	-	-	-	-	-	-	-	-
127	Retention of conception	sirima/hong ihima	-	-	3	0.33	-	-	-	-	-	-
128	Ring worm	buqasha(H)	15	1.40	2	0.22	7	1	15	1.5	-	-
129	Ritual of prayer	fate?e(H)	-	-	-	-	10	1	-	-	-	-
130	Scabies	woshkela, muna(Y)	13	0.80	-	-	-	-	-	-	-	-
131	Sharp back & joint pain	qeso?o(H)keja(Y)	-	-	15	2	3	0.23	9	0.9	8	0.47
132	Shoes smell	chamboba(H)	-	-	-	-	2	0.15	-	-	-	-
133	Skin cancer	fechite(H)	-	-	2	0.22	-	-	-	-	-	-
134	Skin disease	gonsiya guza(Y)	-	-	-	-	-	-	-	-	5	0.29
135	Snake bite	hemeshqesima(H)zewunmero(Y)	-	-	7	1	-	-	-	-	26	2
136	Snake sputum	zawuni mero(Y)	-	-	-	-	-	-	-	-	2	0.12

Appendix 4. cont'd

137	Sore nose & face	aken mero(Y)	-	-	-	-	-	-	-	-	8	0.47
138	Spider poison	shawu mero(Y)	-	-	-	-	-	-	-	-	3	0.18
139	Spider poison/sore	ku?ra(Y)	-	-	-	-	-	-	-	-	2	0.12
140	Sterility	konun tishu(Y)	-	-	-	-	-	-	-	-	7	0.41
141	Stick fight injury	bichmeda(H)	15	1.4	23	3	23	2	21	2	-	-
142	Sting/poison of insect caterpillar	jule?e (H)	-	-	-	-	5	0.38	-	-	-	-
143	Sudden abdominal pain	denggodatisa(H)sato(Y)	-	-	-	-	17	1	-	-	20	1
144	Sudden disease	mat-qesa(H)irba(Y)	11	1	44	5	86	6	98	10	-	-
145	Swelling of feet	awachifeBe?u'/	-	-	-	-	-	-	-	-	21	1
146	TB	suqo?o(H)irba(Y)	-	-	-	-	3	0.23	6	1	13	1
147	Thorn puncture infection	utituticha(H)	5	1	-	-	10	0.75	4	0.4	-	-
148	Typhoid fever	tayfoyd(Y)	-	-	-	-	-	-	-	-	9	1
149	Tinea versicolor	bechero?o(H)dosha(Y)	21	2	7	1	13	1	-	-	7	0.41
150	Tinia capitis/ 'sore head'	birato(Y)	-	-	-	-	-	-	-	-	5	0.29
151	Tonsilitis	semaga(H)fokonimero(Y)	31	3	33	4	75	6	16	2	37	2
152	Tooth & mouth health	inq tura(H)	-	-	5	1	-	-	-	-	-	-
153	Tooth pain	inqtiso(H)he?inmero(Y)	24	2	-	-	28	2	20	2	38	2
154	Tungiasis	muyele(H)	-	-	3	0.33	4	0.30	-	-	-	-
155	Typhoid fever	tesibo(H)	25	2	-	-	9	1	5	0.5	-	-
156	Unwanted pregnancy	godapisa(H)	-	-	-	-	3	0.23	-	-	2	0.12
157	Uterine prolapse	begena(Y)	-	-	-	-			-	-	4	0.23
158	Vomiting / children	ciluw uwa(H)toshayetu(Y)	3	0.30	-	-	10	1	-	-	4	0.23
159	Waist pain	iqemcha/lemed tiso	7	1	-	-	5	0.38	8	1	-	-
160	Warts	idoticho(H)dosha(Y)	26	2	-	-	3	0.23	-	-	7	0.41
161	Weight loss		-	-	-	-	-	-	-	-	2	0.12
162	Whooping cough	qeke?e(H)?(Y)	5	1	3	0.33	9	1	5	1	3	0.18
163	Wide allergic rashes	obogena(H)	-	-	-	-	7	1	-	-	-	-
164	Worming leg sore /Guinea worm/	fenu(Y)	-	-	-	-	-	-	-	-	9	1
165	Wound	omera(H)meza(Y)	-	-	2	0.22	-	-	-	-	5	0.29
166	Wounding VDs	fo?lbey omara(H)	4	0.4	-	-	-	-	-	-	-	-

Appendix 5. List of veterinary ailments and conditions in the five districts

(cit.= citation, A = Anlemo, D = duna, G =Gibe, Gm = Gombora, Y = Yem)

No.	Ailment	Hadiya/Yem name	A		D		G		Gm		Y	
			cit.	%	cit.	%	cit.	%	cit.	%	cit.	%
1	Abdominal pain	godabtiso(H)sato(Y)	23	8	3	1	-	-	26	7	11	2
2	Abdominal water retention / sheep	(wochwoch(H)ketni aka(Y)	-	-	-	-	12	3	-	-	6	1
3	Abdominal worms of sheep & calves	dequra(H)towa(Y)	6	2	10	2	12	3	12	3	28	6
4	African horse sickness	gamamdingetegna(H)fezairba((Y)	-	-	5	1	12	3	-	-	-	-
5	Anthrax	tinticho(H)kemar(Y)	3	1	14	3	8	2	14	4	73	15
6	Ascariasis /in calves/	henshesha(H)	-	-		21	5	-	-	-	5	1
7	Babesiosis	wademuncho(H)amshisho(Y)	3	1	6	1	3	1	-	-	6	1
8	Black leg	toka(H)elphaza(Y)	12	4	21	4	16	4	21	6	48	10
9	Castration of oxen	lartumima(H)	-	-	-	-	5	1	-	-	-	-
10	Cattle cough	kutich(H)oshu(Y)	-	-	-	-	5	1	-	-	12	2
11	Cattle not submitting milking	manile(H)tila(Y)	4	1	-	-	5	1	-	-	-	-
12	Cattle flu	La?lgensha(H)miyanitururu(Y)	-	-	-	-	4	1	-	-	3	1
13	Choking/cattle	siniqa(H)	9	3	34	7	42	11	36	10	-	-
14	Conjunctivitis /Cattle , sheep	ilitiso(H)afnimero(Y)	9	3	8	2	4	1	2	1	16	3
15	Constipation	shiligoka(H)	3	1	13	3	-	-	-	-	-	-
16	Constipation/ calves	watangoka(H)katniketa(Y)	9	3	12	3	3	1	7	2	17	3
17	Cough /mule & horse	salaqa(H)	-	-	-	-	2	1	8	2	-	-
18	Cough /sheep, goat	kutich(H)	-	-	-	-	-	-	4	1	-	-
19	Cowdrosis	qamqemto(H)	-	-	-	-	-	-	8	2	-	-
20	Delayed placenta	gatmeqera(H)kina fara(Y)	9	3	23	5	15	4	15	4	11	2
21	Diarrhea of cattle	miyakenicha(Y)	15	6	36	8	11	3	8	2	6	1
22	Diarrhea of sheep	gerebadite(H)fentonikenicha(Y)	-	-	-	-	-	-	4	1	12	2
23	Difficulty of delivery/sheep & goats	gu?o(Y)	-	-	-	-	-	-	-	-	2	0.4
24	Eastcoast fever	habdesha(H)	-		14	3	-	-	-	-	14	3
25	Enset root boat'	ha?mquruma(H)	-	-	3	1	-	-	-	-	-	-
26	Epizootic dermatitis	chechebsa(H)	-	-	-	-	15	7	4	2	-	-
27	Evil eye	manile(H)asunaafa(Y)	19	7	9	2	8	2	3	1	26	5
28	Evil eye of calves &sheep	manile(H)	5	2	-	-	-	-	-	-	-	-
29	Fasiolosis	afa?ljabo(H)	-	-	-	-	-		3	1	-	-
30	Flu /sheep, goat	gensha(H)tururu(Y)	-		15	3	5	1	11	3	-	-
31	Foot mouth disease	angicho(H)elpfaza(Y)	14	5	6	1	9	2	4	1	7	1
32	Foot swelling cattle	lokidesha(H)	-	-	5	1	-	-	-	-	-	-
33	Fracture	iqamcha(H)fulu(Y)	-	-	5	2	3	1	4	1	5	1
34	Failure of lactation	faye?oma(H)	-	-	-	-	-	-	15	4	15	3

Appendix 5. cont'd

35	Grain bloat	hurbatquruma(H)	9	3	25	5	7	2	-	-	-	-
36	Hate calf	watansaba(H)anqela omto(Y)	-	-	-	-	-	-	-	-	3	1
37	Horse mouth swell	kofir(Y)	-	-	-	-	-	-	-	-	5	1
38	Hovering of eagle related to bad spirit on goat	'Risbala'(O)	-	-	-	-	-	-	-	-	3	1
39	Improve milking/galactogogue	adbecha(H)	-		4	1	-	-	-	-	-	-
40	failure of conception	lijima(H)	3	1		-	-	-	3	1	-	-
41	?	kontez(Y)	-	-		-	-	-	-	-	3	1
42	Leech	urula(H)kerqeda(Y)	11	4	14	5	6	1	9	2	4	1
43	Liver fluke /sheep	afardaqura(H)	-		9	2	-	-	-	-	-	-
44	Lumpy skin disease/ cattle	lobjabo(H)	5	1	12	4	-	-	8	2	18	5
45	Mastitis	hantmeda(H)	-		7	1	-	-	4	1	-	-
46	Neck wound of oxen	ganjmeda(H)maza(Y)	7	1		-	3	1	-	-	5	1
47	Newcastle disease/	fungu?nara(H)isma(Y)	-	-	6	1	-	-	-	-	3	1
48	Orf /goats	sumqosha(H)	-	-	-	-	-	-	5	1	-	-
49	Parasitic insects / tick eggs/	Miskegna(Y)	7	1	-	-	-	-	-	-	-	-
50	Pastereullosis /Cattle /sheep	oshu(Y)	6	2	7	1	15	4	3	1	19	4
51	Pastereullosis equines	salaqa(H)	-		3	1	12	3	-	-	6	1
52	Pasture bloat	dubima(H)	12	4	11	2	41	10	5	1	8	2
53	Poor appetite	mun uka(Y)	-	-	-	-	-	-	-	-	6	1
54	Poultry mites	qinqana(H)miskegna(Y)	-	-	-	-	3	1	-	-	4	1
55	Rabies	nifaso(Y)	-	-	-	-	-	-	-	-	3	1
56	Failure of milk	adgoga(H)	-	-	-	-	-	-	-	-	8	2
57	Failure of conception /cattle	morameza(H)	-		1	0.5	-	-	-	-	-	-
58	Rotten hoof	egnita/kupa(Y)	-	-	-	-	-	-	-	-	4	1
59	Scabies in cattle	muna(Y)	-	-	-	-	-	-	-	-	9	2
60	Sheep flu	fentoni tururu(Y)	-	-	-	-	3	1	-	-	7	1
61	Skin disease	atuni mero(Y)	-	-	-	-	-	-	-	-	8	2
62	Skin scabs /cattle	benqera(H)towa(Y)	10	4	32	7	11	3	-	-	-	-
63	Smelling of milk	Shabo Zeya(Y)	-	-	-	-	-	-	-	-	3	1
64	Snake bite	hemeshqasa(H)zawunmero(Y)	-	-	-	-	3	1	5	1	10	2
65	Stunted calves	chigima(H)	2	1	-	-	-	-	-	-	-	-
66	Sudden disease/ cattle	matqasa(H)miyairda(Y)	22	8	41	9	53	13	42	11	21	4
67	Sudden horse ailment	gamamtiso(H)fezairba((Y)	8	3	21	4	26	7	10	3	7	1
68	Sun stroke calves/ sheep cubs	chine?e(H)	-	-	-	-	8	2	-	-	-	-
69	'Tef' straw bloat	chidgoka(H)	9	3	-	-	16	4	12	3	-	-
70	Trypanosomiasis	surula(H)Shilula(O)	-	-	5	1	-	-	3	1	5	1
71	Wart in cattle	meqa(H)	-	-	5	1	-	-	-	-	-	-
72	Weariness	nechima(H)	4	1	-	-	-	-	-	-	-	-
73	Wound	meda(H)meza(Y)	-	-	15	3	3	1	9	2	4	1
74	Worming wound	fenu(Y)	-	-	-	-	-	-	-	-	7	1

Appendix 6. List of MPs used for human & veterinary ailments in the five districts

(A = Anlemo, D = Duna, G = Gibe, Gm = Gombora, Y, (Y) = Yem, (H) = Hadiya; H = Herb, L = leaf, O, = oral, (O) = Oromifa, P = part used, R = root, s = seed, W = wood, Ail. = ailment treated, Adm = mode of application, Bs = stem bark, Br = root bark, Bl = bulb, Dr = dermal, Dist = district, Ha =habit, Hu = human, Lv = livestock, Md = medicinal for, Mt = method of preparation, Ro = route of administration, Sh = shoottip, Sta = state of use, Wp = whole part, st = stem, † = endemic species to Ethiopian flora, ? = a symbol for glottal sound)

No.	Scientific name	Family	Dist	Local name	Ha	Md	P	Sta	Ro	Ail.	Mt	Adm
1	*Acacia abyssinica* Hochst. ex Benth.	Fabaceae	D	Girara(H)	T	Lv	Bs, Br	F	Dr	Wart in cattle	Maceratitio n	Root & stem bark pulverised & in enough water together & spread the solution over the animal's body
2	*Acacia negrii* Pic.Serm	Fabaceae	Y	Ezu(Y)	T	Hu	L	F	Dr	Allergic rashes	Juice	Crushed painted
3	*Acacia sieberiana* DC.	Fabaceae	A	Gerbe girara(H)	T	Lv	L, Bs	F	Oc, O	Conjunctivitis	Maceration	Crushed, thick solution drop 2x/day
			A			Lv	Bs	F	O	Evil eye	Maceration	Pounded, solution 1 bottle drunk
4	*Acanthus eminens* C.B. Clarke	Acanthaceae	Y	Zarquwa(Y), Sokoro(O)	S	Lv	L, R	F	O	Evil eye	Juice	Crushed water extract 1 gubaya taken 3x
5	*Achyranthus aspera* L.	Amaranthaceae	Y	Za?no(Y), Cagogit(O),Dono?o(H)	H	Hu	Sh	F	O	Dysmenorrhea	Maceration	Crushed extract 1 cup taken 3x
			Gm, Y			Hu	R	F	O	Abdominal pain & diarrhoea	Maceration	Crushed, solution 1 'kubaya' drunk
			G			Hu	Sh, L	F	N	Expistaxis	Juice	Smash with leaf *Solanum incanum* insert in nose
			Gm			Hu	R	O	F	Tooth ache	Juice	Few root pieces chewed & held along the ailing tooth
6	*Achyrospermum schimperi* (Hochst.ex Briq.) Perkins	Lamiaceae	Y	Muya(Y)	H	Hu	L	F	O	Rheumatic arthritis	Maceration	Water extract 1 cup in 'Katikala'/coffee week
			Y			Hu	L	F	O	Hepatitis	Infusion	Buttered & 1 cup drunk twice a week
			G			Hu	L	F	N	Common cold	Juice	Few leaves smashed between palms, dissolved in little water and extract taken via nose
			G			Hu	L	F	O	Abdominal pain	fresh extract	Smash thick extract taken in coffee

			Gm			Lv	L	F	N, O	Maceration	Animal flu	Crushed, soaked in water, solution squeezed via nose
7	*Acmella caulirhiza* Del.	Asteraceae	A,D, G,Y	Shishmo(Y) ,Bishbis ha(H)	H	Hu	F	F	O	Tonsilitis	Juice	4 flowers chewed & spat into mouth,hold in mouth
			G			Hu	Wp	F	O	Toothache	Juice	Chewed with leaf *Pavetta abyssinica* held in mouth
			Y			Hu	Wp	F	O	Gastritis	Juice	Chew & swallow
			Y			Hu	Wp	D	F	Chronic leg sore	Poultice	Whole part smashed, mixed with fresh butter and poulticed with a drag on the location
			D			Hu	L	F	D	Skin cancer & wound	Poultice	Smashed & extract squeezed on location & fibre moistened with butter & poulticed
8	*Adiantum thalictroides* Schltdl..	Adiantaceae	Y	KorichaSididu(O)	H	Hu	L, R	F	O	Spider poison/sore	Decoction	1 glass drunk twice a week
9	*Aframomum cororima* (Braun) Jansen	Zingeberaceae	D,Y	Wokasha(H),Hogiye(Y)	H	Hu	S	D	O	Abdominal pain	Juice	Chewed with *Nigella sativa* & swallow
			D,G ,Gm, Y			Hu	S	D	O	Asthma	Decoction	with *Allium sativum*, tea/ drunk
			A		H	Hu	F	dry	O	Abdominal pain	Juice	chewed along *Nigella sativa* & swallowed
			G			Hu	S	D	O	Choking	Juice	Seeds along with tugmen/pericarp chewed juice held in mouth for some minutes &
			G			Lv	F, S	D	O	Choking	Juice	Seeds along with tugmen/pericarp chewed juice spat into nose & mouth of the animal
10	*Agarista salicifolia* (Comm. ex Lam) Hook. f.	Ericaceae	Y	Totu(Y),Sotra(H)	T/S	Hu	L	F	D	Scabies	Paint	with tuber *Araesema schimperianum*., paint
			Y			Hu		F	D	Chronic leg wound	Paint	with horse bone poder, spread over
			D			Lv	L	F	O	Hematuria, Babesiosis	Decoction	Leaves crushed, decocted & 1 glass drunk twice a week for 4 weeks
			A		T/S	Lv	Bs	F	O	Babesiosis	Maceration	Bark pounded & mixed with enough water and 1 highland drunk twice a week for 5 weeks
11	*Agave sisalana* Perrine ex Engl.	Agavaceae	A	Alge(H)	H	Hu	L	F	O, An	Hemorroids	Poultice	Crushed water homogenate 1 glass drunk, paste inserted anally
12	*Ageratum conyzoides* L.	Asteraceae	**Y**	**?**	H	Hu	L	F	D	Coagulant	Paint	Smashed & thick extract painted on fresh wound
13	*Ajuga integrifolia* Buch.-Ham. ex D. Don	Lamiaceae	A,D, Gm, Y	Tenacho(Y) Harmabuse/ Anamiro(O)Anamur a(H)	H	Hu	L	F/D	O	Arthritis	Maceration	Crushed, mixed with small amount of water ,solution/filtrate 1 cup is drunk in empty stomach, or paste is added in 1 cup of local alcohol 'Hereqe', or coffee, drunk for a week
			G,Y			Hu	L	F/D		Haemorrhoids	Wet paste	Wrapped by leaf of *Ensete* or *Croton macrostacnyus*, cooked fairly & wet paste applied on location
			Y			Hu	L	F/D	O	Malaria	Decoction	Along with leaf of *Justicia shimperiana* decoction 1 cup drunk for 5 days

			Y			Hu	Sh		O	Malaria	Maceration	Dry shoot pounded, paste dissolved in water 1 cup is drunk, or 2 tea spoon paste is added in 1 cup of 'Hereqe', or coffee, or /'Buluqo/borde'/ & drunk for a week
			Y			Lv	Sh	F	O	Black leg	Maceration	Along with root of *Echinops kebericho* root pulverised, homogenised in water & 1 litre is drunk
14	*Alblzia lophantha* (Willd.) Benth.	Fabaceae	Y	Ambelta(O)	T	Hu	Bs	F	O	Sudden illness	Juice	Few pieces chewed & juice swallowed
			Y			Hu	Bs	F	NBp	Belief for Menstrual time "Legu"	Cultural	Along with fresh branch of *Premna schimperi* tied at gate so that avoids people to getting inside of a house
15	*Albizia schimperiana* Oliv.	Fabaceae	Y	Siso(Y),Hembebesa(O),Mande'e - (Chilala)(H)	T	Hu	L, Bs	F	Oc	*Euphorbia* sp. latex poison on eye	Paint	Crushed, water homogenate squeezed on to hurt eye
			Y			An	Bs	F	D	Wound	Paint	Crushed with bark of *Erythrina brucei*, thick extract painted on the location
			A,D, Gm			Hu, Lv	Bs	F	O	Abdominal pain	Maceration	Bark from sunrise/sunset sides crushed, dissolved in water , for human 1 'kubaya', for animal 1 litre is drunk
			G			Hu	Bs	F	O	Ascariasis	Maceration	Stem bark pulverised, dissolved in water & 1 cup given for children, 1 glass taken for adults
			D,G, Gm			An	Bs	F	O	Choking	Maceration	Bark crushed, homogenised in little water. thick filtrate inhaled &is drunk
16	*Allium sativum* L.	Alliaceae	Gm, Y	ForoSunto(Y),Tuma(H)	H	Hu	Bl	F	O, D	'Mich'	Decoction	Cloves added into porridge or soup & eaten/drunk
			A, Y			Hu	Bl	F	O	Asthma	Decoction	Three to 4 bulbs crushed & added into porridge or soup & eaten/drunk, bulbs crushed & boiled in tea & drunk morning & evening
			D,Gm,Y			Hu	Bl	F	O	Cough & bronchitis	Tea	Crushed & boiled in tea & drunk morning & evening
			A,D, G,Gm,Y			Hu	Bl	F	O	Pneumonia	Tea	Crushed & boiled in tea & drunk morning & evening
			A,D, G,Gm,Y			Hu	Bl	F	O	Common cold	Tea	Crushed & boiled in tea & drunk morning & evening
			A,D, G			Hu	Bl	F	O	Tonsillitis	Concoction	Few bulbs chewed along with *Zingiber officinale* & held for few minutes, tea of the same drunk 3 times a day
			A,G			Hu	Bl	F	O	Malaria	Concoction	3-4 cloves pealed & eaten along with food during bed time for a week
			A,G			Hu	Bl	F	O	mouth 'mich' /Herpes simplex	Paint	1 bulb scarred & rubbed along mouth area

			A,D, Gm			Hu	Bl	F	O	Abdominal pain	Concoction	3 bulbs chewed along with *Nigella sativa*, salt & *Zingiber officinale* and swallowed
			A,G			Hu	Bl	F	O	delivery & circumcision time 'mich'	Pait	Bulbs crushed & painted on facial areas & hands
			G			Hu	Bl	F/D	D	Tinea capitis	Paint	Bulbs scared & surface rubbed repeatedly
			D,G			Hu	Bl	F/D	O	Sore throat	Juice	Few bulbs chewed along with *Zingeber officinale*, & held for few minutes, tea of the same drunk 3 times a day
			A			Lv	Bl	F	O	Lumpy skin disease	Concoction	Few bulbs, leaf of *Croton macrostachyus* & salt crushed homogenized with water & 1 bottle is drunk twice a week
17	*Aloe* sp.	Alloaceae	A	Geneno(H)	H	Hu	L, R	F	O, D	Gland cancer	Decoction	Leaf decocted & a cup is drunk for five days
			A			Hu	L	F	O	Rheumatic pain	Decoction	Leaf decocted & a cup is drunk during distress
			A			Hu	L	F	D	Infectious wounds	Concoction	Leaf crushed along with leaf of *Croton macrostachyus* & Vernonia myriantha Hook.f. & squeezed, extract streaked over the wound
			A			Hu	L	F	D	Burns	Poultice	Leaf latex poulticed on location
			A			Hu	L	F	O	Malaria	Concoction	Leaf & root along with leaf of *Ocimum lamiifolium*, ½ a glass of the potion drunk in empty stomach for five days
18	*Allophylus abyssinicus* (Hochst.) Radlk.	Sapindaceae	Y	Serara(O)	T	Hu	Bs, L	F	O	Nephritis	Decoction	Crushed, decoction 1 cup drunk for a week
19	*Amaranthus caudatus* L.	Amaranthaceae	Gm	Heliba(H)	H	Hu	S	D	O	'Mich'	Decoction	Seeds ground & eaten with porridge, also the powder can be taken added in coffee
20	*Amaranthus hybridus* L.	Amaranthaceae	Y	Gu?ea(Y)	H	Hu	Sh	F	O	Uterine prolapse	Maceration	Smashed & water solution 1 glass is drunk, then the said uterine returning done by healer to position touching with its leaf
21	*Anona squamosa* L.	Annonaceae	Y	Gishta(O)	T	Hu	S	F	D	Lice	Juice	Pounded, thick extract painted on body parts
22	*Anthospermum herbaceum* L.f.	Rubiaceae	Y	Nojo/Durbo(Y)	H	Hu	Sh, L	F	O	Bone cancer	Maceration	Smashed & 1 cup water homogenate drunk twice a week for a month
23	*Apodytes dimidiata* E. Mey. ex Arn.	Icacinaceae	G	Mewa(H)	T	Hu	Bs	F	O	Abdominal pain	Decoction	Stem bark pulverised, decocted & 1 glass extract is drunk
			Gm			Hu	Bs	F	O	Malaria	Decoction	Bark pulverised & decoction 1 glass drunk for 3-5 days
			G			Lv	Bs	F	O	Choking	Maceration	Bark is crushed, homogenised in little water, extract sent through nose; also some the extract is blown into mouth of the cattle
24	*Arisaeema schimperanum* Schott	Araceae	Y	Zewunewa(Y)	H	Hu	R	F	O	Chronic bed patient	Concoction	Small pieces along with bark of *Acacia negrii* & *Albizia schimperiana* crushed, homogenised with water & concoction 1 cup drunk twice a week

25	*Artemisia abyssinica* Sch. Bip. ex Engl.	Asteraceae	Y	Akafko(Y) Sukunde(O)	H	Hu	Sh, L	F	O	Mich	Maceration, Juice	Crushed & dissolved in water, extract half a cup for children, 1 cup for adults drunk, also adults can chew & swallow
			A,Y			Hu	L	F	O	Whooping cough	Infusion	Infusion buttered & ½-1 cup is drunk for 5 days
			Y			Hu	L	F	O	Nephritis	Maceration	Crushed, dissolved in water & 1 is cup drunk
			Y			Hu	L	F	O	Gastritis	Maceration	Crushed & thick extract 1 cup is drunk
			Y			Hu	R	F		Magic exercise	Put nearby	Used for protection against magic exercise
			Y			Hu	L	F	O	Child abdominal pain	Infusion	Infusion squeezed & ½ a cup is drunk
			A	Chukuna(H)	H	Hu	L	F	O	Whooping cough	Infusion	Infusion buttered & ½-1 cup is drunk for 5 days
			A			Hu	L	F	O	Infants abdominal upset	Infusion	Fresh leaves crushed and filtrate ½ a cup is drunk
26	*Artemisia absinthium* L.	Asteraceae	Y	Korkodo(Y), Kodo(O),Natrara(H)	H	Hu	L	F/D	O	Acute febrile illness	Concoction	Along with root of *Rumex nepalensis*, of *Stephania abyssinica*, leaf of *Salvia nilotica* & *Allium sativa* chopped & decoction 1 cup is drunk
			Y			Hu	L	F/D	D	Mich	Paint	Smashed & inhaled;also held on exterior ear fan
			Y			Hu	L	F/D	O	Baby common cold	Infusion	Infusion buttered & ½ - 1 cup is drunk
			A,G, Gm			Hu	L	F/D	O	Blood pressure	Maceration	Shoot crushed and dissolved in water & extract 1 cup drunk during the symptom
			A,D, G,G m			Hu	L	F	O	abdominal pain,child diarrhea	Maceration	Young shoot chewed & swallowed, or shoot crushed dissolved in water & 1 cup drunk
27	*Artemesia annua* L.	Asteraceae	A,G, Gm	Artemisa(H)	H	Hu	L	D	O, D	Haemorrhoid	Infusion,Poultice	3 small spoon dried leaf steeped into 1 litre boiling water, then 1 glass of the infusion taken 3 times a day for 1 week., also fresh leaves smashed & applied on location
			A,G			Hu	L	D	O	Malaria	Infusion	Spoonful leaf infused & 1 glass drunk for 7 days
			A,G, Gm			Hu	L	D	O	Typhoid fever	Infusion	Leaf infusion 1 glass is drunk
			Y		H	Lv	R	F	O	Bite of snake	Decoction	Small amount crushed & 1 gubaya is drunk
28	*Arundinaria alpina* K. Schum.	Poaceae	A,G	Lema(H)	T	Hu	St	F	O	gum &teeth health,	Juice	Fresh twig chewed & juice held for a while & brush beneath teeth with fresh twig
			Y		T	Lv	Sh	F	O	Diarrhea	Maceration	Crushed & boiled, 1 bottle given 3 times a week
29	*Arundo donax* L.	Poaceae	D	Shomboqo?o(H)	S	Lv	St	F	E	Fracture of limbs	Flint	Stem flints tied with fiber of 1`*Ensete ventricosum* regularly & tie
30	*Asparagus africanus*	Asparagaceae	Y	Hundufana(H),Keshe	S	Hu	R	F/D	O	Ascariasis, tonic	Decoction	Decocted along bark of *Syzigium guineese* 1

	Lam.			lzona(Y) Seriti(O)								cup for children, 1 glass for adults drunk once
			Y			Hu	R	F/D	O	Snake bite	Concoction	Along with leaf of *Stereospermum kunthianum* crushed, water homogenate 1 glass is drunk; also wet concentrate solution applied on wound
			Y			Hu	R	F/D	O	Impotence	Decoction	Decoction along with juice of *Citrus limon*, coffee flour & honey 1 glass drunk, twice a week for a month
			A,Gm			Hu	R	F	O	General health	Decoction	Shoot & root crushed, decocted 1 glass drunk
			A,D,G			Hu	Sh, R		O	Evil eye	Maceration	Shoot & root crushed, mixed in water & body washed with the solution
			D,G			Hu	R	F	O	Sudden ailment	Decoction	Root decocted & 1 glass is drunk
			D			Hu	R	F	O, D	Insanity	Decoction	Root decoction 1 glass /'kubaya'/ is drunk , body of patient washed with decant of root & shoot crushed & dissolved in water
			D			Hu	R	F	O	Malnourished & stunted children	Decoction	Root decoction 1 cup is drunk per week
			A,D,G,Gm			Lv	R	F	O	Sudden ailment of cattle & equines	Maceration	Root crushed, homogenized with water and ½ - 1 litre drunk
			D			Lv	R	F	O	Improve milking	Decoction	Root decoction salted & a litre drunk
31	*Aspilia africana* (Pers.) C.D. Adams	Asteraceae	Y	Haemu(Y)	H	Hu	L	F	D	Tinea versicolr	Juice	Smashed with palms scratch & paint the juice 1 week
32	*Balanites aegyptiaca* (L.) Del.	Balanitaceae	G	Bedeno?O(H)		Hu	Gm	D	N	Migraine	Sinus snuff	Bark gum melted on heat and the fluid is taken through nose in small amount for
			G			Hu	F	F	O	Diarrhoea	Juice	Fruit pulp is eaten after taking honey mixed with coffee flour
33	*Bersama abyssinica* Fresen.	Melianthaceae	Y	Bo?a(Y) Lolchisa(O),Koreqa(H)	T/S	Hu	L	F	O	Anthrax	Decoction	Added to (other anthrax remedies mentioned) & 1 cup decoction drunk for five days
			Y			Hu	Sh	F	NBp	Evil eye	Put nearby	Planted on farmland amid crops
			D,Y			Hu	Wp	F		Protect magic exercise	Put nearby	Used for protecting magic exercise
			Gm			Hu	Bs	F	O, D	Sudden abortion	Maceration	Stem bark crushed and water extract 1 cup drunk for 3 days
			Gm			Hu	St	F	D	Breast cancer	Poultice	Ash mixed with butter & painted
34	*Beta vulgaris* L.	Chinopodaceae	A,Gm	Keysira(H)	H	Hu	R	F	O	Anaemia	Decoction	Root cooked & eaten as vegetable, soup is drunk
35	*Bidens pilosa* L.	Asteraceae	Y	Metene(O)	H	Hu	L	F	O	Ear disease	Juice	Crushed squeezed, dripped into ear
36	*Brassica carinata* A. Br.	Brassicaceae	A,G,Gm,Y	Wonge(H),Gesha(Y)	H	Hu	S	D	O	Malaria	Decoction	Roasted seed flour steeped into boiling water, 2 cloves of garlic crushed & a spoonful butter added, 1 cup preparation

												drunk for a week
			A			Hu	S	D	O	Stomach bloat	Decoction	Seed flour drunk in coffee or tea
37	*Brassica nigra* L.	Brassicaceae	Y	Gesha /Senafichi(Y)	H	Hu	S	D	O	Abdominal pain	Juice	Along seeds of *Nigella sativa* chewed & swallowed
38	*Brucea antidysentrica* J.F. Mill.	Simaroubaceae	A,D, G,G m,Y	Tolo(Y),Chironta(H)	S	Hu	Br,	F	O	Sudden abdominal pain	Juice	Chewed along with leaf of Myrsine africana L. & swallowed
			Y			Hu	L,F	F	D	Chronic sore leg	Poultice	Crushed together & concentrate mixed with butter, applied on wound
			Y			Hu	Sh, L	F	O	Dysentry	Maceration	Crushed & 1 glass water solution is drunk
			Y			Hu	Sh	F	NB p	Magic exercise	Put nearby	Used for protecting magic exercise
			A,G			Hu	Br	F	O	Diarrhoea	Decoction	Bark & shoot tip decocted and 1 glass drunk & repeated as needed
			D			Hu	Br	F	O	Sudden abdominal pain	Juice	Root bark is chewed along with salt & swallowed
			G			Hu	Br	F	O	Evil eye	Decoction	Root decoction 1 'kubaya' drunk
			G			Hu	Br	F	O	Dyspepsia	Juice	Young tip chewed & swallowed
			G			Lv	R, Sh	F	O	Cattle diarrhoea		Young shoot tip & root decocted, 1 bottle is drunk once a day until improves
			A			Lv	Br	F	O	Sudden disease	Maceration	Root bark is pulverized, salted & dissolved in water & ½ litre is drunk
39	*Buddleja polystachya* Fresen.	Buddlejaceae	Y	Festu(Y),Bulshana(H)	S	Hu	Sh	F	O	Anthrax	Maceration	Crushed, dissolved in water, extract 1 cup drunk
			Y			Hu	L	F	O	Hepatitis	Decoction	Decoction is 1 cup drunk for 5 days
			Y			Hu	L	F	N	Severe headache	Juice snuff	Crushed squeezed onto palms, the concentrate sucked via nose
			Y			Lv	L	F	O	Anthrax	Maceration	Crushed & water homogenate 1 glass is drunk
			G			Hu	L	F	O	Cough	Infusion	Leaf infusion 1 cup is drunk for 3-5 days
		Buddlejaceae	A,G		T/S	Lv	L	F	O	Pastereullosis sheep, cattle & equines	Maceration	A bunch of leaves taken pounded , dissolved in water and 1 'kubaya' for sheep, 1 litre for cattle and equines is drunk twice a week until improves
40	*Caesalpinia decapetala* (Roch) Alston	Fabaceae		Gorta/Koronte'e	S	Hu	Sh	F	Or	Toothache	Juice	Shoot tip chewed & juice held on the location of the ailing tooth
41	*Calpurnia aurea* \(Ait.) Benth/	Fabaceae	Y	Sena(H)	S	Lv	L, R	F	O	Pastereullosis/Coug h of cattle	Concoction	Along with leaf of *Osyris quadripartita* & *Hypericum quartinianum* crushed & water solution 1 glass is drunk

			A, D,G, Y			Lv	L	F	D	Insects / tick eggs/	Paint	Crushed dissolved in water, solution spread over the animal's body
			Y			Lv	L	F	D	Ascariasis /in calves/	Maceration	Crushed & water extract ½ a gubaya drunk
			Y			Lv	L	F	D	Insecticide of poultry	Spray	Water extract spread over nest & body of domestic fowl
			Y			Lv	L	F	-	Insecticide of grains	Paint	For weevil beetles, containers cleaned with its leaf & some extract spread over & left for hours before storing
			A,G m			Hu	S	F	O	Rabies	Maceration	Seeds ground & dissolved in water, a cup drunk for 7 days
			Gm			HU	R	F	D	Gland cancer	Poultice	Piece of longer root is wrapped on a piece of cloth & tied as amulet in neck
			G			Hu	L	F	D	Caterpillar sting/'jule'	Poultice	Leaf crushed & poultice on wounds
42	*Canarina eminii* Schweinf.	Canarinaceae	Y	Ha?un korfu(Y)	H/E	Hu	R	F	O	Typhoid fever	Decoction	Decoction 1 cup drunk for 3 days
43	*Canthium oligocarpum* Hiern.	Rubiaceae	Gm	FugeGarewa(H)	S	Lv	L, R	F	O	Diarrhea	Maceration	Finely pounded, dissolved in water solution, 1 bottle drunk without decanting
			Gm			Lv	L	F	D	Evil eye	Spray	Crushed water solution used to wash animal's body
44	*Capsicum frutescens* L.	Solanaceae	Y	Ziga(Y) Mitmito(H)	H	Hu	F	F/D	O	Abdominal pain, common cold	Concoction	Prepared as salted chili added in soup & taken, or fresh fruit eaten along *Allium sativum L.* & salt
			A			Hu	F	F	O	Flu, common cold	Concoction	Fruit chopped added into *Citrus limon* & *Allium sativum.*, eaten as vegetable soup or enough chili & garlic added into porridge and eaten
			A			Lv	F	F	O	Black leg	Concoction	Dry or fresh red fruit crushed along with leaves of *Croton macrostachyus* & water solution 1 litre is drunk
45	*Carduus schimperi* Sch. Bip.	Asteraceae	Gm, Y	Osewa(Y),Haluta(H)	H	Hu	R	F	O	Sudden febrile illness	Decoction	Decocted & 1 glass is drunk
			A			Hu	R	F	O	'Mich' / 'megagna'	Maceration	Root crushed, diluted with water, 1 cup drunk & repeated as needed
46	*Carica papaya* L.	Caricaceae	A,G, Gm, Y	Papaye(O)	H	Hu	L,F	F	O	Malaria	Infusion	Infusion 1 glass is drunk for a week
			Y			Hu	L	F	D	Dendruff	Paint	Crushed & concentrate extract streaked on surface scratching the surface
			G			Hu	L	F	O	Typhoid fever	Infusion	Leaf infusion1 glass drunk for a week in mornings
47	*Carissa spinarum* L.	Apocynaceae	Y	Alelu(Y)	S	Lv	Sh	F	O	Eastcoast fever	Concoction	Along with leaf of *Olinia rochetiana.*, of *Osyris quadripartita*, of *Juniperus procera* crushed, water & extract 1 gubaya drunk for 2 days

			A	Atura(H)	S	Hu	L, R	F	D	Warts	Paint	Latex along with latex of *Euphorbia abyssinica* & smeared over
			A,G, Gm			Hu	R	F	O	Edema	Maceration	Root pulverised, dissolved in water, then extract added into yoghurt & eaten with Enset corm /of 'Geriye' clone/
			A			Hu	R	F	O	Boil	Decoction	Root decoction fermented in cereal beverage or yoghurt & eaten with enset root
			A,G			Hu	R	F	O	Thorn puncture infection	Decoction	Root decoction fermented in cereal beverage or yoghurt & eaten with enset root
			G			Hu	L	F	O	F lu	Infusion	Leaf infusion 1 glass drunk in morning and evening
48	*Catha edulis (*Vahl) Forssk. ex Endl.	Celastraceae	G,Gm,Y	Jima(Y),Chata(H)	S	Hu	L	F/D	O	Common cold	Decoction	Along with leaf of *Coriandrum sativum*.decocted & 1 glass is drunk
			A,G, Gm			Hu	L	F	O	Tonsillitis	Maceration	Few leaves chewed and water swallowed
			A			Hu	L	F	O	Typhoid fever	Infusion	Leaf infusion 1 glass drunk for 7 days
			A,G			Hu	St, L	F	O	Gonorrhoea	Decoction	Leaf & twigs decocted & 1 cup drunk 4-5 time in different day
49	*Caylucea abyssinica* (Fresen.) Fisch. & Mey.	Resedaceae	Y	Heleqo(Y) Herechi(O)	H	Hu	L, R	F	O	Epilepsy	Decoction	Crushed, decoction 1 glass drunk during the symptom
			Y			Hu	L, R	F	O	Antiemetic	Juice	for passenger vomiting allergy Chewed & swallowed
			Y			Hu	L	F	O	Diarrhoea	Infusion	Crushed & infusion 1 glass is drunk
			Y			Hu	L	F	D	Boil	Juice	Crushed & juice squeezed on to induce pus & bursting out
			Y			Lv	L	F	D	Skin disease	Juice	Crushed & juice painted on
50	*Celtis africana* Burm, f.	Ulmaceae	Y	Netekoma(O)	T	Lv	L	F	O	Swelling	Paint	Crushed & 1 bottle is drunk, residue painted on location
51	*Centella asiatica* (L.) Urban	Apiaceae	Y	Odo(Y) GuraAntuta(O)	H	Hu	L	F	Au	Ear infection	Infusion	Infusion 3 drops dripped into inner ear
			Y			Hu	Wp	F	O	Postpartum abdominal cramping	Juice	Washed, chewed & swallowed
52	*Ceratium* sp.	Caryophyllacea e	Y	Sisu(Y)	H	Hu	Wp	F	O	Baby abdominal pain	Maceration	Crushed, dissolved in little water & half a cup drunk
53	*Chinopodium ambrosioides* L.	Chinopodiaceae	Y	Beketa(Y)	H	Hu	L	F	O	"Mich"	Infusion	Infusion 1 cup is drunk
			Y			Hu	L	F	O	Gonorrhea	Digestion	Along with 'Shimsona'(Yem), 'Pitpitu' (Yem) & *Phytolacca dodecandra* root concocted, 1 'bush'/cup drunk for 5 mornings
54	*Cinamommum* sp.	Lauraceae	A,G	Kerefa	T	Hu	Bs	dry	O, Dn	Toothache, bad breath	Juice	3-4 pieces of bark chewed & juice held in mouth for a while once a day frequently
55	*Cissus populnea* Guill. & Perr.	Vitaceae	Y	Yesha(Y), Hiderefa(O)	CH	Lv	R, L	F	D	Neck wound of oxen	Paint	Crushed applied on location to heal & to induce hair growth

56	*Citrus limon* (L.) Burm.f.	Rutaceae	A,G, Gm, Y	Lomiye(Y) Lomi(O),Lome?e(H)	S	Hu	F	F	O	Common cold	Tea	Juice tea drunk twice a day; or juice squeezed & drunk 2-3 times a day
			A,D, G,Y			Hu	F	F	O	Food poisoning	Juice	Juice squeezed & drunk, then milk for vomiting out
			A,D, G			Hu	F	F	D	Skin rashes	Paint	Rub surface with the pericarp & juice
			A			Hu	F	F	D	Herpes zoster	Paint	Rubbing the surface with the fruit & scarred garlic bulb
			A,G			Hu	F	F	D	Athlete's foot	Paint	Spreading its juice over feet
			A,G			Hu	F	F	Dn	Gingivitis	Juice	Brushing teeth with fresh twig of Olinia rochetiana A. Juss., then washing mouth & teeth with its juice
			A			Hu	F	F	D	Chancroids wounds/ VDs	Juice	Washing the surface with its juice
			D			Hu	F	F	O	Nausea & vomiting	Juice	fruit juice drunk, pericarp sniffed
			A,D, G			Hu	F	F	O	Dyspepsia/ 'Qureta'	Juice	Drinking its juice
			A,G m			Hu	F	F	O	Abdominal pain	Juice	Drink enough of its juice
			A,G			Hu	F	F	O, N	Antiemetic	Juice	Drinking the juice, & smelling the its aroma
			D			Hu	F	F	O	Hypertension	Juice	Fruit juice drunk continuously
57	*Citrus medica* L.	Rutaceae	A	Turungo(H)	S	Hu	F	F	O	Abdominal pain & discomfort	Juice	Fruit juice 1 glass drunk
58	*Clausena anisata*(Willd.) Benth.	Rutaceae	A, D, Y	Kemekesa(Y) Ulmayi(O),Beyteka(H)	S	Hu	L	F	O, N	Febrile rheumatism	Digestion	Along with leaf of *Justicia* & *Ocimum lamiifolium.*, concocted 1 glass drunk, also steam inhaled & face washed with the rest
			Y			Hu	L	F	O	Ascariasis	Infusion	Infusion 1 glass is drunk
			A,G			Hu	L	F	O	Abdominal pain	Infusion	Leaf infusion 1 glass is drunk
			A,G. Gm			Hu	B, L	F	O	Malaria	Decoction	Bark & leaf decoction 1 glass is drunk for 5 days
			G			Hu	St	F	Dn	Mouth & tooth health	Juice	Fresh stem chewed & juice used to rinse mouth & teeth for killing microbes, brush tooth
			G			Hu	L	F	O	Common cold	Infusion	Leaf infusion 1 glass drunk, & steam also inhaled
			Gm			Hu	L	F	O	'Mich'	Infusion	Leaf infusion 1 'kubaya' drunk
			Gm			Hu	L	F	O	Typhoid fever	Infusion	Leaf infusion well buttered 1 cup is drunk morning & evening for a week
			D			Hu	L	F	O	Mumps	Infusion	A cup of leaf infusion drunk
			D			Lv	L	F	O	Sudden horse illness/African	Concoction	Leaf & root of Asparagus africana & 1 litre decoction drunk

										horse disease		
			Gm			Lv	L	F	O	Black leg	Maceration	Along leaf *Clematis longicauda.* & stem & root of *Microglossa pyrifolia* concocted, 1 'kubaya' is drunk morning & evening for 5 days
			G			Lv	Sh, L	F	O	Anthrax	Concoction	Along with stem of *Clematis longicauda*, leaf of *Olinia rochetiana* & leaf of *Nicotiana tabacum* concocted, extract 1 bottle drunk for 3-4 days a week; also shoot is fumigated
			A			Lv	L	F	O, D	Lactogogue(release milk/Qirantira'	Maceration	A bunch of leaves crushed, homogenised in water and extract 1 litre is drunk once & repeated any other time as needed; also massaging the cattle back with leaf
59	*Clematis hirsuta* Perr. & Guill.	Ranunculaceae	Y	Fiti(O)	C	Hu	L, St	F	Dn	Toothache	Juice	Few of the parts chewed & juice held on location
						Hu	L	F	D	Sore nose/ bat urine	Paint	Wrapped in leaf of other species & cooked fire, then wet concentrate solution smeared/painted on location
60	†*Clematis longicauda* Steud. ex A. Rich.	Ranunculaceae	Y	Segu(Y) Fiti(O)	C	Hu	L, St	F	O	Anthrax	Digestion	Along with root of *Cyphostemma adenocaule*, *Stepahnia abyssinica*, & *Momordica foetida* pulverised, concocted 1 cup drunk (Not given for weakened persons, Antidote: borde)
			Y			Hu	L	F	D	Elephantiasis	Infusion	Crushed & concentrate paste inserted hypdermal incising the location; also a glass of infusion drunk twice a week
			Y			Hu	L	F	O	Amoebiasis	Maceration	Crushed & 1 cup drunk twice a week
			Y			Hu	L	F	O	Evil eye	Infusion	Infusion 1 glass is drunk, also wash body with the solution
			Y			Hu	R	F	O	Constipation	Maceration	Crushed &a small cup of solution taken
			G			Hu	L	F	D	Tinea versicolor	Paint	Leaf smashed, moistened with little water, wet paste is smeared on location after scratching with leaf of *Lippia adoensis* and *Microglosa pyrifolia*
			G			Hu	St	F	O	Toothache	Juice	A piece of fresh stem & root, & fresh stem of Microglossa chewed & juice held on ailing tooth, finally spat
			A,D			Lv	St, L	F	O	Foot-mouth disease	Concoction	Leaf & stem along with leaf of *Croton macrostachyus Del.*. crushed, dissolved in water & 1 bottle is drunk morning & evening
			Y			Lv	R, St	F	O	Abdominal diseases	Concoction	Along with root *Momordica foetida* pulverised,concoction 1 'gubaya' is drunk for 3-4 days
			Y			Lv	L, St	F	O	Anthrax	Digestion	Along with root of *Cyphostemma adenocaule*, *Stephania abyssinica*.,

												Momordica foetida pulverised, concoction 1 'gubaya' is drunk for 3-4 days
61	*Clematis simensis* Fresen.	Ranunculaceae	Y	HerqeSegu(Y) Fiti(O)	C	Hu	L	F	O, D	Bone cancer	Poultice	Crushed & concentrate solution poultice on location; also water extract of leaf 1 cup is drunk once a week
62	*Clerodendrum myricoides* (Hochst.) Vatke	Lamiaceae	Y	Mignmignu(Y),Hani ga(H	S	Hu	R	F	O	Anthrax	Maceration	Along with leaf of *Inula confertiflora* & *Premna schimperi* concocted & extract 1 cup drunk for 3 mornings
			Y	.		Hu	L	F	O	Gonorrhoea	Infusion	Infusion 1 glass drunk for 5 mornings
			A,Y			Lv	L, R	F	O, D	Evil eye of cattle	Maceration	Root & leaf crushed, paste sniffed to the animal, then dissolved in water 1 glass/'gubaya given is drunk, & partly the body of animal washed with the solution
			G,Gm			Lv	R	F	G	Choking	Juice	Root bark chewed, the juice blown via nose & mouth of the animal
			A			Lv	L, R	F	O, N	Inducing fertility	Maceration	Root pieces & leaf crushed, dissolved in water, 1 'kubaya' /glass is drunk once a week for 3 weeks
			G			Lv	L	F	O	Cowdrosis	Maceration	Handful of it pulverized, homogenized in water 1 kugaya is drunk
			Gm			Lv	R	F	O	Abdominal pain	Maceration	Root pulverized, dissolved in water salted & 1kubaya is drunk
			Y			Lv	R	F	D	Wound	Poultice	Crushed, wet paste bandaged on the infected part
63	*Clerodendrum serratum*?	Lamiaceae	G	Qale?i haniga(H)	S	Hu	L	F	O	'Mich'	Maceration	Crushed water homogenate 1 cup drunk
64	*Clutia abyssinica* Jaub. & Spach.	Euphorbiaceae	Y	Nagina(Y),Shumtiga (H)	S	Lv	Sh	F	NBp	Evil eye	Put nearby	When crop seedlings variegate, it is believed to be due magic exercise, as a remedy itsshoot along leaves pegged inside crop to restore green colour
			Y			Lv	Sh	F	D	bloat of cattle	Touch with	Beating with fresh stem along leaves
			G			Lv	L	F	O	Babesiosis/ bloodwater	Maceration	Leaf crushed & 1 glass is drunk
65	†*Coccinia abyssinica* (Lam.) Cogn.	Cucurbitaceae	Y	Aju(Y)	CH	Hu	R	F	O	Bone fracture	Decoction	Cooked with vegetables, spiced, buttered & eaten for a week, then as needed
					CH	Lv	R	F	O	Animal fracture	Juice	Enough root pieces salted & fed to the animal
66	*Coffea arabica* L.	Rubiaceae	Y	Buni(Y) Buna(O)(H)	S	Hu	S	D	O	Diarrhoea	Wet paste	Powder of roasted beans mixed with honey & eaten
			G			Hu	S	D	D	Chronic leg sore	Paint	Beans roasted, pounded and flour mixed with little fresh butter wound poulticed
67	*Combretum Collinum* Fresen.	Combretaeae	Gm	Habule(H)	T	Lv	L, R	F	O, D	Blackleg /Toka'/	Poultice, maceration	Crushed, homogenized with water, 1 bottle is drunk; part of the crushed paste applied on wounding area of the animal
68	*Combretum molle* R.Br. ex G. Don.	Combretaceae	Y	Rukensa(O)	T	Hu	Bs	F	O	Gonorrhea, arthritis	Maceration	Crushed & 1 glass is drunk for a week

69	*Commelinia imberbis* Ehrenb. ex Hassk.	Commeliniacea e	Y	Naereya(Y) Laluncha(O)	H	Hu	Wp	F	O	Diarrhoea	Decoction	Decoction 1 glass drunk twice a day
			G			Hu	Sh	F	D	Bone cancer /'Miqicha'/	Insertion/po ultice	Shoot peeled, inner part smashed to soften, then the location is incised and & inserted on location & bandage
70	*Convolvulus kilimandschari* Engl.	Convolvulaceae	Y	Herqa-Loma, Ku?renEta(Y)	CH	Hu	L, R	F	O, D	Sore Nose	Decoction	Decocted, 1 cup drunk; also fresh shoot finely crushed & concentrate solution bandaged on location leaving for 3 days on location
71	*Conyza schimperi* Sch. Bip. ex A. Rich.	Asteraceae	Gm	??		Lv	L	F	O	Conjunctivitis	Juice	Smashed between palms, squeezed & thick extract dripped into eyes
			Y			Hu	L	F	O	Delayed placenta	Maceration	Crushed, dissolved in water & extract 1 cup drunk
72	*Conyza aegyptiaca* (L.) Dryand ex Ait.	Asteraceae	Y	MeshkaFestupo(Y)	S	Hu	L	F	O, D	Oedema	Infusion	Infusion 1 glass drank for 3 days; also concentrate solution of fresh leaf also applied &bandaged on location
73	*Coriandrum sativum* .L.	Apiaceae	A,D, G,G m, Y	Woldimama(H),Dem sa(Y)	H	Hu	L, F	F	O	Abdominal pain	Juice	Few pieces chewed & swallowed
74	*Cordia africana* Lam.	Boraginaceae	Y	Kerewaza(Y)Wadesa (O)Wedesha(H)	T	Hu	L	F	D	Chronic sore leg	Paint	Burnt, seeds of *Aframomum corrorim* a ground & both mixed with butter ointed on the area
			Y			Hu	L	F	D	Scabies	Paint	Burnt, seeds of *Aframomum cororima* ground & both mixed with butter ointed on the area
			D			Hu	Bs, F	F	O	Hypertension	Decoction	Stem bark decoction 1 'kubaya' = 1 glass drunk; also mature fruit pulp eaten for the same
			Y			Lv	L	F	O	Abdominal parasites	Maceration	Crushed & 1 bottle drunk twice a week
			Gm			Lv	Bs	F	O	Sudden disease /cattle	Maceration	Inner bark from sun rise side crushed, homogenized in cold water and solution is drunk
			D			Lv	Bs	F	O	Grain bloat in animals	Maceratitio n	Stem bark crushed, dissolved in water & extract 1 litre & 1 glass of cooking oil given in morning & evening to induce gassing & diarrhoea
75	*Crassocephalum macroppapum* (Sch.Bip. ex A. Rich.) S. Moore	Asteraceae	G	Dado hesbeta	H	Hu	Sh	F	O	Cough	Maceration	Shoot crushed, water extract 1 cup drunk for 3 days & repeated any other day
76	*Crepis rueppellii.* Sch. Bi.	Asteraceae	Y	Kintabo(Y)	H	Hu	Wp , R	F	O, D	Snake bite	Maceration	Crushed 1 cup of water solution drunk; the plant is kept in hand for handling snake
			Y			Hu	R	F	O	Abdominal pain	Juice	Chewed & swallowed
			Y			Hu	R	F	D	Skin disease	Paint	Cooked & mixed with butter & apply on location
			A	Qureqerae(H)		Hu	R	F	O	Edema /in body/	Maceration	Root crushed, dissolved in water & extract 1 cup drunk
			A			Hu	R	F	O	Dyspepsia / 'Qureta'	Maceration	Root crushed, dissolved in water & extract 1

												cup drunk, for children ½ a cup drunk
77	*Crinum abyssinicum* Hochst. ex A. Rich.	Amaryllidaceae	Y	Ke?umasunto(Y),Ha ?me(H)	H	Hu	L	F	O	Gonorrhoea	Infusion	Infusion 1 cup drunk
			D,G, Y		H	Lv	R	F	O	Sudden disease	Concoction	Along with leaf of *Juniperus procera* & *Clutia abyssinica* , crushed, dissolved in water, 1 bottle is drunk
			Y			Lv	R	F	O	Black leg	Concoction	Along with leaf of *Juniperus procera.*& *Clutia abyssinica* crushed, dissolved in water, 1 bottle is drunk, & cauterise the location
			A			Lv	Bl	F	O	Sudden disease of horses	Maceration	Root crushed, salted and water filtrate 1 litre is drunk
78	*Crotalaria incana* L.	Fabaceae	Y	Sekseko(Y)	S	Hu	L	F	D	Allergic rashes	Paint	Crushed homogenised with little water, the solution smeared over the hurt surface
			G			Hu	L, S	F	D	Chronic nose wound /bat urine/	Poultice	Leaf & fruit crushed & tied on the location for few days
79	*Crotalaria spinosa* Hochst. ex Benth.	Fabaceae	A	Kurunchita/Qertefa(H)	H	Hu	Wp	F	O	Malaria	Maceration	Whole part crushed, dissolved in water, extract 1 cup drunk for 3 days
80	*Croton macrostachyus.* Del.	Euphorbiaceae	Y	Woshkela(Y) Mekanisa(O),Mesena (H)	T	Hu	L	F	O	Malaria	Maceration	Crushed, dissolved & filtrate 1 cup is drunk for 3 days; Antidote cooked teff flour is eaten to stop diarrhoea, hide from people shadow for one day
			A,G, Y			Hu	Nectar	F	O	Malaria	Juice	Few bulbs of *Allium sativum* chopped & eaten along with its honey
			A,Gm			Hu	Lx	F	D	Fresh wounds	Paint	Smeared on location
			Y			Hu	Bs	F	O	Typhoid fever	Decoction	Pulverised & decoction 1 cup is drunk twice a week; also leaf & bark fumigated at house
			Y			Hu	Bs	F	O	Gonorrhoea	Maceration	Pulverised, mixed with water overnight & filtered and drunk 1 cup for 3-5 days
			Y			Lv	L	F	D	Scabies in cattle	Paint	Crushed & soaked in water then wash with the solution &paint
			A,Gm			Hu	Lx	F	D	Ringworm/Tinea captis /	Paint	Shoot tip latex applied scratching the surface
			A			Hu	L	F	O, N	Severe headache	Juice	Leaf crushed juice squeezed onto palm & taken through nose
			A,G, Gm			Hu	Bs	F	O	Abdominal worms,	Decoction	Bark taken from sunset/rise sides crushed bark decocted and 1 glass drunk
			A,G			Hu	L	F	D	Feet infection /Yechama mich/	Paint	Leaf crushed & paste applied on location
			A,G			Hu	Bs	F	O	Nephritis,Cirhosis/' demtoke'	Decoction	Bark decoction drunk
			G			Hu	Bs	F	O	Dyspepsia	Maceration	Bark from sunrise/set side crushed, dissolved in water, the extract, l cup is drunk
			G,Gm			Hu	Sh	F	D	Elephantiasis	Cauterisation	Top foot cauterised in different locations with fresh twigs

			A			Hu	Bs	F	O	Fever	Decoction	Bark decoction drunk
			D			Hu	W, L	F	Fm	Rheumatic pain	Inhalation	Fresh wood & leaf burnt , the patient inhales the smoke & sleep near fire place get heat to get relief by sweating
			A,G			Lv	L, S	F	O	Foot -mouth disease	Maceration	Handful of fresh leaves along with that of *Nicotiana tabacum* pulverized, homogenized in cold water & ½ litre drunk for 5 days
			Gm			Hu	Bs	F	O	TB	Decoction	Bark decoction 1 cup is drunk for 7 days
			G			Lv	L, Bs	F	Fm	Horse cough	Fumigation	Fresh leaf & bark fumigated before the animal
			A,D, G			Lv	L	F	O	Pasture bloat of cattle	Infusion	Leaf wrapped with enset leaf & cooked on fire, adding butter & 2 tea spoons of chili chunks let swallowed
			D,G			Lv	L	F	O	Black leg/ 'hyqesa'	Concoction	Leaf along with leaf of *Clematis longicauda* & *Microglossa pyrifolia (*crushed, concocted & 1 glass drunk for 3 days
			G			Lv	L, Bs	F	O	Lumpy skin disease	Concoction	Leaf & bark along with leaf of *Nicotianatabacum* pulverised & homogenised in water along with salt 1 bottle given orally
81	*Cucumis ficifolius A.Rich.* A. Rich.	Cucurbitaceae	Y	Sikiya(Y),Wagerech o(H)	CH	Hu	R	F	O	Malaria	Macerartio n	Crushed along with root of *Phytolacca dodecandra* /'She?a andode' red variety, homogenised with water, filtrate 1 cup added to local brew/Borde/ &drunkonce a week for 3 weeks in mornings
			G,G m,Y			Lv	R	F	O	Sudden disease	Maceration	Pulverised & 1 gubaya is drunk
			A			Hu	R, L	F	O, Ep	Hemorrhoids	Paint	Leaf & root smashed & paste smeared on location
			A			Hu	R, L	F		Warts	Paint	Leaf & root smashed & paste smeared on location
			A,G m			Hu	R	F	O	Hepatitis	Concoction	A piece root along with stem bark of *Croton macrostachyus*. & root of Rumex concocted & filtrate 1 cup is drunk per week for a month
			Gm			Hu	R	F	O	Evil eye	Decoction	Root crush, decoction ½ a cup is drunk, also wash body with decoction
			A,G			Lv	R	F/D	O	Abdominal pain	Decoction	A small piece of root crushed decoction 1 glass is drunk
			A,G m			Lv	R	F	O, D	Evil eye of cattle	Decoction	Pieces of root crushed , decoction 1 glass is drunk; body of animal washed with the solution
			Gm			Lv	R	F	O	Anthrax	Maceration	Along with Asparagus africana & *Croton macrostachyus* concocted & 1 bottle is drunk for 3 days
82	*Cucurbita pepo.* L.	Cucurbitaceae	A,G, Y	Buqe/dubaO),Debeq ula(H)	CH	Hu	S	D	O	Taeniasis	Wet paste	Handful of roasted beans eaten

83	*Cupressus lusitanica* Mill.	Cupressaceae	Y	Ferenjini Arkewa(Y),Ferenjhoma(H)	T	Hu	L	F	O	Hepatitis	Digestion	Along with leaf of *Juniper procera* pounded, concoction 1 glass taken for a week
			Y			Hu	L	F	O	Amoebiasis	Infusion	A glass of leaf infusion drunk for 3 days a week
			A			Hu	L	F	O	Typhoid fever	infusion	Palmful infused 1 glass is drunk in empty stomach
84	*Cuscuta* sp.	Convolvulaceae	D	Helansh-tuda	H	Lv	Sh	F	O	Intestinal worms - sheep, calves	Maceratitio n	Shoot smashed homogenised in water and 1 glass given once, repeated any other day
85	*Cyathula cylinderica* Moq.	Amaranthaceae	Y	Umo(Y),Beraba/qecheba(H)	H	Hu	R	F	N	epistaxis	Maceration	Crushed, dissolved in little water & thick extract sucked via nose
			Y			Hu	R	F	O	Ear disease	Maceration	Crushed, dissolved in little water & thick extract 2-3 drops dripped
			Y			Hu	L, R	F	D	Spider poison	Poultice	Crushed, moistened with drops of water & wet concentrate solution bandaged on location
			Y			Hu	R	F	O	Rabies	Concoction	Crushed along with root of *Ricinus communis*. 1 cup is drunk
			Y			Lv	R	F	O	Constipation	Digestion	Along with leaf of *Discopodium penninervium* & young sheath/leaf of Arundinaria alpina K. Schum. crushed, concoction1 bottle is drunk for 3 days
			Y			Lv	R	F	O	delivery difficulty	Concoction	Along with root of Acanthus eminens & leaf of *Maesa lanceolata* crushed, dissolved in water & 1 'gubaya' is drunk
			Y			Lv	R, L	F	O	Stomach water retention	Concoction	Along leaf of *Prunus persic*a pulverised, water extract 1 'gubaya' drunk for 5 days
			A			Hu	R	F	O	Abdominal pain	Juice	Chewed & swalloed
			A			Hu	L	F	N	Epistaxis	Sinus snuff	Crushed & extract sniffed
			D			Hu	R	F	O	Common cold	Decoction	Hot root decoction 1 cup drunk twice a day
			A			Lv	R	F	N	Choking of cattle	Sinus snuff	Root is crushed, dissolved in little water and concentrate solution squeezed via nose of the animal
86	*Cymbopogon citratus* (DC.) Stapf	Poaceae	A	Hitana(H)	H	Hu	Ps, L	F/D	O	Malaria	Maceration	Pseudostem & leaf along leaf of *Vernonia amygdalina* & few bulbs of *Allium sativum* concocted & 1 glass drunk in empty stomach twice a week
			A			Hu	L	F/D	O	Toothache	Juice	Leaf chewed & juice & fiber kept in mouth for at least half an hour swallowing some of the juice
			A,D			Hu	S, L	F	O	Febrile illness /'mich'/	Infusion	Leaf crushed infusion 1 cup drunk & repeated
			A			Hu	L	F/D	O	Arthritis	Concoction	Leaf along with leaf of *Ajuga integrifolia* crushed finely steeped into a boiling water, then concoction 1 glass drunk 3-4 times a week until improves

			A,D, G			Hu	L	F/D	O	Choking	Juice	Leaf is chewed & juice dwelt along throat, then swallowed
			D			Hu	St, L	F	O	Typhoid fever	Infusion	Leaf & pseudostem infusion 1 cup drunk for 5 days
			D			Lv	St, L	F/D	O	Conjunctivitis s	Maceratitio n	Leaves smashed, little drop of water added & filtrate dripped amply
			A			Hu	L	F/D	Fm	Repellent	Fumigation	Leaf fumigated to evade vectors /mosquitoes & flies/ that are; the name 'hitana' is the same as incense from the fact it is fumigated to gain a characteristic aroma
			A			Hu	L	F/D	L	Blood pressure	Concoction	Along with leaf of *Thymus schimperi* crushed, concoction 1 glass is drunk during distress
			A			Lv	L	F/D	O, N	Choking of cattle	Juice	During distress few dry or fresh leaves chewed in human mouth, the juice blown into mouth & nose
87	*Cynodon dactylon*.(L.) Pers.	Poaceae	Y	Ashu?ro(Y)	H	Hu	Wp	F	O	Snake bite	Maceration	Whole part ground water homogenate 1 glass drunk
88	*Cynoglossum amplifolium* Hochst. ex A. DC. in DC.	Boraginaceae	Y	Kereza?no(Y),Gotbu ya(H)	H	Hu	L	F	O	Epilepsy	Maceration	Crushed, dissolved in water and extractsmall tin can drunk
			G,G m			Hu	R	F	O	Infants abdominal upset & diarrhoea	Decoction	Root is collected where a crow of cock is not reached, decocted, 1/2-1 cup buttered & drunk
89	*Cynoglossum coeruleum* Hochst. ex DC. in DC.	Boraginaceae	D	Qecheba(H)	H	Lv	L, R	F	O	Anthrax	Maceration	Crushed along with leaf of *Croton macristachyus* & *Nicotiana tabacum* water homogenate 1 litre for 5 days
90	*Cynoglossum lanceolata* Forssk.	Boraginaceae	Y	ForoZa?no(Y),Qeche ba(H)	H	Hu	L, R	F	O	'Mich' / 'Be?u'	Decoction	Decoction1 cup drunk 2-3 mornings (for Areke & coffee mich)
			G			Hu	R	F	O	Febrile rheumatoid pain,	Decoction	Root decocted and ½ a glass extract drunk
			Y			Lv	L	F	D	Worming woulnd	Decoction, paste	Decoction drunk
			D			Lv	R, L	F	O	Anthrax	Maceratitio n	Root along with leaf of *Croton macrostachyus*, of *Nicotiana tabacum* crushed, homogenised in water & 1 litre drunk twice a day for 5 days
			Gm			Lv	R	F	O	Snake bite	Maceration	Along with root of *Crepis rueppellii* crushed water extract 1 bottle is drunk
91	*Cyperus rotundus* L.	Cyperaceae	Y	Che?ra(Y)	H	Hu	Cm	F	O	Ascariasis	Decoction	Chewed & swallowed; or crushed, decocted &drunk in tea or enset soup
92	*Cyphostemmia adenocaule* Desc. ex Willd & Drimond	Vitaceae	Y	Yesha, Agutu,(Y),Lalo?o(H)	CH	Hu	R	F	O	feet swelling ailment	Decoction	Along with root of *Stephania abyssinica*.&root *Momordica foetida* pulverized decoction 1 tin can is drunk, or concoction 1 tin can is drunk
			G			Hu	R	F	D	Evil eye	Maceration	Root crushed, homogenised with water and wash body parts of humans with the solution

			G			Lv	R	F	D	Evil eye cattle	Wash	Root crushed, homogenised with water then wash body parts, udder &tits of the animal
			Gm			Lv	R	F	O	Trypanosomiasis/'hilefa'	Maceration	Crushed, water extract 1 bottle is drunk once for 3 weeks
			Y			Lv	R	F	O, D	Blackleg	Maceration	Root crushed along with root of *Cyathula cylinderica*, 1 bottle for 3-4 days
			D,Y			Lv	R	F	D	Oxen neck wound	Maceration	Crushed & fresh paste applied on sore neck
93	*Datura stramonum* L.	Solanaceae	G,Y	Asangira(O),Mechara(H)	H	Hu	S	F	O	Toothache	Maceration	Chew few of them & hold the juice in mouth
			Y			Hu	S	F	D	Insecticide	Maceration	Pounded along with fruit of Anona spread mixed with water & spray the solution
			Y			Hu	S, L	F	Fm	Evil spirit	Fumigation	Smoked on fire
			A,G			Hu	L	F	O	Epistaxis	Juice	Leaf smashed & inserted into nose & kept in atleast for 1 hour
			A			Hu	L	F	O	Rabies	Maceration	Leaf crushed & water extract 1 cup is drunk
			D			Lv	R, L	F	O	Anthrax	Maceratitio n	Root along with leaf of *Croton macrostachyus*, of *Nicotiana tabacum* crushed, homogenised in water & 1 litre drunk twice a day for 5 days
			D			Lv	R, L	F	O	Anthrax	Maceratitio n	Root along with leaf of *Croton macrostachyus*, of *Nicotiana tabacum*. crushed, homogenised in water & 1 litre drunk twice a day for 5 days
94	*Daucus carota* L.	Apiaceae	G,Gm	Karota(H)		Hu	R	F	R	Night blindness	Decoction	Root cooked & eaten as vegetable
95	*Dicrocephalia integrifolia* (L.f.) Kunze	Asteraceae	Y	Sonshi(Y),Ulihere fa(H)	H	Hu	Wp	F	O	Amoebiasis,	Maceration	Smashed, water extract 1 cup drunk 3 days a week
			D			Hu	Wp	F	O	Abdominal worms	Maceratitio n	Whole plant crushed, dissolved in water & 1 glass drunk
96	*Dicliptera laxata* C.B. Clarke	Acanthaceae	D,G, Gm, Y	Focho(Y), Omoro(H)	H	Hu	L	F	O, N	'Mich'	Infusion	Infusion 1 'kubaya' drunk; also steam inhaled
			Y			Hu	L	F	O	Abdominal cramping	Infusion	Infusion 1 gubaya drunk
			A			Lv	Sh	F	E	Leech	Juice	Aerial part is pulverised, homogenised in water & thick filtrate squeezed sent into mouth; also added into water source
			A			Hu	L, Sh	F	O, D	mich' Eye, face, nose, mouth '	Decoction	Decoction of shoot & leaf drunk in coffee; also affected parts washed & mouth rinsed with the decoction for 3 days
			A,G			Hu	L	F	O	Common cold	Infusion	A glass of leaf infusion is drunk while hot
			A,G			Hu	L	F	O	Hypertension	Infusion	Leaf infusion 1 glass drunk twice a week
			G			Hu	L	F	O, D	Herbal bath of postpartum	Concoction	Leaf also added in ingredients of herbal bath (see Pentas lanceolata)

			A,G, Gm			Hu	L	F	O	Recovery of womb	Decoction	A glass of decoction added into porridge and eaten for 3 mornings
			Gm			Hu	Wp	F	O, D	Cancer	Decoction	Decoction of whole part 1 'kubaya' is drunk every 3rd day for 2 weeks; also some of it applied on wound
97	*Discopodium penninervium* Hochst.	Solanaceae	Y	Fururu(Y), Meraro(O)	S	Lv	L	F	O	Constipation of newborn	Infusion	Infusion 1ùkubaya is drunk until improves
98	*Dodonaea angustifolia*. L.f.	Sapindaceae	Gm, Y	Titra(Y), Itecha(O) Kitkita(H)	S	Lv	L	F	O	Diarrhea	Digestion	Crushed along with leaf & root bark of Leucas calostachys Oliv.& Brucea antidysentrica J.F. Mill. concoction 1 can is drunk
			Gm			Lv	L	F	O	Cattle bloat	Maceration	Crushed , dissolved in water & 1 litre extract is drunk
99	*Dombeya torrida* (J. F. Gmel.) P. Bamps	Steculiaceae	Y	Borebosha(Y)	T	Hu	L	F	O	Nephritis	Infusion	Infusion 1 glass drunk 3-4 days
			Y	Borebosha(Y),Jana(H)	T	Lv	L	F	O	Internal parasites	Maceration	Crushed & homogenised in water, 1 can is drunk for a week
			D			Hu	Bs	F	O	Abdominal pain	Decoction	Decoction 1 glass is drunk, for children 1 cup given
100	*Dovyalis abyssinica* (A. Rich.) Warb.	Flacourtiaceae	Y	Boni Sona(Y)	S	Hu	L	F	O	Anthrax	Infusion	Infusion 1 'gubaya' drunk in mornings for 5 days
101	*Dracaena steudneri* Engler	Dracaenaceae	Y	Teso(Y), Alge(O)	T	Hu	Lx	F	Oc	conjunctivitis	Juice	Dripped into ailing eye until progress seen
			Y	Teso(Y), Alge(O)	T	Lv	R	F	O	Black leg	Concoction	With root of *Ricinus communis* (red variety), leaves of *Senna didymobotrya* crushed together, homogenised with water & 1 tin can filtrate is drunk
102	†*Drougetia insers* (Forssk.) Schweinf.	Urticaceae	D,Y		H	Hu	Sh	F	O	Mich	Infusion	Infusion 1 cup is drunk
	Drymaria cordata (L.) Schultes	Caryophyllaceae	Y	Mo?eya(Y),Duqusha (H)	H	Hu	Sh	F	O	Hepatitis	Infusion	Smashed infusion 1 glass drunk twice a week for 3 weeks
			Y			Hu	L	F	N	Epistaxis	Concoction	Concocted along with leaf of *Artemesia abyssinica* & *Salvia nilotica*, squeezed & sucked via nose
			A,D, G,Gm			Hu	Sh	F	D	Forgivess/Stick fight injury	Belief	One who hurt in the fight, touches shoot and *Kalanchoe petitiana*, put in bowl of water for forgiveness and recovery of the hurt one by praying elders
			Y			Lv	Wp	F	O	Hate calf	Decoction	Decocted along with *Englerina woodfordioides* (epiphytic on *Calpurnia aurea* & 1 bottle is drunk 2-3 days a week
			D			Lv	Sh, L	F	D	Swelling	Poultice	Leaves wrapped in *Ensete ventricosum* leaf and slightly on fire and poulticed on the location
103	*Dyschoriste multicaulis* (A. Rich.) O. Kuntze	Acanthaceae	Y	Meshka-kesa(Y)	H	Hu	Wp	F	O	Bone cancer	Concoction	Ingredient with other remedy/species, concoction 1 glass is drunk twice a week for a month

104	*Dyschoriste nagchaga* (Nees) Bennet	Acanthaceae	Y	Herqe-Kesa(Y)	H	Hu	Wp	F	O	Infertility	Maceration	Crushed, dissolved in water & 1 glass drunk one a week for 2-3 months
105	†*Echinops kebericho* Mesfin	Asteraceae	D,Y	Korbo(Y),Tosa(H)	H	Hu	R	F/D	O	Cough	Decoction	Pieces pulverised, decocted, buttered & 1 cup drunk for 5 mornings
			Y			Hu	R	F/D	Fm	Headache	Fumigation	Pieces d & smoke inhaled
			Y			Hu	R	F/D	Fm	rheumatic fever, e vil spirit	Fumigation	Pieces also d & smoke inhaled by covering the smoke from escape
			Y			Hu	R	F/D	Fm	Avoid snake	Fumigation	Smoked at house
			Y			Lv	R	F/D	O	Pastereullosis , appetite	Maceration	Root pulverised, dissolved in water 1 tin can drunk
			A,D, Gm			Hu	R	F	O	Sudden abdominal pain	Juice	Root chewed along with salt & swallowed
			A,G			Hu	R	D	Fm	Dysentry	Fumigation	Root fumigated for cure & as repellent for flies in house
			A,D, G			Lv	R	F	O	Sudden ailment	Concoction	Root along with some leaves of *Nicotiana tabacum* crushed, diluted & squeezed with Ensete fibre, filtrate 1 bottle drunk
			D,G, Gm			Lv	R	F/D	O	Pasture bloat	Maceration	Root crushed, homogenised with water and extract 1 bottle is drunk
			D			Lv	R	F/D	O	Blackleg	Concoction	Pulverised along with leaf of *Nicotiana tabacum* & *Croton macrostachyus*, & *Clematis longicauda* concoction, salted & 1 litre drunk
			D			Lv	R	F/D	O	Anthrax	Concoction	Pulverised along with leaf of *Nicotiana tabacum* & *Croton macrostachyus* & *Clematis longicauda* concoction, salted & 1 litre drunk
106	*Ehretia cymosa* Thonn.	Boraginaceae	Y	Ulaga(O)	T	Hu	L	F	O	Hepatitis, Nephritis	Infusion	Leaf infusion 1 glass is drunk 2-3 times a week
			Y			Lv	L	F	O	Trypanosomiasis	Concoction	Crushed along with leaf of *Justicia shimperiana* & shoot of *Caylusea abyssinica* , homogenised in water then 1 litre filtrate is drunk, the repeat any other day till progress
			Y			Lv	L	fresh	O	Anthrax	Maceration	Few leaves crushed along with the leaves of *Caylusea abyssinica*, *Justicia shimperiana* , homogenized with water, then extract 1 litre is drunk in morning and evening
			Gm			Hu	L	F	O, D	'Mich'	Infusion	Leaf infusion is drunk, facial areas also washed with some of the infusion
			Gm			Lv	L, Bs	F	O	Abdominal pain	Maceration	Crushed, mixed with water ½ a litre filtrate given
107	*Ekebergia capensis* Sparrm.	Meliaceae	Y	Oroma(Y)	T	Hu	Bs	F	O	Diarrhoea	Decoction	Pulverised & decoction ½ a 'gubaya' is drunk

108	*Eleusine coracana* (L.) Gaertn.	Poaceae	G,Gm	Fegeja(H)	H	Hu	S	D	O	Edema	Concoction	Local beer 'aydara' is made & eaten along with other ingredients
109	*Embelia schimpei* Vatke	Myrsinaceae	D,G,Y	Tomoqo(Y), Hanqu(O)	S	Hu	F	F/D	O	Helminthiasis	Concoction	Crushed &mixed with dry fruits of *Hagenia abyssinica* , dissolved in water & let overnight for fermentation, then the potion 1 tin can drunk in empty stomach
			Y			Hu	L, F	F/D	O	Blood pressure	Concoction	Along with fruit of *Hagenia abyssinica* concocted &1 cup drunk in the mornings during symptoms
						Hu	F	D	O	Abdominal worms	Maceration	Fresh or dried fruit crush, mixed and *Hagenia abyssinica* fruit powder and water solution 1 'kubaya' drunk once
110	*Englerina woodfordioides* (Schweinf.) M. Gilbert (of *Justicia schimperiana*)	Loranthaceae	Y	Tigna Atebiyo(Y)	S	Hu	L	F	O	Epilepsy	Infusion	Infusion 1 glass taken in mornings for 3 days a week
a	(of *Calpunia aurea*)		Y	Ertuhegemsa(O)	S	Hu	L	F	O	Asthma	Infusion	Infusion 1 glass drunk until improves
b	(of *Vernonia myriantha)*		Y	Tigna Buzo(Y)		Hu	L	F	O	Malaria, Fever	Infusion	Infusion 1 glass drunk for 5 days
			Y	Tigna Buzo(Y)	S	Hu	Sh, L	F	O	Anthrax	Decoction	Pulverised, decoction 1 glass drunk for 5 days
			Y	Tigna Buzo(Y)		Hu	Sh, L	F	O	Neck gland cancer	Decoction	Decoction ½ a glass drunk twice a per week for a month
			Y	Tigna Buzo(Y)	S	Lv	L	F	O	Evil eye	Juice	Along with *Galium simense* smashed & extract squeezed on eye
c	(of *Vernonia amygdalina*)	Loranthaceae	A,G	Heb Tenko?o (H)	S	Hu	L	fresh	O	Malaria	Infusion	Leaf smashed, infusion 1 glass drunk for a week
			Gm			Hu	L	F	O	Rheumatic pain	Infusion	Leaf infusion 1 'kubaya' is drunk & repeated every 3rd day for two weeks
111	*Ensete venteicosum* (Welw.) Cheesman Ewa(Y),Wesa(H)	Musaceae	Y	Clone Elewa(Y)	H	Lv	Cm , Ps	F	O	Delayed placenta	Chunks	Corm & pseudostem fed to the animal
			Y	Clone 'Kerona' (Y)		Hu	Cm , Ps	F	O	Edema	Bulk/slices	Cooked &eaten; also pseudostem exudate decocted &1 can is drunk
			Y	Clone Gomoruwa(Y)		Hu	Cm	F	O	Amoebiasis	Bulk/slices	Cooked & eaten
			Y	Clone Kinkiso(Y)		Hu	Cm	F	O	Delayed placenta	Bulk/slices	Cooked adding its pseudostem exudate, cool & decoction is drunk, corm eaten
			Y	Clone Kinkiso(Y)		Lv	Cm	F	O	Delayed placenta	Chunks	Root cooked adding of its water & cool soup of it drunk
			Y	Clone Anchiro(Y)		Hu	Cm	F	O	Amoebiasis		Cook & eaten upto fill
			Y	Clone Asu(Y)		Lv	Cm , Ps	F	O	Delayed placenta	Chunks	Corm & pseudostem fed to the animal
			A,G	Clone "Qiniwar"(H)		Hu	Cm	F	O	Fracture, waist pain	Maceration	Corm cooked & eaten with yoghurt /'Gi?ina'/ for 2-3 weeks

			A	Clone "Agade"(H)		Hu	Cm	F	O	Waist/back/disc pain	Maceration	Corm cooked & eaten along with yoghurt "Gi?ina"/"irgo"
			G	Clone 'Astera' (H)		Hu	Cm	F	O	Bone fracture & waist pain	bulk/slice	Corm cooked and eaten with supplements like yoghurt, 'borde'
			A,D,G,Gm	Clone "Gishir"(H)		Lv, Hu	Cm	F	O	Fracture	Maceration	Human-corm cooked and eaten along with Yoghurt "irgo", or local fermented beverage "borde"; animal corm sliced & fed until improves
			A,D,G,Gm	Clone 'Meqe?l Wesa'(H)		Lv	WP	F	O	Delayed placenta	Maceration	Whole parts chopped & feed the cow
			Gm	Clone'/Haywona'(H)		Hu	Cm	F	O	Thorn puncture infection	bulk/slice	Corm cooked eaten with that has been fermented along with root bark extract of Carissa spinarum L. day & night for two days
			G	Wesa(H)('kocho' of any clone)		Hu	Ps, R'	F	D	Mumps	Fomentation	'Kocho' boiled on fire & hold both cheeks with hot material near neck repeatedly until cools
112	*Eragrotis tef* (Zucc.) Trotter	Poaceae	Y	Neja(Y)	H	Hu	S	D	O	Rabies	Digestion	Bread baked along with solution of crushed root of *Momordica foetida* & *Stephania abyssinica* root & eaten
113	*Erucastrum arabicum* Fisch. & Mey.	Brassicaceae	Y	KesiBo?a(Y)	H	Hu	W	F	O	Rashes /Child	Paint	Smashed between palms & painted on location
114	†*Erythrina brucei* Schweinf.	Fabaceae	Y	Forokocho(Y-yellowflower),Wore?a	T	Hu	Bs	F	O	Chronic leg sore	Paint	Finely pounded & wet concentrate solution painted on location for 8 days
			Y			Hu	Bs	F	O	'Nekele Be?u'	Digestion	Along with its epiphyte *Englerina woodfroides* concoction & 1 glass drunk twice a day
			Y			Hu	Bs	F	O	Leprosy	Maceration	Pulverised, homogenised in water, 1 gubaya drunk continuously
			Y			Hu	Bs	F	O	Evil eye	Digestion	Crushed with *Embelia schimperi*, concoction 1 cup drunk, also wash with solution
			D,Gm			Hu	Sh	F	O	Tonsillitis	juice	Shoot tip is chewed & juice spat into mouth of children; adults hold juice in mouth swallowing little by little
			Y			Lv	Bs	F	O	Pasteurellosis	Concoction	Crushed along with *Viscum* sp. (of *Croton macrostachyus*) 1 bottle drunk 2 days a week
			A,G,Gm			Lv	Bs	F	O	'teff' straw bloat	Maceration	Bark is crushed, dissolved in water and 1 litre & a glass of cooking oil is drunk
115	*Eucalyptus camadulensis* Dehnh.	Myrtaceae	A,G,Gm	KesherBarzafa(H)	T	Hu	L	F	Fm	Flu, common cold	Sinus snuff, infusion	Hot leaf infusion inhaled, or shoot tip smashed between palms & sniffed
			A			Hu	L	F	Fm	Tonsillitis	Inhalation	Hot leaf infusion inhaled
			Gm			HU	L	F	O	Children cough	Infusion	Young leaf infusion buttered & 1 cup is drunk as expectorant
			A			Hu	L	fresh	Fm	Febrile rheumatic pain	Inhalation	Hot leaf infusion inhaled

116	*Eucalyptus globulus* \Labill	Myrtaceae	A,D, G	ForoBarzafi(Y),Qeda lbarzafa(H)		Hu	L	F	Fu m	Flu & cough	Inhalation	Leaf infusion inhaled
			A			Hu	L	F	Fm	Asthma	Inhalation	Hot leaf infusion inhaled
			G			Hu	L	F	N	Tonsillitis	infiusion	Leaf infusion boiled & steam inhaled, or shoot tip smashed between palms & sniffed
			G,Y			Hu	L	F	N	Febrile rheumatic pain	infusion	Leaf infusion boiled & steam inhaled
			G			Hu	L	F	R	Shoe smell	Paint	Leaf crushed and streaked all over the feet and amid of toes
			G			Lv	Sh	F	Oc	Conjunctivitis	Juice	Young shoot along with crushed & soaked in water along with dry leaf of *Nicotiana tabacum* extract dripped amply on eye morning & evening
117	*Euclea racemosa* Murr. subsp. *schimperi* (A.DC.) White	Ebenaceae	G	Megara(H)	S	Hu	L	F	O	Tonsillitis	Juice	A piece of bark is chewed and juice held in mouth for 10-20 minutes then juice swallowed throwing the bark
			Gm			HU	L, Br	F	O	Purgative	Decoction	Leaf & root decoction 1 'kubaya' drunk
			Gm			Lv	R	F	O	Constipation / calves	Decoction	Decoction 1 glass is drunk
118	*Euphorbia abyssinica* Gmel	Euphorbiaceae	Y	Okma(Y) Adami(O)	T	Hu	Lx	F	O	Evil eye	Infusion	Added into coffee & drunk
			Y			Hu	Lx	F	D	Chronic l eg sore	Poultice	Painted & bandage the wound
			Y			Hu	Lx	F	D	Scabies	Paint	Painted over the affected part/s
			Y			Hu	Lx	F	O	Blood pressure	Syrup	Boiled along honey & 1 cup drunk
			D			Hu	Lx	F	D	Swelling	Plaster/Pain t	Latex is smeared on for making tender, erupt out pus
			Gm			Hu	R, Lx	F	O, D	TB & gland TB	digestion	Latex is collected and cooked along with bread of *Ensete ventricosum (*/Kocho/ eaten, root is also wrapped in a piece of clean cloth as amulet tied in neck for gland TB
			G,G m			Lv	L	F	Fm	Pastereullosis /Horse /	Fumigation	Dry shoot & root of *Echinops kebericho* tuber is fumigated closely for few days until improves
119	*Euphorbia cotinifolia* L.	Euphorbiaceae	Y	MukaAbeba(O)	S	Hu	Lx	F	D	Warts	Paint	Used in very small amount painted, otherwise it is toxic & allergenic
120	*Euphorbia schimperiana*	Euphorbiaceae	Y	Gendela(H), Binebisha(Y),	S	Hu	L	F	D	Tinea versicolor	Paint	Painted on location by scratching it
			Y			Hu	Lx	F	D	Warts	Paint	Painted on location
						Lv	L	F	O	Black leg	Digestion	Along with leaf of *Discopodium penninerviun* & of *Juniperus procera* concocted & 1 bottle is drunk for 5 days
			A			Hu	R	fresh	O, Lx	Vomiting of children	Juice	Root chewed & juice 2-3 drops spat into mouth

			A			Hu	Lx	fresh		Warts	Paint	Scratch the location & latex is painted
121	*Euphorbia* sp1.	Euphorbiaceae	Y	Gognoneta(Y)	H	Hu	L, R	F	O	Evileye	Decoction	Decocted & 1 cup is drunk
122	*Euphorbia* sp2.	Euphorbiaceae	G	Gufi Olewa(H)	H	Hu	R	F	O	Infant abdominal pain	Juice	Root is chewed & the juice is spat in mouth
123	*Euphorbia tirucalli* L.	Euphorbiaceae	A	Azefulcho(H)	S	Hu	Lx	fresh	D	Warts	Paint	Latex applied for on location
124	*Faurea speciosa*. Welw.	Proteace	Y	Geri(O), Ankulusa(H)	T	Hu	Bs	D	Fm	Repelflent	Fumigation	Smoked for evading mosquitoes
						Lv	W	F	N	mule cough /	fumigation	Fumigated in front of the animal
125	*Ferula* sp.	Apiaceae	Y	FezeDemsa(Y)	H	Hu	R	F	O	Tonsillitis	Juice	Chewed along with salt, juice held in mouth for few minutes then swallowed little by little
126	*Ficus ovata* Vahl	Moraceae	G	Odo/qonda'la/(H)	T	Lv	L	F	O	Foot-mouth-disease	Infusion	Leaf infusion 1 litre given for 3 days
127	*Ficus sur*. Forssk.	Moraceae	Y	Teya(Y)	T	Hu	Lx	F	N	Chronic nose infection	Juice	Dripped inside nose at different time intervals
128	*Ficus thonningii* Blume	Moraceae	Gm	Dimbo?iChuka(H)	T	Hu	Bs, Lx	F	O, D	Edema	Paint	Milky latex of bark applied on location, then boiled *Kalanchoe schimperiana* leaf held on location for a while to induce bursting or decline away
			Gm			Hu	L	F	O	Fever	Infusion	Leaf crush & infusion 1 kubaya is drunk
			Gm			Hu	Bs	F	O	Diarrhoea	Decoction	Bark decoction 1 kubaya drunk
129	*Ficus vasta* Forssk.	Moraceae	Y	Kasha(Y), Qiltu/O)Qilto'o(H)	T	Hu	Bs,	F	O	Hepatitis	Juice	Decocted & 1 glass drunk for a week
			Y			Hu	Br	F	Dn	toothache	Juice	Chewed, held on location
			Gm			Hu	L	F	O	Ascariasis	Maceration	Leaf crush, dissolved in water, extract 1kubaya is drunk
			Gm			Lv	L	F	O	Abdominal worms	Maceration	Crushed & finely dissolve & 1 bottle of solution is drunk
130	*Flacourtia indica* (Burm.f.) Merr.	Flacourtiaceae	Y	Chika(Y)	T/S	Lv	L	F	O	Anthrax	Concoction	One ingredient among others (see *Olinia rochetiana*.)
131	*Foeniculm vulgare* Miller	Apiaceae	Y	Inchilal(Y)	H	Hu	Br	F/D	O	TB	Concoction	Concoction along with others & 1 cup is drunk for 5 days (see *Withania somnifera)*
			A	Ashbe?e(H)	H	Hu	Wp	F/D	O	Gonorrhoea & nephritis	Maceration	Whole parts crushed, dissolved in water & extract 1 glass taken for & days for 7 days
			D			Hu	R, L	F	O, N	Influenza	Decoction	Root & leaf crushed along with garlic bulbs, decoction 1 glass is mixed with a cup of local alcohol /Hereqe/ & drunk for 3-4 days
			D			Hu	R, L	F	O	Cough	Decoction	Root & leaf crushed along with garlic bulbs, decoction 1 glass is drunk for 3-4 days
			D			Hu	R, L	F	O	Asthma	Decoction	Root & leaf crushed along with garlic bulbs, decoction 1 glass is drunk
132	*Fuerstia africana* T.C.E. Fr.	Lamiaceae	Y	Demsitu(Y)	H	Hu	Sh, L	F	D	Scabies	Juice	Smashed between palms & juice mixed with butter & painted

			A,D		H	Hu	Sh	F	O	'Mich'	Infusion	Few leaves smashed between palms before the sick person, if the extract turns orange red it is believed to be mich, then infusion 1 cup is drunk, & repeated as needed until the febrile pain recedes
			A,D, G			Lv	L	Fh	Oc	Conjunctivitis	Wet paste	Fresh/dry leaf powdered, mixed with fresh butter and ointing the eye
133	*Galiniera saxifraga* (Hochst.) Bridson	Rubiaceae	G	Gendeqa(H)	S	Hu	Br	F	O	Malnourished children	Maceration	Root bark crushed & dissolved in water & 1 cup extract is drunk once & repeated any other time
134	*Galium simense* Fresen.	Rubiaceae	Y	Achicha(Y),Qecheba (H)	H	Hu	Wp	F	D, O	Rabies	Concoction	Along with *Schrebera alata* leaf pounded, concoction drunk along *Eragrotis tef* (red variety) soup; also homogenate poultice on sore
			Y			Hu	Wp	F	O	Nephritis	Concoction	Along with fruit & leaf of *Coriandrum sativum*, *Clutia abyssinica*,root of *Achyrantes aspera* & leaf of *Cupressus lusitanica* crushed & conoction 1 gubaya drunk twice a week for a month
			Y			Hu	Wp	F	D	Herpes zoster	Paint	Smashed & paint on hurt locations
			Y			Lv	Wp	F	O	Black leg	Concoction	Crushed along with leaf *Agarista salicifolia* pulverised, dissolved in water & ½ a bottle drunk for 3-4 days
			A		H	Hu	Sh	F	O	'Mich'	Maceration	Shoot smashed, dissolved in little water and extract 1 cup is drunk
135	*Gardenia ternifolia* Schumach. & Thonn.	Rubiaceae	Y	Gembelu(O),Ankulu sa(H)	T	Hu	F	F	An	Hemorrhoids	Paint	Crushed along with root of *Cyathula cylinderica*, mixed oil of *Olea europaea*, paste applied on location, also
			Y			Hu	F	F	O	Edema	Maceration	Crushed, homogenised in water 1 cup drunk for 3 days
			Y			Lv	F	F	O	Edema	Maceration	Crushed, homogenised in water bottle drunk for 5 days
			A			Hu	Sh	F	O	Tonsilitis	Juice	Shoot tip is chewed & juice dwelt in mouth & swallowed
136	*Geranium aculeolatum* Oliv.	Geraniaceae	Y	DaniFofa(Y)	H	Hu	L	F	O	Snake bite	Concoction	Along with that of *Nicotiana tabacum* leaf/leaf bread pounded, concoction 1 cup drunk
			Y			Hu	L	F	D	Thorn puncture	Paint	Crushed, squeezed extract painted/streaked on location
137	*Gnaphalium rubiflorum* Hilliard	Asteraceae	Y	Kemisu(Y),Os hata(H)	H	Hu	Wp	F	O	Baby distress	Maceration	Crushed, homogenised in little water & half a cup is drunk
			A		H	Hu	L	F	O	Baby diarrhoea	Infusion	Infusion buttered, ½ a cup is drunk
			D			Hu	Sh	F	O	Abdominal pain	Maceratitio n	Leaf crushed, water extract 1 cup drunk
			A			Hu	Wp	F	O	Diarrhoea	Maceration	Crushed, homogenised in water 1 cup drunk twice a day

138	*Gnidia glauca* (Fresen.) Gilg.	Thymelaeceae	Gm	Olewa(H)	S	Hu	R	F	O	Dyspepsia /'Qureta'/	Juice	Small piece of root is chewed & swallowed
139	*Gnidia involucrata* Steud. ex A. Rich.	Proteaceae	D,G	Mismisa(H)	H	Hu	L	F	O	Abdominal pain infants, dyspepsia	Maceration	Crushed & dissolved in small amount of water extract 1 cup drunk in morning & evening until improves
140	*Gnidia stenophylla* Gilg.	Thymelaeaceae	Y	Ke?unaluwo(Y)	S/H?	Hu	L, R	F	O	Induce labour	Maceration	Leaf & root crushed homogenised in water & 1 'gubaya' is drunk
141	*Glycine* sp.	Fabaceae	Y	Nekeshilo(Y)	CH	Hu	L, R	F	O	Infectious edema	Decoction	Crushed, decocted & 1 glass drunk for 5 days
			Y			Hu	Wp	F	O	Nephritis	Maceration	Crushed & water homogenate 1 cup drunk for a week
142	*Gomphocrpus purpurascens* A. Rich.	Asclepiadaceae	Y		H	Lv	Sh	F	D	Edema	Paint	Latex & smashed shoot painted on location
143	*Gouania longispicata* Engl.	Rhamnaceae	A,G	Herira(H)	C	Lv	L	F	O	Teff straw bloat	Maceration	Leaf crushed, diluted with little water and extract 1 liter drunk
144	*Guizotia abyssinica* (L. f.) Cass.	Asteraceae	A,Y	Nugi(Y),Nuga(H)	H	Hu	S	D	O	Pneumonia, bronchitis	Concoction	Seed flour soup along *Allium sativum L.*, buttered 1 glass drunk as hot twice in mornings & evenings until improves
145	*Guizotia scabra*. (Vis.) Chiov.	Asteraceae	A,Gm	Jela(H)	H	Hu	Sh	F	Ep	Fresh wound	Paint	Shoot smashed between palms, squeezed & extract spread on fresh wound
146	*Hagenia abyssinica* (Bruce) J. F. Gmel.	Rosaceae	G,Y	Ofa(Y) Heto(O),Suto(H)	T	Hu	F	D	O	Taeniasis	Maceration	Paste dissolved in water, the solution 1 glass is drunk in morning in empty stomach for adults, half a glass for children
			Y			Hu	Bs	F	O	Taeniasis	Maceration	Crushed & homogenised in water, 1 'kubaya' is drunk morning in empty stomach
			Y			Hu	L, F	F	O	Anthrax	Maceration	(see *Lobelia giberroa Hemsl.*)
			Y			Hu	L, F	F	O	Amoebiasis	Maceration	(see *Lantana trifolia*)
			A,D, Gm			Hu	F	D	O	Vermifuge	Concoction	Powder dissolve in water & solution 1 'kubaya' to 1 can drunk singly in empty stomach, or as concoction of bark of *Croton macrostachyus* fruit of *Embelia schimperi*, *Dodonaea angustifolia* & *Cucurbita pepo seeds';* For children-Powder moistened to thick paste, coated with fried enset 'bula'/'atekana', 4-5 medium coats can be swallowed/
			A,D			Hu	F	D	O	General purity	Maceration	pound dissolve in water & 1 glass is taken in empty stomach to induce diarrhea i.e assumed as cleansing
			A			Hu	F	D	O	Norm for brides	Maceration	In olden times, brides drink paste solution 1 can for emptying stomach to avoid visit of toilet not to be seen family-in-laws
			D			Lv	L, F	D	O	Liver fluke /sheep	Maceratitio n	Few fruit & leaves crushed salted and homogenised in water 1 glass is drunk
147	*Haplocarpha rueppellii* (Sch. Bip.) Beauv.	Asteraceae	D,Y	Taseta(Y),Fecheqe(H)	H	Hu	R	F/D	O	Abdominal pain	Maceration	Either chewed & swallowed in small piece, or crushed & water homogenate 1 glass is

												drunk
			Y			Hu	R	F/D	O	Arthritis	Maceration	Root crushed, water homogenate 1 glass drunk
			Y			Lv	R	F/D	O	General health, galactogogue	Concoction	Added in Semo-Eta collection & 1 bottle is drunk
148	*Haplocarpha schimperi* (Sch. Bip.) Beauv.	Asteraceae	Y	Taseta(Y)	H	Hu	R	F	O	Tonsilitis	Juice	Chewed slowly swallow the juice
			Y			Lv	L	F	O	Sudden disease	Maceration	Crushed & water solution along other ingredients 1 litre is drunk
149	*Helinus mystacinus* (Ait.) E. Mey. ex Steud.	Rhamnaceae	G,Gm	Huda(O),Homecho(H)	S	Lv	L	F	O	Bloating	Maceration	Crushed & bottle given twice a day until get relief
			Y		S	Hu	R	F	O	Gonorrhea	Decoction	Decoction buttered & 1 cup drunk for 5 days
			A		S	Lv	L	F	O	Stunted calves	Maceration	Crushed mixed with water and 1 glass drunk a week for 3 weeks
150	*Helichrysum schimperi* (Sch. Bip. ex A. Rich.) Moeser	Asteraceae	Y	Hapso(Y)	H	Lv	L	F	O	Sudden ailment	Maceration	Crushed & water solution along other ingredients 1 litre is drunk
151	*Helichrysum stenopterum* DC.	Asteraceae	Y	Apso(Y)		Hu	L	F	O	Baby abdominal pain	Maceration	Crushed & water extract 1 cup is drunk
152	*Hibiscus* sp.	Malvaceae	Y	Kesa(Y)	S	Lv	R	F	O	Evil eye	Maceration	Crushed, homogenised in water, extract 1 bottle is drunk; also the same solution put in a bowl & body of the animal washed for the same
153	*Hordeum vulgare* L.	Poaceae	Y	Agewa(Y),So?o(H)	H	Hu	Sh	D	O	Tonsilitis	Juice	Fresh malt chewed, held in mouth & swallowed
			G			Lv	S	D	-	Newcastle disease		Polished seed coat is dusted up on chicks to protect, also feed
154	*Hypericum peplidifolium* A. Rich.	Hypericaceae	Y	Dani Arinshesho(Y)	H	Hu	Wp	F	O	Epilepsy	Maceration	Crushed & water extract 1 cup is drunk
			Y			Lv	Sh	F	O	Sudden disease	Maceration	Crushed, dissolved in water 1 bottle is drunk
155	*Hypericum quartinianum* A. Rich.	Hypericaceae	Y	Arinshesho(Y)	T/S	Hu	L	F	O	Anthrax	Concoction	Along with leaf of *Myrsine africana, Pavetta abyssinica*, *Premna schimperi*, *Leucas martinicensis, Olinia rochetiana , Calpurnia aurea* & *Buddleja polystachya* crushed, homogenised in water & 1 cup is drunk for 3 days
			Y			Hu	L	F	O	'mich'	Infusion	Infusion 1 glass is drunk
			Y			Lv	L	F	O	Anthrax	Concoction	Along with leaf of *Myrsine africana*., *Pavetta abyssinica*, *Premna schimperi*, *Leucas martinicensis, Olinia rochetiana*, *Calpurnia aurea* & *Buddleja polystachya* crushed, homogenised in water & 1 glass given for 5 days
			Y			Lv	L	F	O	Pastereullosis	Concoction	Leaf along with *Clutia abyssinica* crushed together, homogenised in water, 1 glass is

												drunk for 3-4 days
156	*Hypericum revolutum* Vahl	Hypericaceae	D	Geremba(H)		Lv	L	F	O	Wound	Maceratitio n	Leaf crushed, homogenised with little water, concentrate solution splashed on wound
157	*Ilex mitis (L.) Raldk.* (L.) Radlk.	Aquifoliaceae	Y	Botewa(Y),Ashiminq a(H)	T	Hu	L	F	O	Bone cancer	Maceration	Crushed & homogenised in water, 1 glass filtrate drunk twice a week for 3 weeks
			G			Lv	Bs	F	O	Tef straw bloat	Concoction	Bark pulverised along with fruit of *Coriandrum sativum*, dissolved in water & extract 1 glass litre drunk
158	*Impatiens ethiopica* Gey-Wilson	Balsaminaceae		Doche?e(H)	H	Hu	R	F	D	Edema	Compress	Root cooked on fire & hot material held on location
159	*Impatiens rothii* Hook. f.	Balsaminaceae	Y	Amemnorka(Y)	H	Lv	R	F	O	galactogogue	Decoction	Decoction 1 gubaya is drunk for five days
160	*Indigofera spicata* Forssk.	Fabaceae	Y	Festupo(Y),Chiurbata(H)	S	Hu	L	F	D	Wounds	Paint	Crushed & wet concentrate solution painted on location
			Y			Hu	L	F	D	Tiniasis	Paint	Crushed & concentrate juice painted by scratching
			Y			Hu	L	F	D	Leg cancer	Paint	Crushed & concentrate juice painted on location, fresh solution 1 gubaya is drunk
			Y			Lv	Sh	F	O	Foot-Mouth disease	Concoction	Added into ingredients of 'Black leg', crushed together and 1 litre is drunk
161	*Indigofera arrecta* Hochst. ex A. Rich.		Gm			Lv	L	F	O	Anthrax	Maceration	Crushed & water extract 1 bottle is drunk
162	†*Inula confertiflora A.Rich.* A. Rich.	Asteraceae	Y	Oyazu(Y)	S	Hu	L	F	O	Mich	Infusion	Infusion 1 cup is drunk & steam inhaled
			Y			Lv		F	N	flu	Maceration	Crushed along *Nicotiana tabacum.*, solution sqeezed nasally
			Y		S	Lv	L	F	O	Anthrax	Concoction	Along leaf of *Premna schimperi* & root of *Clerodendrum myricoides* crushed together water solution 1 bottle is drunk twice a day for 3 days
163	*Jasminum abyssinicum* Hochst. ex DC.	Oleaceae	Y	Forogemdu(Y)	C	Hu	L	F	O	Bone cancer	Infusion	Infusion 1 cup is drunk for 10 days
			Y			Hu	L	F	O	Blood pressure	Infusion	Infusion 1 cup is drunk during symptoms
164	*Juniperus procera* Hochst. ex Endl.	Cupressaceae	Y	Arkewa(Y) Tidi(O),Homa(H)	T	Hu	L	F	O	Abdominal pain	Concoction	Leaf cooked along with enset 'Bula' porridge with *Allium sativum* & eaten mainly in summer
			Y			Hu	L	F	O	Diarrhoea	Decoction	Pounded & cooked with enset/bula/ porridge & eaten
			Y			Hu	L	F	O	Jaundice/hepatitis	Digestion	Along with leaf of *Cupressus lusitanica* decoction 1 glass drunk for a week, or added into porridge &eaten
			Y			Hu	L	F	O	Common cold	Infusion	Infusion 1 'gubaya' drunk as hot morning & evening along with enset porridge
			Y			Hu	L	F	O	General health, tonic	Infusion	Eaten with porridge

			Y			Hu	L	F	O	Poor appetite	Infusion	Eaten with porridge
			A			Hu	L	F	O	Abdominal pain	Infusion	Pounded & infusion 1 glass taken
						Hu	L	F	O	Ailment	Juice	Handful of young shoot tip chewed & swallowed
			Y			Lv	L	F	O, D	Evil eye	Maceration	Along with root & leaf of *Pycnostachys abyssinica* pounded, dissolved in water & 1 bottle is drunk for 2 days
165	*Justicia heterocarpa* T. Anders	Acanthaceae	Y	Metene Guracha(O)	H	Hu	L	F	O	Gonorrhea	Digestion	Along leaf of *Tragia brevipes* & concoction 1 'kubaya' is taken
166	*Justicia schimperiana* (Hochst ex Nees) T. Anders	Acanthaceae	Y	Atebiyo(Y), Dumuga(O),Tumunga(H)	S	Hu	W	F	L	Postpartum rheumatism	Digestion	Along with leaf of *Momordica foetida* & of *Myrsine africa* crushed & concoction 1 'kubaya' is drunk, steam inhaled too
			A,D			Hu	L	fresh	O	Rheumatic disease	Infusion	Leaf boiled in water & wash body parts
			A			Hu	L		O	Malaria	Infusion	Fresh leaf crushed, infusion 1 cup is drunk five days
			A			Hu	L	F	O	Arthritis	Infusion	Infusion 1 glass is drunk
167	†*Kalanchoe petitiana A.Rich.*A. Rich.	Crassulaceae	Y	Temesa(Y) Henchura(O)	H	Hu	R	F	O	Gonorrhoea	Maceration	Crushed &water extract 1 'kubaya' is drunk
			D			Hu	R	F	O	Tonsilitis	Juice	Root few pieces chewed, juice held in mouth along ailing tooth
			D			Hu	L	F	NBP	Forgiveness	Symbolism	For conflict resolution
			D			Hu	R	F	O	Arthritis	Maceratition	Root crushed, dissolved in water and extract 1 cup drunk for 5 days
			Y			Hu	R	F	O	Children constipation	Concoction	Crushed along with leaf *Ruta chalapensis*, water extract buttered &1 cup is drunk
			Y			Hu	R	F	O	Sharp pain	Concoction	(See *Microglossa pyrifolia*)
168	†*Kalancoe schimperiana* A. Rich.	Crassulaceae	D,G, Gm	Gabal henchura	H	Hu	L	F	D	Edema	Fomentation	Leaf cooked on fire wrapped in leaf of *Croton macrostachyus or Ensete verntricosum*, hot leaf then held on location repeatedly
			G			Hu	L	F	D	Boil eruption	Compress	Leaf wrapped in its own leaf & cooked on fire hot material held on while hot
			G,Gm			Hu	L	F	Au	Ear infection	Infusion	Leaf cooked on fire & extract squeezed, 3-4 drops dripped into ear
			D,Gm			Lv	L	F	D	Mastitis/cattle	Poultice	Along with shoot of *Drymaria cordata* wrapped & boiled on fire & location touched with the remedy once a day for a week
169	*Koztelezkya adoensis* (Hochest. ex. A. Rich.) Mast.	Malvaceae	A,D, G	Ulborara(H)	H	Lv	Wp	fresh	O	Constipation	Maceration	A bunch of shoot pounded homogenized with 1 bottle of water,filtrate is exposed in sun for 2 hours, drunk
170	*Lactuca inermis* Forssk.	Asteraceae	Y	Osote/Gendela	H	Hu	R	F	O	Skin disease	Maceration	Crushed& wet concentrate solution painted on location with butter for 3 days
			D			Hu	R	F	O	Abdominal pain	Juice	Small piece of root is chewed & juice swallowed

171	*Lagenaria abyssinica* (Hook.f.) C. Jeffrey	Cucurbitaceae	Y	Gengana(Y)Udumbusha/umbusha(H)	CH	Hu	R	F	O	Fertility	Maceration	Crushed, homogenised in water&1 cup drunk once a week for 4 weeks
			Y			Hu	Sh	F	NBp	Evil spirit	Put nearby	During circumcision of boys hanged on the gate to evade evil spirit
			D		CH	Hu	F,R	F	O	Gonorrhoea	Maceratition	Root & fruit crushed & dissolved in water, extract 1 cup drunk once a week for a month
172	*Lagenaria siceraria* (Molina) Standl.	Cucurbitaceae	A,Y	Bocha(Y),Qoma(H)	CH	Hu	F,L	F	O	Malaria	Maceration	Crushed& dissolved in water & solution filtered by enset fibre /gauze 1/2-1 cup drunk once an week for 3 weeks
			Y			Hu	L	F	D	Dendruff	Paint	Along leaf of *Hordeum vulgare* & thick extract painted on surface
			Gm			Lv	L	F	D	Wound	paint	Along with that of *Nicotiana tabacum*. crushed, paste squeezed & applied for disinfecting
173	†*Laggera tomentosa* ((Sch. Bip. ex A. Rich) Oliv. & Hiern.	Asteraceae	G,Gm,Y	Gufufa(Y),Bobe?e(H)	H	Hu	Sh	F	Oc,	Conjunctivitis	Paint	Used to clean eyes, the aroma & tenderness of young leaves is sought as a medicine
			Y			Hu	L	F	N	Mich	Paint	Ccrushed & inhlaled, also clean face ear, eyes with young shoot tip
			A			Hu	L	F	D	Mich	Sinus snuff	Smashed & sniffed & facial area is rubbed with it
174	*Landolphia buchananii* (Hall.f.) Stapf.	Apocynaceae	Gm	Homba(H)	C	Lv	L	F	O	Induce mating /cattle	Concoction	Crushed , mixed with salty mineral /'bora'/ & 1 litre drunk twice a week in a month
175	*Lantana trifolia* L.	Verbenaceae	Y	Boreboma(Y)	S	Hu	L	F	O	Amoebiasis	Digestion	Along leaf of *Cyphotemma adencaule*, of *Hagenia abyssinica*, of *Brucea antidysentrica*, of *Clutia abyssinica*, of *Cucurbita abyssinica*, of *Embelia schimperi*, of *Myrsine africana*., of *Artemesia abyssinica*, of *Engleriana woodfordioides* & *Leucas martinecensis* crushed concoction 1 cup for 2-3 days,
176	*Lannea fruticosa* (A. Rich.) Engl.		Y	Andereku(O),Dechemereche(H)	T	Lv	R	F	O	Abdominal pain	Paint	Pulverised & water solution 1 can drunk, thick extract is also painted on the wound
			Gm			Lv	R	F	D	Wound	Paint	Crushed, paste mixed with butter & applied on location
177	*Lens culinaris Medik.*Medikus	Fabaceae	Y	Fi?a(Y)	H	Hu	S	D	O	Weight loss	Digestion	Cooked along with *Triticum aestivum*, & adding *Citrus limon* .& eaten
178	*Leonotis ocymifolia* (Burm. f.) Iwarsson	Lamiaceae	Y	Mika(Y),Hororamo(H)	S	Hu	L	F		Mich	Decoction	Along with leaf of *Eucalyptus globulus* \& *Oilinia rocheiana*,1 cup is drunk; also steam inhaled
			Y			Hu	L	F		Eye pain	Infusion	Wash with infusion, inhale steam
						Hu	L	F	O, N	Febrile illness /Mich/	Concoction	Leaf along with leaf *Ocimum lamiifolium* infusion, 1 cup drunk in morning & evening; also steam inhaled
179	*Lepidium sativa* L.	Brassicaceae	A,G,Gm,Y	Shima(Y), Shinfa(O)(H)	H	Hu	C	D	S	Mich and severe headache	Fumigation	smoke inhaled , or seeds added into coffee & drunk

			Y			Hu	S	D	O	Boil	Poultice	Chewed & concentrate solution bandaged on location to induce pus & bursting & healing
180	.*Leucas calostachys* Oliv.	Lamiaceae	Y	Debase(Y)Qibetora/(H)	S	Hu	L	F	O	Tooth ache	Juice	Chewed & held in mouth on ailing location
			Y			Hu	L	F	O	Amoebiasis	Infusion	Infusion1 cup drunk in mornings before meal for 3-5 days; leaf extract of cold water 1 cup drunk 3 times a week
			Y			Hu	L	F	O	Bad odour flatulence	Juice	Along with that of *Ruta chalepensis* chewed & swallowed
			A			Hu	R	fresh	O	Dyspepsia/ 'Qureta'	Decoction	Root crushed, decocted & extract 1 cup drunk
			G			Hu	S	F	O	Ascariasis	Maceration	Leaf collection crushed and homogenised in water, extract 1 cup is drunk
			Gm			Hu	L	F	O	Sudden disease /	Concoction	Leaf mixed with *Coriandrum sativum*, & *Ruta chalepensis* all in one crush & concoction 1 kubaya drunk morning & evening
			Gm			Lv	L	F	O	Sudden disease	Concoction	Along with fruit of *Coriandrum sativum L.*, and leaf/fruit of Ruta chalepensis L. all in one crushed and water extract 1 bottle is drunk
181	*Leucas martinicensis* .(Jacq.) R. Br.	Lamiaceae	Y	Meri (Y), Gali(O)Qibetora/tombora(H)	H	Hu	L, R	F	O	Sudden disease	Juice	Chewed & swallowed
			Y			Hu	L	F	O	Tonsillitis	Juice	Chewed & juice spat into mouth; and adults hold the juice
			A		S	Hu	L	F	O	Evil spirit	Maceration	Leaf crushed, dissolved in water & extract 1 cup drunk
182	*Linum usitatissimum* L.	Linaceae	A,D, G,Y	Mororo(Y),Telba(H)	H	Hu	S	D	O	Gastritis	Decoction	Steeped into boiling water & 1 glass viscous soup drunk during distress
			A,G			Hu	S	dry	O	Amoebiasis	Decoction	Roasted seeds steeped into boiling water, & soup 1 glass drunk 3-4 times a week
			G, Gm			Hu	S	D	O	Diarrhoea	Decoction	Roasted seeds ground, the flour steeped into boiling water, enough salt added, a glass of it taken twice a day
183	*Lippia adoensis* Hochst. ex.Walp. var. *adoensis*	Verbenaceae	G,Gm,Y	Shasha(Y)	S	Hu	L	F	O	Bad odour flatulence	Juice	Chewed & swallowed
	Lippia adoensis Hochst. ex.Walp. var. *koseret* Sebsebe	Verbenaceae	G	Kosereta(H)	S	Hu	R	F	O	Typhoid fever	Decoction	Decoction along with root of *Ocimum lamiifolium*, buttered & 1 'kubaya' is drunk once a week for a month
			Gm			Hu	R	F	O	Cough	Decoction	Root concoction along with Ocimum lamifolium,root decoction buttered & 1 'kubaya ' is drunk
184	*Lobelia giberroa* Hemsl.	Lobeliaceae	Y	Umiri(Y),Boyondena (H)	S	Hu	L	F	O	Anthrax	Digestion	Along leaf of *Clerodendrum myricoides*, of *Hagenia abyssinica*, of *Embelia schimperi*, of *Clematis longicauda*, of *Buddleja polystachya* , of *Olinia rochetiana* , of *Inula confertiflora* , of *Croton macrostachyus* &of

												Premna schimperi crushed, passsesd on heat, ½ a cup drunk
			Y			Lv	L	F	O	Anthrax	Concoction	Added into leaf of *Premna schimperi* & root of *Clerodendrum myricoides* crushed together water solution 1 bottle is drunk twice a day for 3 days
			Y			Lv	L	F	O	Anthrax	Digestion	Along leaf of *Clerodendrum myricoides*, of *Hagenia abyssinica*, of *Embelia schimperi*, of *Clematis longicauda*., of *Buddleja polystachya*, of *Olinia rochetiana*., of *Inula confertiflora*., of *Croton macrostachyus*.& of *Premna schimperi* crushed, passsesd on heat, ½ a cup drunk
			Y			Lv	L	F	O	Trypanosomiasis a	Maceratitio n	Leaf crushed, dissolved in water & extract 1 bottle is drunk for 3-5 days
			Y			Lv	L	F	O	Enset root bloat	Maceratitio n	A glass of water extract of leaf is drunk
			Y			Lv	L	F	O	Cough	Digestion	Boiled along with leaf of *Premna schimperi Engl.* & of *Periploca linearifolium* fresh solution is 1 gubaya drunk one a day until improves
			Y			Lv	L	F	O	Kontez	Concoction	Crushed long with Inula confertiflora A.Rich., Justicia schimperiana (Hochst. ex Nees) T.Anders., water of Gaye/pipa 1 bottle drunk 3-5 days
185	*Lysimachia ruhmeriana* Vatke	Primulaceae	A,D	Chelego/Uli sereta(H)	H	Hu	F	F	Ep	Tinea versicolor	Paint	Surface is scratched with *Lippia adoensis* then fruit crushed & mixed with little water and applied on location
			D			Hu	R, F	F	O	Prevent abortion	Maceratitio n	Root & fruit crushed, decocted & 1 glass drunk per week for a month for retention of conception
			D			Hu	R, F	F	Va	Retention of conception	Maceratitio n	Root & fruit smashed & 1 cup drunk for 5 mornings;
			A,D, Gm			Lv	F	F	N	Animal choking	Sinus snuff	Root is chewed and the juice is blown via nose of the animal
186	*Maesa lanceolata Forssk.* Forssk.	Myrsinaceae	D,G, Y	Tegewa(Y),Kowada(H)	T/S	Hu	F	F	O	Abdominal worms	Maceration	Roasted, pounded & concentrate solution drunk in coffee; or fresh fruits crushed finely, dissolved in water & the solution 1 'gubaya' drunk once
						Hu	L	F	O	Delayed placenta	Concoction	Leaf chewed along with leaf of *Podocarpus falcatus* & juice swallowed
			Y			Lv	F	F	O	Abdominal parasites.	Concoction	Smashed along with 3-5 bulbs of *Allium sativum* dissolved in water & 1 can is drunk
			Y			Lv	F	F	O	Cattle cough	Concoction	Along with leaf of *Vernonia myriantha* pounded & dissolved in water & 1 can is drunk for 2-3 days
			Y			Lv	F, L	F	O	water retention & cough	Maceration	Crushed, dissolved in water & 1 'gubaya' is drunk for 2 days

			A			Hu	L	F	O	Expulsion of placenta	Concoction	Leaf chewed along that of *Podocarpus falcatus* & juice swallowed
			A,G			Hu	F	F	O	Vermifuge	Tea	Dry fruit pounded and tea 1 glass is drunk
			A			Lv	F	F	O	Abdominal worms	Maceration	Fruit crushed, mixed with water and 1 glass given orally for 3 days a week
187	*Malva parviflora* Höjer	Malvaceae	Y	Nosma(Y)	S	Hu	L	F	O	Evil eye	Maceration	Crushed, water homogenate extracted &1 glass drunk
			Y			Hu	Sh, L	F	O	Constipation	Infusion	Crushed, infusion 1 tin can drunk for 3 - 4 mornings; also extract added into enset porridge & eaten
			Y			Hu	Sh, L	F	D	Fresh wound	Paint	Crushed & applied on fresh wound
			Y			Hu	Sh	F	O	Mich	Concoction	Crushed along with leaf of *Rhamnus prinoides*, boiled 1 gubaya is drunk
			Y		S	Lv	WP	F	O	Delayed placenta	Maceration	Crushed, homogenised in water, filtrate 1 litre is drunk
188	*Manilkara butugi* Chiov.	Sapotaceae	Gm	Lega(H)	T	Hu	Bs	F	O	Pneumonia	Decoction	A cup of bark decoction is drunk for 3 days
			Gm			Hu	Bs	F	O	Burning of prostate	Decoction	A cup of bark decoction drunk 3-5 days
			Gm			Hu	Bs	F	O	Constipation	Decoction	A cup of bark decoction drunk
			Gm			Lv	Bs	F	O	Foot-mouth disease	Concoction	Along with stem & leaf of *Clematis longicauda* & leaf of *Croton macrostachyus* pulverized & concoction 1 bottle is drunk for 3 days
189	†*Maytenus addat* (Loes.) Sebsebe	Celastraceae	Y	Ma?era(Y)	T/S	Lv	L	F	O	Anthrax	Concoction	Along with leaf of *Myrsine africana* & of *Juniperus procera* pounded & concoction 1 bottle is drunk for 5 days
190	*Maytenus gracilipes* (Welw. ex Oliv.) Exell.	Celastraceae	Y	Tuluma(Y)	S	Lv	L	F	O	Conjunctivitis	Maceration	Finely pounded, homogenised with little water & thick extract dripped into eyes until improves
191	*Melia azedarach* L.	Meliaceae	Y	Nimi(O),Nima(H)	T/S	Hu	L	F	NBP	Repellent	Fumigation	Smoked to evade mosquitoes & flies
			A		S	Hu	L	fresh	O	Malaria	Infusion	Fresh leaf infused & 1 glass drunk for 3 days
192	*Microglossa pyrifolia* (Lam.) Kuntze	Asteraceae	Y	EtniSuqeru(Y),Se?a(H)	S	Hu	L	F	O	Sharp pain	Concoction	Along with root of *Kalanchoe petitiana* & leaf of *Panicum maximum* (Wajo) crushed concoction 1 cup drunk
			Y			Hu	St, R	F	O	Dyspepsia	Maceration	Stem bark and leaf crush, dissolved in water 1 cup drunk
			A,G, Gm			Lv	St, L	F	G	Cattledisobeymilking	Juice	Chewed & juice blown via genitalia
			G			Lv	St, L	F	O	Blackleg	Concoction	It is added to other black leg remedy species mentioned under *Croton macrostachyus*
193	†*Mikaniopsis clematoides* (Sch. Bip. ex A. Rich.) Milne-	Asteraceae	D	Bukuke?e(H)	CH	Hu	R	F	O	Dyspepsia	Juice	Chewed along salt & juice swallowed

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194	*Millettia ferrugnea* (Hochst.) Bak.	Fabaceae	D	Hengeda(H)	T	Hu	Bs	F	O	Pneumonia	Maceration	Bark crushed & dissolved in water, adults drink 1 glass of extract for five days; Children 1 cup for 3 days
			D			Lv	Bs	F	O	Choking	Maceration	Stem bark crushed and water extract 1 bottle is drunk during the symptoms
195	*Momordica foetida* Schumach	Cucurbitaceae	Y	Wojimiya(Y),Hemesesa(H)	CH	Hu	R	F	O, N	Swelling feet	Concoction	Along with root of *Stephania abyssinica.*& eaf of *Discopodium peninervium* crushed & concoction 1 'gubaya' drunk for 3 days a week; steam also inhaled
			Y			Lv	R	F	O	Babesiosis/ redwater	Concoction	Crushed along leaf of Nekeshilo (Glycine sp.?), solution 1 bottle is drunk twice a week for a month
			D,G, Gm			Hu	L, R	F	O	Sudden illness	Maceration	A piece of root & few leaves crushed, dissolved in water, then extract 1 cup drunk
			Y			Lv	R	F	O	Pastereullosis	Maceration	Pulverised, homogenised in water, 1 kubaya is given twice a week
			D			Lv	R	F	O	Edema	Maceratitio n	Root crushed & water extract 1 'kubaya' is drunk for 5 days
			G,G m			Lv	R, L	F	O	Sudden disease	Maceration	Tuber is crushed, homogenised in water and extract 1 bottle is drunk
			D,G			Lv	R, L	F	O	Bloat /cattle	Maceration	Root & leaf crushed, dissolved in water & extract 1 bottle is drunk
196	*Moringa* sp.	Moringaceae	A	Shifera(H)	T	Hu	L	F	O	Blood pressure	Juice	Infusion 1 cup is drunk morning & evening
197	*Myrsine africana* L.	Myrsinaceae	Y	Futuwaya(Y)	S	Hu	L, F	F	O	Anthrax	Concoction	Along with leaf of *Clematis longicauda*, leaf of *Hypericum revolutum* & root of *Solanum anguivi* concocted, 1 'gubaya' drunk for 3 days
			G			Hu	L	F	O	Abdominal upset	Maceration	Handful of leaves along with leaf of *Teclea nobilis* crushed, dissolved in water and extract ½-1 glass drunk
			G,G m			Hu	F	F	O	Abdominal worms	Maceration	Handful of fruits crushed, dissolved in water, 1 cup for children, 1 glass for adults
198	*Musa x paradisiaca* L.	Musaceae	G	Muzqelim(H)	H	Hu	Lx	F	D	Fresh wound	Paint	Fruit stalk wounded and the latex taken and applied on wound
			G			Lv	Lx	F	D	Fresh & chronic sore	Paint	Flower stalk latex amply dripped & plastered
			Y			Hu	L, F	F	O	Leg worming	Concoction	Along with leaf of *Clematis longicauda* & *Hypericum quartinianum* concocted 1 cup drunk for 3 days
199	*Nicotiana rustica* L.	Solanaceae	A	Tembaea /kote(H)	H	Lv	L	F	O	Grain bloat	Concoction	Leaf crushed along with fruits of *Coriandrum sativum*, water extract 1 bottle & 1 cup of cooking oil drunk
			G			Hu	L	F	O	TB	Bulk	Leaf bread with highly matured butter chewed & swallowed; and/or 'pipa' water whey mixed half & a glass is drunk for repeated doses

			G			Lv	L	F	O	Lump skin disease of cattle,	Maceration, paint	Few fresh leaves or leaf bread is pulverised, water homogenate 1 bottle drunk & s also panted over the sore body of the animal
			G			Lv	L	F	D	Epizootic lymphangitis	Maceration	Few fresh leaves or leaf bread is pulverised, water homogenate in painted over
200	*Nicotiana tabacum* L.	Solanaceae	Gm, Y	Tumako(Y),Temba?a/kosho(H)		Lv	L	F/D		Flu	Maceration	Solution squeezed & drunk via nose
			A,G			Hu	R, L	F	O	Sudden disease	Maceration	Along with *Phaseolus lunatus* root crushed & 1 glass is drunk
			A			Hu	L	F	Fm	Blood pressure	Inhalation	Dry leaf smoked as cigarette
			A,G, Gm			Hu	L	F	N	Common cold	Concoction	Dry leaf soaked in water, 1 clove of garlic added solution squeezed between palms & sucked via nose
			D			Hu	L	D	D	Evil eye	Concoction	Leaf along with leaf of *Croton macrostachyus* & *Vernonia myriantha* crushed & homogenised in water & wash the body of the patient with the solution
			A,G			Lv	L	F/D	O, N	Lumpy skin disease	Concoction	Dry or fresh leaf crushed along with *Croton macrostachyus* & water filtrate 1 bottle is drunk morning & evening for 3-4 days
			A			Lv	L	F	O	African horse disease	Concoction	Leaf along with leaf of *Croton macrosyachus*, bulbs of *Allium sativum* crushed, salted & concentrate extract 1 litre drunk morning & evening for 3-5 days
			A,D, G			Lv	L	F	O, N	Leech	Sinus snuff	Dry leaf soaked in water, salted & the solution is drunk via nose & mouth
			G,Gm			Lv	L	F	D	Epizootic lymphangitis	Maceration	Leaf along with leaf of *Olinia rochetiana* & stem *Microglossa pyrifolia* pulverized, homogenized with little water, potion is spread on legs to kill germs & evade vector flies
			D,G			Lv	L	D	N	Pastereullosis	Sinus snuff	Along with crushed bulbs of Allium sativum L. & *Zingiber officinale* soaked with little water, sent via nose twice a day
201	*Nigella sativa* L.	Ranunculaceae	A	Abesota(Y),Hemach Enja(H)	H	Hu	S	dry	O	Migraine / 'dan/sembecha'	Sinus snuff	Seeds pounded & boiled, few drops taken through nose
			A,G, Gm, Y			Hu	S	D	O	Abdominal pain	Juice	Chewed along with *Coriandrum sativum*, *Zingiber officinale*, or with few salt & swallowed
202	*Nuxia congesta* R.Br. ex Frsen.	Loganiaceae	Gm	Bitena(H)	S	Lv	L	F	D	Orf /goats	Paint, concoction	Pulverized & shoot of *Commelinia imberbis*, *Drymaria cordata* wrapped in enset leaf & cooked on fire, then paste applied on mouth & ear cracks & lesions
203	*Ocimum lamiifolium* Hochst. ex Benth.	Lamiaceae	G,Y	Demekasi(Y),Minantofa(H)	S	Hu	L, R	F	O	Sudden febrile pain	Decoction	Decoction 1 'gubaya' drunk for 2 mornings
			Y			Hu	L	F	O	foul flatulence	Juice	Leaf chewed & swallowed

			A			Hu	L, R	F	O, N	Malaria	Decoction	Leaf & root collections decocted, 1 glass drunk 1 cup drunk
			A,D, G,G m			Hu	L	F	N	Common cold	Juice	Few young leaves smashed between palms, filtrate squeezed on palm & taken through nose
			A			Hu	L	F	N	Flu	Infusion	Hot leaf infusion inhaled morning & evening
			A			Hu	L	F	N	Headache	Inhalation	Few fresh leaves smashed & inserted into nose & inhaled
			A			Hu	L	F	O	Amoebiasis	Infusion	Leaf infusion 1 ass drunk for 2- 3 mornings
			A,D, Gm			Hu	L	F	N	'Mich'	Inhalation	Enough leaves boiled & steam inhaled
			A,G			Hu	R, L	F	O	Arthritis	Decoction	Root & leaf decoction 1 glass is drunk for 5 days
			A,D			Hu	L	F	O	Tonsilitis	Juice	Chewed & held juice held b/n mouth & pharynx then swalloed
			Gm			Lv	R, L	F	O	Helminthiasis	Decoction	Decoction 1 'kubaya' is drunk for two mornings
204	*Ocimum urcilifolium* Roth	Lamiaceae	Y	Anchebi(O),Lebefanfo /La'l gimenja/(H)	S	Hu	L	F	O	bloat, mich	Concoction	Crushed along with *Ocimum lamiifolium Hochst. ex Benth. Hochst. ex Benth. &Dicliptera laxata C.B. Clarke*„solution 1 cup drunk
205	*Ocotea kenyensis* (Chiov.) Robyns & Wilczek	Lauraceae		Shewa(H)	T	Hu	Bs	F	O	Whooping cough	Decoction	Bark decoction along honey comb of wasp mixed together, extract squeezed 1 cup drunk for 3 days
						Lv	Bs	F	O	Cough /sheep, goat	Decoction	Decoction 1 bottle is drunk
			A			Hu	L	F	N, O	'Mich'	Infusion	Leaf infusion 1 cup is drunk
206	*Olea europaea* L. subsp. *Cusidata* (Wall ex G. Don) Cif.	Oleaceae	Y	Buna(Y) Ejersa(O),Wera(H)	T	Hu	W	F	L, W	Gonorrhoea	Decoction	Wood oil drunk
			G,Y			Hu	Bs, L	F	D	Toothache	Juice	Chewed & juice held on ailing tooth
			Y			Hu	W-Oil	F	An	Hemmoroids	Liniment	Applied on location as antiinflamation & stop bleeding
			A		T	Hu	L, F	F	NBp	Avoidance of disease	Fumigation	Fumigation leaf fumigated in house
			A			Hu	S	F	D	Hemorrhoid	Paint	Handful of seeds roasted, pounded & oil is ointed on location
			A			Hu	St	F	Dn	Toothpain	Juice	Fresh twig chewed & juice held inside mouth
207	*Olea capensis* L. subsp. *macrocarpa* (C.A. Wright) Verdc.	Oleaceae	G,Gm	Onema(H),Jega(Y)	T	Hu	Bs	F	O	Dyspepsia	Maceration	Stem bark is crushed, dissolved in water and extract 1 glass drunk
			G			Hu	Bs, Wd	F	Fm	Sharp back &joint pain	Fumigation	Wood burnt & aroma and heat helps for treating
			Y		T	Hu	L	F	O	Amoebiasis	Decoction	Crushed & decocted along with others 1 cup

												is drunk
208	*Olea welwitschii* (Knobl.) Gilg. & Schellenb.		G	Sigeda(H)		Hu	S	F	O	Diarrhoea	Macdration	Seeds pounded & water mixture 1 cup drunk
			G			Hu	W	F	Ar	Sharp back & joint pain	Inhalation	Wood burnt, aroma and heat is said to relieve the distress
			G			Lv	Bs, S	F	O, N	Choking	Maceration	Bark is crushed, mixed with water and a cup of extract drunk via nose & mouth
209	*Olinia rochetiana* A. Juss.	Oliniaceae	Y	Fegegu(Y),Guna(H)	T	Hu	L	F	O, D	Mich	Infusion	Mixed with *Eucalyptus globulus* leaf infusion ½ cup taken, steam inhaled
			Y			Hu	L	F	D, O	Early child teet	Fomentation	Along leaf of *Premna schimperi* & *Allium sativum*. smashed & hot concoction touched with
			A,G, Gm			Hu	Sh	F	O	Toothache	Juice	Young shoot chewed & held along the ailing tooth & juice held for minutes inside mouth as mouth wash , then spat
			A			Hu	Bs	F	O	Bad breath	Juice	Bark chewed & juice held, brush with twig
			A,D, G			Hu	Sh	F	Dn	Gingivitis	Juice	Young fresh branches chewed at one end, juice held as mouth wash
			D			Hu	Bs	F	O, D	Chronic scabies /Wichiba/	Maceratition	Stem bark is pulverised, mixed butter & ointed on location
			A			Lv	L	F	O	Anthrax	Concoction	Along with leaf of *Periploca linearifolium*, *Maytenus addat*, *Flacourtia indica* ground together, homogenised in water & residue water of Pipa/'Gaye' added, & 1 'gubaya' is drunk for 4 days
			A			Lv	L	F	O	Pasture bloat	Maceration	*Plant part detoxifying alkaloid of *Medicago trancatula* crushed & 1 litre drunk
			A			Lv	L	F	O	Abdominal parasites & diarrhea	Maceration	Leaf crushed, homogenized in water & 1 bottle drunk
			Gm			Lv	L	F	O	Lumpy skin disease / cattle	Maceration	Along with that of *Nicotiana tabacum* crushed together, homogenized in water & 1 litre is drunk
210	*Orobanche minor* Smit	Orobanchaceae	Y	HerkoY)	H	Hu	R	F	O, D	Tonsillitis	Decoction	Decoction 1 cup drunk; for those can't control urine in bed during night, root decoction 1 cup drunk
			Y			Hu	Wp	F	D	Foot cracking	Paint	Crushed & mixed with chicken faeces and apply wet paste
211	*Oreosyce africana* Hook.f.	Cucurbitaceae	Y	Ke?un Aju/ Sikilu (Y)	CH	Lv	R, L	F	O	Sudden disease	Decoction	Crushed, decocted & 1 tin drunk
212	*Osyris quadripartita* Decn.	Santalaceae	Y	Mekekuma(Y),Karo?o(H)	T/S	Hu	L	F	O	Abdominal pain	Maceration	Crushed, dissolved in water, 1 cup of extract drunk once
			Y			Lv	L	F	O	Pastereullosis	Concoction	Along with leaf of *Olinia rochetiana*.crushed & 1 'gubaya' homogenate is drunk until improves
			Gm			Lv	L	F	O	Abdominal pain	Maceration	Along with leaf of *Olinia rochetiana* crushed, dissolved in water and 1 'kubaya' is

213	*Oxalis radicosa* A. Rich.	Oxalidaceae	Y	Silketa(Y), Chele(O)	H	Hu	Wp	F	D	Tinia capitis	Paint	Along with leaf of *Croton macrostachyus* crushed together, concentrate solution mixed with butter smeared on location every 3 days until 10 days
			G,Y			Hu	Wp	F	D	Thorn puncture infection	Poultice	Crushed & tied on wound punctured with sharp tools & thorn
			Y			Hu	Wp	F	D	Chronic soreleg	Paint	Crushed & painted
			Y			Hu	L, Wp	F	NBp	Snake repellent	Put nearby	Mulching leaves on floor
			Y			Hu	Wp	F	O	Rabies	Maceration	Crushed & concentrate solution 1 glass drunk
214	*Oxyanthus speciosus* DC.	Rubiaceae	Y	Wetekibo(Y)	S	Lv	L	F	O	Anthrax	Concoction	Ingredient among others (see *Hypericum quartinianum*) drunk for 5 days
215	*Panicum maximum* Jacq.	Poaceae	Y	Wajo(Y)	H	Hu	L	F	O	Sharp pain	Concoction	(see *Microglossa pyrifolia*)
216	*Parthenium hysterophorus* L.	Asteraceae	Y	Abufast(O)	H	Hu	L	F	O	Mich	Maceration	Pulverised, dissolved in water & 1 cup drunk once
217	*Pavetta abyssinica* Fresen.	Rubiaceae	Y	Wotekibo(Y), Mukebunti(O)	T/S	Hu	L	F	O	Toothache	Maceration	Fresh chewed & juice held on location
			Y	Wotekibo(Y) ,Mukebunti(O)		Lv	L	F	O	Diarrhoea	Maceration	Crushed, homogenised in water & solution 1 can is drunk
218	*Pavonia urens* Cav.	Malvaceae	Y	Nosa(Y), Derbeta(O),Borara(H)	S	Hu	L	F	O	Delivery pain	Digestion	Added into *Lens culinaris*, *Hordeum valgare* &*Triticum aestivum* flour making porridge/soup & eaten
			A			Hu	L	fresh	O	Children abdominal pain	Maceration	Few leaves crushed, diluted & filtrate ½ cup is drunk
219	*Pennisetum clandestinum* Chiov.	Poaceae	Y	Seda(H),Geda(Y)	H	Hu	Sh	F	O	Snake bite	Concoction	Crushed, homogenised in water & 1 glass drunk
			G			Hu	Wp	F	NBp	Ritual of prayer	Cultural	Fresh shoot dipped into bowl of water or butter, prayed by spraying symbol of good hope by senior members
			Y			Hu	Sh	F	O	Children diarrhoea	Concoction	Along with root of *Cyperus rotundus* crushed, dissolved in water & extract 1 cup drunk
220	*Pennisetum sphacelatum* Th. Dur. & Schinz	Poaceae	Y	Fesha(Y),Migra(O)	H	Hu	W	F	Sh	Impotence	Maceration	Pounded, dissolved in little water, thick extract 1 glass drunk in mornings for two weeks
			D			Lv	St, L	F	O	Cattle diarrhoea	Maceratition	Stem & leaf crushed, water extract 1 litre drunk twice a day, also this grass is fed to improve it
221	*Pentas lanceolata* (Forssk.) Deflers	Rubiaceae	Y	Wetekibo(Y),Wobeta (H)	S	Hu	R	F	Au	Ear pain	Decoction	Crushed, decocted & few drops into ear
			A			Hu	L	F	O	Abdominal pain	Maceration	Leaf crushed dissolved in water and extract 1 glass is drunk
			A			Lv	L	F	O	Abdominal pain	Maceration	Leaf crushed & dissolved in water and 1 litre drunk

			G,Gm			Hu	L, F	F	D	Postpartum herbal bath	Digestion	Shoot along shoots of *Croton mcrostachyus*, *Satureja paradoxa*, *Ocimum lamifolium*, *Premna schimperi* cooked together for herbal bathing ritual of postpartum mothers which is held on 3rd day of delivery
222	*Periploca linearifolia* Quart.-Dill. & A. Rich.	Asclepiadaceae	Y	Tubu(Y)	C	Hu	L, R	F	NBp	Evade evil spirit (birth of twins)	Put nearby	Left near the newborn; when their father dies shoot hanged on spear till drip of rain
			Y			Lv	L	F	O	Evil eye	Juice	Crushed, dissolved in water & 1 can is drunk; also leaf chewed & juice spat on tits, mouth & front part to submit milking
			Y			Lv	L, R	F	O	hovering of eagle/'risbala'	Maceration	Crushed, dissolved in water & solution is drunk
			G			Hu	Lx	F	D	Tinea versicolor	Paint	Latex applied on location by scratching the surface
223	*Persicaria setosula* (A. Rich.) K.L. Wilson	Polygoniaceae	Y	DumniShe? luwa(Y)	H	Lv	R, L	F	O	Rabies	Maceration	Crushed, homogenised in water, & 1 litre solution is drunk twice a week
224	*Persea Americana* Mill.	Lauraceae	Gm	Abokato(H)	T	Hu	F	F	O	Gastritis	bulk	Fresh fruit eaten during distress
			Gm			Hu	F	F	D	Dendruff	Paint	Fruit peeled smashed & smeared on head
225	*Phaseolus lunatus* L.	Fabaceae	G,Gm	Otongola(H)	CH	Hu	R	F	O	Sudden disease	Juice	Root chewed & the juice swallowed
226	*Phoenix reclinata* Jacq.	Arecaceae	Y	Deya(Y)	T	Lv	F	F	O	Eastcoast fever	Maceration	Pulverised & 1 glass of water homogenate drunk for 2-3 days
227	*Phragmanthera macrosolen (*A. Rich.) M. Gilbert	Loranthaceae	Y	ErtuLaftoO)	S	Hu	L	F	O	Breast pain delivery	Infusion	Crushed & drunk in soup or eaten in porridge
			Y			Hu	L	F	O	Asthma	Infusion	Infusion 1 glass drunk until improves
			Y		S	Lv	L	F	O	Release milk	Digestion	Crushed along with shoot tip of *Cordia africana* concoction salted, 1 bottle is drunk a day for a week
228	*Physalis peruviana*.L.	Solanaceae	A,d, G,Gm	Onjoro?o	H	Hu	R	F	O	Sudden pain	Maceration	Few root pieces chewed along with salt & swallowed; or crushed, dissolved in water & 1 glass drunk
	Phytolacca dodecandra L. 'Hérit	Phytolaccaceae	Y	Foro-Andode(Y),Hanja(H)	S	Hu	R	F	O	Chronic amoaebiasis	Decoction	Root decoction 1 cup is drunk
			Y			Hu	L	F	D	Chronic scabies	Paint	Along with leaf of *Cordia africana*, young sheath of *Arundinaria alpina* pulverised, concentrate solution mixed with butter and battery ash smeared over
			Gm, Y			Hu	L, R	F	O	Gonorrhoea	Decoction	Root crushed, decocted &1 cup drunk every 3rd day for a week /chronic/; for benign one leaf infusion 1 cup is drunk 3-4 days
			Y			Hu	L	F	Oc	Eye disease	Juice	Crushed, juice dripped
			Y			Hu	R, L	F	O	Helminthiasis	Maceration	Small pieces crushed, dissolved in water & extract 1 cup is drunk; outsiders not allowed to enter, if diarrhoea becomes severe,

												outsiders allowed to enter which is believed to stop
			Y			Hu	R, L	F	O	Unwanted pregnancy	Decoction	Decoction & 1 cup is drunk
			Y			Lv	L	F	D	Leeches	Wet paste	Crushed & small amount of wet paste sent into animals mouth; also applied into water body
			A			Hu		F	R	Rabies	Maceration	Root crushed, 1 cup water extract added into traditional beverage called 'qaribo' & drunk
			Gm			Lv	R	F	O	Fasiolosis	Maceration	Crushed, dissolved in water & 1 'kubaya' drunk once for 3-4 days
229	*Pisum sativum*. L.	Fabaceae	A,G	Gite?e(H)	H	Hu	S	fresh		Fracture	Decoction	Roasted seed flour cooked, buttered well & eaten with fresh milk for 15-30 day once a day
230	*Pittosporium viridiflorum S*ims	Pittosporiaceae	Y	Tosh(Y),Qeshe?a(H)	T/S	Hu	Bs	F	O	Dyspepsia	Digestion	Stem bark is boiled along with kocho/enset juice &1 'gubaya' drunk
			A			Hu	Sh	F	N	Migraine /'dan'/	Sinus snuff	Crushed &juice taken via nose
231	*Plantago lanceolata* L.	Plantaginaceae	Y	Buriyo(Y) Gurdo(O)	H	Hu	L	F	D	bleeding wound	Paint	Leaf crushed & wet concentrate solution applied on wound
			Y			Hu	L	F	D	Herpes zoster	Paint	Crushed & juice applied on location
			Y			Hu	L	F	Oc	Eye pain	Juice	Crushed & concentrate juice dripped
			Y			Lv	L	F	O	Leech	Maceration	Crushed & water solution is drunk
232	*Plantago major* L.	Plantaginaceae	D	?? Wish ababo	H	Hu	L, R	F	O	Tonsilitis	Juice	Leaf and root chewed, juice kept in mouth for five minutes, then swallowed
233	†*Plectocephalus varians* (A. Rich.) C.Jefferey ex Cofod.	Asteraceae	Gm	Guf hata(H)	H	Hu	Wp	F	O	Children abdominal problem	Decoction	Decoction of whole plant 1 cup buttered & drunk
234	*Podocarpus falcatus (*Thaub.) R.B. ex Mirb.	Podocarpaceae	Y	Gedewa(Y)	T	Hu	Resin/ Wax	F	O	Nephritis	Concoction	Along with *Helinus mystacinus*/'doqonu' concoction 1 cup drunk for 3-4 days
			Y			Hu	L	F	O	Nephritis	Digestion	Milled along with leaf & fruit of *Lagenaria abyssinica*, leaf of *Clutia bayssinica*, of *Olinia rochetiana*., boiled, 1 cup drunk twice a week for amonth
			Y		T	Lv	L	F	O	Conjunctivitis	Juice	Crushed, homogenised with little water extract squeezed onto eye
			Y			Lv	F	F	O	Eastcoast fever	Decoction	Crushed decoction 1 glass is drunk for 3 days
			Gm			Hu	Sh	F	Dn	Toothache	Juice	Young shoot tip chewed & held on location
			Gm			Hu	L	F	O	Diarrhoea	Infusion	Young leaf infusion 1cup drunk
235	*Premna schimperi* Engl.	Lamiaceae	Y	Wagnara(Y) Urgessa(O),Totenke?e(H)	T	Hu	L	F	N	Migraine	Sinus snuff	Along with root of *Clematis longicauda* decocted, added into melt butter then sucked via nose in small amount

			Y			Hu	L	F	N	Migraine	Maceration	Along with *Ocimum lamiifolium* finely pulverised homogenised with little water & thick filtrate sucked via nose
			A			Lv	L	F	O	Anthrax	Maceration	Added into other MPs of Anthrax/'Kemar' & 1 bottle is drunk
			A			Hu	L	F	O	Common cold	Inhalation	Leaf infusion inhaled steam covering escape of steam
			A			Hu	L		O	Pneumonia	Infusion	Leaf infusion, buttered 1 cup is drunk for 5 days
			A,G			An	L	F	O	Ascariasis & constipation	Infusion	Leaf infusion 1 bottle is drunk
236	*Prunus africana* (Hook.f.) Kalkm		Y	Ona(Y),Arara(H)		Hu	Bs	F	O	Amoebic diarrhoea	Tea	Tea 1 'gubaya' is drunk
			Y			Hu	Bs	F	O	Sterility	Digestion	Crushed along with bark of *Schefflera abyssinica* & boiled, 1 cup drunk once a week for 3 weeks
			G			Hu	Bs	F	O	Gonorrhoea	Maceration	Bark pulverised, soaked & dissolved in enough water overnight 1 glass of extract drunk in empty stomach twice a week
			G			Lv	L	F	D	Castration of oxen	Paint	Leaf crushed and & applied on wounded testicles for healing the wound
237	*Prunus persica* (L.) Batsch	Rosaceae	Y	Kuku(Y)	T/S	Hu	L	F	O	Edema	Maceration, Poultice	Milled along with leaf of *Nicotiana tabacum L.*, of *Lagenaria abyssinica* water solution half a cup drunk; also blister the location&poultice with the wet concentrate solution
			Y			Hu	L	F	D	Tinea versicolor	Paint	Along leaf of *Acacia negrii* & comb of termites smashed together, paint on location
			Y			Hu	sh	F	O	awchifebeu	Maceration	Crushed along with leaf *Lagenaria abyssinica*, Nicotiana tabacum L., water solution 1 cup is drunk
						Lv	L	F	O	water retention -sheep	Concoction	Along leaf & root of *Cyathula cylinderica* pulverised, water extract 1 'gubaya' drunk for 5 days
238	*Pterolobium stellantum* (Forssk.) Brenan	Fabaceae	Y	Gemema (Y)	S	Hu	R	F	O	Influenza	Decoction	Decoction 1 cup is drunk in tea
			Y			Hu	R, L	F	O	Elephantiasis	Decoction	Decoction 1 cup drunk for twice a week for a month
			Y			Hu	R, L	F	O	Hepatitis	Decoction	Decoction 1 cup drunk for twice a week
			Y			Hu	L	F	O	Amoebiasis	Maceration	Leaf crushed & root dissolved in water, extract 1 cup drunk for 2-3 mornings
239	†*Pycnostachys abyssinica* Fresen.	Lamiaceae	Y	Zero(Y),Bobanqa(H)	S	Hu	L	F	D, O	Sudden mich	Infusion	Infusion 1 'gubaya' drunk, body washed with the infusion as well
			Y			Hu	L	F	O	Amoebiasis	Infusion	Leaf infusion 1 'gubaya' is drunk for 2 mornings
			D,G, Gm,			Hu	L	F	Oc	Conjunctivitis	Infusion	Cleaning with young tip, wash eyes with the infusion

			Y									
			Y			Hu	L	F	An	Thyphoid fever & thyphus	Suppository	Young leaves smashed &pushed along anus
			A,G			Hu	L	F	O	Malaria	Infusion	Leaf infusion 1 glass drunk for a day
			A,Gm			Hu	L	F	O	Typhoid fever	Infusion	Leaf infusion 1 glass drunk for 3 days
			A			Hu	L	F	O	Rheumatic pain	Maceration	Some leaves cut & kept overnight at back yard, the decocted, 1 glass is drunk on Wednesdays & Saturday
			A			Hu	Sh	F	O	Children flu	Infusion	Young shoot tips infused 1 cup buttered & drunk
			D,G,Gm			Hu	Sh,L	F	O	Infant diarrhea'	Infusion	Few young shoot tips infusion half a cup some fresh butter added & drunk
			A,D			Lv	L	F	O	Constipation of calves	Infusion	Handful of young leaf infused, 1 bottle is drunk
240	*Pycnotachys eminii* Gürke	Lamiaceae	Y	?Zemu?(Y)/)Mika?(Y)	S	Hu	L	F	D	Demelanised skin	Paint	Concentrate solution painted/streaked over the surface
241	*Rhamnus pyrinoides* L'Hérit	Rhamnaceae	Y	Gesho(Y),Gesho?o(H)	S	Hu	F	F	O	Tonsilitis	Juice	Chewed along with 'amergeda' (Y) grass & juice swallowed
			Y			Hu	L	F	O	Anthrax	Concoction	Ingredient among other anthrax remedies (see Clematis longicauda Steud.ex A.Rich.)
			A,G			Hu	F	fresh	D	Tinea versiscolor /'Bechero'	Concoction	Fruit &leaf of *Lagenaria siceraria* crushed, scratch the surface smeared on
242	*Rhus natalensis* Krauss	Anacardiaceae	Y	Kamo(Y),Qemo?o(H)	S	Hu	L	F	O	Anthrax	Maceration	Concentrate solution of leaf of *Premna schimperi*, *Olinia rochetiana*, *Olea europaea*, *Juniperus procera.*, *Agarista salisifoli*a all in one 1 bottle is drunk for 3 days
			Gm			Hu	R,L	F	O	Abdominal pain & diarrhoea	Decoction	Leaf & root decoction 1 'kubaya' is drunk
243	*Ricinus communis L.* L.	Euphorbiaceae	Y	She?aQobo (red variety)(Y)	S	Hu	L	F	O	Children diarrhoea	Maceration	Crushed, homogenised with little water, extract 1 cup drunk for 2 days
			Y			Hu	L	F	O,D	Evil eye & witchcraft	Maceration	Crushed, water homogenate 1 cup drunk, put fresh leaf around the patient
			G			Hu	R	F	O	sudden disease	Juice	Few root pieces chewed along with salt &juice swallowed
			D			Hu	L	F	O,D	Snake bite	Maceratition	Leaf crushed & a thick water filtrates 1 glass drunk
			D			Hu	F,L	F	O	Foot swelling	Poultice	Fruit & leaf pulverised together, poulticed with a piece of drag on location, leaf & root decoction 1 glass drunk
			Y	She?aQobo (red variety)(Y)	S	Lv	L	F	O	Black leg	Concoction	Crushed along leaf of *Justicia schimperiana* & bulb of *Crinum abyssinicum* water homogenate 1 gubaya is drunk for 3-5 days
244	*Rosmarinus officinalis* L.	Lamiaceae	A,G	Ma?lenja	S	Hu	L	F	O	Blood diarrhoea	Decoction	Root & leaf decoction 1 glass drunk in morning & night until get improvement
245	*Rubia cordifolia* L.	Rubiaceae	G,G	Kokeku/	CH	Hu	R,	F	O	Sudden febrile	Decoction	Decoction 1 glass drunk

			m,Y	Kerchicha(Y),			L			illness		
			Y			Hu	R, L	F	Dn	Toothache	Juice	Chewed & held by the sick teeth
			G,Gm			Hu	Sh, R	F	O	Malaria	Decoction	Shoot & root decoction, buttered & 1 glass drunk 3-5 days
			G,Gm			Hu	L	F	O	Evil eye	Maceration	Leaf crushed, homogenised in water & body parts of the patient washed, & a cup of extract drunk
			Y			Hu	R	F		TB	Digestion	Root along with roots of *Echinops kebericho* & *Orobanche minor* heated mixed with honey of Trigona bees, 1 glass drunk twice a week along with
			Y			Lv	Sh, L	F	O	Blackleg	Concoction	Along with *Clerodendrum myricoides* root & leaf, leaf of 'Oya (Y) (sample not found) tree' crushed and 1 bottle is drunk for 5 days
			Y			Lv	R	F	O	Pastereullosis	Concoction	Crushed along leaf of *Clutia abyssinica*, 1 bottle is given
			Y			Lv	R	F	O	Hate calf	Digestion	Along with leaf of *Drymaria cordata* & *Engleriana woodfordioides* heated together & 1 bottle is drunk 2-3 days a week
246	*Rubus* sp.	Rosaceae	G	Chiegora	S	Hu	R	F	O	Nephritisdemtoke'/	Maceration	Few root pieces crushed, homogenised in water and 1 glass drunk twice a week until get recovery
247	*Rumex abyssinicus* Jacq.	Polygoniaceae	G,Y	Ferfeku(Y),Shisho?o (H)	H	Hu	R	F	O	Hepatitis	Digestion	Along with root of *Acacia negrii* crushed, digested on heat buttered 1 cup is drunk for 5-7 days
			A,D			Hu	R	F	O	Hepatitis	Decoction	Root chopped, decocted & 1 glass drunk once a week, also decoction added into porridge & consumed twice a week for a month
			A			Hu	R	F	O	Recovery from abortion	Decoction	Root decocted & extract cooked along porridge and eaten
			D			Hu	R	F	O, D	Tinea versicolor	Paint	Root tuber cooked & mixed with gasoline & the mixture ointed
			G			Hu	R	F	O, D	Haemorrhoid	Decoction	Root crushed decoction 1 'kubaya' is drunk, & gely filtrate smashed & applied on location
248	*Rumex nepalensis* Spreng.	Polygoniaceae	Y	Go?rewa(Y),Ashbe?e/Goicho/Tohogna/(H)	H	Hu	R	F	Dn	Toothache	Juice	Chewed & held on ailing tooth
			Y			Hu	R	F	O	Children ascariasis	Decoction	Decoction 1 cup drunk
			Gm, Y			Hu	R	F	O	Abdominal pain	Concoction	Along with *Embelia schimperi* fruits, crushed concoction 1 'gunbaya' drunk
			A			Hu	R	F	Oc	Rashes in eye	Maceration	Crushed & concentrate solution squeezed on eye
			A			Hu	R	F	O	Mich	Digestion	Along with leaf *Ocimum lamifolium* & leaf of *Leonotis ocymifolia* heated & 1 'gubaya' drunk

			D			Hu	R	F	D	Insect larvae sting	Poultice	Root crushed & poulticed with bandage on location
			A			Hu	R	F	D	Allergic rashes	Decoction	Decoction & extract eaten in porridge
			A			Hu	R	F	D	feetl Cracking	Paint	Cooked & gelly concentrate solution painted on location
			A			Hu	R	F	O	Diarrhea	Decoction	Crushed, decoction salted & 1 gubaya is drunk
			A			Hu	R	F	O	Tonsilitis	Juice	Chewed, juice held in mouth, swallow slowly
			G			Hu	R	F	O, D	Sudden abdominal pain	Juice	Root piece washed and chewed along with salt & swallowed
			D,G, Gm			Hu	R	F	O	Haemorrhoids	Decoction	Root crushed, decoction ½ a glass drunk twice a week for a month,
			G			Hu	R	F	D	Warts	Paint	Root cooked on fire, then smashed & applied topically
			G			Hu	R	F	O	Hepatitis	Digestion	Root along with stem bark of *Croton macrostachyus Del.*. crushed, boiled & ½ a 'kubaya' drunk once a week for a month
			D			Hu	R	F	O	Abdominal pain	juice	Root washed & chewed with salt, juice swallowed
			D			Hu	R	F	O	Ascariasis	Maceratitio n	Root crushed, homogenised with water & extract ½ - 1 glass drunk
			G			Lv	R	F	O	Bloating	Maceration	Few roots crushed, homogenised in water & 1 litre drunk
249	*Rumex nervosus* Vahl	Polygoniaceae	Y	Sheiluwa(Y)	H	Hu	R, L	F	O	Diarrhoea	Decoction	Crushed, decoction buttered & a cup is drunk morning & evening
			Y			Hu	L	F	D	Eye boil	Paint	Cooked on fire & wet paste painted on location
			Y			Hu	L	F	D	Skin rashes	Maceration	Smashed & wet concentrate solution painted over affected parts
250	*Ruta chalepensis* L.	Rutaceae	Y	Chireta(Y)Qentelam a/charota(H)	H	Hu	L, F	F	O	Abdominal pain	Concoction	Along with leaf of *Leucas calstachys*, *Echinops kebericho* & *Verbena officinalis* crushed, dissolved in water, extract 1 cup drunk
			A,D, G,G m			Hu	L	F/D	O	Dyspepsia	Juice	Leaf chewed along with salt swallowed
			A,D, G			Hu	L	F	O	Bad odour of flatulence	Juice	Leaf chewed & swallowed
			A			Hu	F	F	O	Aphrodisiac	Decoction	Fruit crushed added into coffee & drunk
			Gm			Hu	L	F	NB	Evade evil spirit	fumigation	Leaf fragrance is used as a protection
			A,G, Gm			Hu	L	F	O	Womb recovery	Infusion	Leaf put into porridge and eaten for postpartum mothers
			A,D, Gm			Hu	L	F	O	Purgative	Infusion	During occasion of 'koso' / *Hagenia abyssinica* drinking, leaf added into porridge & eaten

251	*Rytigynia neglecta* (Hiern) Robyns	Rubiaceae	Y	Mito(O)	S	Hu	L	F	O	Hiccupping	Juice	Chewed & juice swallowed slowly
252	*Salvia nilotica* Jacq.	Lamiaceae	Y	Okta(Y)	H	Hu	Wp	F	D	Fresh wound	Paint	Crushed & wet paste painted on location
253	*Salvia tiliifolia* Vahl	Lamiaceae	Y	Shushma(Y)	H	Hu	L	F	N	'Mich'	Infusion	Infusion inhaled
			Y			Hu	R	F		Sudden disease	Sinus snuff	Pounded, mixed with water & solution sucked via nose
			Y			Hu	Wp	F	D	Protecting STD	Held in hand	Simply held in hand
254	*Sanicula elata* Buch-Ham. ex D. Don	Apiaceae	Y	DaniFofa(Y)	H	Hu	Wp	F	O	Wound	Maceration	In olden time, for a person stabbed with a spear, enough amount of the plant crushed & enough water solution drunk for once a day for few days
			Y			Hu	L	F	O, D	Fresh wound	Maceration	Crushed in dissolved water, extract 1 glass drunk; also wet paste poultice on wound
255	*Sapium ellipticum* (Krauss) Pax	Euphorbiaceae	Y	Bosoqa(O),Badewacho(H)	T	Hu	L	F	O	Tonsilitis	Juice	Chewed &swallowed
			Gm			Lv	O	F	O, N	Choking	Sinus snuff	Chewed & the extract blown via nose
256	†*Satureja paradoxa* (Vatke) Engl. ex Seybold	Lamiaceae	Y	Afgeta, Kembewa(Y), Hore(Y)	H	Hu	L	F	Oc	Conjunctivitis	Juice	Clean infected eye with smashed material
			Y			Hu	Wp	F	O	Children parasites	Decoction	Decocted & 1 cup is drunk
			Y			Lv	L	F	Oc	Conjunctivitis		Crushed, homogenised with little water & thick extract squeezed onto eye
257	*Schinus molle* L.	Anacardiaceae	Y	Kondobe rbere(Y),Turmanture (H)	T	Hu	L, F	F	O	TB	Concoction	Added into remedies of the disease
			A					F	-	Insect repellent	Fumigation ,Difusion	Fresh leaf left on house furniture, or smoked
258	*Schrebera alata* (Hochst.) Welw.	Oleaceae	Y	Orewa(Y)	T	Hu	Bs, L	F	O	Hepatitis	Digestion	Ingredient along with others (bark of *Erythrina brucea*, of *Dracaena steudneri*, leaf of *Clausena anisata*, of *Olea europaea*, of *Inula confertiflora.*, root of *Phytolacca dodecandra*, *Myrsine africana* leaf, root *Stephania abyssinica*, leaf *Olea* sp. (Jiga)(Yem) small amount of each crushed & concoction 1 cup is drunk for 2-3 days
			Y			Hu	L	F	O	Rabies	Concoction	Added into other remedies of the disease given elsewhere
259	*Securidaca longepedunculata* Fresen.	Polygalaceae	D,G, Gm, Y	Muke(H),Ameli/ Heymela(Y)	T/S	Hu, Lv	Br	F	O	Sudden disease	Juice	Chewed & swallowed
			Y			Hu	Br	F	O	Malaria	Decoction	Decoction 1 cup is drunk
			Y			Hu	Br	F	O	TB	Decoction	Decocted along with others & 1 cup is drunk for 5 days (See *Withania somnifera*)

			Y			Hu	Br	F	N	Headache	Sinus snuff	Flour sniffed via nose
			G			Hu	Br	F/D	O	Rheumatic pain	Maceration	Root decoction 1 cup is drunk
			Y			Hu	Br	F/D	O	Abdominal worms	Decoction	Root decoction 1 cup drunk
260	*Senecio hadiensis* Forssk.	Asteraceace	G	Hayborsa(H)	S	Hu	L	F	D	Breast cancer & other swellings	Fomentation	Leaf cooked on fire wrapped by enset leaf and hot leaf material held and/or tied on location
			G			Hu	L	F	D	Chronic nose wound/'Chijebo'/	Paint	Leaf crushed and applied on location
			G			Lv	Sh, L	F	O, D	Cattle bloat	Maceration	Handful of leaves crushed and homogenised with water &1 litre solution is drunk
			G			Lv	Sh	F	O, D	Frustrated cow that boycotted milking	Maceration	Young shoot crushed& mixed with water & bottle of the preparation drunk; also tits &body of the animal washed with the potion
261	*Senna didymobotrya* (Fresen.) Irwin & Barneby	Fabaceae	Y	Uza(Y),Checho?o(H)	S	Hu	S	F	O	Migraine	Decoction	Pounded & concentrate solution added into coffee & drunk
			Y			Hu	L	F		Snake bite	Paint	Crushed & drunk, paint some on location
			Y			Lv	R	F	O	Black leg		Crushed along with root of *Ricinus communis*. & 1 litre is drunk
			A			Lv	L	F	O	Black leg	Maceration	Leaf crushed homogenized in water & 1 litre drunk 3 times for 1 week
262	*Senna petersiana* (Bolle) Lock	Fabaceae	A	Checho?o(H)	S	Lv	L	F	O	Black leg	Maceration	Leaf smashed, dissolved in water, chili added & 1 litre is drunk
263	*Senna septemtrionalis* (Viv.) Irwin & Barneby	Fabaceae	Y	Sinameg(O), Semamoti(O),Checho?o(H)	S	Hu	L	F	O	Snake bite	Maceration	Crushed along with leaf & bark of *Stereospermum kunthianum*, leaf of *Nicotiana tabacum* homogenised in water 1 glass drunk, wet painted on location
			Y			Hu	L	F	D	Snake sputum	Paint	Along with leaf of *Stereospermum kunthianum*.& of *Nicotiana tabacum* smashed, concentrate solution painted on location
			D			Hu	F	F	D	Evil eye	Decoction	Fruit crushed, decoction half a cup drunk and wet paste spread over face, head, hand & feet
			A,G			Lv	L	F	D, O	Evil eye	Maceration	Leaf crushed, in a bowl of water & wash the animal's body with the solution, also drink 1 cup of the solution orally
264	*Sida schimperiana* Hochst. ex A. Rich.	Malvaceae	Y	Keja(Y),Jejegoda(H)	S	Hu	R	F	O	Sudden pain	Maceration	Pulverised finely, dissolved in water& extract 1 glass drunk
			D			Hu	Wp	F	O	Constipation	Maceratition	Whole plant crushed, dissolved in water & extract 1 glass drunk
			A			Hu	R	F	O	Dyspepsia/ 'Qureta'	Maceration	Root crushed, water extract 1 cup is drunk
			D			Lv	Wp	F	O	Animal diarrhoea	Maceratition	Whole plant crushed, homogenised in water and the filtrate 1 litre drunk for 3 days

			D,Y			Lv	R	F	O	Constipation		Crushed, water extract 1 can is drunk
			D			Lv	Wp	F	O	Grain bloat	Maceratitio n	Whole plant crushed, homogenised in water and the filtrate 1 litre drunk
265	*Sideroxylon oxyacanthum* Baill.	Sapotaceae	Y	Ma?era(Y)	T/S	Hu	L	F	O	Anthrax	Decoction	Decocted along with leaf of *Myrsine africana* & *Juniperus procera* , 1 tin can drunk morning & night for 3 days
266	*Smilax aspera* L.	Smilacaceae	Y	Kowa(Y),Hobemeda (H)	C	Hu	L , St	F	O	Anthrax	Concoction	Crushed along with leaf of Clematis longicauda Steud.ex A.Rich., dissolved in water, extract 1 cup drunk for 3-5 days
			G			Hu	St	F	Dn	Tooth & gum health	Juice	Brushing teeth with stem, then chewing fresh stem, mouth rinsed with the juice
			Y			Hu	L	F	D	Tinea versicolor	Paint	Crushed along few salt, homogenised with little water & concentrate solution painted on location
			Y			Lv	L, Sh	F	O	Anthrax /Kemar		Along with leaf *Olinia rochetiana* crushed finely, homogenised in water, extract 1 can is drunk morning & evening for 5 days
267	*Snowdenia polystachya* (Fresen.) Pilg.	Poaceae	Y	Bon?a(Y),Muja(H)	H	Hu	Wp	F	O	Malaria	Maceration	Smashed, water extract 1 glass is drunk for a week
			D			Lv	Sh	F	O	Calf constipation	Maceratitio n	A bunch of grass pounded homogenised with water and 1 bottle is drunk until improves
268	†*Solanecio gigas* (Vatke) C. Jeffrey	Asteraceae	Y	Domorisa(Y)	S	Hu	L	F	O	Poisoning	Concoction	Alone smashed & water extract 1 glass is drunk, or root of *Stephania abyssinica* and tuber of *Crinumabyssinica* crushed, fresh solution 1 glass is drunk
			Y			Hu	L	F	Bf	Feet pain	Touch with	Soaking in water, wash feet with the water and splash the washed water on road
			Y			Lv	L	F	O	Black leg		Crushed & 1 bottle concentrate solution drunk
269	*Solanum anguivi* Lam.	Solanaceae	Y	Gemekewa(Y)	S	Hu	R	F	O	Gonorrhoea	Maceration	Pulverised, water extract 1 cup is drunk for 3 days
			Y			Hu	Sh	F	Fm /N	Aacute febrile rheumatism	Fumigation	Create fire by friction on stool, Inhale the smoke
			Y			Hu	Sh	F	Fm /N	Asthma	Fumigation	Ignite dry shoot friction on stool& inhale the smoke
			Y			Hu	Sh	F	Fm /N	Worm erupting disease	Poultice	Create smoke by friction on wood, inhale the smoke, apply fresh/dry *Nicotiana tobacum* concentrate solution on wound
			Y			Hu	Sh	F	Fm /N	Evil eye	Fumigation	Dry shoot smoked by friction & inhale
			Y	Gemekewa(Y)	S	Lv	Sh, R	F	O	Black leg		Added into other MPs of Black leg mentioned pulverised & drunk for 5 days
270	*Solanum dasiphyllum* Schumach	Solanaceae	Y	IdiWerabesa(Y)	S	Lv	F	F	O, N	cough/sheep & cattle		Incised, seeds removed then on fruit butter added & boiled on fire then cooling it given via nose
271	*Solanum incanum* L.	Solanaceae	D,G, Gm,	Amemu(Y) Hidi(O),Achongera(	S	Hu	R	F	O	Abdominal pain	Juice	Piece of root chewed & juice swallowed

			Y	H)								
			Y			Hu	S	F	N	Chronic nose infection	Sinus snuff	Smashed & mixed with Ficus sur Forssk.latex, concentrate solution sent into nose
			Y			Lv	R, S	F	O, D	Foot-mouth disease		Crushed, dissolved in water extract 1 bottle is drunk
			A,G, Gm			Hu	Gl		Au	Ear infection	Infusion	Gall bored & boiled, some fresh butter added in, few drop squeezed into inner ear
			D,G			Hu	F	F	D	Tungiasis	Paint	Fruit water is used cure & prevent the insect from further penetration
			Gm			Hu	R	F	O	Antidote of poison	Maceration	Root crush, mixed with chicken feces, solution drunk
			A			Hu	R	F	O	Abdominal pain	Juice	Root piece chewed along with salt & swallowed
			A			Lv	F	F	D	Evil eye	Amulet	Few fruits pierced, thread inserted tied as beads around the neck of new born sheep & goats
			Y			Lv	F	F	D	Chicken bugs / mites		Fruit juice squeezed on a bowl, adding little water, thick juice spread body of the fowl; also over poultry perching bar
			D			Lv	F	F	Oc	Evil eye	Amulet	Some fruits are tied on neck of new born sheep, goats & calves
272	*Solanum marginatum* L.f.	Solanaceae	Y	Foro-Amemu(Y)Idi(O),Ajar loro?o(H)	S	Lv	F	F	O, N	Leeches & insects		Pulp boiled in fire & dripped into nose of animals
			A			Hu	R	F	O	Tonsilitis	Juice	Root piece chewed, juice spat onto child's throat
			G			Lv	F	F	D	Sun stroke	Digestion	seeds removed, inserting fresh butter boiled on fire cooled extract sent via nose of animal
273	*Solanum nigrum* L.	Solanaceae	Y	Ereto(Y),Deme?e(H)	S	Lv	L	F	O	Leech		Crushed and ingested into mouth of animals, and added into drinking water for the same
			D			Lv	F	F	Oc	Evil eye	Amulet	Some fruits are tied on neck of new born sheep, goats & calves
274	*Sonchus bipontini* Asch.	Asteraceae	Y	Gogma(Y)	H	Hu	R, L	F	O	Rheumatic pain	Decoction	Decoction1 cup drunk in mornings twice a week for a month.
						Hu	R	F	O	Edema	Decoction	Decoction 1 cup drunk for two mornings, & concentrate solution also poultice on location
275	*Stephania abyssinica (*Dillon & A. Rich.) Walp.	Menispermacea e	Y	Temteko(Y)	CH	Hu	Sh, R	F	D	Swelling of legs	Touch with	Twigs tied to feet protect spreading swelling
			Y			Hu	R	F	O	Hepatitis	Digestion	Along with bark of Acacia negrii pulverised boiled & 1 'gubaya' drunk for 4 days
			Y			Hu	R	F	O	Rabies	Concoction	Crushed along with root of Momordica foetida Schumach. Schumach & added to Eragrostis tef (red variety dough & bread given to the patient

			G			Hu	R	F	O	Anthrax	Maceration	Root crushed, homogenised in water and 1 'kubaya' drunk for 3 days
			D,G			Hu	R	F	O	Sudden disease	Juice	Root is chewed & juice swallowed
			D,G			Lv	R	F	O	Black leg	Maceration	Root crushed, homogenised in water &1 cup extractdrunk
			G			Lv	R	F	O	Grain bloat	Maceration	Crush water extract 1 kubaya drunk
			G			Hu	R	F	O	Diarrhoea	Maceration	Root crushed, homogenised in water and 1 cup filtrate drunk
276	*Stereospermum kunthianum* Cham.	Bignoniaceae	Y	Botoro(Y)	T	Lv	L	F	O	Snake bite		Crushed along with root & leaves of *Asparagus africanus*, homogenised with water and 1 litre is drunk
277	*Swertia abyssinica* Hochst.	Gentianaceae	Y	Forofiga(Y)	H	Hu	Wp	F	Cl	'SEMOETA'	Concoction	Added into SEMO ETA
278	*Syzygium guineese* (Willd.) DC. subsp. *guineense*	Myrtaceae	Y	Shewu(Y), Bedesa(O)	T	Hu	Bs	F	O	Tonsilitis	Decoction	Decoction 1 cup drunk
			G			Hu	Bs	F	O	Diarrhoea	Decoction	Stem bark decoction 1 glass salted & drunk
			G			Hu	Bs	F	O	Hypertension	Maceration	Stem bark along root of *Lippia adoensis* decocted, 1 glass drunk twice a week
			Gm, Y			Lv	Bs	F	O	Abdominal pain		Pulverised, decocted & 1 bottle is drunk
279	*Swertia abyssinica*	Gentianaceae	G	Zeraro(H)	H	Hu	Fl	F	NBp	Ritual	Cultural	Used for showing end of 'Mesqel' holiday & good wish for the new season
280	*Tagetes minuta* L.	Asteraceae	Y	Shonu(Y)	H	Hu	L	F	N	Head ache	Sinus snuff	Smashed between palms & sniffed
281	*Teclea nobilis* Del.	Rutaceae	A,D, G,Gm	Ta?ae	T/S	Hu	L	F	O	Diarrhea, abdominal pain	Maceration	Leaf crushed, dissolved in water & 1 cup to 1 'kubaya' is drunk
282	*Tetradenia riparia* (Hochst.) Codd	Lamiaceae	Y	Benejo(Y) Sacculent	S/soft	Hu	L	F	O	Amoeba	Infusion	Infusion 1 cup drunk
			D			Hu	L	F	O	Ascariasis	Maceratition	Leaf crushed & dissolved in water & extract taken half a cup drunk
			D			Hu	L	F	O	Dyspepsia	Maceratition	Leaf crushed and dissolved in water extract 1 cup drunk in empty stomach
			Gm, Y			Hu	L	F	O	'Mich'	Infusion	Infusion1 glass drunk
283	*Tephrosia interrupta* Hochst. & Steud. Ex Engl.	Fabaceae	Y	Bu?run festupo(Y)	S	Hu	L	F	O	Sun stroke	Maceration	Pulverised & water extract 1 glass drunk
284	*Thalictrum rhychocarpum* Dill.& A. Rich.	Ranunculaceae	Y	Shotesa(Y)	H	Hu	R	F	O	Gonorrhoea	Digestion	Along with bark of *Prunus africana.* pulverised, digested 1 cup for 3– 5 days
			Y			Hu	R	F	O	Nephritis	Decoction	Root decoction 1 cup drunk 3 days a week
285	*Thunbergia alata* Boj. ex Sims	Acanthaceae	Y	Acnthaceae	CH	Hu	L	F	Au	Ear pain	Juice	Smashed homogenised in little water & extract dripped into ear

286	*Thunbergia* sp.	Acanthaceae	Y	Gadidu(O)	H	Lv	WP	F	D	Evil eye, humanshadow		Crushed & homogenised in water & drunk for new born calves; also the plant put near cage for the same
287	†*Thymus schimperi* Ronninger	Lamiaceae	A,D, Y	Zifia(Y),Tosigna(H)	H	Hu	L	F/D	O	Blood pressure	Infusion	Infusion 1 cup drunk for 5 days
			Gm			Hu	L	F/D	O	Rheumatic pain	Infusion	Leaf infusion 1 soup glass is drunk for weeks
			D			Hu	Sh, L	F/D	O	Abdominal pain	Juice	Leaf chewed and swallowed
288	*Toddalia asiatica* (L.) Lam.	Rutaceae	G	Sego(H)	S	Hu	F	F	O	Abdominal parasites ,amoebiasis	Juice	Eaten once day for 5 days
			Gm			Hu	L	F	O	Evil eye	Maceration	Leaf crushed, homogenised in water & filtrate 1 cup drunk
289	*Tragia brevipes* Pax	Euphorbiaceae	G,Y	Geldu(O) (Y),Doba(H)	CH	Hu	L	F	O	Impotence	Digestion	Along with leaf of *Hypoestes trifolia* crushed & decoction with coffee & 1 cup taken as tea until progress observed
290	*Trigonella foenum-graecum* L.	Fabaceae	D,Gm	Shuqota(H)	H	Hu	S	D	O	Arthritis	Maceration	Flour dissolved in water, mixing with honey & 1 glass drunk twice a week
291	*Urera hypselodendron* (A. Rich.) Wedd.	Urticaceae	Y	Helu(Y)	C	Hu	L	F	O	Delayed Labor	Maceration	Crushed, water extract 1 cup is drunk
			Y			Lv	Sh, L	F	O	Constipation calves		Crushed along with *Sida schimperiana*, dissolved in water, 1 bottle is drunk until improves
292	*Usnea* sp	Parmeliaceae	Y	E?onHepso(Y)	H	Hu	Wp	D	Fm	Evil spirit	Fumigation	Smoked during symptoms
			Y			Hu	Wp	D	Fm	Epilepsy	Fumigation	Smoke in fire inhaled
293	*Verbascum sinaiticum* Benth.	Scrophulariaceae	Y	GuraHare(O),Doboqo(H)	H	Hu	R	F	O	delivery abdominal pain	Decoction	Crushed & decoction 1 cup is drunk
			A		H	Lv	R, L	F	O	Bloating of cattle	Maceration	Root & leaf pulverized, dissolved in water, salted & 1 litre is drunk
294	*Verbena officinalis* L.	Verbenaceae	D,G, Y	Gala(Y),Kiskisa/qisqisa(H)	H	Hu	R, L	F	O	Baby diarrhoea	Decoction	Decoction 1 cup drunk once & repeated as needed, or r*oot decocted along* leaf Ruta chalepensis , 1 cup drunk
			Y			Hu	R	F	O	Sudden pain	Juice	Washed, chewed & juice swallowed
			A		H	Hu	R	F	O	Stomach pain	Decoction	Root decocted & ½ a cup for children, 1 cup for adults is drunk
295	*Vernonia amygdalina* Del.	Asteraceae	A,D	Heba(H)	T/S	Hu	L	F	O	Ascariasis	Maceration	Leaf crushed, dissolved in water 1 glass drunk
			A			Hu		F	O	Malaria	Maceration	Leaf crushed, dissolved in water 1 glass drunk for adults for 5 days
			A			Hu	L	F	O	Giardiasis	Maceration	Leaf crushed, dissolved in water 1 glass is drunk for adults, ½ - 1 cup for children
			A			Lv	Wp	F	O	Diarrhea	Maceartion	Whole part crushed, dissolved in water, extract 1 glass - 1 litre depending on the size
			G			Lv	L	F	O	Hematuria	Maceration	Enough leaf is pounded, mixed in enough

												water & 1 litre filtrate is drunk twice a week for 5 weeks
			A,D, G,G m			Hu	L	F	O	Stick fight injury	Maceration	For a person hit during stick fighting, leaf crushed, dissolved in water, extract, 1 glass drunk 3-4 time until recovery
			A			Lv	L	F	O	Abdominal worms	Maceration	Leaf pulverized, homogenized in water, 1 litre filtrate is drunk for 3-5 days
			G			Hu	L	F	O	Malaria/Benign	Maceration	Leaf crushed, dissolved in water, extract 1 cup drunk for 10 days
			G			Hu	L	F	O	Arthritis	Maceration	Leaf crushed, dissolved in water, extract 1 cup drunk for a week
			G			Hu	L	F	O	Gastritis /'wodeno'/	Maceration	Leaf crushed, dissolved in water, extract 1 glass taken
296	*Vernonia hochstetteri* Sch. Bip. ex Walp.	Asteraceae	Y	Otomiya(Y), Soyema(O)	S	Hu	L	F	O	Fracture	Infusion	Infusion with butter & 1 glass is drunk
			Y		S	Lv	L	F	O	Diarrhea calves	Maceration	Crushed, dissolved in water, 1 medium can is drunk for 3 days
297	*Vernonia ischnophylla* Muschl.	Asteraceae	Gm	Agega(H)		Lv	L	F	O	Abdominal bloat	Maceration	Along with rhizome of *Zingiber officinale*, fruits of *Coriandrum sativum*.& leaf of *Nicotiana tabacum*. crushed in one homogenized with water, extract 1 litre is drunk
298	*Vernonia myriantha* Hook.f.	Asteraceae	A,D, G,G m,Y	Buzo(Y) Reji(O),Barewa(H)	S	Hu	L	F	D	Fresh wounds	Poultice	Smashed, concentrate solution squeezed on wounds & bandage it
			Y			Lv	L	F	O	Anthrax	Decoction	Along with root of *Clematis longicauda Steud.ex A.Rich*. crushed, decoction 1 bottle is drunk
299	*Viscum sp. (parasitic on Croton macrostachyus* Del..	Viscaceae	Y	Tignawoshikela(Y), Mekanisa ertu(O)	S	Lv	L	F	O	Poor appetite	Macerartio n	Crushed along with leaf of *Enlerina woodfordioides* (on *Calpurnia aurea)* homogenised in water,1 bottle solution is drunk
			Y			Lv	L	F	D	Cattle skin disease	Maceration	Crushed along with bark of *Erythrina brucei* (white flowering) water homogenate painted on locations
300	*Withania somnifera* (L.) Dunal	Solanaceae	Y	ZebonEreto/Gizawa(Y)(H)	S	Hu	R	F/D	O	TB	Decoction	Along with root bark of *Securidaca longepedunculata*, *Foeniculum vulgare* root, *Schnus mole* fruit crushed & boiled, add *Citrus limon*.juice , 1 'bush'/cup is drunk once a day for 5 days
			A			Hu	R	F/D	O, D	Ascariasis	Maceration	Root crushed a, mixed with water & 1 cup to 1 glass is drunk
			A			Hu	R	F	Fm	Evil eye	Fumigation	Root fumigated
			A			Hu	Sh, R	F	D	Insanity	Maceration	Root & shoot crushed, mixed with water and body of the patient washed with the solution
			A			Hu	R	F	O, D	Rheumatic pain	Maceration	Root crushed & mixed with water and drunk

			A			Lv	L, R	F/D	O	Abdominal worms	Maceration	Leaf & root crushed & 1 bottle is drunk
			A			Lv	R, L	F	D	Evil eye	Maceration	Animal's body washed with its leaf & root solution
			A			Lv	R, L	F	D	Weariness	Maceration	Animal's body washed with its leaf & root solution drunk
301	*Zingiber officinale* Roscoe	Zingiberaceae	G,Y	Chercheku(Y),Janjibela(H)	H	Hu	Rz	F/D	O	Sore throat	Tea	Pulverised, tea made spiced with *Allium sativum*, *Nigella sativa* 1 cup taken as hot & repeated
			Y			Lv	R	F/D	O	Horse mouth disease	Concoction	Crushed along with *Allium sativum*, dry *Capsicum frutescns*, leaf of *Croton macrotachyus* & seed of *Lepium sativa*,dissolve in water & 1 litre is drunk

Apendix 7. MPs encountererd in the markets of the five districts

(A = Anlemo, D = Duna, G = Gibe, Gm =Gombora, Y = Yem, bl = bulb, br = branch, df = dry fruit, f = fruit, l = leaf, lb = leaf bread, M = medicinal only, MC = material culture, N = nutraceutical, Pr = price (ETB), r = root, s =

Species	Uses	Uses Family	Local name	Part	Quantity	Pr.	A	D	G	Gm	Y
Aframomum corrorima	N	Zingiberaceae	Hogiye(Y)	df	2	1	x	x	x	x	x
Ajuga integrifolia	N	Lamiaceae	Anamura(H)	sl	estimate	5	x	x			x
Allium sativum	N	Alliaceae	Sunto(Y)	bl	3 pc	5	x	x	x	x	x
Artemisia absinthium	M	Asteraceae	Natrara(H)	sl	5	2	x				
Arundinaria alpina	MC	Poaceae	Wesha(Y), Lema(H)	st	1	25	x				x
Beta vugaris.	N	Chinopodiaceae	Keysira(H)	r	10	5	x	x	x		x
Brassica carinata	N	Brassicaceae	Gesha(Y)	s	1 cup	2	x	x	x		x
Capsicum frutescens	N	Solanaceae	Ziga(Y)	f	1 cup	2	x	x	x	x	
Carica papaya	N	Caricaceae	Papaya(H)	f	1	3	x		x		x
Catha edulis	St	Celastraceae	Chata(H),Jima(Y/O)	l	bundle	10	x				x
Citrus limon	N	Rutaceae	Lomiye(Y)	f	1	0.5	x	x	x	x	x
C. medica	N	Rutaceae	Turungo(H)	f	1	2	x				
Coccinia abyssinica	N	Cucurbitaceae	Aju(Y)	r	estimate	2					x
Coriandrum sativum	N	Apiaceae	Woldimama(H)	df, sl	bunch	3	x	x	x	x	x
Cucurbita pepo	N	Cucurbitaceae	Debequla(H)	f	1 kubaya	3	x	x	x	x	x
Cymbopogon citratus	N	Poaceae	Hitana(H)	wp	bundle	5	x		x		
Daucus carota	N	Apiaceae	Karota(H)Karote(Y)	r	5 pc	5	x		x		
Eucalyptus camaldulemnsis	MC	Myrtaceae	Kesherbarzafa(H)	sl	bundle	10	x	x	x		
E. globulus	MC	Myrtaceae	Qedalbarzafa(H)	sl	bundle	10	x	x	x		
Echinops kebericho	M	Asteraceae	Tosa(H) Korbo(Y)	r, sl	1 pc	2	x	x			x
Juniperus procera	MC	Cupressaceae	Homa(H),Arkewa(Y)	sl	bunch	10	x	x			
Lagenaria siceraria	MC	Cucurbitaceae	Bocha(Y)	df	1 jar	35					x
Lens culinaris	N	Fabaceae	Fi?a(Y)	s	1 kubaya	5	x	x	x	x	x
Lepidiun sativum	M	Brassicaceae	Shima(Y)	s	1 cup	3	x		x		x
Linum usitatissimum	N	Linaceae	Mororo(Y)	s	1 gubaya	3	x	x	x	x	x
Nigella sativa	N	Ranunculaceae	Abesota(Y)	s	1/2 cup	2	x	x	x	x	x
Niacotiana rustica	St	Solanaceae	Temba?a(H)TumakoY)	lb	1 slice	12	x		x	x	
Niacotiana tabacum	St	Solanaceae	Tumako/Y)	l	estimate	2	x		x	x	x
Olea europaea subsp. *cuspidata*	MC	Oleaceae	Wera(H) Buna(Y)	sl	4	10	x		x		
Pennisetum sphacelatum	MC	Poaceae	Fesha(Y)	mc	1 pc	30		x			x
Phoenix reclinata	MC	Arecaeaee	Deya(Y) Dimbaba(H)	mc	mat	30					x
Pisum sativum	N	Fabaceae	Gite(H)	s	1 kubaya	5			x	x	
Rhamnus prinoides	N	Rhamnaceae	Gesho(Y)	br	estimate	5			x		x

Appendix 7. cont'd

Rosmarinus officinalis	N	Lamiaceae	Ma?l enja(H)	br	estimate	5	x					
Ruta chalepensis	N	Rutaceae	Charota (H)Chireta (Y)	f	estimate	2	x	x				x
Securidaca longepedunculata	M	Polygalaceae	Muke/Aymela(H)	r	1 pc	10			x			
Thymus schimperi	N	Lamiaceae	Tosigna(H)	wp	estimate	5	x					
Trigonella foenum-gracecum	N	Fabaceae	Abiso(Y)	s	1 cup	4	x					
Withania somnifera	N	Solanaceae	Gizawa(H)	wp	1 plant	20	x					
Zingiber officinle	M	Zingiberaceae	Janjibela(H)Chercheku(Y)	rz	group	5	x	x	x	x	x	

Appendix 8. Interview guide of Ethnobotanical data collection

This guide is prepared for Ethnobotanical study of medicinal use and conservation of medicinal plants in Hadiya and Yem areas.

Name of the Researcher: **Gideon W/mariam** Institution: **Addis Ababa University**

Dear informants; I am interested in documenting those plants that you use for treating human and livestock ailments. Your knowledge in this regard is very much important. Therefore, you are kindly asked inorder to give genuine and correct responses to the best of your knowledge. Thank you.

Part I.Interview guide to general informants

StudyArea_____Site/Subdistrict_____Altitude_____Agro-ecology_____

Coordinate_____ Village_____Time/Date_____

Namep of Informant_____Gender F___App.Age_____

_____Education_____Occupation_____Ethnic group_____Religion_____

1 List the human and livestock ailments that are prevalent in this village: of human_____of livestock_____

2/ List the MPs you use fot treating human and livestock ailments.

2.Which ones are the most prevalent ones/one?_____

3. Which medical system do you use to treat human and livestock illnesses?? Traditional/herbal medicines? Why?___

Modern medicines?___Why? Both too?_____ To which types of ailments you use traditional medicine? And, to which

ones you may use traditional plant medicines?

4. Do you usually collect your traditional medicines yourself? Or visit local healers experts?

5. Where do you most often collect medicinal plants? Homegarden ___ on farm land___ forest patches_____ grazing fields___ ___Buy from market _____Other__

6. Which ones of the medicinal plants you used to treat different diseases have become rare and difficult to find at present?

List names and diseases treated. What are the reasons for the disappearance of these medicinal plants

7. Do you believe these medicinal plants should be conserved and protected? Suggest options of conserving.

8. Do you think MPK is facing loss? If "ye"What do you think are the reasons?

Part Two: Interview for Key Informants

1. Name_____Sex_____Age_____Educ level_____Ethnic g._____Religion____

Experience in this skill_____yrs.

2. Please, would you show the medicinal plants that are the most preferred in this village?.....

3. Where did you learn from about your medicinal plants? From parents____from friends_____from religious inst.___from training_____Revealed as nightmare_____

a/ How many patients visit you traditional clinic? Few_____many____

b/ Do you give herbal for one/specific ailment or generally for a number of ailments?

c Do you treat both males & females? Children &adults?

5. Are the medicinal plants you give your patients becoming rare or no change?List those becoming rare

6. What makes medicinal plants good and what makes them bad?_

7. How do you evaluate the demand of traditional plant medicines in your locality? Increase/steady/declined.Give reasons for your answers….

8. Give ranks for the factors that threaten the edicinal plants in this locality?.....

9. Rank the medicinal plant/s that is/are most threatened in this locality?.....

10/ Rank those plants that are preferred for treating a given disease. (highest points for the most preferred, 1 least preferred)

11/ What the additional uses of the medicinal plant/s with multiple uses (farm&household uses, for food, medicinal, fire wood, construction, charcoal, food/wild food, fence, soil and climate protection)?..

Part Three

Marketability of medicinal plants

1.Information

Date_____ Study site_____ Market place name_____
Name of informant_____sex__ Age __ Ethnicity _____Subdistrict_____
Religion_____
Location of market place_____Educational level_____ Type of vendor: Permanent__ Temporary__
2. How often do you sell here? _____How much are your plant remedies demanded?_____
3. Which medicinal plants species is commonly used to treats for both human diseases and animal diseases in study area?
4. Local name of medicinal plants _____ The plants grow in wild_____in cultivation_____
5. Plant part used_____
6. Number of medicinal plants species of collection in market place: Single_____ multiple___
7. Condition of medicinal plants for sale: fresh _____powdered_____
8. Estimated quantity: vendor_____whole market_____
9. Is you income attractive or not_____.

Part Four

Interview to Health office Management

1/ What are the most prevalent ailments the populace suffer from?
2/ How many health providers public & private(NGO) health institutions?
3/ Do you believe the use of traditional medicinal plants for healing ailments?
4/ Do you know members of the local people use traditional medicinal plants?
5/ What is your perception in the use traditional medicinal plants?

Declaration

I, the undersigned declare that this Dissertation is my original work and it has not been presented in other universities, colleges or institutes for a degree or other purpose. All sources of the materials used have been duly acknowledged.

Name: Gideon Woldemariam Signature: _____ Date: _____

This work has been done under my supervision.

Name 1. Prof. Sebsebe Demissew Signature: _____ Date: _____

2. Prof. Zemede Asfaw Signature: _____ Date: _____