PLANT DIVERSITY AND ETHNOBOTANICAL STUDY OF MEDICINAL AND WILD EDIBLE PLANTS IN SHEKA ZONE, SOUTHERN NATIONS, NATIONALITIES AND PEOPLES REGIONAL STATE, ETHIOPIA

Zewdie Kassa Tessema

Addis Ababa University

Addis Ababa, Ethiopia

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Zewdie Kassa Tessema

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GRADUATE PROGRAMMES

This is to certify that the Dissertation prepared by Zewdie Kassa Tessema, entitled*: Plant Diversity and Ethnobotanical Study of Medicinal and Wild Edible Plants in Sheka Zone, Southern Nations, Nationalities and Peoples Regional State, 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

Plant Diversity and Ethnobotanical Study of Medicinal and Wild Edible Plants in Sheka Zone, Southern Nations, Nationalities and Peoples Regional State, Ethiopia

Zewdie Kassa, PhD Dissertation

Addis Ababa University, 2017

A study on plant diversity and ethnobotany, emphasizing on medicinal and wild edible plants, was conducted between September 2013 and January 2016 in Sheka Zone, Ethiopia. The objective was to document and analyze the floristic composition and the associated ethnobotanical knowledge, giving due emphasis to the medicinal and wild edible plants. The study applied a combination of standard plant taxonomic, plant ecological and ethnobotanical methods. Ninety five plots of 30 m x 30 m for trees, 10 m x 10 m for shrubs and 5 m x 5 m for herbs were used to collect vegetation data. Four hundred fourteen (384 randomly sampled general and 30 purposively sampled key) informants were involved in the ethnobotanical data collection with application of semi-structured interviews and discussion with informants. Data were analyzed using R Statistical Software version 3.2.3 and analytical methods of ethnobotany. A total of 555 (458 from plots, 97 out of plots) plant species of which 266 (48%) those used as medicinals; 35 (6.31%) wild plants consumed by people were recorded. The research found 30 (5.4%) plant species endemic to Ethiopia. The plant species recorded indicated high taxonomic diversity as they belong to 341 genera and 115 families. The Shannon-Wiener Diversity index is H'=3.41 with overall species evenness (equitability), J= 0.56. Eight plant community types (Olea welwitshii-Podocarpus falcatus community, Ficus cycomorus-Albizia grandibracteata community, Cyperus dichroostachyus-Cyperus latifolius community, Arundinaria alpina-Lepidotrichillia volkensii community, Erythrina brucei-Dombeya torrida community, Ficus sur-Croton macrostachyus community, Schefflera abyssinica-Syzygium guineense community, Ilex mitis-Macaranga capensis community) were identified. In addition to climatic (rainfall and temperature) variability, five environmental factors including altitude (r^2=0.722, p=0.001), slope (r^2=0.236, p=0.001), aspect (r^2=0.207, p=0.001), grazing (r^2=0.075, p=0.036), and disturbance (r^2=0.066, p=0.047) had significant contributions in determining plant community types where altitude is the most influential at lowest AIC value of 531.01 using RDA ordination. Fourteen major plant use categories were identified including the medicinal and the wild edibles. The medicinal plants are distributed within the eight plant communities constituting 46% to 72% of their species composition. Of the 35 wild edible plants, 85.71% were also said to be medicinal. These medicinal plants are used to treat 204 (77%) human, 10 (4%) livestock and 52 (19%) human and livestock ailments. There is significant (α= 0.05) positive correlation between respondents' average distance from health centers and medicinal plant use citation frequencies. Increasing population, commercial agriculture and firewood collection were among the major threats to the vegetation of the study area. Plant communities that include Ficus-sur-Croton macrostachyus, Schefflera abyssinica-Syzygium guineense, Ilex mitis-Macaranga capensis and Arundinaria alpina-Lepidotrichillia volkensii constituted more than 65% of their species composition as medicinal, hence, need priority attention for conservation.

Key words*: Cluster analysis, diversity, ethnobotany, multipurpose species, relative cultural importance*

DEDICATION

This dissertation is dedicated to:

The people of Sheka Zone who maintained the rich plant diversity, ethnobotanical knowledge and associated practices for generations despite the ever increasing anthropogenic and natural constraints: environmental, socio-economic and socio-political challenges over the years;

The late Professor ENSERMU KELBESSA, staff member of the Department of Plant Biology and Biodiversity Management Addis Ababa University who untimely passed away when his university and his country is highly in need. I always remember him with love and respect.

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List of Acronyms

AIC= Akaike Information Criterion
CBD= Convention on Biological Diversity
CCA= Canonical Correspondence Analysis
CEPF= Critical Ecosystem Partnership Fund
CSA= Central Statistical Agency of Ethiopia
CSI= Cultural Significance Index
DECORANA= Deterended Correspondence Analysis
EBI= Ethiopian Biodiversity Institute
EFMHACA= Ethiopian Food Medicine and Healthcare Administration and Control Authority
EPCC= Ethiopian Panel on Climate Change
FAO= Food and Agriculture Organization of the United Nations
FL= Fidelity Level
IBC= Institute of Biodiversity Conservation
ICF= Informant Consensus Factor
IK= Indigenous Knowledge
MAB = Man and the Biosphere
MEA= Millennium Ecosystem Assessment
MELCA= Movement for Ecological Learning through Community Action
NCR= National Research Council
NTFP= Non Timber Forest Product
OTV= Ordinal Transformed Values
PCA= Principal Component Analysis
RCI= Relative Cultural Importance
RDA= Redundancy Analysis
RUV= Relative Use Values
SCBD= Secretariat of the Convention on Biological Diversity
SNNPRS= Southern Nations, Nationalities and Peoples Regional State
SZHD= Sheka Zone Health Division
TAB= Total Abundance Values
TEK= Traditional Ecological Knowledge
UNDP= United Nations Development Programme
UNEP= United Nations Environmental Programme
USDA= United States Department of Agriculture
UNESCO= United Nations Educational Scientific and Cultural Organizations
WBISPP= Woody Biomass Inventory and Strategic Planning Project
WCMC= World Conservation Monitoring Centre
WHO= World Health Organization

Table of Contents

CHAPTER FOUR

CHAPTER FIVE

List of Tables

List of Figures

List of Appendices

CHAPTER ONE

1. Introduction

1.1. Background

Rapid population growth is among the fundamental problems currently facing our planet earth. Both natural and anthropogenic factors are the current problems threatening biodiversity and associated traditional ecological knowledge systems worldwide in general and so does Ethiopia in particular. Such concerns are global, national and local. Sheka Zone is among the biodiversity priority areas in Ethiopia and also under highly accelerated rate of population increase due to population influx from the Ethiopian high lands and elsewhere coupled to coffee and tea plantation investment projects. Research based biodiversity and ethnobotanical information which can be obtained through detailed studies is required to be used as an input for planning sustainable development projects and policy formulations to be implemented in environmentally friendly manner.

Green plants play vital role in the process of creating suitable environment to live in. They are natural sinks of greenhouse gases and can minimize problems of climate change. Losses of biodiversity as well as associated ethnobotanical knowledge are becoming critical issues at global, national as well as local levels. Botany and plant ecology are key areas of science with reciprocal impacts on human societies having both positive and negative consequencies on life and livelihoods. Ethnobotany studies about the dynamic reciprocal interactions between plants and people (Martin, 1995).

While plant biology (botany) is among the oldest disciplines as far as natural science is concerned, ethnobotany is a relatively young science. The study of plants is vital because they are fundamental part of life on earth generating the oxygen we breathe, the food we eat as well as fibers, fuels and medicines that allow humans and other life forms to exist. Through photosynthesis, plants absorb carbon dioxide, a greenhouse gas that in large amounts can affect global climate. Plants also release the oxygen we breathe into the atmosphere and remove the carbon dioxide from the atmosphere during photosynthesis and in so doing they sustain life on earth. In addition, they play great ecological role such as prevention of soil erosion and influential in the water cycle. Botanical research has had long relevance to understanding of fundamental biological processes other than just botany. Fundamental life processes such as cell division and protein synthesis can be studied using plants without moral issues that come with conducting studies upon animals and humans.

A better understanding of plants and their relation to human affairs is possible through botanical and ethnobotanical studies. Understanding plant-human relations plays crucial role to the future of human societies through allowing humans to understand the critical roles played by plants as producers and provision of oxygen. It also helps humans to better cognition/metacognition of production of food and feed, fundamental life processes in relation to biological diversity, produce medicinal and materials to treat diseases and other ailments. Moreover, understanding environmental changes more clearly thereby coming up with possible solutions in conservation, biodiversity management techniques, and sustainable development to combat the current issues in climate change and resource scarcity can be possible through botanical research.

Plants are good sources of traditional herbal medicines and modern drugs. According to the World Health Organization (WHO, 1999), traditional system of medicine have become a topic of global importance during the past decades. The current estimates suggest that the majority of developing countries' population depends mainly on traditional healers where medicinal plants serve as major sources of medicines to meet primary healthcare requirements. The World Conservation Monitoring Centre (Groombridge and Jenkins, 1992; WCMC, 1992) reported that around 119 pure chemical substances extracted from some 90 species of vascular plants. Plant bioactive chemicals include alkaloids, terpenes, saponins, steroids, flavonoids, essential oils and many others (Azmir *et al*., 2013; Guan and Quing, 2015). These chemicals are used as modern medicines all around the globe. Similarly, it was stated that out of the estimated 250,000 higher plants on earth, about 35,000 to 70,000 species have at one time or another been used in some cultures for medicinal purposes (WHO, 1998; 1999; 2002a; 2007; 2009).

Traditional medicines where the use of herbal remedies play crucial roles as source of medicines is widely used and rapidly growing healthcare practice of economic significance. About 80% of the African populations, for instance, use traditional medicine to fulfill their primary healthcare requirements. At the same time nearly 90% of the Ethiopian population use traditional medicine as their first line of healthcare requirements as a result of historical and cultural reasons even in the presence of modern medicines (WHO, 2002b). Rai *et al*. (2012) for instance noted that from the global perspectives, medicinal plant research is a prime area where integration of concepts and methods from various research practices such as agriculture and health is important. Hence, it is obvious that medicinal plants are produced either agriculturally cultivated or collected naturally from their wild habitats.

According to the WCMC (Groombridge and Jenkins, 1992; 1992), supplying the world's food is among the most fundamental uses of plant biodiversity. Plants were originally consumed directly from their wild habitats and collection of wild edible plants continues throughout the world till today. Sources from the United Nations Population Fund (CSA and ICF, 2012; FAO, 2015) indicated that the world population has currently reached nine billion. The role of plants for human life in nutrition is also crucial to combat food shortage due to the fast growing rate of population size particularly in developing countries. FAO further noted that agriculture could face the dual challenge of feeding a 9 to 12 billion global population by 2050 reducing its footprint on the environment. Since nearly all the food we eat comes directly or indirectly from plants, knowledge of the producers in depth would be important. Botanists and ethnobotanists are also expected to do much in understanding how plants produce the food we eat, how to increase yields and the contribution of ethnobotanical studies emphasizing wild edible plants as multidisciplinary subject.

Food security refers to the availability of food and one's access to it and it exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 2006, 2011). Hence food security at a minimum is the ready availability of nutritionally adequate and safe food and an assured ability to acquire acceptable foods in socially acceptable ways that is without resorting to emergency food supplies, scavenging, stealing or other coping strategies (USDA, 2000; UNDP, 2011; EPCC, 2015). The study of wild edible plants is vital to explore additional potentials and options for food diversification and to correct the wrong belief that wild edible plants are sometimes regarded as "famine foods" in some cultures and traditions.

1.2. Statement of the Problem

On one hand, due to the remoteness and inaccessibility of most of the sites in the Zone and its districts, the vegetation of the area was not ethnobotanically fully explored. Moreover, it was reported that the vegetation in the western escarpment, which includes the study area, has been described as being imperfectly known despite its intact nature and huge biological diversity (Sebsebe Demissew *et al*., 2005).

None of earlier studies (Kumelachew Yeshitela and Tamirat Bekele, 2002; Abreham Assefa *et al*., 2013; Seada Yasin *et al*., 2015) fully addressed the ethnobotanical aspect of the vegetation of Sheka Zone. The earlier studies focussed only on plant communities and floristic composition covering few portion of the zone recording small number of species: only 139 plant species (Kumelachew Yeshitela and Tamirat Bekele, 2003); only 130 plant species (Abreham Assefa *et al*., 2013) indicating that the floristic composition of the area is also not fully explored. The later study (Seada Yasin *et al*., 2015) recorded only 113 plant species from only the two districts of the zone emphasizing only on indigenous knowledge of plan-material culture which is also incomplete in fully addressing the floristic and ethnobotanical aspect of the entire Zone of Sheka.

On the other hand, although high numbers of vascular plant species are known to be used for medicinal purposes, very few of the plant species traditionally used as medicines have been scientifically evaluated for their possible medicinal applications (WHO, 1998; 1999; 2002a; 2007; 2009). In countries like Ethiopia, absence of enough research based data is a good indicator of the need for calling actions that can generate evidence based information on the quality, safety and efficacy of traditional therapies and hence one of the aims of this research work which focused on generating first hand ethnobotanical information for later use.

The Woody Biomass Inventory and Strategic Planning Project (WBISPP) revealed that land use/land cover statistics in Ethiopia indicates woody vegetation including high forests cover over 50% of the land (WBISPP, 2004; Yitebitu Moges *et al*., 2010; Gessler *et al*., 2013). For instance, natural forests and woodlands cover 12.3 million ha, down from 15.1 million ha in 1990 (FRA, 2010; FAO, 2010; Million Bekele, 2011). Of this area, the remaining closed natural forest is 4.12 million ha or 3.37% of Ethiopia's land area. Between 1990 and 2005, Ethiopia lost over 2 million ha of the forests with an average annual loss of 140,000 ha (FAO, 2010; Million Bekele, 2011). Hence, today this rich biological diversity is relatively more of history and the reality is that very few parts of Ethiopia relatively maintained their natural vegetation cover and associated biological diversity together with the rich ethnobotanical knowledge accumulated over millennia. Loss of vegetation resources in other words means loss of the associated medicinal and wild edible plant resources from their natural habitats and ecosystems where they are well adapted for *in situ* conservation. This tells us the idea that relatively degraded ecosystems with their species are at the verge of extinctions need immediate restoration programmes. On the other hand, areas like the southwestern Ethiopia that are in a relatively better status of their natural vegetation and associated indigenous ecological and ethnobotanical knowledge need special attention before it is too late. This is because restoration and resilience of degraded ecosystems is not an easy task from the point of view of resources: time, money and energy. Hence, prevention measures towards ecosystem degradation and indigenous knowledge systems erosion coupled with biodiversity loss is relatively an easy task.

Sheka Zone in the Southern Nations Nationalities and Peoples Regional State (SNNPRS) where the study was carried out is known for the relatively high vegetation cover and at a relatively better status of biological diversity. However, there are potential threats that could affect the future of these ecosystems and the associated biodiversity in them which can be understood from the lessons learned from past events elsewhere in the country in order to take appropriate preventive actions. For instance, Tadesse Woldemariam and Masresha Fetene (2012) reported that reduction in respect to cultural forests have brought changes in local community's perception and respect to traditional beliefs regarding cultural forests, sacred sites and sensitive habitats. As a result, vegetation cover of Sheka Zone is declining from time to time with parallel erosion of indigenous ecological knowledge and associated ethnobotanical knowledge systems that are believed to be contributing a lot to the conservation and sustainable use of biodiversity if properly managed. Therefore, the above scenario calls for the need to carryout detailed studies on ethnobotany as well as plant biodiversity in the area for documentation and further use for research and development planning activities. Hence, it is worth noting the lessons learned from past events and plan for future scenarios.

The research entitled "Plant Diversity and Ethnobotanical Study of Medicinal and Wild Edible Plants in Sheka Zone, Ethiopia" is rooted in understanding the problems of conservation and biodiversity challenges in the country in general and that of Sheka Zone in particular. Therefore, detailed ethnobotanical studies emphasizing on medicinal and wild edible plants of Sheka Zone was conducted. Therefore, it is worth noting the role of ethnobotanical investigations in providing relevant information for priority settings in formulating appropriate development policies in biodiversity conservation in general and environmental wellbeing in particular.

Moreover, it is known that the United Nations has already nominated the period from 2011-2020 as the decade of biodiversity (http://www.cbd.int/2011-2020) and there are ample opportunities for countries like Ethiopia to carry out biodiversity and ethnobotanical studies in recognized areas such as the Sheka Biosphere Reserve contributing solutions to the conservation and management of the country's genetic resources. This can be done by carrying out studies on medicinal and wild edible plants in Sheka Zone. Sheka Zone has already been identified as high priority area for conservation by United Nations Educational Scientific and Cultural Organization (Tadesse Woldemariam and Fite Getachew, 2011; UNESCO-MAB, 2015). Similarly, the forest areas in the southwest Ethiopia are among the areas identified as the centres of plant diversity globally (Myers *et al*., 2000; Baillie *et al*., 2004; CEPF, 2011; Tadesse Woldemariam, 2012; CEPF, 2015). Sheka Zone is part of southwest Ethiopian forests. Furthermore, the vegetation in Sheka Zone falls within the Eastern Afromontane biodiversity hotspot areas of the world which calls for special attention (Mittermeier *et al.*, 2011; CEPF, 2011, 2015).

It is worth noting here the idea raised by Hedberg (2014) about enrichment of teaching intuitions and teachers with a useful Flora or handbook for the relevant region to gain much in making people realize the value of their plants and biodiversity. Hence, in our case, for meaningful conservation and management of the country's plant diversity incorporation of ethnobotanical information in the context of Ethiopian cultures and traditions is going to be an assignment to us to be taken over for the next steps. Therefore, detailed studies on the plant diversity of the area together with the associated ethnobotanical knowledge is needed which is the main aim of this research work.

1.3. Research Questions, Hypotheses and Objectives

1.3.1. Research Questions

The following are the major research questions to be answered in this dissertation.

- What is the floristic composition of the vegetation of Sheka Zone?
- What plant community types exist in Sheka vegetation?
- What is the current status of plant biodiversity in Sheka Zone?
- Are there considerable numbers of medicinal and wild edible plants that are traditionally used by the people in Sheka Zone?
- Is there relationship between respondents' distance from health centres and frequency of medicinal plant use in the area?
- How do the local communities perceive the change in plant diversity and the associated ethnobotanical knowledge in the study area over the past decades?
- What is the status of knowledge of the local communities of Sheka Zone on the sustainable use and conservation of plant biodiversity of their area in general and medicinal and wild edible plants in particular?
- What ethnobotanical knowledge is available in Sheka Zone contributing to biodiversity management?
- What are the major threats to plant diversity in Sheka Zone?
- What are the major possible solutions to combat the problems identified?
- What are the roles of indigenous knowledge of different ethnic groups of Sheka Zone on the future of plant diversity of the area?

- What are the future implications of the current situations to biodiversity if the existing problems of conservation will not be tackled?

1.3.2. Research Hypotheses

- The vegetation of Sheka Zone is not plant diversity rich and cannot serve as a major source of medicinal and wild edible plants for the people of the area;
- The people of Sheka have limited ethnobotanical knowledge and related cultural assets relevant for natural resource management;
- There is no increasing human encroachment into the natural ecosystems in Sheka Zone and hence no increasing threat to the plant diversity due to distrbance;
- Vegetation disturbance is not among the driving forces in structuring plant community types;
- The existing problems of conservation and plant diversity loss in Sheka Zone are not due to lack of knowledge/understanding or commitment from concerned stakeholders;
- There is no correlation between respondens' distance from health centres and frequency of medicinal plant use for thier primary healthcare in Sheka Zone.

1.3.3. Research Objectives

General Objectives

The general objective of this study is to investigate the floristic composition of Sheka Zone (southwestern Ethiopia) and the ethnobotanical knowledge of the local people emphasing on the medicinal and wild edible plants that the vegetation maintains.

Specific Objectives

The specific objectives of the study are:

- To document the plant diversity of Sheka through floristic and ethnobotanical study;
- To document medicinal plants used for treating human and livestock ailments in Sheka Zone;
- To document wild edible plants used in Sheka Zone;
- To document the ethnobotanical knowledge of the Sheka people with a focus on the medicinal and wild edible plants;
- To see the relative cultural significance of plant species in Sheka Zone;
- To identify the status of the indigenous knowledge about medicinal and wild edible plants used by the local people of Sheka Zone;
- To document traditional practices contributing to maintaining medicinally important as well as wild edible plant species both in the wild and in managed environments (homegardens) and implications for biodiversity conservation in Sheka Zone;
- To rate the level of threats to plants in Sheka Zone through priority ranking identifying the threats to plant diversity in general and medicinal as well as wild edible plants in particular through priority ranking thereby predicting future implications for conservation and sustainable use.

CHAPTER TWO

2. Literature Review

2.1. Biodiversity

It was stated that biological diversity includes all plants, animals, microorganisms and their ecosystems as well as the diversity within species, between species and of ecosystems where none of its single component is consistently a good indicator of the overall biodiversity (SCBD, 2003). In other words, all the components of biodiversity can vary independent of one another. On that note, the Convention on Biological Diversity (CBD, 2011) defined biodiversity as the variability among living organisms from all sources including, *inter alia*, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part. Hence, it refers to diversity within species, between species and ecosystems. In short, biodiversity includes all organisms, species, populations; the genetic variations among these; and all their complex assemblages of communities and ecosystems resulting in the variety of life on earth. This variety of life provides the building blocks necessary to adapt to changing environmental conditions in the future.

2.2. Biodiversity and Ecosystem Services

According to the National Research Council (NRC, 1999), every component of biodiversity whether it is gene, species and ecosystem; whether directly or indirectly, sustain humanity with a wide range of goods and services and hence marked as biological resources. These broad services of biodiversity to humanity are summarized under major categories of: biological resources where they serve as main sources of food, medicines, fibers, fuels and industrial out puts; domesticated systems where relatively small fractions of plant species act as reservoirs of the world's food supply; wild systems where humans collect vast quantities of food, medicine, fuel and fiber; pharmaceutical and biotechnological industries where wild species of flora and fauna have long been the main inputs for the production of medical, agricultural, industrial and environmental research out puts; bioremediation where microorganisms play crucial role in environmental monitoring as well as restoration; ecosystem services where biodiversity play major roles in hydrologic cycle, control of erosion and pollution prevention. The Secretariat of the Convention on Biological Diversity (SCBD, 2010) also noted that the ecosystem approach to interdependence of biodiversity and development under global change was not only designed as a primary framework for conservation action under the Convention on Biological Diversity but also equally expected to include strategies that addressed the inter linkages between biological diversity and human development.

Similarly, in the Ethiopian context, the Ethiopian Biodiversity Institute (EBI, 2015) noted that ecosystems of Ethiopia and the biological diversity contained within them provide to humanity a number of services that are essential for the economic development and many other aspects of human welfare. Hence, wherever it is; continent, region, country or locality, it is undeniable that each and every plant, animal and microorganism species plays its part in the regulation of ecosystem services.

2.3. Plant Diversity

Arthur (2009) reported that the estimated number of species in the world is about 11 million of which nearly 1, 900,000 are accepted published species and about 18,000 new species are being described per year. This author added to his idea that 11% of the new species discovered solely in the year 2007 were vascular plants. His major conclusion was that the estimated number of described flowering plant species in the world range from 300,000 to 400,000 of which 268, 600 were described and published. He further summarized that some 92% of the vascular plants are endemic to their respective geographical region where they are restrictly found. This idea is also inline with that of Hobohm (2014) about endemism in the vascular plant taxa. He took detailed and in depth survey of the possible number of higher plants globally from various published sources. Moreover, Arthur's estimation of flowering plants is closer to what Crane *et al.* (1995) had already estimated as 250,000 to 300,000 extant species of angiosperms that dominated the vegetation of most terrestrial ecosystems. However, the most recent data from the Royal Botanic Garden, Kew showed that approximately 391, 000 vascular plant species are currently known to science (RBGK, 2016).

The modern Ethiopian Flora Project was initiated in 1980 and documented thousands of plant specimens in the Ethiopian National Herbarium that grew from 14, 000 in 1980 to 80, 000 currently (Sebsebe Demissew, 2014). The Flora of Ethiopia and Eritrea documented about 6, 027 vascular plant species including subspecies with about 10% endemism (Ensermu Kelbessa and Sebsebe Demissew, 2014). They further noted that the number of species in Ethiopia is about 5, 757 species. Although the Ethiopian Flora Project is successfully completed, detailed ethnobotanical information of each and every vascular plant species documented is still lacking. As building botanical reference centres for pharmacognosists, agriculturalists, foresters and wildlife specialists is among the core objectives of the Ethiopian Flora Project (Sebsebe Demissew, 2014), herbarium activities are dynamic and ever operating. Ethnobotanists take their part in enriching the floras and filling the gaps and hence the aims of the current study too.

2.3.1. Plant Diversity and Health

World Conservation Monitoring Centre (Groombridge and Jenkins, 1992; WCMC, 1992) stated that an extremely wide range of plant species is used medicinally at local level confirming the role of biodiversity in health services. Similarly, the Millennium Ecosystem Assessment (MEA, 2005) also noted that since balanced diet is an important component of health, humans' risk of exposure to both infectious and noninfectious diseases is directly or indirectly linked to maintenance of biological diversity in its natural ecosystems. They further emphasized, for instance, that approximately 7, 000 plant species together with several species of animals have been consumed by humans at one or another time in the past and currently some indigenous traditional communities use about 200 and above species as sources of food.

Humankind depends of biological diversity for the services it provides to maintain the normal ecosystem dynamics to operate. Maintaining of healthy ecosystems, provision of food and medicines are the key elements that people depend on to stay healthy. According to the Secretariat of the Convention on Biological Diversity (SCBD, 2010), approximately 80% of the worlds' population from developing countries depend mainly on traditional medicines derived from plant materials and about 25% of prescriptions dispensed in developing countries contained plant extracts or active ingredients derived from plant products. They also added that as a result of the ever shrinking crop varieties from which 90% of the world's calories come during the past 50 years, people's diets have been simplified causing food or nutrition deficiency diseases. Hence, they concluded that changes to biodiversity can have severe and unpredictable consequences on the health of living things in general and that of people in particular.

This is also true in the Ethiopian context as vast number of plant species is used as traditional medicines throughout the country. The Ethiopian Biodiversity Institute (EBI, 2015) for instance noted that biodiversity has a direct link to the livelihoods and economic wellbeing of most Ethiopians such as food security, human health and nutrition. The above scenario is good implication that wild resources of food remain an important balanced diet particularly for the poor and vulnerable people to stay healthy. However, there has been increasing pressure on biodiversity and ecosystems thereby leading to further decline and degradation due to interactions of multiple threats.

Biodiversity changes caused by a range of both direct and indirect drivers at global, regional and local scales need reversing responses at all levels through increasing recognition of the roles of ecosystems and biodiversity in promoting human health through multi-sectored approach (WHO, 2006; UNEP, 2014). Climate change scenarios as a result of biodiversity loss have strong link to the emergence of infectious diseases. The United Nations Environment Programme (UNEP, 2014, 2015), for instance, reported that about 25% of the global mortality is due to emerging infectious human diseases caused by pathogenic microorganisms such as bacteria, viruses, parasites and fungi that spread directly or indirectly through vectors from one organism to another including humans. Such problems are coupled with the growing resistances of vectors as the development of new vaccines has been a slow process. At its extreme level, biodiversity losses resulted in severe environmental changes with its associated health problems by further impacting economic productivity contributing to perpetuation of poverty (UNEP, 2015).

2.3.2. Plant Diversity and Food Security

Wild plant varieties became reservoirs of new crop species through the processes of domestication and today they are the major tools of genetic resources for improving the world's crops. The World Conservation Monitoring Centre (WCMC, 1992) estimated that out of 250,000 species of flowering plants, only about 3,000 species have been regarded as food sources and around 200 plant species have been domesticated for food where only 15-20 of them belong to major crops of economic significance worldwide. Many wild plant uses for food in Ethiopia during the times of food shortage are consumed representing potential new crop plants to be further domesticated (Heywood, 1995; Barthlott *et al*., 2005). Case studies showed that the Ethiopian centre of crop genetic diversity represents one of the world's eight major primary centres of crop plant diversity (Smith, 1968; Damania *et al*., 1998; Heywood, 1995; Hummer and Hancock, 2015).

2.4. Threats to Plant Diversity and Conservation Measures

Light (2004) noted that resource-based extractive economies in regional ecosystems create painful transitions imposed by convergence of processes operating at local as well as global scales. The fact that the world population is increasing in an alarming rate particularly in developing countries meant that it created an inverse relationship between population growth and vegetation cover. Such population pressure impairs the normal ecosystem dynamics through reducing the capacity of providing goods and services.

Reports of the Millennium Ecosystem Assessment (MEA, 2005), indicated that biodiversity changes due to human actions were more rapid in the past 50 years than at any time in human history. The drivers of changes causing biological diversity loss leading to changes in ecosystem services are either steady, show no evidence of declining through time or are increasing intensity. It was further noted that high rates of biodiversity loss provide an urgent incentive to increase our knowledge of earth's remaining species (Mora *et al*., 2011) and that ecosystems are now losing species at rates only seen in previous mass extinction events. It takes us to the fact that there is a need to develop National Biodiversity Strategies and Action Plans (NBSAP) as ratified by the Convention on Biological Diversity (CBD, 2011) at global, regional and local (national) scales.

It is also worth remembering the concept stated by Talent (2012) that temporal and spatial dynamics of biodiversity over long intervals of time need a clear and thorough understanding of diversity patterns and controlling factors thereby adopting it as academic exercises. Therefore, increasing loss of biodiversity is among the most concerning issues to modern ecology and society (Mora and Zapata, 2013). It was noted that the current and future extinction rates are aggravated by habitat destruction, modification, and fragmentation which are widely recognized as the most serious current threats to biological diversity as well as the primary cause of recent extinctions (Jackson *et al*., 2013). The Secretariat of the Convention on Biological Diversity (SCBD, 2014) emphasized that actions are required to minimize the negative impacts on biodiversity. It was believed that such actions can support a broad range of societal benefits laying the ground work for socioeconomic transition to a more sustainable and inclusive model of development options. Moreover, predicting the implications of the interaction between habitat loss and climate change helps to understand the implications for biodiversity loss and conservation priorities (Mantyka-Pringle *et al.,* 2015).

In the cause of Ethiopia, both direct and indirect causes and consequences of biodiversity loss attracted attention to heighten Ethiopia's commitment to design and implement conservation strategies to save the country's genetic resources. Such direct drivers include habitat conversion, unsuitable resource utilization, invasive species, coupled to climate change and population pressure whereas the indirect drivers include demographic changes, poverty, and low level of awareness and lack of coordination (EBI, 2015). Hence, the Ethiopia's revised National Biodiversity Strategy and Action Plan 2015-2020 is a good implication of the implementation of CBD targets within the context of Ethiopia's real situation to reverse the challenges (EBI, 2015).

2.5. Measurement of Diversity

It is often noted that biological diversity is not evenly distributed all around the globe and one can measure diversity at different scales. The World Conservation Monitoring Centre (WCMC, 1992) noted that the overall diversity of any given area will be a reflection of both the range of habitats it includes and the diversity of the components of habitats. They also added that analysis of worldwide trends in biological diversity often treats the global distribution of species richness as species richness is the only indicator of diversity for which anything approaching sufficient data is available on a global scale. The National Research Council (NRC, 1999) reported that statistical indices of species diversity are used to compare biodiversity among areas. Such statistical indices help scientists whether biodiversity has changed or not through trend analysis although it has its own advantages and disadvantages. It was further noted that such indices combine two different metrics namely: the total number of species, richness, and the relative abundance of all species, evenness, in a sample. Among the disadvantages of diversity indices is that similar values of an index might reflect different sample compositions and a given index value could also reflect a high species richness.

2.6. Floristic Diversity

Mayers *et al*. (2000) noted that it is possible to support the most species for conservation, management and sustainable use at the least cost through identifying biodiversity hotspots which is among the best approaches to take priority measures. Lawrence and Hawthorne (2006) emphasized that plant identification is an important component of floristic studies that help to manage resources accommodating all of humankind and their aspirations for the benefit of life on earth. They further elaborated that maintaining climate regulations, food security, medicinal plant studies and drug discoveries alleviates the benefits and meaning of nature and its resources for our planet earth's diverse cultures and religions which is one of the main concerns of the broad concepts of biological diversity.

Hence, understanding the local and regional diversity patterns is critical for efficient conservation and management planning where vegetation inventory and forest classification systems can be very valuable in connection with emphasizing the roles of Traditional Ecological Knowledge (TEK) systems that have been accumulated empirically over generations (Halme and Bodmer, 2006). Moreover, understanding the present diversity status and forest biodiversity conservation is made possible through floristic inventory and diversity assessment (Jayakumar, *et al*., 2011). Hence, inventory and diversity studies are taken up globally at different levels despite the variations in methods and techniques followed during the studies and it is an integral part of gap filling activities in biodiversity knowledge pool for conservation and management.

Floristic diversity assessment helps to provide scientific data based information to design conservation plans. Rai *et al*. (2012) also added that strategies for plant identification through integrated approach of classical morphology, herbarium reference specimens, monographs, floristic treatments coupled to the use of molecular techniques to examine plant taxonomic relationships is the increasing interest of modern science.

In the context of our vegetation resources, the contribution of our modern Flora of Ethiopia and Eritrea to various aspects of the biological diversity of the country is of paramount importance. Local floristic diversity analysis is among the key elements of vegetation studies that can contribute a lot to biodiversity management by conservationists at local, regional and global scales. The completion of the Ethiopian Flora Project that documented 6,027 vascular plant taxa with 10.074% endemism along with information on the description, ecology and distribution (Sebsebe Demissew, 2014; Ensemu Kelbessa and Sebsebe Demissew, 2014) is a good example of local contributions to the global biodiversity information pool. The authors further noted that different specialized research and conservation initiatives have been made possible through the publication of a complete modern Flora of Ethiopia and Eritrea locally and it is a good example for other countries intending to write their Floras in the future as underlined by Ensemu Kelbessa and Sebsebe Demissew (2014). It is also obvious that changes of Flora information over time may occur and hence continuous floristic studies is needed to keep up up-to-date information about any changes that may occur through time (Friis, 2014). The above scenario is also what the Ethiopian Flora has already completed although future updates are needed.

2.7. Floristic Richness and Endemism

2.7.1. Floristic Richness

Ethiopian is characterized by a wide range of agro-climatic conditions accounting for the huge diversity of biological diversity existing in the country (Hurni, 1998; Mosisa Worku *et al*., 2012). Despite presence of enormous biological diversity, there are gaps in the availability of sufficient data and information on the floristic richness of the country (Edwards *et al*., 2001; Sebsebe Demissew *et al*., 2005). Sebsebe Demissew *et al.* (2005) for instance reported that the vegetation in the western Ethiopian escarpment such as the Benshangul Gumuz National Regional State is still fairly intact but imperfectly known. Furthermore, they added that there is only few detailed information about the environment of western Ethiopian escarpment due to the fact that the areas have had little attention before the beginning of the Ethiopian Flora Project. Similarly, Friis (2009) reported that floristic regions such as Wellega and Ilubabor are under collected.

Sebsebe Demissew *et al*. (2005) noted that that the flora area covered by the vegetation of western Ethiopian escarpment is not well known and only rough estimate is presented. Since the two areas; the western Ethiopian escarpment of Benshangul Gumuz and Sheka Zone of southwestern Ethiopia where this study is carried out are at a relatively similar eco-regions in terms of accessibility for floristic data collection, the amount of detailed information about the vegetation of Sheka Zone is also not sufficient. Friis (2009) summarized the general trends of floristic richness as; the southwestern, southern and southeastern parts of Ethiopia have the highest richness although the values found for richness in some areas such as the Shewa floristic region clearly reflects high collecting intensity whereas the most humid areas in the southwest with more than 2000 mm rainfall per annum are not the richest.

2.7.2. Endemism

Africa is known for the Guineo-Congolian, Somalia-Masai and Afromontane archipelago-like regional centers of endemism (White, 1983). The vegetation of Sheka Zone also belongs to the Afromontane-like region of endemism and it is recently (in 2012) demarcated as one of the world's biodiversity hotspot areas by UNESCO under the Sheka Forest Biosphere Reserve (Tadesse Woldemariam and Fite Getaneh, 2011; UNESCO-MAB, 2015).

The National Research Council (NRC, 1999) noted that as one moves across a region, the species composition might change highly even though the specie number might not indicating that changes in species in a region is an important measure of diversity. Hence, species restricted to a unique particular area said to be endemic to that area. Floristic analysis of local and regional endemism valuably contributes to the global concerns of endemic species to take conservation measures by concerned bodies such as the IUCN Red List of species (Walter and Gillett, 1998; Baillie, *et al*., 2004).

Vivero *et al.* (2005) also noted that the countries of Ethiopia and Eritrea are among the richest assemblages of plants in the Horn of African continent. The authors further added that there is yet no complete red list of plants for Ethiopia and Eritrea despite the Horn of African Region is a major centre of plant diversity and endemism. Here is where plant systematists and conservationists are expected to work hard on regional basis availing information for conservation concerns and planning. Progress on the Red List of plants of Ethiopia and Eritrea as reported by Vivero *et al.* (2006) indicated that there are 464 threatened taxa, three times more than the 1997 Red List report with over all endemism of 9.7% where nine local centers of endemism were identified for Ethiopia. Accelerated rates of the gradual extinction of species due to transformation of ecologically diverse natural areas into homogenized agro-ecosystems heighten the estimated number of Red Lists of Threatened Species (Deke, 2008).

Many studies in the central plateau of Ethiopia revealed that the huge landscape and climatic diversity of the country is responsible for making Ethiopia home to numerous endemic species of flora. They further added that Ethiopia is known for its relatively better floristic richness in Africa with about 10.74% endemism (Teshome Soromssa and Ensermu Kelbessa, 2013; Ensermu Kelbessa, 2014; Fikadu Erenso and Melese Mariyo, 2014). The authors concluded that there was a possibility of designating the Horn of African Region as a world hotspot with more than 1500 endemic plants and hence it is a good justification for the recent finding of the Sheka Biosphere reserve (Tadesse Woldemariam and Fite Getaneh, 2011; Tadesse Woldemariam and Masresha Fetene, 2012).

2.8. Diversity: Spatial and Temporal Dimensions

Changes in biodiversity through time and space are among modern concerns that attracted a wide range of audience where conservationists and biodiversity professionals have to work on a lot to reverse the ever increasing challenges. Glen-Lewin and Van der Maarel (1992); Van der Maarel (1989) noted that temporal and spatial patterns of vegetation dynamics reflects processes and patterns that cannot be easily generalized. Smith and Huston (1989) added that the ecological consequence of evolutionary adaptations to unique set of environmental conditions is the pattern of plant distributions across the range of environmental conditions on a landscape through time and space. Therefore, it is worth considering the value of integrating concepts stated by different scholars bearing in mind the conclusion put forward by Van der Maarel about the relevance of temporal time scale, degree of isolation and level of integration as the major forms of vegetation dynamics which in turn depends on the average lifespan of the prevailing species of plants.

The Millennium Ecosystem Assessment (MEA, 2005) noted that data to hand are often insufficient to provide accurate pictures of the extent and distribution of all components of biodiversity in relation to hotspots, biomes, bio-geographic realms, ecosystems as well as eco-regions. Moreover, MEA added that understanding of patterns of biodiversity over time allow for only very approximate estimates background rates of extinction where there is a mismatch between the dynamics of changes in natural systems and human responses to these changes. A good justification is that biodiversity has been relatively constant over most of human history except for the last 1000 years as it is perceived from past global scenarios (MEA, 2005). Losos and Ricklef (2010) also added that dynamism of vegetation in space and time can be explained through the application of island biogeography concepts and hence biodiversity too. Moreover, events and ecosystem changes have something to do with the ever increasing human population that poses devastating impact on human health, nature and its resources leading to future famine hence need special attention (UNEP, 2012, 2015).

2.9. Plant Communities

Practical ecological problems such as biological conservation and management processes can be possibly managed through information inputs from study of vegetation (Kent and Cocker, 1992; Kent, 2012). The Braun-Blanquet approach, often called phytosociology, was among the prominent frontiers of vegetation science in the early decades of the 20th century (Grabherr *et al*., 1990; Van der Maarel and Franklin, 2013). Van der Maarel and Franklin (2013) defined a plant community as a relatively uniform piece of vegetation in a uniform environment with recognizable floristic composition and structures that is relatively distinct from the surrounding vegetation. They further noted that to convey information about vegetation and its environment, plant community analysis can be a convenient unit.

The above concept is in line with the idea already stated by (Kent, 2012; Kent and Cocker, 1992) that there was a debate between the two schools of thought about the existence of plant communities. The early plant ecologists expressed the most extreme points saying that on one hand, the Clements's view of plant community as recognizable and definable entities or the organism concept of communities. The second school of thought on the other hand known as Gleason's view or the individualist concept believes that species assemblages may change considerably through time and space and hence spatial boundaries of communities are not sharp (Verhoef and Morin, 2010; Kent, 2012). In connection with the above concepts, the concept of diversity indices is also worth remembering that alpha diversity or within community diversity, beta diversity or between community diversity and gamma diversity or within landscape diversity all concerned with species diversity or the variation in taxa are important parameters to be considered (Lepš, 2013). Hence, plant community and floristic analysis of given vegetation provides the basis for predicting possible future scenarios in plant distributions linking to human impacts on habitats through land use as well as climate concerns.

2.10. Ethnobotany

Ethnobotany is the scientific study of the relationship between plants and people (Martin, 1995; Cotton, 1996). When such kind of study is turned to the investigation of plant-people relationships in the past, it is referred to as archeobotany or paleobotany. Ethnobotanists aim to document, describe and explain complex relationships between cultures and issues of plants focusing primarily on how plants are used, managed and perceived across human societies as food, clothing, currency, rituals, medicines, dye, construction, cosmetics, and many more. According to Martin (1995), the study of people's classification, management and use of plants or more simply the science of ethnobotany is an endeavor which attracts people from various academic disciplines. Ethnobotanists and local people face the challenging task of not only recording knowledge of the plant world but also applying the results of their studies to biodiversity conservation and community development. In summary, ethnobotany is a multi-disciplinary science encompassing botany, anthropology, economics and linguistics which studies the ways in which a society relates to its environment where indigenous knowledge and practices play significant roles in scientific disciplines (Martin, 1995; Balick and Cox, 1996; Cotton, 1996; Grenier, 1998; Cunningham, 2001). Hence, ethnobotany is the study of the interrelationships between people and plants, particularly the way in which plants impact on human culture, and practices and how humans have used and modified plants, and how they represent them in their systems of knowledge. These relationships can be social, economic, symbolic, religious, commercial, and artistic practices.

According to Cunningham (2001), the effect of harvesting individual plants will vary obviously according to what part of the plant is used. Hence, Cunningham emphasized that long before any conservation biologist, local resource users walk further or pay more for scarce resources and thus aware of scarcity. The knowledge and practice of such individuals provide short-cut for local inventories of important species and its economic value in terms of time, money and energy thereby enabling biologists to monitor key species. Ethnobotaists performing field research today know that to fully understand and appreciate native plants, one must be knowledgeable both in the study of plants and in the observation of the indigenous culture (Young, 2007).

Ethnobotanical knowledge is a rapidly growing science. In this respect, Hamilton *et al*. (2003a) indicated that the purposes and teaching of applied ethnobotany in the past have all too often been just academic exercises or have served only external interests, with the results benefiting neither local people nor conservation. But in the current approach it is cross-disciplinary, participatory, and geared towards local problem solving. The fundamental strengths of applying the approaches and methods of applied ethnobotany are that: they allow the knowledge, wisdom and practices of local people to play important roles in identifying and finding solutions to problems of conservation and sustainable development; local people are involved fundamentally in investigations so that there is a better chance of involvement; realistic case-studies serve as ways of balancing conservation with sustainable use and would help in developing appropriate policies towards their proper implementation (Hamilton *et al*., 2012).

It is also worth remembering here that when knowledge of ethnobotany is integrated into indigenous knowledge and the scientific principles and concepts so as to attain both short-term and long-term aims, it is best referred to as ethnobotanical knowledge (Grenier, 1998; Hamilton, 2003). It was also argued that understanding the heterogeneity of knowledge and practices within a given area is crucial to design management practices that are built on the intricate links between knowledge, practices and institutional context (Ghimire *et al*., 2004). According to Garcia *et al*. (2007), studies of individual ethnobotanical knowledge have the potential to contribute to a systematic understanding of humanity's most widespread and ancient form of knowledge.

Ethnobotany and Taxonomy

Since ethnobotany is a multidisciplinary subject and the science of systematics is the key for knowing what the plant species under question is all about, the concept and applications of the two subjects are inseparable. In this regard, the work by Burger (1967) on the families of flowering plants of Ethiopia and later the publication of the Ethiopian Flora are good success in knowing the vegetation potential of Ethiopia and associated ecosystem diversity, yet there is a gap in amount of available ethnobotanical information included in these publications. Hence the role of plant systematics in the application of ethnobotanical concepts and principles through integration is a very important one.

Reviewing comparative studies undertaken both in Ethiopia and elsewhere on wild edible plants with regard to their processing and commercialization helps to identify the knowledge of sustainable utilization, promotion and conservation gaps. Hence, experiences from other countries could be the lessons learned for Ethiopia to design research projects on proper use and management of vegetation resources in general and wild edible plants in particular. It is also a good idea to assess the brief insight of the roles of ethnobotanical investigations in connection with taxonomic knowledge that can be applied to conservation and management of natural resources, biodiversity and environment in general and vegetation resources in particular.

2.10.1. Medicinal Plants

The World Health Organization WHO (1998) defined a medicinal plant as a plant that has been used for medical purposes at one time or another and which, although not necessarily a product available for marketing, is the original material of herbal medicines. The work of the United

Nations Environment Programme (UNEP, 1999) on the value chain of medicinal plants can be viewed in several dimensions including health, spiritual, food and the like. It was noted that local health traditions, for instance, urge medicinal plant collectors to worship the medicinal plants praying to them before collecting with the real intention that recognition and acknowledgment of the spiritual properties of the plants assures potency through such traditional beliefs. The World Health Organization (WHO, 2002) added to this concept that traditional medicine is an important element of healthcare system as a frequently well established, preventive, curative as well as rehabilitative modality which depends on the nation's historical development of traditional medicine where herbal medicine is more prominent.

According to WHO (2002), many countries use traditional medicine for their primary healthcare system; Ethiopia (90%), Benin (80%), India (70%), Rwanda (70%), Tanzania (60%), Uganda (60%), China (40%) and Africa total (80). From historical perspectives, Jiuzhang and Lei (2010) noted that the establishment of traditional medicine in countries like China is based on thousands of years of experiences owing to prescriptions, principles and reflections on the human-nature relationships. Rai *et al*. (2012) underlined that medicinal plants have been cornerstones of healthcare systems since immemorial times probably over 4000 years. However, from the global perspective, there is lack of complete information on traditional herbal medicine that is collected and stored in databases for global use for the establishment and development of research programmes. Osuki (2014) concluded that traditional medicine in Africa has remained an enduring future of the family in particular and of the African society in general.

Ethiopian medicinal plants

There are number of research out puts indicating the presence of vast number of plant species used as traditional medicines in Ethiopia. However, information on the total number of medicinal plants is limited. Hence, there is a need to bring the different ethnobotanical research reports together to get the exact figure. In the absence of diversity studies, the tentative list of indigenous medicinal plants provided in the published Flora of Ethiopia and Eritrea may form the basis for collection, conservation as well as sustainable utilization of available Ethiopian medicinal plants (IBC, 2000, 2005). Tessema Tanto *et al.*, (2003) reported the presence of 887 medicinal plant species in Ethiopia of which 2.7% are endemic and mostly found in the wild habitats. However, limited information about the chemical profile of these medicinal plants is available. Hence, screening of ethnomedicinal plants is needed to evaluate their pharmaceutical potential to discover new knowledge (Abera Geyid *et al.*, 2003). Moreover, Tesfaye Awas (2007) recommended that detailed information on Ethiopian medicinal plants can be obtained when studies are undertaken in different parts of the country where there are limited ethnobotanical studies. In Ethiopia, medicinal plants have considerable roles in traditional healthcare system where greater than 70 percent of humans and 90 percent of livestock populations depend on traditional herbal medicine at present (EBI, 2015).

UNEP (1999) underlined that harvesting scales of medicinal plants is much greater than their sustainable use because local herbal practitioners over-exploit herbs in local healthcare. It is worth remembering here the harvesting impacts on medicinal plants as stated by Cunningham (2001, 2008). Consequently, the number of medicinal plants appears to be at the verge of extinctions mainly due to human actions that are distructive to the natural ecosystems in addition to over harvesting. Similarly, the Ethiopian Biodiversity Institute (EBI, 2015) noted that most of the medicinal plants utilized in Ethiopia are collected from the wild habitats and thus are threatened by human induced activities such as uprooting and unsustainable utilization although some efforts have been made to conserve and promote sustainable utilization.

Pertaining to the absence of scientific information on medicinal plants both nationally and globally, the World Health Organization (WHO) in its global survey on national policy and regulation of herbal medicines noted that countries are encouraged to prepare their own monographs using the monographs prepared by (WHO, 1999; 2002; 2007; 2009) as an authoritative reference. It was further noted that WHO strategy 2014-2023 (WHO, 2013) also emphasized that there is a need to integrate traditional herbal medicine with conventional modern medicine. The main connotation of WHO (2013) is that ensuring all people's access to healthcare through promoting traditional medicine of proven quality, safety and efficacy ensures fostering appropriate integration, regulation and supervision and to developing proactive policies towards medicinal plant use.

Having all the above concepts in mind, it is going to be a good idea to return back to the important recommendations put forward by Rai *et al*. (2012) about the roles of ethnobotany in knowledge integration. The authors summarized that over the millennia, the knowledge of plant preparations, the methods of administration of the medicine and cultivation become too much to remember and hence it becomes a written record creating critical opportunity for the future of humankind. They further noted that traditional medicinal practice all around the globe can be integrated through ethnobotanical exploration of the various new strategies in regulation, information systems, botany, chemistry, biology and chemical trials.

2.10.2. Wild Edible Plants

According to Hamilton (2003b), agriculture provides the great bulk of food supporting people on Earth although a very high percentage of terrestrial primary production is being devoted to this cause; 700-800 million people still lack adequate access to food. In this regard, Hamilton noted that it is not hard to predict that demands for food will rise sharply, not least because the size of the human population itself is predicted to grow from 6 billion in 2003 to 8.3 billion in 2025. On that note, the data sources from the United Nations Population Fund; UNPF (2011) indicated that the world population has currently reached seven billion (beyond the prediction by Hamilton) or else which is in line with Hamilton's prediction on the ever increasing size of human population of the world. There is considerable disagreement about how best to meet this challenge, a problem compounded by the likelihood of considerable environmental uncertainty, for example due to climatic change. Many wild edible plants have their own share in combating the problem if properly studied, documented and utilized following integration of ethnobotanical knowledge system of indigenous community and the scientific world. There have been dramatic changes in agriculture in many parts of the world over recent centuries and decades. Individual research and suggestions from friends and neighbors must have always been normal parts of farming life as farmer's knowledge has dramatic influence on any development plan as well as research activities that are going to be undertaken.

Zemede Asfaw and Mesfin Tadesse (2001) stated that some plant species are wild and others are slightly or strongly associated with humans revealing a living analogue of the wild-semi-wild-domesticated continuum. Moreover, wild edible plants are considered "Hidden Harvest" and play a critical role in ensuring food and livelihood security for countless families and communities around the world (Demel Teketay *et al*., 2010; Neudeck *et al*., 2012; Babitseng *et al.*, 2013; Badimo *et al*., 2015). Furthermore, the authors noted that wild edible plants are collected to improve diets, serve as sources of food for people in times of famine, supplement income, and provide genetic material for experimentation, medicines, food, feed, utensils as well as craft and building materials. Moreover, they are good source of income in market at local, national as well as international levels.

A number of authors discussed the potential of Ethiopia in harboring a number of underutilized edible plants most of which are wild edibles (Zemede Asfaw and Ayele Nigatu, 1995; Zemede Asfaw and Mesfin Tadesse, 2001; Tigist Wondimu *et al*., 2006; Demel Teketay *et al.,* 2010; Ermias Lulekal *et al*., 2011; Neudeck *et al*., 2012; Getachew Addis *et al*., 2013). A study conducted on prospects for sustainable use and development of wild food plants in Ethiopia by Zemede Asfaw and Mesfin Tadesse (2001) noted that information on wild edible plants of Ethiopia is scattered in botanical monographs, glossaries, and informal notes as well as in the rich oral traditions of the different communities.

CHAPTER THREE

3. Materials and Methods

3.1. The Study Area

3.1.1. Location

Sheka Zone is located at approximately 700 km southwest of Addis Ababa in the Southern Nations Nationalities and Peoples Regional State (SNNPRS), SW Ethiopia. It is bordered by Bench Maji Zone in the south, Kefa Zone in the east, Oromia Region in the north and northwest and Gambella Region in the west. The geographical coordinates of Sheka Zone based on actual field observation lies between 07°07.494’ to 07°52.301’N and 035°16.576’ to 035°39.516’ E with altitudinal ranges of 950 (Bako River Gorges in the south) to 2780 (peak around Lake Gandochi in Andracha District) masl. The average elevation of the Zone is about 1846 meters and composed of three districts; Yeki, Andracha and Masha with three urban centers namely Tepi, Gecha and Masha respectively (CSA, 2008, 2011) (Figure 1).

3.1.2. Geomorphology

According to Lovett and Waster (1993), recent rift tectonics and volcanism have changed some spectacular scenery found in countries like Burundi, Rwanda, Uganda, Ethiopia, Kenya, Tanzania and Malawi resulting in Eastern African monotonous landscapes. Physical observation of the geomorphologic features of Sheka Zone reveals diverse landscapes with associated plant species which varies accordingly from the very lowland areas of Yeki district to the very highland areas Masha and Andracha Districts.

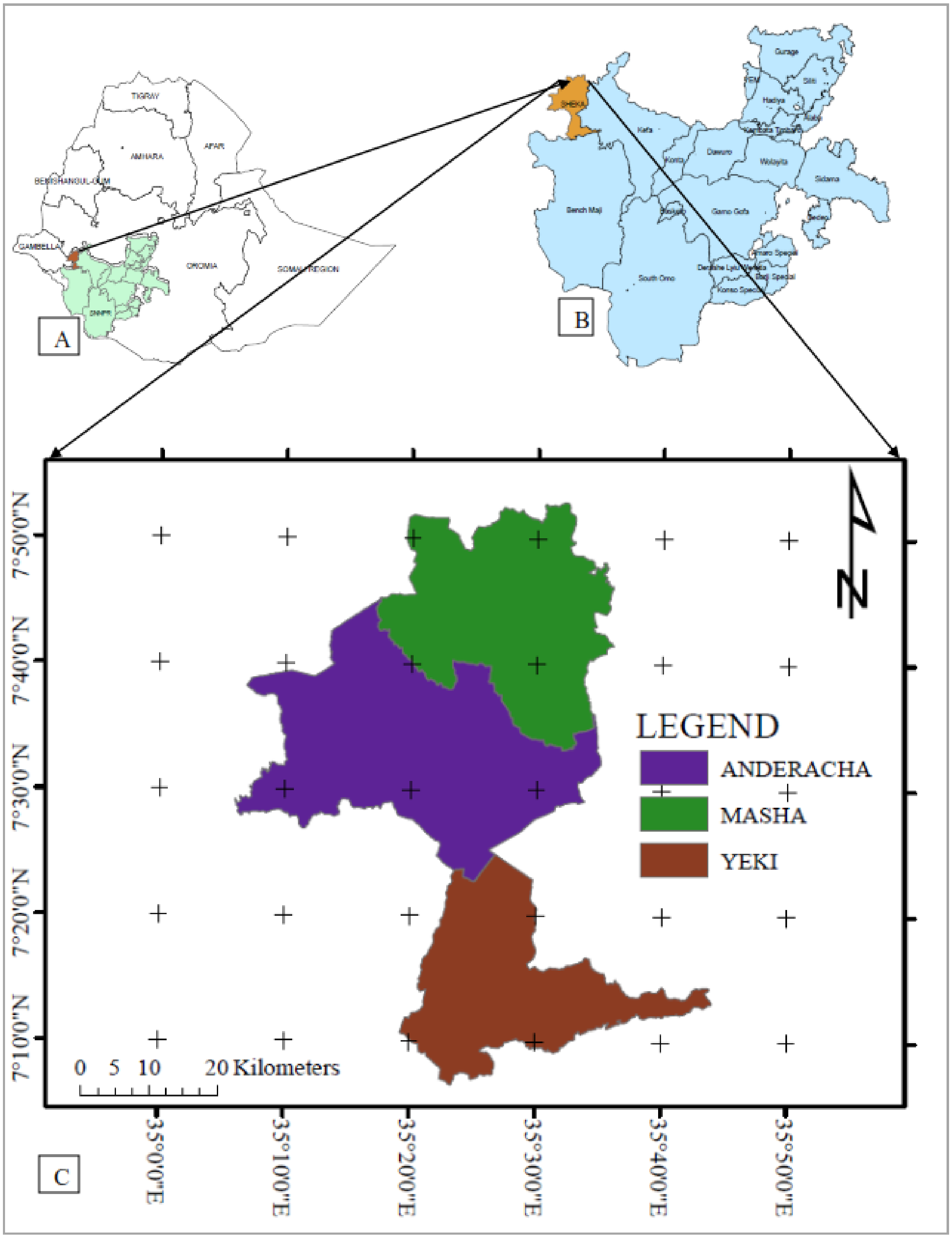


Figure 1. Map of Ethiopia showing the location of the study area

Key: A) Map of SNNPRS in SW Ethiopia, B) Zones in SNNPRS and C) Districts in Sheka Zone

The highest elevation in the zone was recorded in Andracha District around Lake Gandochi at about 2780 masl. The lowest elevation was recorded around Bak'o River in Yeki at 950 masl (Figure 2). An undulating landscape with pure stands of *Arundinaria alpina* and mosaics of tree species such as *Ilex mitis* and *Schefflera volkensii* running east-west approximately 100 km covering part of Andracha District and part of the Masha District is among unique features of the landscape in Sheka Zone. The landscape extends from the highest peak of Bushashi Mountains near Lake Gandochi of Yukchichi KEBELE in Andracha about 2700 masl from the east to 2350 masl around Atile KEBELE of Masha District from the west. The *Arundinaria alpina* dominated vegetation creats a curve on the undulating landscape of the Highland Bamboo Conservation area at Gada KEBELE (smallest administrative unit) locality demarcated by Ethiopian Biodiversity Institute extending to the extreme of Sheka and Kefa Zone boundary in the east and to Atile KEBELE of Masha District in the west.

Landscape in Yeki District is described by ups and downs of disturbed lands with scanty vegetation within altitudinal ranges between 950 and 1600 masl. Bako River is the largest in the district with many of its tributaries. It divides the district into two parts with its incised valleys and deep gorges where the lowest point was recorded during actual field work. It flows from Northeast to southwestern direction creating a boundary between Sheka Zone and Bench Maji Zone in the south.

Landscape in Andracha District is characterized by diverse morphological features. The lowest elevation is found around the Gambella border along the Ganji River basin in Shakibedo KEBELE about 50 km west of Gecha Town. The highest elevation is found around Lake Gandochi northeast of Gecha Town. The undulating block mountains surrounding Gecha Town with its associated intact vegetation cover is among the most attractive landscapes in Sheka Zone. The largest river in Andracha District is Ganji River dividing the district from east-west direction and passes about 2 kilometers north of Gecha Town.

Landscape in Masha District is very variable starting from the lower altitudes around Baro River Basin at about 1600 masl in the northwest with highly disturbed habitats due to tea and coffee plantations to higher altitudes of Kanga and Gada localities about 4500 masl which is part of the *Arundinaria alpina* dominated vegetation in the south. Three major big rivers in Masha Distrct are Wanani, Gama and Duchi Rivers that are directly flowing into the Baro River as tributaries.

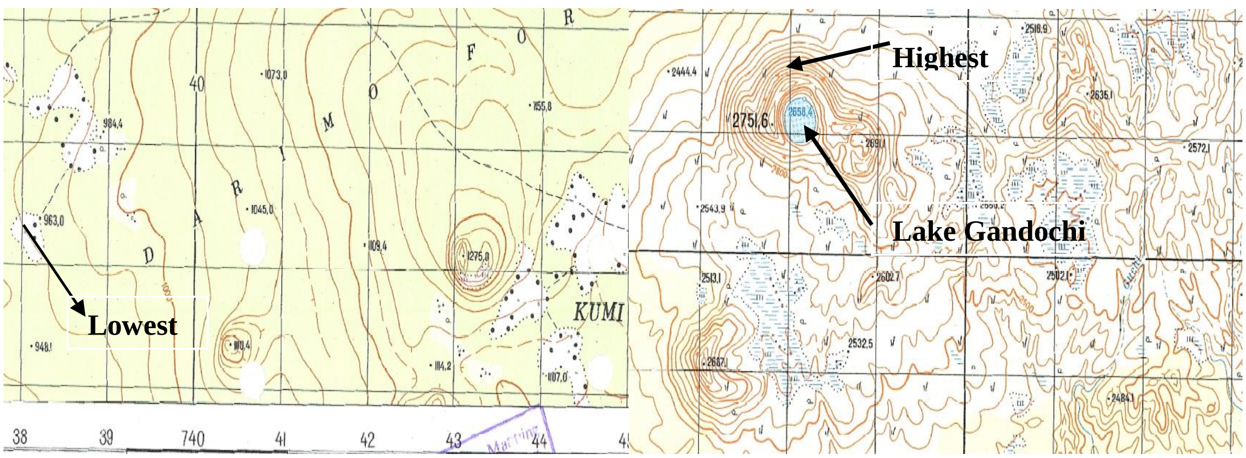


Figure 2. Elevation range in Sheka

(Source: Ethiopian Mapping Authority, 1986 Topographic Sheet)

3.1.3. Geology

Davison and Rex (1980) explained that volcanism in the Ethiopian region of the Afro-Arabian Rift system has migrated with time both laterally and longitudinally representing that change has taken place in temporal and spatial dimensions. Friis *et al*. (1982) added that Precambrian rocks underlie all other rocks in Ethiopia forming a more or less level land surface produced by erosion over a long period, undisturbed by crustal movement basement of highly folded metamorphosed sediments and igneous intrusions that the country consists basically of two plateau regions divided by the Rift Valley and bounded on all sides by lowland plains. Recent studies have confirmed that the Afro-Arabian Rift system gets wider and complex in southwestern Ethiopia extending from east to west in the southern extreme of the main Ethiopian Rift (Roberts and Bally, 2012).

Analysis of sub-lithospheric quaternary alkaline from Tepi shield for instance represented the geochemical variations observed in the Tepi lavas. It was interpreted in terms of variable open systems fractional crystallization of a magma sourced from primitive mantle like sources (Dereje Ayalew *et al*., 2006). Hence, it is a good justification that the earliest Tertiary volcanism in East Africa is found in south and southwest Ethiopia supporting the idea that the Afro-Arabian large igneous province includes the Tepi-Masha geological history. This takes us to the conclusion that the geological setting of Tepi area of Sheka Zone originated from Miocene basalts while that of Masha-Andracha area of Sheka Zone is better explained in terms of Oligocene basalt and rhyolites (Ernesto Abate *et al*., 2015).

Furthermore, geological studies revealed that the Ethiopian region is known to be about one billion years of geological history with the development of the Ethiopian basement ranging from 880 to 550 Million years of age (Ernesto Abate *et al*., 2015). The authors emphasized that the transition to the southwestern plateau volcanites is marked by a 700 km long and 80 km wide east-west trending volcano tectonic alignments. Ernesto Abate *et al.* (2015) summarized that the simplified geological map of Ethiopia, the geology of Sheka Zone and its surrounding areas is represented by the Pleistocene-Holocene volcanites in Yeki District and the Oligo-Miocene trap basalt as well as Neoproterozoic basement rocks in Masha-Andracha Districts.

3.1.4. Climate: Rainfall and Temperature

The weather and climate in Yeki District where elevation is below 1600 masl is characterized by high temperature, high moisture and low wind speed. The climate in Andracha and Masha Districts is closer to each other and relatively moderate. Analysis of secondary climate data from Ethiopian National Meteorological Service Agency (ENMSA) for the years1999 to 2014 indicated that the monthly minimum and maximum temperature for Tepi is 13.0°C and 33.3°C respectively with annual average of 22.4°C with average annual rainfall of 1547 mm while that of Masha is 10.1°C and 24.8°C respectively with annual average of 16.9°C with average annual rainfall of 2190 mm.

Since there is no weather stations available for Adndracha District and the climate of Masha and Andracha Districts are closer together as both districts are at relatively the same average elevation, the data obtained for Masha District may possibly work for Andracha District (Figure 3). The rainfall type for the whole zone is uni-modal with almost all year round. Sheka Zone is traditionally classified as 56% highland, 24% midland and 20% lowland (Mohammed Worku, 2010). It also receives high amount of rainfall with an average between 1800 and 2200 mm per annum where such agroclimatic data indicates partly the Moist-Evergreen Montane Forest vegetation and partly the transitional forest vegetation with their respective characteristic plant species (Friis *et al*., 2011).

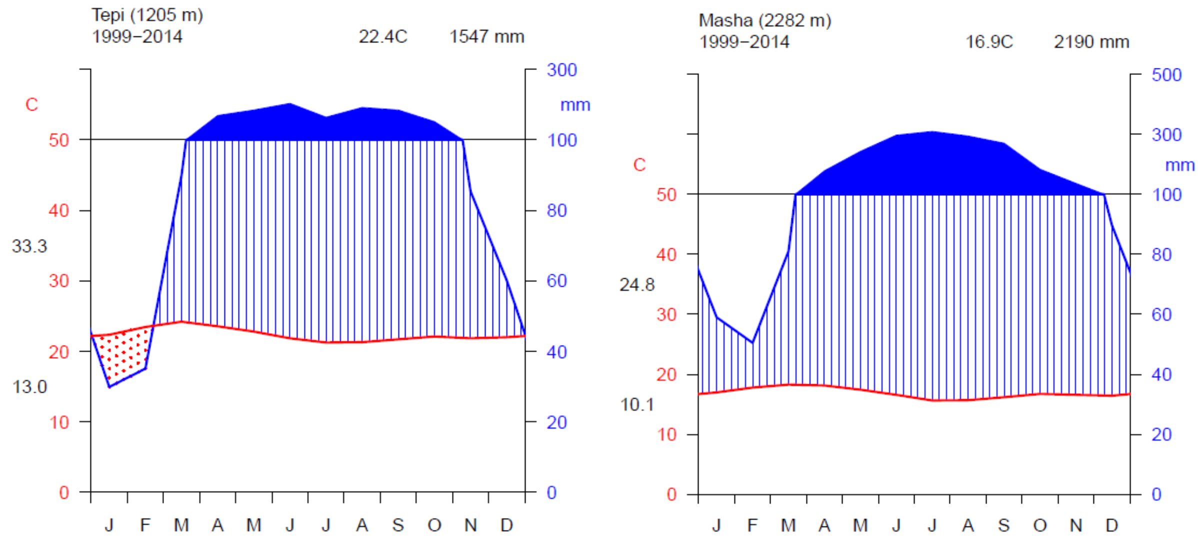


Figure 3. Climate diagram of the study area

(Left: Tepi; Right: Masha; Data source: EMNSA); NB: Letter C in the climate diagrams is to mean °C.

3.1.5. Vegetation of the Study Area

The forest vegetation in west of the Ethiopian Rift Valley belongs to the humid broad leaved forest, including the humid transitional forest of the southwestern Ethiopian escarpment, of the southwestern plateau in Wellega, Ilubabor and Kefa floristic regions (White, 1983; Friis, 1986). In the context of this work, the vegetation of Sheka Zone belongs largely to the Ilubabor (Masha, Andracha and part of the Yeki Districts) and slightly to the Kefa (part of the Yeki District) floristic regions.

According to Mohammed Worku (2010), Sheka Zone covers an area of about 2175.25 km^2 of which about 47% is covered by forests and it is one of the few remaining forests found in Ethiopia. The area receives high amount of rainfall with average between 1800 to 2200 mm per annum (Friis *et al*., 2011). The authors further noted that areas with an annual rainfall between 700 and 2000 millimeters or more are marked as the moist evergreen Afromontane forests in the western high lands and the vegetation of Sheka Zone belongs partly to the Moist Evergreen Afromontane Forest and partly to the Transitional Forest vegetation type. Some of the common plant species in the study area include *Albizia gummifera, Arundinaria alpina, Bersama abyssinica, Cordia africana, Cyathea manniana, Polyscias fulva, Pouteria altissima, Pouteria adolfi-friederici, Alastonia boonei, Prunus africana, Schefflera abyssinica, Syzyguim guineense subsp. afromontanum, Ilex mitis,* and *Schefflera volkensii*.

3.1.6. Socio-economy

Demographics

According to the Central Statistical Agency of Ethiopia (CSA, 2008), Sheka Zone has a population size of about 199, 671 (101, 232 males and 98,439 females) of whom 165,033 are rural dwellers and 34,638 are urban dwellers with 41,462 total households. The population distribution in the three districts of Sheka Zone is Yeki District had (134150, 67.2%), Masha District (41217, 20.6%), and Andracha District (24304, 12.2%). Further data sources from (CSA, 2008) also revealed that Sheka Zone is known for very diverse ethnic groups, languages and cultures. Based on the CSA (2008) information, there are six large ethnic groups in the Zone.

In Yeki District, there are Kaficho (29.8%), Amhara (29.5%), Oromo (11.7%), Shekkacho (7.5%), Bench (7.3%), Sheko (7.3%) and others (7.0%). Similarly, Amharic is spoken as first language by 32.9% of the inhabitants followed by Kefa (28.5%), Afan Oromo (11.4%), Shakkacho (7.6%), Sheko (7.2%), Bench (6.8%) and other languages (5.7%) of the inhabitants. In the case of Masha and Andracha Districts, the five large ethnic groups are Shakacho (85.3%), Oromo (5.6%), Amhara (3.8%), Kaficho (3.4%), Sheko (0.93%) and others (0.99%). Shakkinano is spoken as the first language by 89.2% of the inhabitants followed by Afan Oromo (5.2%), Amharic (2.7%), Kafino (1.5%), Sheko (0.93%) and other primary languages (0.4%) of the inhabitants (CSA, 2008).

Urban and Rural facilities: Infrastructure, Agriculture, Health and Education

The CSA (2008) data indicated the distribution of rural agricultural development centres. There are five development agents (DAs) offices in Masha, three in Andracha and three in Yeki Districts. There are two farmers training offices in Masha, two in Andracha and seven in Yeki. Similarly, the distribution of Sheka Zone Rural Health facilities indicate that as of the 2007 population census, there were thirteen clinics and one health post in Masha District, three clinics one veterinary and one health post in Andracha and twelve clinics, one veterinary and two pharmacies in Yeki District with a total of 34 rural health facilities at zone level (Masha 14, Andracha 5 and Yeki 15). Moreover, the distribution of rural educational facilities indicates that as of the 2007 population census, the zone total is 64 (with Masha 20, Andracha 15 and Yeki 29). However, all the above information is based on the 2007 population census and it is worth noting that the current up to date data would be much more beyond what has been reported during the 2007 population and housing census. For instance, Tepi Hospital of Yeki District is recently established and many more high schools are opened even at the remotest pats of the zone and care should be taken about the current figures of zone rural facilities. There is only one single gravel road crossing the zone from southeast to northwest direction and the majority of sites are very remote and inaccessible creating major challenge during actual data collection.

3.1.7. The Sheka Biosphere Reserve

According to the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2010), biosphere reserves are areas of terrestrial, coastal and marine ecosystems, internationally recognized under UNESCO's Man and the Biosphere (MAB) programme which involves and demonstrates approaches to conservation and sustainable development. Hence, biosphere reserves are places recognized by Man and Biosphere (MAB) where local communities are actively involved in governance and management, research, education, training and monitoring at the service of both socio-economic development and biodiversity conservation.

Sheka Forest is found in the Sheka Zone of the southern Nations, Nationalities and Peoples Regional State (SNNPRS) covering a unique bio-geographic unit in the area. It extends from cold and very wet highlands bordering Ilubabor Zone of the Oromia Regional State and Kefa Zone of SNNPRS. Sheka is an Administrative Zone in SNNPRS where one of the few remaining wet forests found in Ethiopia covering more than 47% of the total land area (http://www.melca-ethiopia.org). The rich cultures of Sheka are an important part of the biosphere reserve shaping the landscape and the sustainable development of the area. It was also noted that the Sheka Forest Biosphere Reserve has a total area of 238, 750 hectares of which 55, 255 hectares (23.14%) is designated as Core Zone, 76, 395 (30%) is Buffer Zone and the remaining 107, 100 hectares (44.86%) is Transitional Zone (http://www.melca-ethiopia.org). Movement for Ecological Learning through Community Action (MELCA-Ethiopia) is a nongovernmental organization working actively in Sheka Zone for the conservation and management of Sheka Biosphere Reserve. Hence, it is good implication that Sheka Zone is an appropriate place to take biodiversity and ethnobotanical studies to indicate possible human-nature relations and conservation based on ethnobotanical knowledge systems.

3.2. Methods

Reconniassance survey

Before starting the actual data collection a reconnaissance study was made between July and Augst, 2013. Stackeholder identification, finding out suitable time for data collection time and season for fieldwork, together with the how best ethnobotanical knowledge can be collected was done. Aerial photographs using Google Earth (Digital Globe, Spot Image and Landsat) and ground survey through recording geo-referencing followed by ArcGIS based mapping was conducted to identify clearly distinct vegetation types, physiognomy and habitat heterogeneity.

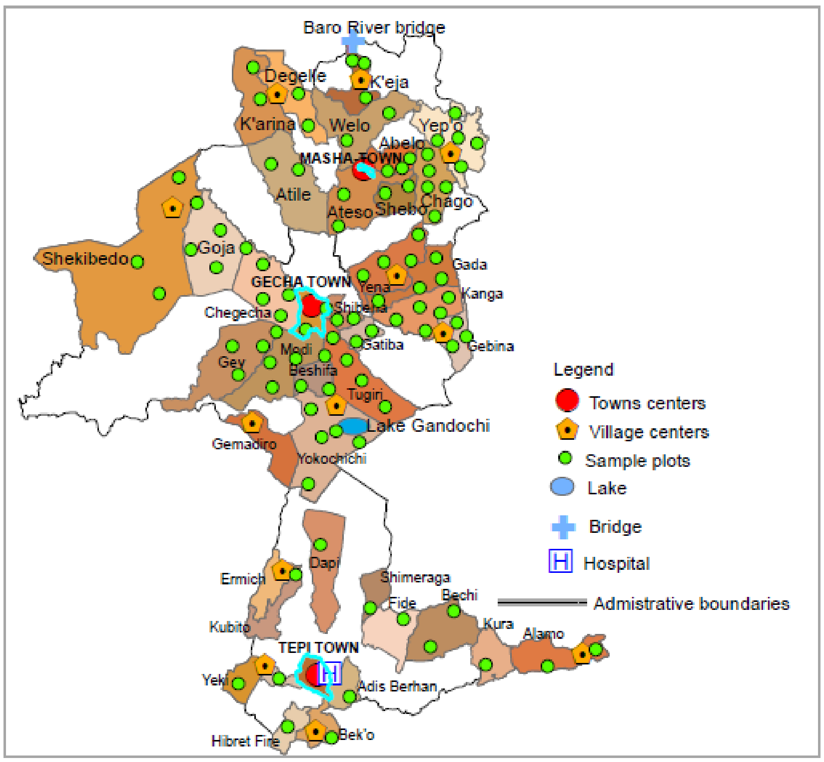


Figure 4. Layout of sampling frame for informant and vegetation sampling

Site and informant selection

It is clear that any research activity is influenced by the site selection, amount of time, money and energy available during the study. Therefore, preferential sampling technique was followed taking note of the even distribution of samples through ecological/ethnoecological proportions from 59 smallest administrative units or KEBELES (56 rural and 3 urban) in the three districts (Masha = 20 KEBELES, Andracha = 16 KEBELES and Yeki = 23 KEBELES) of Sheka Zone for both ethnobotanical and vegetation data collection. A total of 39 study KEBELES (proportionally taken from each District of Sheka Zone: Masha=13, Andracha=13 and Yeki=13) were selected based on distance from administrative towns (Masha, Gecha and Tepi), presence/absence of health facilities (clinics, health posts, nearby pharmacies) especially for collecting medicinal plant information and other infrastructures (roads and transportation facilities) were taken into consideration. These include: Atile, Degelle, K'arina, Weloshoba, K'eja, Yep'o, Chago, Abelo, Shibo, Ateso, Yina, Gada and Kanga from Masha District; Gecha, Gebina, Shebena, Gatiba, Tugri, Modi, Bashifa, Yukichichi, Gemadro, Gayi, Chegecha, Goja and Shakbedo from Andracha District; Dapi, Shomerga, Fide, Bachi, Kura, Alamo, Addis Berhan, Hibretfire, Bak'o, Darimu, Yeki, Kubit'o and Ermich from Yeki District.

Sites were first identified using satellite image from Google Earth and topographic sheets and historical map analysis of the study area. The information obtained was supported by intensive ground survey using GPS, clinometers and compass to identify the physical setup, physiognomy and vegetation heterogeneity. Sample plots and sites were then established for the entire Zone of Sheka. Three urban centers (one from each district) where the 12 village centers for ethnobotanical and floristic data collection centered were established (Figure 4). Hence, twelve cluster sites were identified during the survey and both vegetation and ethnobotanical data were preferentially sampled from the twelve cluster sites. The urban centers are Masha Town from Masha District, Gecha Town from Andracha District and Tepi Town from Yeki District. Distance from each urban centre was considered to locate the village centers preferentially placed in the way that it was suitable for both vegetation and ethnobotanical data sampling simultaneously. These are Masha-Chewaka, Masha-Yepho, Masha-Kanga and Masha-Karina from the Masha District; Gecha-Gebina, Gecha-Yukichichi, Gecha-Gamadro and Gecha-Shekbedo from the Andracha District; Tepi-Alamo, Tepi-Yeki, Tepi-Ermich and Tepi-Fide (Shomerga) for the Yeki District (Figure 4). A mosaic of vegetation and ethnobotanical samples were taken along these sampling centres.

A total of 95 plots were sampled from the whole zone proportionally (more plots taken from more dense and more heterogenous vegetation and less from less dense and less heterogenous vegetation) taken from the three districts based on their vegetation density and heterogeneity using preferential sampling technique. Species accumulation curve is used to maintain whether the floristic and species composition sampled to its maximum or not. For informant sampling, population projection based on CSA (2013) was used to determine sample size. Informant sampling was followed an even distribution for the twelve cluster sites. Thirty two informants were taken per each cluster site and a total of 384 informants were interviwed randomly. Additionally, 30 key informants were purposively sampled (384+30=414 informants for the zone total) (Figure 5). Average distance in km of respondents from respective health centres and frequency of medicinal plant citations were also recorded.

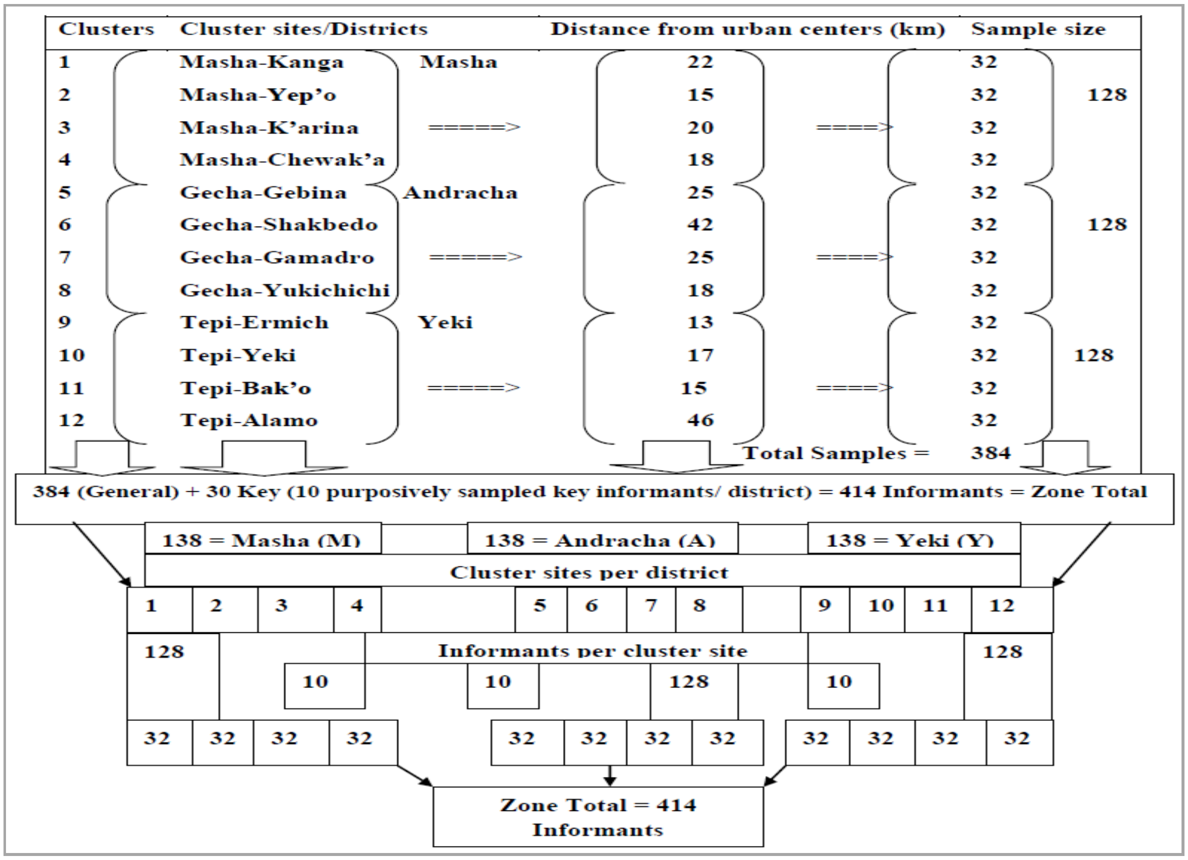


Figure 5. Flow diagram for sampling informants

3.2.1. Ecological Methods

3.2.1.1. Geo-referencing and environmental data

To determine plot coordinates and associated geophysical parameters such as slope, aspect and elevation data, global positioning system (GPS), clinometers and compass were used by setting the GPS on the projected coordinate system format (UTM_Adindan_Zone 36). Similarly, SILVA compass and SILVA ranger clinometers were used to record aspect and slope respectively right during plant specimen collection. Aspect was recorded as: N=0, NE=1, E=2, SE=3, S=4, SW=3.3, W=2.5, NW=1.3 and ridge top=4 following the modified scale for the amount of solar energy received by each site (plot) (Zerihun Woldu *et al.*, 1989 in Tamirat Bekele, 1993; Kumilachew Yeshitela and Tamirat Bekele, 2002; Simon Shibiru and Zerihun Woldu, 2006).

Geophysical features, presence/absence and intensity of disturbance were observed and recorded following the method of Milgo (2011) where the type of disturbance was determined by the real situation of the study area. Therefore, the disturbance scales were rated following Milgo (2011) as 0= no disturbance, 1= 0-20% of the plot disturbed, 2= 21-40% of the plot disturbed, 3= 41-60% of the plot disturbed, 4= 61-80% of the plot disturbed and 5= 81-100% of the plot disturbed. Similarly, grazing was also rated as 0= no grazing, 1= low grazing, 2= medium grazing, 3= higher grazing and 4= very high grazing intensities based on the number of grazing animals observed on a given plot of land during data collection.

3.2.1.2. Floristic data collection and sample plots

According to Kindt and Coe (2005), sampling design, size and shape of sample plots mainly depend on the objectives of the research project as well as the realities in the field. Hence sampling design has to be adjusted depending on specific research objectives and the hypothesis needed to be tested in this respect. This idea is also in line with the concepts stated by Van der Maarel (2005), Van der Maarel and Franklin (2013). Vegetation data collection was performed using preferential sampling techniques. It was stated that plots have been traditionally put following preferential sampling method if the researcher is interested in covering the range of variations needed in his project (Van der Maarel, 2005, 2007). Van der Maarel and Franklin (2013) also noted that defining the geographical and compositional variation in vegetation to be classified determines the number of plots needed and the difficulty of getting the plots; hence it is the first step in vegetation classification project.

Field experiences with different vegetation types minimize the difficulty to select representative sampling area during vegetation survey and sampling (Van der Maarel, 2005). Hence, the size of a sample plot also depends on the type of vegetation thereby varying from a few square meters to several hectares of vegetation under study. The authors summarized that there is no fixed sampling strategy as it is influenced by factors such as the hypothesis to be tested, the types of organisms under study, the types of vegetation under consideration, available resources to run the study project and the genuine creativity of the researcher.

Plant specimens were collected in four seasons through repeated visit of the respective plots. A plot size of 30 m x 30 m for tree species sub-plots of 5 m x 5 m for herbaceous plant species and 10 m x 10 m for shrubby plant species were used to estimate the cover abundance values of different plant growth habits. The plot layout was in a way that one sub plot from each four corner of the large plot and one sub plot at the centre for the respective growth forms. Cover abundance values for respective plant species in their respective plots were calculated following the methods of Kent (2012), Kent and Cocker (1992) then transformed. Cover was calculated as the area of the ground within a plot occupied by the above ground parts of every plant species when viewed from the above (canopy cover) visually estimated as percentage. The extended Braun-Blanquet and Domain Cover Scales as indicated in (Kent, 2012; Kent and Cocker, 1992) was used to quantify the cover abundance numerically. The species cover abundance values were then converted into appropriate numerical values to be used in the R Statistical Software for analysis following the Braun-Blanquet 1~9 scales as modified by (Van der Maarel, 2005, 2007;

Van der Maarel and Franklin, 2013) by calculating the Ordinal Transformed Values (OTV): $OTV = 1.415 \ln C + 2$ where $\ln$ is the natural logarithm and C is the cover abundance value in percentage.

The vegetation data were arranged in a three column format of creating ecological data tables for ease of analysis where the first column of the data table is the plot ID (samples) for N 1~ 95, the second column of the data table is the taxon ID (the species) and the third column is the cover abundance values of the respective taxon in the respective sample (abundance) (Zerihun Woldu in press). Careful data inspection in the three column form for possible sources of errors was made before starting data analysis then saved in the CSV(comma delimited) type in Microsoft Excel office 2007 to be run in R with appropriate file directory.

Hence, the floristic data collected were also made ready for numerical analysis. The raw data were arranged in a three column format (sites, species, and abundance) of creating ecological data tables for ease of statistical and numerical analysis using R Statistical Software version 3.2.3 (R Core Development Team, 2014) as given in Zerihun Woldu (in press).

3.2.2. Ethnobotanical Data Collection Methods

Necessary ethical clearance was made through the official letter of support written from the Department of Plant Biology and Biodiversity Management (DPBBM) to Sheka Zone Administration Office to get permission for carrying out research in the area. Then the local administrators from each KEBELE were contacted and discussions were made with each of them on how to contact the clan leaders of the respective KEBELES for ethnobotanical information retrieval. The objectives of the study were introduced to the local officials and the community as well to have common consensus and survey was done.

The ethnobotanical data collection was guided by a pre-prepared semi-structured interview (Appendix 7). Both qualitative and quantitative ethnobotanical data were collected through the application of standard ethnobotanical methods following Martin (1995); Cotton (1996); Alexiades (1996). Anthropological methods (semi-structured interview, demonstration, participant observation) were applied during data collection. Martin (1995) noted that if one is attempting to carry out the tasks in a scientifically rigorous way, interviews should be held with one individual at a time and with no onlookers nearby. Therefore, surveys and analytical tools in ethnobotany were properly applied. Ethnobotanical data from and around homegardens were collected by first surveying the types of homegardens and their orientations. Homegarden plant diversity and ethnobotanical knowledge were recorded during guided field walk and participant observation.

Informants were selected following even distribution (32 informants per cluster site) for all the twelve cluster sample sites (Figure 5, Table 1). Two types of informants were considered; those who were deliberately interviewed because of their detailed ethnobotanical knowledge as provided by the local guides, and those who were randomly picked and interviewed to make the sampling frame representative of the whole population of the study area. Sample size for informants was determined following Cochran's (1977) as:

$n_o = \frac{(t)^2 * (p)(q)}{(d)^2}$, Where t= value for selected alpha level of significance at 0.025 in each tail,

α= 1.96 in the normal distribution where the alpha level of α= 0.05 indicates the level of risk the researcher is willing to take that true margin of error may exceed the acceptable margin of error; (p)(q)= estimates of variance = 0.25, that is {(maximum possible proportion(0.5)*{(1-maximum possible proportion (0.5)}= maximum possible sample size, p=q=0.5; d= acceptable margin of error for proportion being estimated =0.05, is the error the researcher is willing to accept; n_o= sample size to be drawn from population (N). If n_o/N is negligible, n_o is a satisfactory approximation to n. If not, a correction factor is used and defined by the formula $n= n_o/ (1 + n_o/N)$ (Cochran, 1977).

According to Bartett *et al*. (2001), two key factors in Cochran's (1977) formula are first the risk the researcher is willing to accept in the study, commonly known as the margin of error (e), or the error the researcher is willing to accept. Second, the alpha level of acceptable risk the researcher is willing to accept that the true margin of error exceeds the acceptable margin of error; that is the probability that differences revealed by statistical analysis really does not exist. Hence, a total of 414 informants (384 randomly sampled informants plus 30 purposively sampled key informants) were sampled from the total population of 41, 462 households in Sheka Zone (CSA, 2013). However, individuals with special ethnobotanical knowledge and focus groups were purposively sampled and interviewed as key informants (Table 1).

Table 1. Random sample size for informants and key informants

Zone	**Urban + Rural, NHH= Number of households**					Remarks (Purposive sample)
	Total	Male	Female	N.HH	Sample size	
Total	199, 671	101, 232	98, 439	**41, 462**	**384**	**+ 30** key informants
Masha	41, 217	20, 318	20, 899	8559	128	+ 10 key informants
Andracha	24, 304	12, 219	12, 085	5047	128	+ 10 key informants
Yeki	134, 150	68, 695	65, 455	27, 856	128	+ 10 key informants
Total sample size					**384+30= 414**	

3.2.2.1. Semi-structured interviews

Ethnobotanical data sheet was prepared ahead of time and semi-structured items were incorporated into it to be used during ethnobotanical information retrieval from both general and key informants during actual field work (Appendix 7). The semi-structured items were prepared following Martin (1995), Cotton (1996), Cunningham (2001), and McClatchey and Gollin (2005). The data sheet containned open ended questions about the ethnobotanical knowledge of the Sheka people on both medicinal and wild edible plant use information. Some interview items were determined beforehand and others arose during the course of the conversation. Both general and specific ethnobotanical information and data were retrieved using the semi-structured interview.

3.2.2.2. Participant observation and sensitive data recording

Field notes were recorded keeping a secrete knowledge (taboos and secretes) of the local people following Martin (1995). Keeping secrete knowledge is an impotant part of building cooperation trough respecting local peoples' desire for confidentiality. In order to creat confidentiality necessary ethical clearance was done by briefing to the informants. Bennett's Golden Rules (being truthful, sharing, considering values and religion, respect, learning from people, intellectual and real property rights, listen to people, ask permissions, respect secrets) for ethnobotany fieldwork (McClatchey and Gollin, 2005) were considered (Appendix 11).

Ethical issues such as informants' privacy while giving sensitive information like medicinal plant knowledge were taken into account. Observation of public cultural celebrations and rituals, individual or group activities and the way the people of the study area react to their environment were carefully recorded. Interpretation of the retrieved ethnobotanical knowledge was made through the emic/etic approach (looking into local problems of interest both from the local peoples/stackeholders pont of view as well as the researchers' point of view). Then interpretation of the implications to the world of science was made during the course of the study.

3.2.2.3. Market surveys

Market surveys were made to get general information on the multipurpose roles and marketability of plant species in general and that of medicinal and wild edible plants in particular. A total of 15 market surveys: 12 market surveys from the 12 village centres (one market survey per village centere) and three market surveys (one market survey per each town centere) from the three town centres were made. Those marketable plant species and their products (plant derived products) sold on markets were recorded. The information recorded during market survey include: the type of plant species, place of its origin (wild, homegarden, far from/near to the market place), processed/unprocessed, plant parts marketable, drivers of marketability (prices, medicinal value, food value) and implications to species rarity/abundance for conservation, management and sustainable use (Appendix 11).

3.2.2.4. Group and individual discussions

Group discussions were made with both group and individual informants. Group formations with both general and key informants were made respecting their interest and privacy. Those informants (the key informants) who were willing to give sensitive ethnobotanical information (medicinal plant knowledge) were participated in individual discussion. Those informants who were willing to share non-sensitive ethnobotanical information (medicinal plant knowledge that they were willing to share publicly) were participated in the group discussion.

Five to ten groups were formed per the 12 village centres and discussions were made twice in two rounds to validate the information retrieved avoiding biases. A total of 24 (ten informants each in the first round discussion and five informants each in the second round discussion) group discussions were made for the entire ethnobotanical data collection. Consideration of the number of male and female informants participating during group or individual discussion was not taken into account as this is difficult to apply in the real situation and culture of the people of the study area. The researcher needed to avoid biases related culture to freely contact his informants.

It was noted that intuitions and experiences are the best guides to informal ways of gathering information (Martin, 1995). Although initial dialogues in group discussion may not cover some issues not clearly linked to ethnobotany, relevant subjects will naturally arise as people begin to understand what interests the researcher. Hence, discussions are likely to drift more and more towards ethnobotany. In the current study, the information obtained from both the general and the key informants were carefully recoreded for later interpretation (Appendix 11).

3.2.2.5. Demonstration

Some key informants have well experienced ethnomedicinal knowledge. They serve the local community with great confidence and respect especially when there is no modern medicine available in their locality for certain types of health problems (jaundice for instance). Even in case there were enough modern drugs available in the nearby pharmacies, people prefer traditional herbal remedies provided by those well known trational healers due to price affordability and the confidence they have about its healing potenitial.

Such traditional healers (the key informants) from the study area were asked to demonstrate their ethnomedicinal knowledge both at their home as well as on the field keeping secrete not to be revealed to onlookers and passers by individuals. Terms of promis of understanding were also negotiated with the traditional healers so that the information and knowledge they provided will not be exposed to anybody prior to their permission and consent. The demonstration was then followed by explanation, discussion and interpretation.

3.2.2.6. Guided field walk

The methods of guided field walk were applied through negotiation with the repective field guide to each site. Accessible sites with associated risk factors were first identified before starting the actual field walk. Field guides from respective town centeres as well as village centers were selected based on their willingness, ability to walk long distances within the forest, general plant knowledge in local language (SHEKINANO), ability to translate the Sheka terms into Amharic, English or Afaan Oromoo (the three languages that the research can easily understand).

Guided field walk help to create an opportunity to make note on the habit, habitat, appearance, and the relationships of medicinal plants with other species (plant associations). Hence, it was conducted with patience by walking through the areas where they were found. In the meantime, all possible sensations such as seeing, feeling, smelling, and tasting of the medicinal and wild edible plants under question were made to understand the unique feature of the species. Moreover, traditional healers who helped during the guided field walk also played crucial role in identifying the medicinal and wild edible plants encountered in the field by providing its vernacular names, medicinal use, parts used, preparations, dosage and traditional applications.

Voucher specimens were also collected and recordings explaining about the medicinal plant were done at the spot. Voucher specimen collection by guided field walk supported by digital photographing of both fresh specimens and pressed dry specimens. The specimen collection was conducted in the wild, homegardens and markets of the study area. The information obtained during the guided field walk was also cross-checked with the information recorded in the data sheet for plot sampling (ecological data sheet) (Appendix 7) to identify and characterize the medicinal plant species recorded from the respective plant communities (see also Appendix 11).

3.2.2.7. Free listing

In order to avoide biases in retrieving the required ethnobotanical information from the study area, the use and focus on local terms was done by asking the informants to made free listing of the plant species in their locality and the associated uses. According to Martin (1995), free listing help to discover the subject that interests the researcher and how the local people talk about it. In other words, it means that the technique of free listing is considered culturally important and easily recoginizeable by the people the researcher is interviewing. In the current study, informants were requested to free list the plant species along their uses in Sheka terms. The information recorded in such away was then correlated with botanical/ethnobotanical terms and scientific names. List of wild edible plants of the study area were obtained by free listing.

3.2.2.8. Simple preference ranking

In order to discover in a scientifically rigorious way how the people of the study area perceive and classify medicinal plant use, health problems and associated factors analytical tools of ethnobotany were employed (Martin, 1995) during the course of the study. These include simple preference ranking, direct matrix ranking and paired comparisons. Hence, the properties and effectiveness of various medicinal plants to treat a given health problem were analyzed using simple preference ranking during field work.

3.2.2.9. Paired comparisons

In order to test for the consistency of the relationships of preferences and the transitivity of results, paired comparion of medicinal plants used to treat a given health problem was made. The results of paired comparison were then compared with that of simple preference ranking. Martin (1995) noted that inconsistent results would lead the researcher to believe the answers are arbitrary, informants do not have strong preferences, the objects are classified on multiple confilicting dimensions or that pairwise ranking is not an appropriate analytical tool for the cultural domain being tested.

3.2.2.10. Direct matrix rankig

The multipurpose roles of plant species recorded from the study area were evaluated through direct matrix ranking which was drawn upon several multiple dimensions. Hence, direct matrix ranking of ten most cited plant species in the study area against fourteen general plant use categories were done. These use categories include medicinal, food, drink, firewood, charcoal, shade, construction and tools, commercial value, animal feed/fodder, bee forage, culture and rituals, ornamental, life fence and others. Use values were assigned from 0 to 14 where 0= no use for the assigned significance and 14= best for the assigned significance.

3.2.2.11. Preferred or priority species and associated priority threats

Preffered or priority plant species and threats associated with them were identified using a combination of methods: simple preference ranking, direct matrix ranking and the method of cultural significance index. The key informants (knowledgeable persons) were involved in ranking plants species of high priority especially those with great ethnomedicinal use.

3.2.3. Data Analysis Methods

Data were analyzed through the applications of ecological, both quantitative and qualitative ethnobotanical methods using R Statistical Software (R Core Development Team, 2014) following Zerihun Woldu (in press) for comparison of plant community types with respect to medicinal plant species richness. Clustering into major plant community types using R Statistical Software was done and the result was compared with the dendrogram output for the ecological data analysis in determining plant community types which later inspected for the number on medicinal plant species contained in each plant community type for the ethnobotanical data analysis. The position of ClusterIDs on the dendrogram was determined by using the programme for cluster analysis to classify sites using base R and Euclidean distance in the R Statistical Software version 3.2.3 thereby pasting the programme onto RStudio version 0.99.489 (RStudio Inc., 2016: http://www.dllexe.info/rstudio-0.99.489.exe/m-download-16319.html) following Zerihun Woldu in press). Comparisons of the general flora were done using the methods of Sørensen’s coefficient of similarity index Kent and Cocker (1992); Wildi (2010); Kent (2012).

3.3.3.1. Ecological Data Analysis

Vegetation and other ecological data (altitude, slope, aspect, grazing and disturbance) collected and arranged in the Microsoft Excel 2007 spreadsheet in its appropriate format were saved in

CSV (comma delimited) (file format that is supported in Excel and which saves only the active sheet for use on another windows operating system ensuring that tab characters, line breaks and other characters are interpreted correctly) and run with R Statistical Software (R Core Development Team, 2014) for occurrence, abundance, cluster analysis and diversity analysis. Kent (2012) noted that although a large number of diversity indices have been devised and each of them seeks to express the diversity of a sample or a plot by single number, Simpson Index (D) and the Shannon Index (H') are the most widely used in plant ecology. The Shannon and Simpson Diversity Indices were used to determine diversity, richness, evenness and equitability within and among plant community types as well as cluster analysis (Kent and Cocker, 1992; Kindt and Coe, 2005; Wildi, 2010; Kent, 2012). Hence, the Shannon-Weiner Diversity Index (H') is the average uncertainty per species in an infinite community made of S species with known proportional abundance and the Pi are the population parameters calculated as:

$$Shannon\ Diversity\ Index\,(H') = \sum_{i=1}^{S} Pi \ln Pi\,,$$

where ni = the number of individuals belonging to the i^{th} of S species in the sample, n = the number of individuals in the sample, Pi is the probability of sampling species i, $\ln Pi$ = the natural logarithm of the probability of sampling species i. Shannon's equitability (J) was calculated to test species evenness as:

$$Equitability(J) = \frac{H}{H\max} = \frac{H}{\ln S}\ ,$$

where S is the species richness, $\ln S$ is the natural logarithm of the species richness and J assumes the values between 0 and 1 with 1 being complete evenness and 0 being no evenness. Simpson's coefficient of diversity index is then computed as:

Simpson's Diversity Index $(D) = 1 - \sum_{i=1}^{S} Pi^2$,

indicating that the probability of any two species taken at random from an infinitely large community will belong to the same species; where, Pi = proportion of individuals or the abundance of the ith species. The Simpson index can also be calculated as Simpson = 1-P and $P = \sum (pi * pi)$.

Test of significance (*F*) was used to see the significance of multiple correlation coefficients (*R*) for environmental variables. The adjusted R^2 denoted by $R^2 adj$ was used to avoid sampling error while checking for correlation between environmental variables (Bluman, 2012). The standard equation for Minkowski: $djk = [|xij - xik|]^{1/\lambda}$ where, $\lambda = 2$ and *djk=Euclidian distance*, was used to validate clusters and test for relative proximity/compactness of clusters or plant community types (Zerihun Woldu in press).

Therefore, by running the vegetation data in R Statistical Software for diversity analysis, one can compute diversity, richness and evenness values.

Similarly, comparison of floristic similarity of the study area with other studies was performed using Sørensen's coefficient of similarity index computed:

$$Ss = \frac{2a}{(2a + b + c)} ,$$

was used to compare similarity between sample sites (the study area of the current study in this case) following Kent (2012); where a= the number of species common to both samples 1 and 2 (respective plots in our case), b= the number of species in sample site 1 and c= the number of species in sample site 2.

3.3.3.2. Ethnobotanical Data Analysis

Ethnobotanical data were analyzed following the basic analytical tools (Höft *et al*., 1999; Martin, 1995; Hoffman and Gallaher, 2007). R Statistical Software was also used following Zerihun Woldu (in press) of creating and modifying data frames and sub-vectors to create an ethnobotanical data matrix. Potentially effective medicinal plants were identified by the method of informant consensus factor (Trotter and Logan, 1996 in Heinrich, 2000). Hence,

$$ICF = \frac{n_{ur-nt}}{n_{ur-1}},$$

where: ICF = Informants consensus factor, n_{ur} = relationships between number of each use category of medicinal plants, n_t = number of taxa used.

Simple preference ranking, direct matrix ranking and paired comparisons were done to test for the consistency in responses, single and multiple dimensions of responses, transitivity as well as clustering techniques (Martin, 1995). The numbers of pairs of objects to be compared were computed as: Number of pairs of objects $(\mathrm{NP}) = \frac{n(n-1)}{2}$,

where $NP =$ number of pairs of objects/items to be compared, n = number of objects/items to be compared. By randomizing the orders of presentation to a single respondent through drawing numbers 1-6 written on cards and by randomizing the order of each medicinal plant within each pair by flipping a coin such that head (H) indicated the original order is maintained and tail (T) indicated the original order is reversed before presenting to the respondent, the results were recorded for a single respondent. This activity was repeated for the ten key informants (R1 through R10) to get the complete response for ranking.

The use values for a given plant species was calculated following Cotton (1996) as:

$$UV_s = \frac{\sum UV_{is}}{i_s};$$

Where, UV = the overall use-values of species s, UV_{is} = is the use value of species s as determined by informant i, i_s = the total number of informants interviewed for species s. The Shannon-Wiener use value diversity index for over all use values of the entire species data set was calculated as: $\text{UVDs} = \sum_{i=1}^{S} UVi \ln UVi$,

Where S= is the number of species in the entire data set, UV= a simple sum of all known uses for each species, UVi= the relative use value of species i, lnUVi= the natural logarithm of the relative use value of species i (Albuquerque *et al*., 2014).

The relative healing potential of each reported medicinal plant used against human aliment was calculated as Fidelity Level (FL) computed as:

$$FL(\%) = (\frac{I_P}{I_U})x100,$$

Where, FL =Fidelity level or relative healing potential, I_P = the number of informants who independently cited the importance of a species for treating a particular diseases (frequency of citation of a species for a particular aliment), I_U = the total number of informants who reported the medicinal plant for a given diseases(total number of citations of that species) (Hoffman and Gallaher, 2007; Frieman *et al*., 1986 cited in Haile Yinger *et al*., 2008a). Clinical explanations of important medical terms in connection with emic categorization of health problems were cross-checked with standard medical terms Elizabeth and Martin (2010); EFMHACA (2010, 2014).

The cultural significance index (CSI) of respective species was calculated through subjective allocation of weighed numerical values (WV) for four variables: Management (i), 2= managed, 1= not managed; Preference (e), 2= preferred for a given use, 1= not preferred species for a given use; Frequency (c), 2= species effectively used for a given use, 1= species rarely cited for a given use and 0= species not cited for a given use. Hence, the cultural significance index (CSI) was calculated as: $CSI = \sum_{i=1}^{n} (i * e * c) * CF$,

where CSI= cultural significance index of a given species designed to combine elements from former indices with consensus methodology and binary use classes to reduce subjectivity, i= species management, e= use preference, c= use frequency and CF= correction factor defined as the number of citations for a given species divided by the number of citations for the most mentioned species (Hoffman and Gallaher, 2007).

The Pearson product moment correlation coefficient (r) with P values was computed using R Statistical Software in library Himsc as indicated in (Zerihun Woldu in press). Pearson's correlation was used to see the degree of linear relationship between respondents' average distance (SR) from health centeres and the average number or frequencies (N) of medicinal plants cited by respective respondents from the 12 village centers. The level of significance difference was estimated at α= 0.05. The linear relationship was also supposed to indicate the medicinal plant use frequencies in the absence of modern healthcare services.

CHAPTER FOUR

4. Results

4.1. Plant Diversity

Following the visually identified vegetation physiognomy and homogeneity, 95 plots were taken and a total of 458 plant species were collected. Additional 97 plant species were recorded outside plots due to their ethnobotanical significance as mentiond by informants. The collected plant specimens were pressed, dried, identified and deposited at the National Herbarium (ETH) following standard herbarium techniques. Taxonomic keys, characters, herbarium posters, Flora books, herbarium specimens and other related herbarium resources were used for determination of the species. Hence, 555 plant species of which 266 (48% medicinal), 35 (6.31% wild edible), 30 (5.4%) endemic to Ethiopia and 57 (10.3%) new records to the Flora of Ethiopia and Eritrea were collected from the study area. Note that the medicinal and wild edibles are add up together to 271 plant species and 30 (85.71%) of of the wild edible plants are also medicinal and 5 (14.29%) of the wild edible plants serve only as food (i.e. medicinal only= 236, wild edible only= 5, medicinal and wild edible= 30, total medicinal plus wild edible= 236 + 5 + 30= 271). A total of 284 plant species recorded from the study area are neither used as medicines nor food.

4.1.1. Floristic Composition and Growth Forms

The 555 plant species (including three subspecies) belonging to 341 genera and 115 families all these were recorded from the vegetation of Sheka Zone (Appendices 1, 5, 6). These species were grouped under six major growth forms (Figure 6). Note that the lianas are referring to the woody climbers.

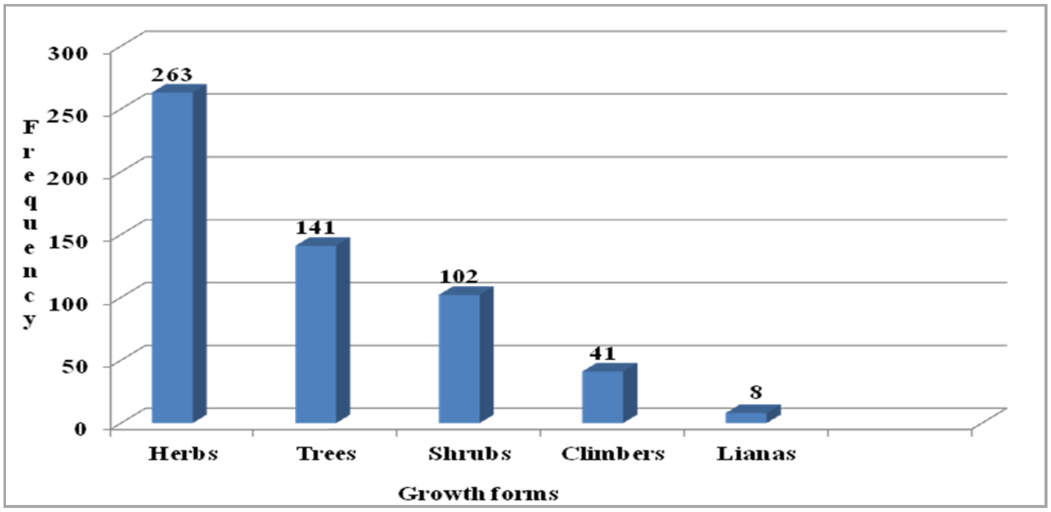


Figure 6.Diversity of growth forms

Most frequent plant families with the highest percentages of the total recorded from the study area are shown in Table 2. About 65 (56.52%) of the families were represented by more than one species. The remaining 50 (43.48%) of the families were represented by single species each accounting 0.87% of the total families (Appendix 6).

Table 2. The 15 most species rich plant families recorded from the study area

Families	Number of species	Percentage
Asteraceae	62	54.40%
Fabaceae	51	44.70%
Lamiaceae	27	23.70%
Poaceae	24	20.80%
Solanaceae	21	18.40%
Moraceae	20	17.50%
Euphorbiaceae	18	14.90%
Rubiaceae	17	14.90%
Malvaceae	15	13.20%
Amaranthaceae	12	10.50%
Cucurbitaceae	12	10.50%
Acanthaceae	11	9.60%
Rosaceae	11	9.60%
Celstraceae	10	8.80%
Rutaceae	9	7.90%

Results of proportion of plots among sampling localities based on the heterogeniety of the vegetation, elevation, accessiblity, distance, intensity of disturbance and the geomorphological diversity of sampling localities were indicated in Table 3.

Table 3. Proportion of plots among sampling localities

SN	Localities	Plots	Size	%
1	Masha-Kan	6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 68, 69, 70, 91	17	18
2	Masha-Yep'	24, 25, 26, 27, 60, 61, 62, 63, 64, 65, 66, 67, 71	13	14
3	Gecha-Sha	30, 31, 32, 33, 34, 84, 85, 86, 87, 88, 89, 90	12	13
4	Gecha-Yuk	44, 45, 46, 76, 77, 78, 79, 80, 81, 94, 95	11	12
5	Gecha-Gam	35, 36, 37, 38, 39, 40, 41, 42, 43	9	9.5
6	Gecha-Geb	17, 28, 29, 72, 73, 74, 75, 93	8	8.4
7	Tepi-Alamo	48, 49, 50, 51, 55, 56, 57	7	7.4
8	Masha-K'ar	20, 21, 22, 23, 59, 92	6	6.3
9	Masha-Che	1, 2, 3, 4, 5	5	5.3
10	Tepi-Bak'o	52, 53, 54	3	3.2
11	Tepi-Erm	82, 83	2	2.1
12	Tepi-Yeki	47, 58	2	2.1
		Total	95	100

4.1.2. Analysis of Occurrence and Abundance

Results of the analysis of occurrence and abundance of 458 plant species in the 95 plots are indicated in Appendix 3. The relative species frequencies were computed using species species occurrences and its relative occurrences within the plots using R Statistical Software Programme. Ten most frequent plant species that occurred in at least 45 percent of the total 95 plots were indicated in Table 4. Ten plant species; *Ozoroa pulcherima*, *Combretum molle*, *Ficus sycomorus subsp. sycomorus*, *Manilkara butugi*, *Schefflera abyssinica*, *Podocarpus falcatus*, *Pouteria adolfi-friedericii*, *Syzyguim guineense subsp. afromontanum, and Pouteria altissima* were found within mean abundance classes between six and nine. These species comprise 2.40% of the total 458 species from plots. Similarly, 340 species were within mean abundance values between 0 and 2. These species comprised of 74.3% of the total 458 species from plots. Most of them were those in the herbaceous layer (Figure 9). The remaining species were found within mean abundance values between 3 and 5. These contain 23.3% of the total 458 species from plots.

Table 4. Frequencies of ten plant species that occurred in at least 50% of the plots

Key: **subsp.afromontanum*, F=Number of species occurrences, RelF= Relative species occurrences, TA= Total abundance, MA= Mean abundance, $maxcls= the class for which each species has maximum indicator value, $indcls= The indicator value for each species to its maximum class, $pval= The probability of obtaining as high indicator value, IVI= Importance value index of species.

SN	Species	F	RelF	TA	MA	$maxcls	$indcls	$pval
1	*Croton macrostachyus*	58	61.05	275	4.74	5	0.26	0.007
2	*Ilex mitis*	57	60.00	322	5.65	4	0.24	0.007
3	*Maesa lanceolata*	53	55.79	141	2.66	4	0.22	0.046
4	*Schefflera abyssinica*	53	55.79	372	7.02	3	0.30	0.001
5	*Vernonia auriculifera*	52	54.74	75	1.44	3	0.31	0.003
6	*Syzygium guineense**	49	51.58	326	6.65	3	0.32	0.001
7	*Ekebergia capensis*	47	49.47	285	6.06	3	0.24	0.035
8	*Prunus africana*	47	49.47	231	4.92	7	0.18	0.125
9	*Ficus sur*	46	48.42	254	5.52	5	0.36	0.001
10	*Bersama abyssinica*	45	47.37	116	2.58	7	0.26	0.021

Results of analysis of mean abundance classes of the vegetation data matrix for the 458 species recorded from the 95 plots is shown in Figure 7.

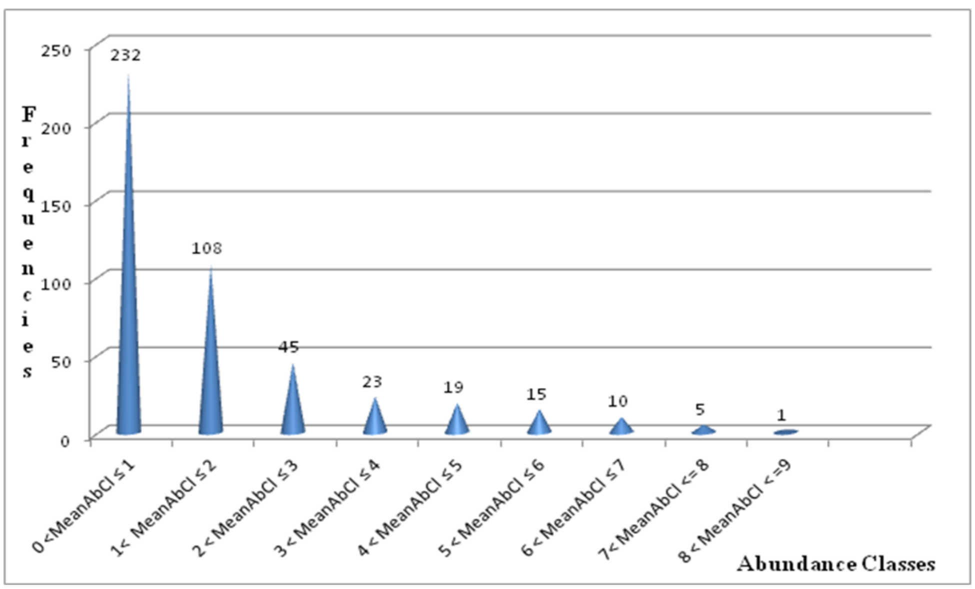


Figure 7. Mean abundance classes (MeanAbCl=Mean abundance classes) of vegetation data

Result of the species frequencies in the 95 plots indicated that about 396 (86.5%) of the species occurred in 10 and below number of plots and about 62 (13.5%) of the species occurred in greater than 10 number of plots. This can be indicated by plotting the mean abundance classes of species versus the number of plots in which they occurred (Figure 8). It implies that those plant species occurring in 10 and more number of plots were considered relatively more frequent in the study area as compared to those species occurring in less than ten plots.

The summary of species occurrences, relative occurrences, total abundance values, mean abundance values, the indicator value of each species to its maximum class, the class for which each species has maximum indicator value in their respective clusters and the probability of obtaining as high as an indicator value as observed over the specific interaction is given in Appendix 3. Similarly, plot richness (number of species per plot), sum of abundance values per plot, ranks of plots based on their plot richness and values of diversity indices for plots are indicated in Appendix 4.

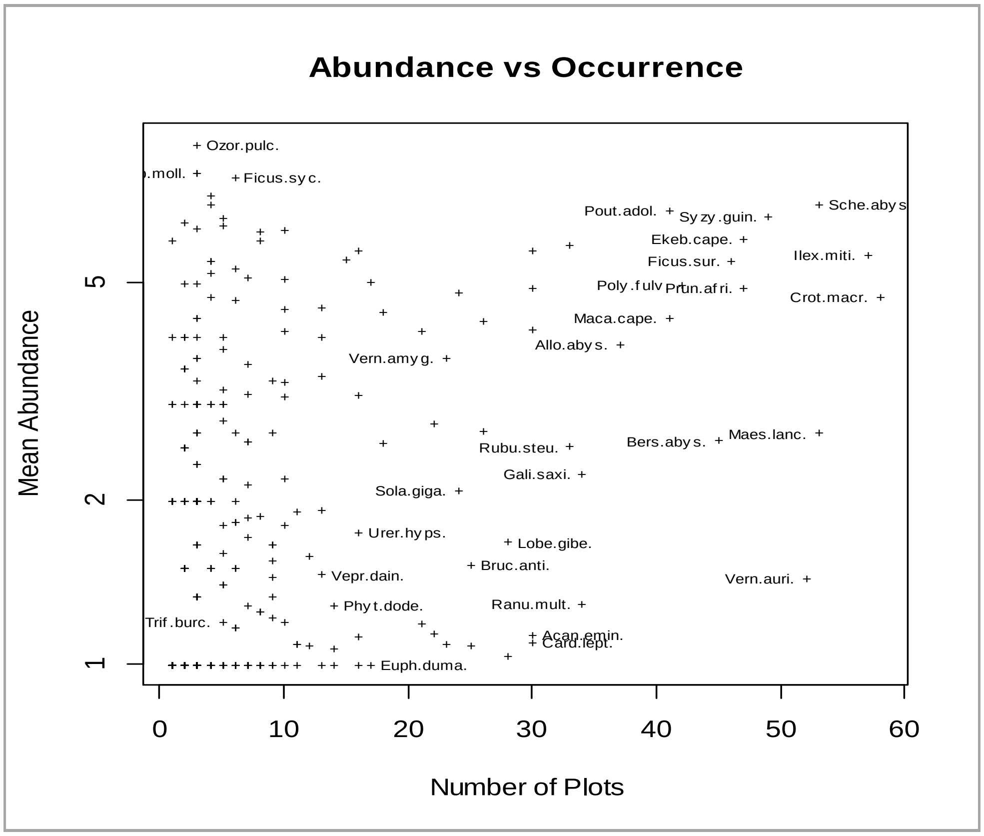


Figure 8. Mean abundance of species versus the number of plots in which they occurred

4.1.3. Plant Community Types

Visual/Physiognomic classification**:** Results of analysis of physical observation of the vegetation of Sheka Zone through Google Earth aided image interpretation and ground walk indicated 12 major vegetation groups. Sample plots were taken preferentially from the respective physiognomy. Plot distribution among visually classified vegetation groups and sites for sampling frame is indicatedas in Figure 9.

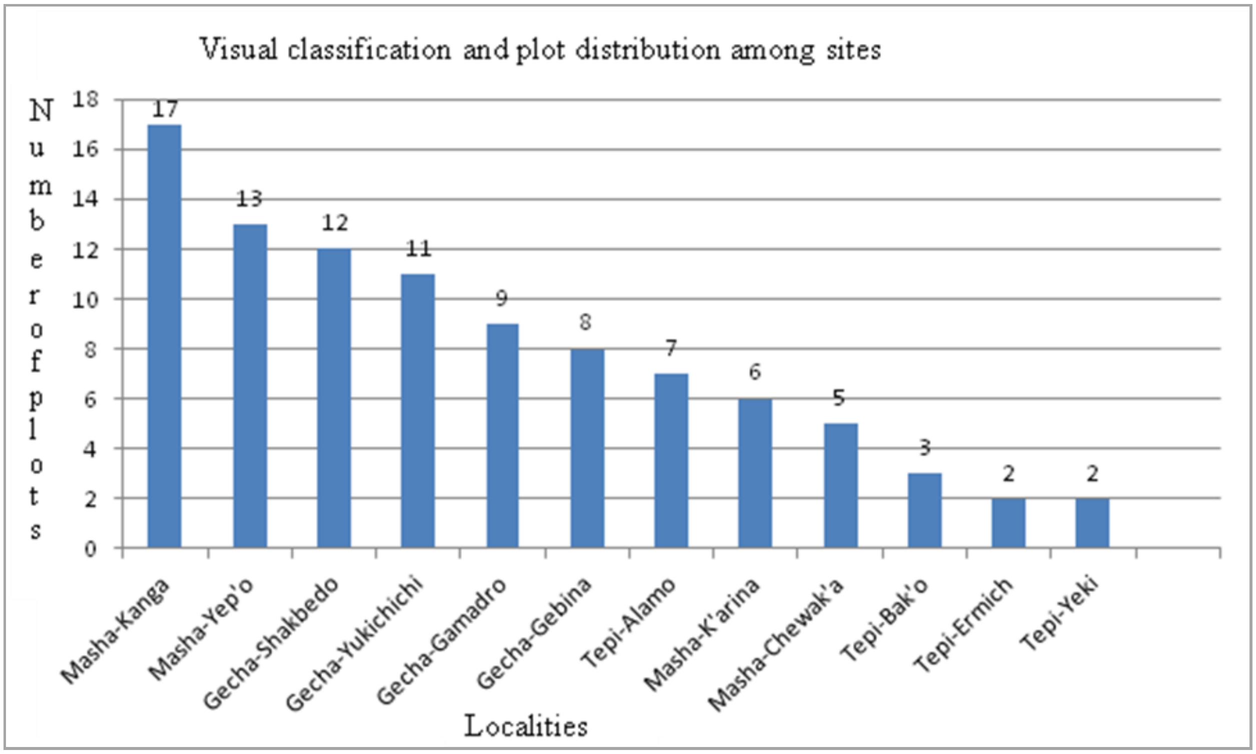


Figure 9. Plot distribution among visually classified vegetation into sampling sites

First site: Masha-Kanga locality at about 22 km to 25 km south and southeast of Masha Town. This vegetation group was characterized by mosaic of relatively disturbed and undisturbed vegetation where human encroachment was relatively higher and not too high. It was found within altitudinal range of 2200 m to 2400 masl. The major vegetation disturbances observed in the locality were tree cutting, vegetation clearance for agriculture and grazing.

Second site: Masha-Yep'o locality found at about 14 km to 30km east and northeast of Masha Town and within elevation range of 1600 m to 2200 masl. This vegetation was at relatively less disturbed when compared to the Masha-Kanga locality but there was intermitent forest clearance for coffee plantation (between Gama and Duc'i Rivers at about 14 km east near Chago and between Duc'i and Baro Rivers at about 25 km northeast near Yep'o of Masha Town).

Third site: Masha-K’arina locality located at about 20 km to the west and southwest of Masha Town within altitude range of 2200 m to 2235 masl. The vegetation of this locality was somewhat relatively sparse with patches of undisturbed forests in some localities near Gambaka and K’arina KEBELES. The major vegetation disturbances in these localities were tree cutting, vegetation clearance for agriculture, grazing and settlement.

Fourth site: Masha-C’ewak’a locality at about 18 km north of Masha Town within elevation range of 1600 m to 2200 masl. This vegetation was the most disturbed in the Masha District due to coffee and tea plantation coupled to tree cutting, slash and settlement. The only intact forest in this locality is the Shat’o forest along the Baro River Basin and surrounding areas.

Fifth site: Gech-Gabina locality at about 25 km to 30 km east and northeast of Gecha Town in Andracha District. This vegetation includes the relatively more disturbed areas of Gatiba and Duyna localities due to vegetation clearance for coffee and Eucalyptus plantation, settlement and grazing. This vegetation continues to the highest elevation to the tip of Gada locality at about 2500 m crossing the *Arundinaria alpina* vegetation that runs from southeast through northeast to Gebina kebele at the border of Kefa Zone to 30 km northeast of Gecha Town.

Sixth site: Gecha-Shakbedo locality was at about 42 km to 50 km north, northwest and west of Gecha Town within the elevation range of 1900 m to 2400 masl. This was the most remote site in Sheka Zone with no transportation facility and the majority of the sites could not easily be accessed for data collection. The vegetation in this locality was highly intact with minimum disturbance. The most disturbed part of this locality is the C’agecha kebele locality about 6 km west of Gecha Town due to vegetation clearance for coffee plantation, agriculture and settlement. The vegetation near the village in Shakbedo at 42 km west of Gecha town was also moderately disturbed. The name Shakbedo in Sheka language means the village of the Sheka people. The northwestern extreme of this locality along the Yeshekako River Basin was dominated by intact forest of *Podocarpus falcatus*, *Prunus africana*, *Albizia gummifera*, *Olea welwitschii*, and *Millettia ferruginea* plant species.

Seventh site: Gecha-Gamadro was at 20 km to 25 km south and southwest of Gecha Town within elevation range of 1661 m to 2365 masl. The vegetation of this locality was a mix of highly intact (undisturbed) forest near the uplifted slopes running from east-west direction in the southwestern slopes of Gecha Town in Modi and Gayi KEBELES and the most disturbed localities of Gamadro area where there is intense coffee plantation and human settlement.

Eighth site: Gecha-Yukic'ic'i locality was at about 18 km to 28 km east and southeast of Gecha Town within altitude range of 1850 m to 2780 masl. This site contains the highest elevation in Sheka Zone where the elevation reaches about 2780 masl around the Bushashi Mountains near Lake Gandochi that is covered with pure stands of *Arundinaria alpina*, herbaceous layers and few scattered woody species of *Prunus africana*, *Lepidotrichilia volkensii* and *Bersama abyssinica*.

Ninth site: Tepi-Ermich locality was at 13 km to 15 km north of Tepi Town within altitude range of 1200 m to 1600 m. The vegetation of Yeki district was the most disturbed in Sheka Zone due to extensive coffee plantation, commercial turmeric and other spices and condiments farming, over population and habitat fragmentation. Hence the vegetation in Ermich locality of Yeki district at a relatively better status and it is an extension of the intact vegetation of Yukic'ic'i kebele from Andracha District and that of Godere forest from the Gambella Region.

Tenth site: Tepi-Yeki locality was found at 15 km west of Tepi Town within altitude range of 1000 m to 1200 masl. This vegetation was the most disturbed in Yeki District and dominated by coffee plantation, agriculture and settlement. Only few numbers of natural forests remnants were found in the Tepi-Yeki locality and it is among the most disturbed areas of Sheka Zone.

Eleventh site: Tepi-Bak'o locality was 5 km to 10 km south and southwest of Tepi town within altitude range of 900 m to 1260 masl. The vegetation of this locality was also highly affected by coffee plantation, turmeric farming and settlement. Few intact forests were remaining along the Bak'o River Basin running from east-west direction and the lowest elevation of Sheka Zone (about 900 masl) was recorded from this river gorge during actual data collection.

Twelfth site: Tepi-Alamo locality includes about 46 km east of Tepi town within altitude range of 1200 m to 1600 masl. The vegetation of this locality was also highly disturbed due to intense human activity for agricultural activities and commercial farming of spices and condiments. Few remnant forests patches dominated by *Manilkara butugi*, *Cordia africana*, *Albizia grandibracteata*, Combretum *molle* and *Terminalia brownii* are observed in this locality. Hence, very close observation of the vegetation of Sheka through intense field walk shows that the Masha-Andracha Districts were at a better status of vegetation with intact forests whereas the vegetation of Yeki District was highly disturbed and most threatened by human induced changes.

Results of Agglomerative Hierarchical Cluster Analysis using Similarity Ratio

Agglomerative Hierarchical Cluster Analysis using Similarity Ratio grouped the visually identified vegetation into eight major clusters (Table 5). Proper inspection of the dendrogram structure and partitioning methods validated the eight cluster groups which can be considered major plant community types.

Table 5. Plot distribution/percentage of plots per cluster

C	Plots/Cluster groups/ sites/	S	%	NS	ER (m)	Diff.
C1	1, 24, 25, 47, 56, 57, 7, 67, 88, 60, 89, 90, 61, 62 MC1, MY1, MY2, TY1, TA6, TA7, MKG2, MY12, GS10, MY5, GS11, GS12, MY6, MY7	14	15	216	1050-2325 (m)	1275 (m)
C2	48, 49, 50, 51, 54, 55, 58, 52, 53 TA1, TA2, TA3, TA4, TB3, TA5, TY2, TB1, TB2	9	9.5	113	1000-1550 (m)	550 (m)
C3	91, 92, 93, 94, 95 MKG17, MKR6, GGB8, GY10, GY11	5	5.3	16	1800-2490 (m)	690 (m)
C4	79, 81, 80, 82, 83 GY7, GY9, GY8, TE1, TE2	5	5.3	20	2375-2800 (m)	425 (m)
C5	2, 3, 87, 4, 19, 27, 30, 35, 37, 44, 63, 68, 43, 64, 41, 45, 46, 72, 73 MC2, MC3, GS9, MC4, MKG13, MY4, GS1, GG7, GGD1, GY2, GGD3, GY3, GY1, GGB4, MY8, MKG14, GGB5, GGD9, MY9	19	20	199	1650-2450 (m)	800 (m)
C6	36, 66, 38, 39, 42, 40, 65, 70, 71 GGD2, MY11, GGD4, GGD5, GGD8, GGD6, MY10, MKG16, MY13	9	9.5	126	1850-2350 (m)	500 (m)
C7	5, 9, 10, 26, 20, 22, 11, 34, 13, 85, 31, 18, 33, 32, 84, 14, 16, 17 MC5, MKG4, MKG5, MY3, MKR1, MKR3, MKG6, GS5, MKG8, GS7, GS2, MKG12, GS4, GS3, GS6, MKG9, MKG11, GGB1	18	19	170	2200-2575 (m)	375 (m)
C8	6, 21, 8, 78, 15, 69, 76, 77, 23, 59, 86, 12, 74, 75, 28, 29 MKG1, MKR2, MKG3, GY6, MKG10, MKG15, GY4, GY5, MKR4, MKR5, GS8, MKG7, GGB6, GGB7, GGB2, GGB3	16	17	170	1900-2625 (m)	725 (m)
	Total plots	95				

Key: C= Cluster, S= Cluster size, NS=Number of species, ER=Elevation range, Diff= Altitudinal difference, NB: Plant communities with similar elevation range could come to different clusters because they can also be affected by slope, aspect, disturbance and grazing.

Validation of possible number of clusters

Possible cluster groups with K-value equal to eight indicates plant community types. The K-value was also confirmed for consistency by partitioning method which is obtained by plotting within groups' sum of squares versus number of clusters and observing the possible region of the graph where there is a sharp break. The value on the x-axes where there is sharp break of the graph represents the optimal number of clusters in the dendrogram output (Figure 10).

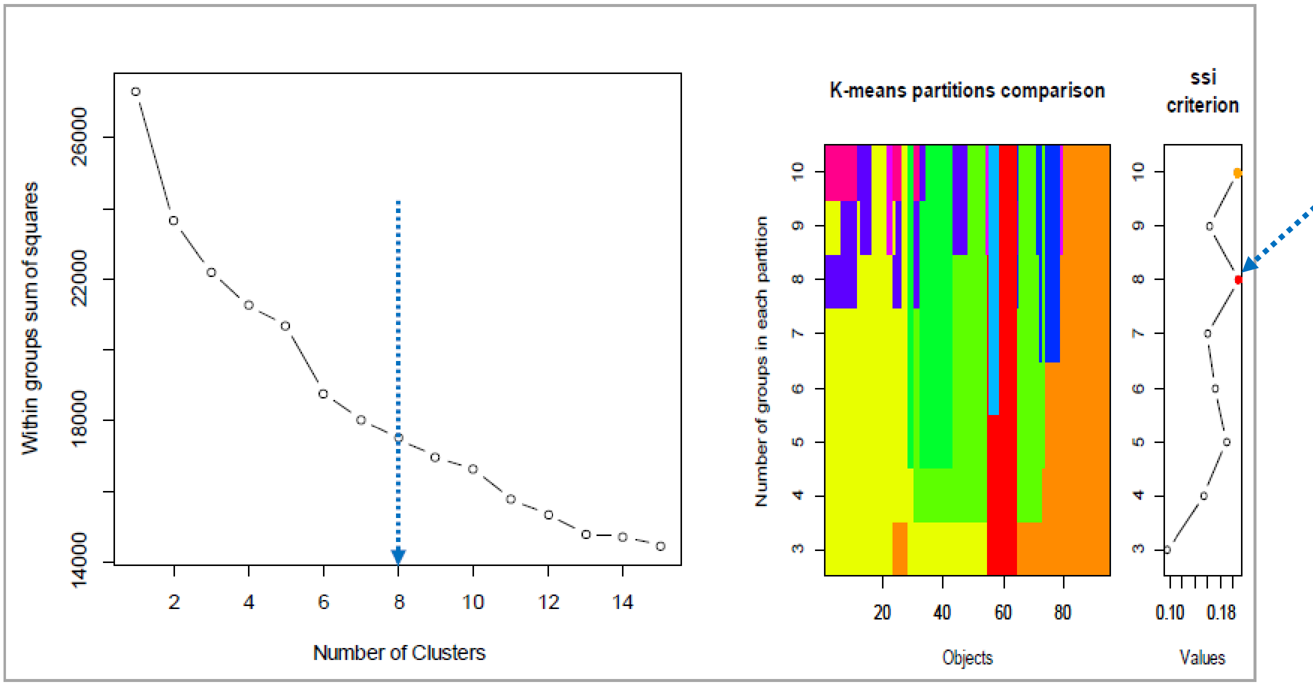
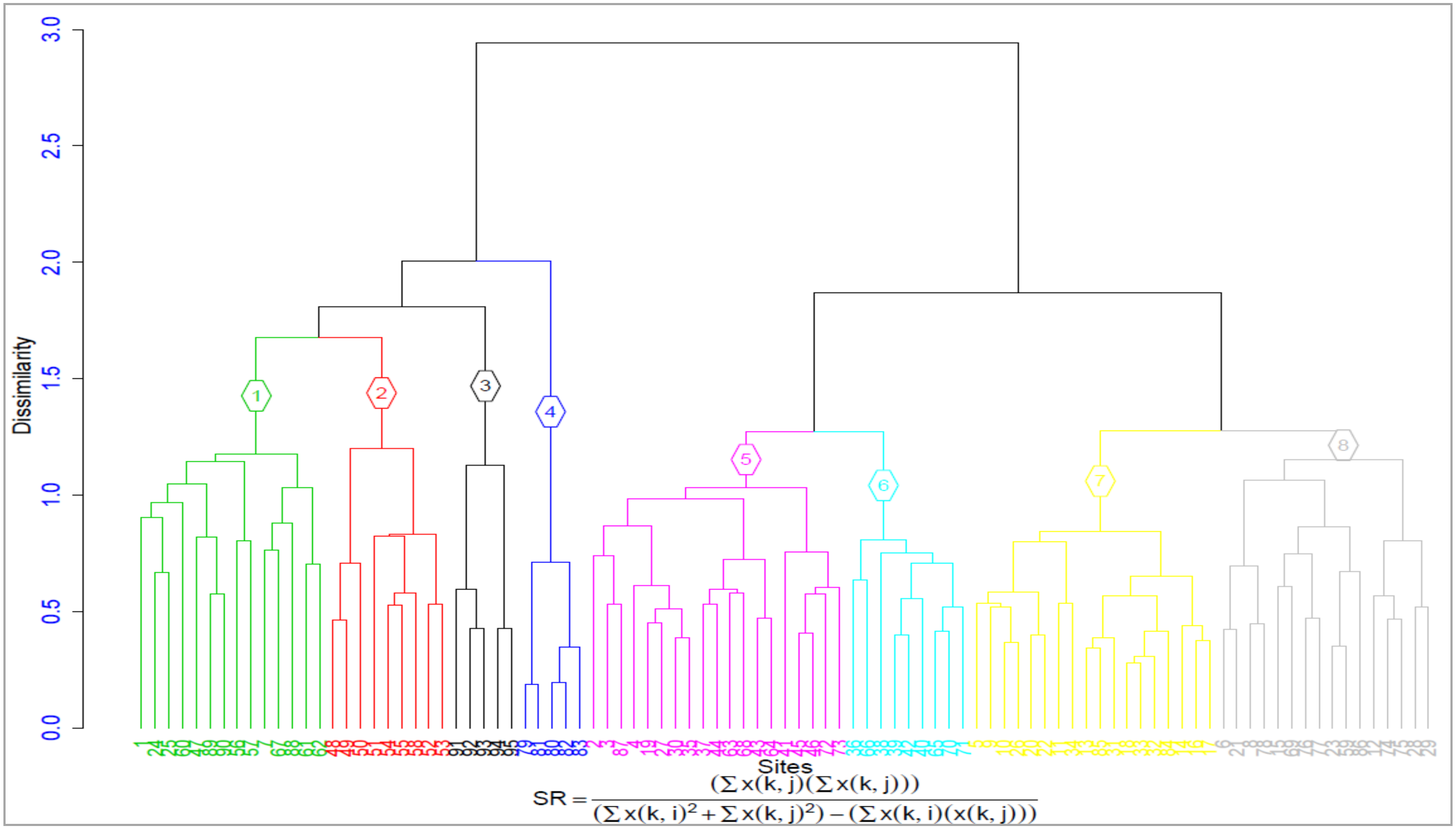


Figure 10. Optimal number of clusters for the vegetation data set

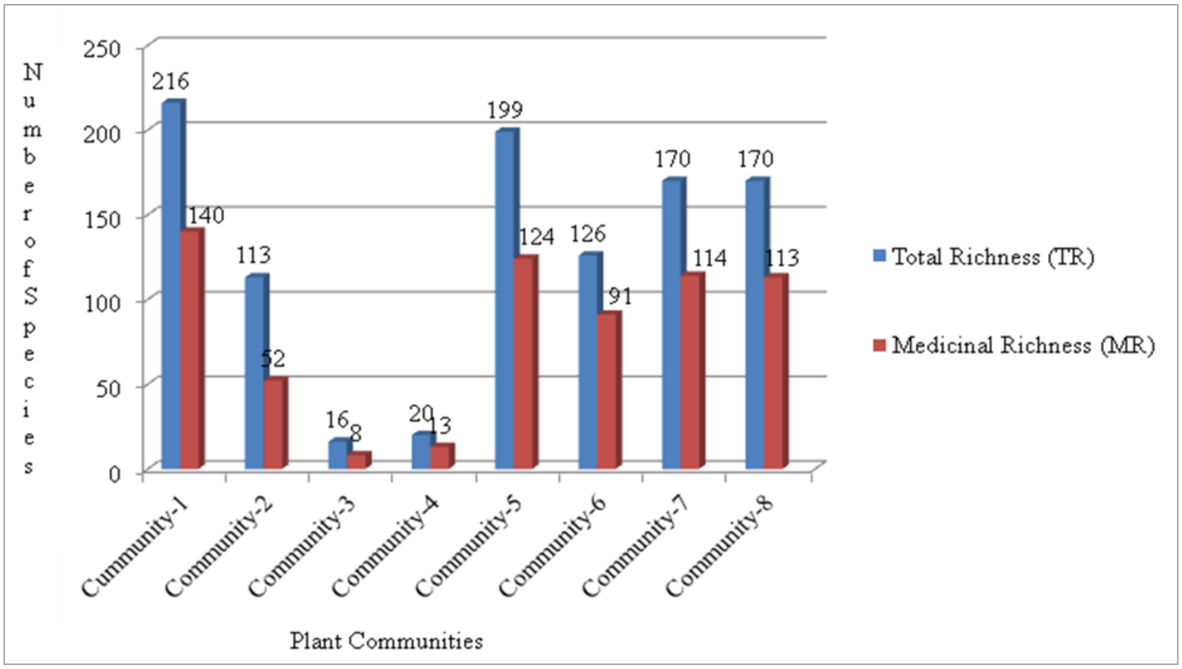
The eight clusters representing plant community types were indicated in the dendrogram output of agglomerative hierarchical cluster analysis using similarity ratio (SR) in Figure 11.



NB: The i, j and k letters are indicating the vector values in the three dimensional space.

Figure 11. Agglomerative Hierarchical Cluster analysis using Similarity Ratio (SR)

The results of number of species versus plant community types are shown in Figure 12.



Key: TR= Total plant species richness, MR= medicinal plant species richness.

Figure 12. Plant species richness of the eight plant community types

Test for relative proximity of communities through validation of clusters (C1 through C8)

Results of intra-cluster/within cluster/ and inter-cluster/between cluster/ diameters: The complete intra-cluster diameter represents the distance between two of the most remote objects belonging to the same cluster. The average intra-cluster diameter defines the average distances between all of the samples belonging to the same cluster. The single inter-cluster linkage distance defines the closest distance between two samples belonging to two different clusters. The complete inter-cluster linkage distance represents the distance between the most remote samples belonging to two different clusters. The average inter-cluster linkage distance defines the average distance between all of the samples belonging to two different clusters. The

Hausdorff metrics inter-cluster linkages are based on the discovery of a maximal distance from samples of one cluster to the nearest sample of another cluster (Appendix 9).

Synoptic table

Combinations of dominant or characteristic species (species predominantly characteristic or restricted to a given vegetationtype of habitat) with high synoptic values in each community type were used to name these plant community types (Table 6). Possible environmental variables for these plant species composition and community types were also considered. Such environmental variables include altitude, aspect, slope, grazing and intensity of disturbance hence presumed to be structuring plant species composition and community types. These environmental variables were shown in the ordination graphs of multivariate data analysis. Synoptic table of species reaching synoptic value of 2 in at least one community type were indicated in Table 6.

Table 6. Synoptic table of species reaching synoptic value of plant species

Clusters		1	2	3	4	5	6	7	8
Size	95	14	9	5	5	19	9	18	16
Species	458	216	113	16	20	200	126	170	170
Olea welwitschii		**2.1**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Podocarpus falcatus		**2.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Elaeodendron buchananii		**1.6**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ficus sycomorus subsp. cycomorus		0.0	**5.2**	0.0	0.0	0.0	0.0	0.0	0.0
Albizia grandibrateata		0.0	**5.1**	0.0	0.0	0.0	0.0	0.0	0.0
Cordia africana		0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0
Trichillia dregeana		0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0
Sapium elepticum		0.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0
Celtis africana		0.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0
Poutteria altissima		0.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0
Ficus mucuso		0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0
Ficus exaserpata		0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0
Millettia ferrruginea		**2.2**	3.6	0.0	0.0	0.0	0.0	0.0	0.0
Milicia excelsa		0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0
Manilkara butugi		0.0	3.2	0.0	0.0	0.0	0.0	0.0	0.0
Ozoroa pulcherrima		0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0
Combretum molle		0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0
Diospyros abyssinica		0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0
Antiaris toxicaria		0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0
Cyperus dichroostachyus		0.0	0.0	**3.8**	0.0	0.0	0.0	0.0	0.0
Cyperus latifolius		0.0	0.0	**3.8**	0.0	0.0	0.0	0.0	0.0
Oenanthe palustris		0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0
Sphaeranthus suaveolens		0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0
Cyperus sesquiflorus		0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0
Ranunculus multifidus		0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0
Arundinaria alpina		0.0	0.0	0.0	**8.8**	0.0	0.0	0.0	0.0
Lepidotrichilia volkensii		0.0	0.0	0.0	**3.6**	0.0	0.0	0.0	0.0
Cyperus dereilema		0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0
Bersama abyssinica		0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0
Galinerea saxifraga		0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0
Ensete ventricosum		0.0	0.0	0.0	2.0	0.0	**2.0**	0.0	0.0

Synoptic table 6 (Continued)

Clusters		1	2	3	4	5	6	7	8
Size	95	14	9	5	5	19	9	18	16
Species	458	216	113	16	20	200	126	170	170
Eryttrina brucei		0.0	0.0	0.0	0.0	**3.7**	0.0	2.1	0.0
Dombeya torrida		0.0	0.0	0.0	0.0	**3.0**	0.0	0.0	0.0
Hallea rubrostipulata		**2.0**	0.0	0.0	0.0	2.5	0.0	0.0	0.0
Euphorbia ampliphylla		2.1	0.0	0.0	0.0	2.3	0.0	0.0	0.0
Ficus sur		2.1	2.9	0.0	0.0	2.7	**7.1**	3.2	0.0
Croton macrostachyus		1.6	2.2	0.0	0.0	4.7	**5.8**	2.9	2.4
Polyscias fulva		2.6	0.0	0.0	0.0	4.1	5.4	0.0	0.0
Albizia gummifera		2.0	2.7	0.0	0.0	0.0	3.1	0.0	0.0
Schefflera abyssinica		0.0	0.0	0.0	2.4	6.2	6.0	**7.6**	2.4
Syzygium guineense subsp. afromontanum		0.0	0.0	0.0	0.0	5.8	2.1	**6.7**	3.9
Pouteria adolfi-firiedericii		2.2	0.0	0.0	0.0	2.9	6.3	6.6	0.0
Cyathea manniana		0.5	0.0	0.0	0.0	0.0	0.0	5.4	4.6
Ekebergia capensis		0.0	0.0	0.0	0.0	3.2	4.2	5.4	4.1
Schefflera volkensii		0.0	0.0	0.0	2.4	0.0	0.0	4.7	4.2
Prunus aficana		0.0	0.0	0.0	4.0	3.1	3.0	4.1	2.3
Ilex mitis		0.0	0.0	0.0	4.2	4.2	0.0	5.4	**6.2**
Macaranga capensis		0.0	0.0	0.0	0.0	2.8	0.0	3.1	**3.8**
Allophylus abyssinicus		0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.8
Maesa lanceolata		0.0	0.0	0.0	0.0	0.0	0.0	2.1	2.6

Plant community types

Combinations of dominant or characteristic species reaching synoptic values of 2 and above were considered to name the plant community types (Table 6). Hence, the eight plant communities identified together with their species richness (R) are:

1. ***Olea welwitshii-Podocarpus falcatus* community**

This community type was the most species rich community containing 216 species within plot size of 14 comprising 15% of the total plots. This plant community was found within elevation range of 1050 m to 2325 m above sea level. Characteristic species of this community type include species of *Olea welwitshii, Podocarpus falcatus, Elaeodendron buchananii, Millettia ferruginea, Hallea rubrostipulata, Euphorbia ampliphylla, Ficus sur, Croton macrostachyus, Polyscias fulva, Albizia gummifera,* and *Pouteria adolfi-firiedericii.*

2. *Ficus cycomorus-Albizia grandibracteata* community

This community type was also relatively species rich community containing 113 species within plot size of 9 comprising 9.5% of the total plots. The elevation range for this plant community was 1000 m to 1550 masl. Characteristic species to this community include species of *Ficus sycomorus subsp. sycomorus, Albizia grandibracteata, Cordia africana, Trichillia dregeana, Sapium ellipticum, Celtis africana, Pouteria altissima, Ficus mucuso, Ficus exaserpata, Millettia ferruginea, Militia excelsa, Manilkara butugi, Ozoroa pulcherrima, Comberetum molle, Diospyros abyssinicus, Antiaris toxicaria, Ficus sur, Croton macrostachyus* and *Albizia gummifera.* The community contained the most disturbed areas of Yeki District extending from Alamo locality through Bachi locality to the tip of Ermich locality.

3. *Cyperus dichroostachyus-Cyperus latifolius* community

This community was one of the least species rich communities with only 16 species within plot size of 5 and 5.3% of the total plots belonging to elevation range of 1800 m to 2490 masl. It belonged to the wetland vegetation of the study area that was found in open spaces between forests or grazing lands. This community is among the major sources of forage and water for cattle and the traditionally well known Cyprus species locally called DISHO used in the construction of traditional houses (hats) as a substitute to corrugated iron in modern house construction. Characteristic species of this community type include *Cyperus dichroostachyus*, *Cyperus latifolius, Oenanthe pallustris, Sphaeranthus suaveolens, Cyperus sesquiflorus,* and *Ranunculus multifidus.*

4. *Arundinaria alpina-Lepidotrichillia volkensii* community

This community type was found within relatively higher altitudes between 2375 m to 2800 masl in the study area. Due to the domination of pure stands of *Arundinaria alpina*, it is also one of the least species rich plant communities with only 20 species within plot size of 5 comprising 5.3% of the total plots. It contains the highland bamboo conservation area enclosed by the Ethiopian Biodiversity Institute (EBI) and hence among the highly recognized vegetation. Characteristic species include *Arundinaria alpina, Lepidotrichinilla volkensii, and Cyperus dereilema, Bersama abyssinica, Galinerea saxifrage, Ensete ventricosum, Schefflera abyssinica, Schefflera volkensii, Prunus africana, Ilex mitis and* the herbaceous layer of *Pilea bambuseti, Pilea rivularis, Laportea aestuans* and *Alchemilla fischeri.*

5. *Erythrina brucei-Dombeya torrida* community

This plant community type was the second most species rich community next to community one with species richness of 199 species within 19 plots comprising 20% of the total plots in between 1650 m and 2450 masl. Characteristic species of this community type include *Erythrina brucei*, *Dombeya torrida, Hallea rubrostipulata, Euphorbia ampliphylla, Ficus sur, Croton macrostachyus, Polyscias fulva, Schefflera abyssinica, Syzygium guineense subsp. afromontanum, Pouteria adolfi-firiedericii, Ekebergia capensis, Prunus africana, Ilex mitis* and *Macaranga capensis*.

6. Ficus sur-Croton macrostachyus **community**

This plant community type was the fifth relatively species rich community next to community one, community five, community seven and community eight with species richness of 126 species within 9 plots comprising 9.5% of the total plots. The range of altitude for this plant community type lies in between 1850 m and 2350 masl. Characteristic species of this community type include species of *Ficus sur, Croton macrostachyus, Polyscias fulva, Albizia gummifera, Schefflera abyssinica, Syzygium guineense subsp. afromontanum, Pouteria adolfi-firiedericii, Ekebergia capensis, Prunus africana,* and *Ensete ventricosum*.

7. Schefflera abyssinica-Syzygium guineense **community**

This community was one of the fourth relatively species rich community with species richness of 170 within 18 plots comprising 19% of the total plots in between 2200 m and 2575 masl. Characteristic species of this community type include *Schefflera abyssinica, Syzygium guineense subsp. afromontanum, Pouteria adolfi-firiedericii, Cyathea manniana, Ekebergia capensis, Schefflera volkensii, Prunus africana, Ilex mitis, Macaranga capensis, Allophylus abyssinicus, Maesa lanceolata, Croton macrostachyus, Ficus sur* and *Erythrina brucei*.

8. Ilex mitis-Macaranga capensis **community**

This community type was also one of the fourth species rich communities as that of community seven with species richness of 170 species. It was found within 16 plots comprising 17% of the total plots in between 1900 m and 2625 masl. Characteristic species of this community include species of *Ilex mitis, Macaranga capensis, Allophyllus abyssinicus, Maesa lanceolata, Prunus Africana, Shefflera volkensii, Ekebergia capensis, Cyathea manniana, Syzygium guineense, Schefflera abyssinica* and *Croton macrostachyus*.

Indicator, Constancy and Importance values Indices of plant species

Summary of species occurrences, relative species occurrences, mean abundance values, the class for which each species has maximum indicator value in the cluster and their importance value index (IVI) are indicated for top the 20 plant species with IVI >20 in Table 7 and for the whole plot dataset in Appendix 3. Similarly, 54 of the total 458 plant species recorded from plots have IVI values greater than 10 and account for 47% of the total IVI values as shown in Appendix 3.

Table 7. Plant species with importance value indices (IVI) $\geq$ 20

Key: $indcls= the indicator values of each species to its maximum class, $maxcls= the class for which each species has maximum indicator value, $pval= the probability of obtaining as high indicator value as observed over specific interactions, Ta= total abundance values, Ma= Mean abundance, F= Frequency

Species	F	RelF	Ta	Ma	$m	$in	$pval	Cons	IVI
Schefflera abyssinica	53	55.8	372	7.0	3	0.30	0.001	0.673	40.3
Pouteria adolfi-firiedericii	41	43.2	280	6.8	3	0.30	0.005	0.675	37.3
Ekebebrgia capensis	47	49.5	285	6.1	3	0.24	0.035	0.613	36.9
Syzygium guineense subsp. afromontanum	49	51.6	326	6.7	3	0.32	0.001	0.745	33.5
Ficus sur	46	48.4	254	5.5	5	0.36	0.001	0.52	33.2
Polyscias fulva	42	44.2	209	5.0	5	0.28	0.009	0.63	33.1
Ilex mitis	57	60.0	322	5.6	4	0.24	0.007	0.733	31.6
Prunus africana	47	49.5	231	4.9	7	0.18	0.125	0.543	30.8
Croton macrostachyus	58	61.1	275	4.7	5	0.26	0.007	0.563	28.6
Albizia gummifera	24	25.3	116	4.8	5	0.21	0.049	0.613	26.0
Arundinaria alpina	16	16.8	92	5.8	7	0.75	0.001	0.835	25.6
Eryttrina brucei	30	31.6	148	4.9	2	0.32	0.005	0.68	24.2
Sapium elepticum	15	15.8	83	5.5	6	0.37	0.006	0.755	24.2
Euphorbia ampliphylla	30	31.6	124	4.1	2	0.16	0.183	0.538	23.6
Schefflera volkensii	30	31.6	173	5.8	3	0.31	0.005	0.755	22.6
Cyathea manniana	33	34.7	195	5.9	3	0.42	0.001	0.793	22.4
Vernonia amygdalina	23	24.2	84	3.7	2	0.14	0.238	0.588	21.0
Hallea rubrostipulata	17	17.9	86	5.1	2	0.20	0.07	0.73	20.7
Dombya torrida	26	27.4	111	4.3	2	0.29	0.005	0.663	20.4
Dracaena steudneri	13	13.7	52	4.0	5	0.14	0.181	0.745	20.1

NB: F= Frequency, RelF= Relative frequency, $m=$maxcls, $in=$indcls

4.1.4. Validation of Environmental Factors and Plant Community Types

Indirect Gradient Analysis*: Results of Redundancy Analysis (RDA)*

Results of significant environmental variables using indirect gradient analysis using RDA were given in Appendix 10. Significance levels were given as: Pr (>F): 0(***) =Very high, 0.001(**) =High, 0.01(*) =medium, 0.05('.')=Low, 0.1('') =Very low, 1=none. Results of test for significance of environmental variables for both backward and forward selection of variables indicated that all the five environmental factors are significant at p-values ranging between p=0.005 to p=0.05 for redundancy analysis. Similarly, results of stepwise selection with variance inflation factor in conjunction with canonical correspondence analysis were computed. Variables that are collinear and are therefore candidates for elimination will have vif values higher than 5.

Indirect Gradient Analysis: *Results of Canonical Correspondence Analysis (CCA)*

Results of CCA for backward and forward selection of environmental variables indicated that they are significant except slope for stepwise selection of environmental variables. Summary of results of anova.cca test for the significance of each environmental variable prior to analysis, sequential test for terms, test for axes and permutation test for cca under reduced model marginal effects of terms using indirect gradient analysis for CCA are given in Appendix 10. Terms added sequentially from first to last. Under reduced model, the results of anova.cca is very significant for the 5 environmental variables at p=0.001 and five degree of freedom. Whether to reject or retain environmental variable depends on vif.cca values. None of the values for the five environmental variables were found to be with vif.cca > 5 using permutation tests for cca under reduced model and marginal effects of terms.

Results of Redundancy Analysis (RDA)

The results of RDA/PCA values to fit environmental variables to unconstrained ordination represented that in the absence of PC1 Redundancy Analysis significantly explain environmental variables. The significant vectors (***VECTORS) for RDA are given in Table 8. The biplot of RDA/PCA ordination is shown in Figure 13.

Table 8. Significant vectors for environmental factors, RDA

Variables	RDA1	RDA2	r^2	Pr(>r)	Codes	Sign.
Altitude	0.978	0.211	**0.722**	0.001	***	Yes (very high)
Slope	-0.166	-0.986	0.236	0.001	***	Yes (very high)
Aspect	-0.650	0.760	0.207	0.001	***	Yes (very high)
Grazing	-0.349	0.937	0.075	0.036	*	Yes (medium)
Disturbance	-0.998	0.060	0.066	0.047	*	Yes (medium)

The importance of components and biplot scores for constraining variables is determined by interpreting Eigen values and their contribution to variance accumulated Eigen values. Biplot of RDA/PCA where environmental factors are fitted into unconstrained ordination is represented in Figure 13.

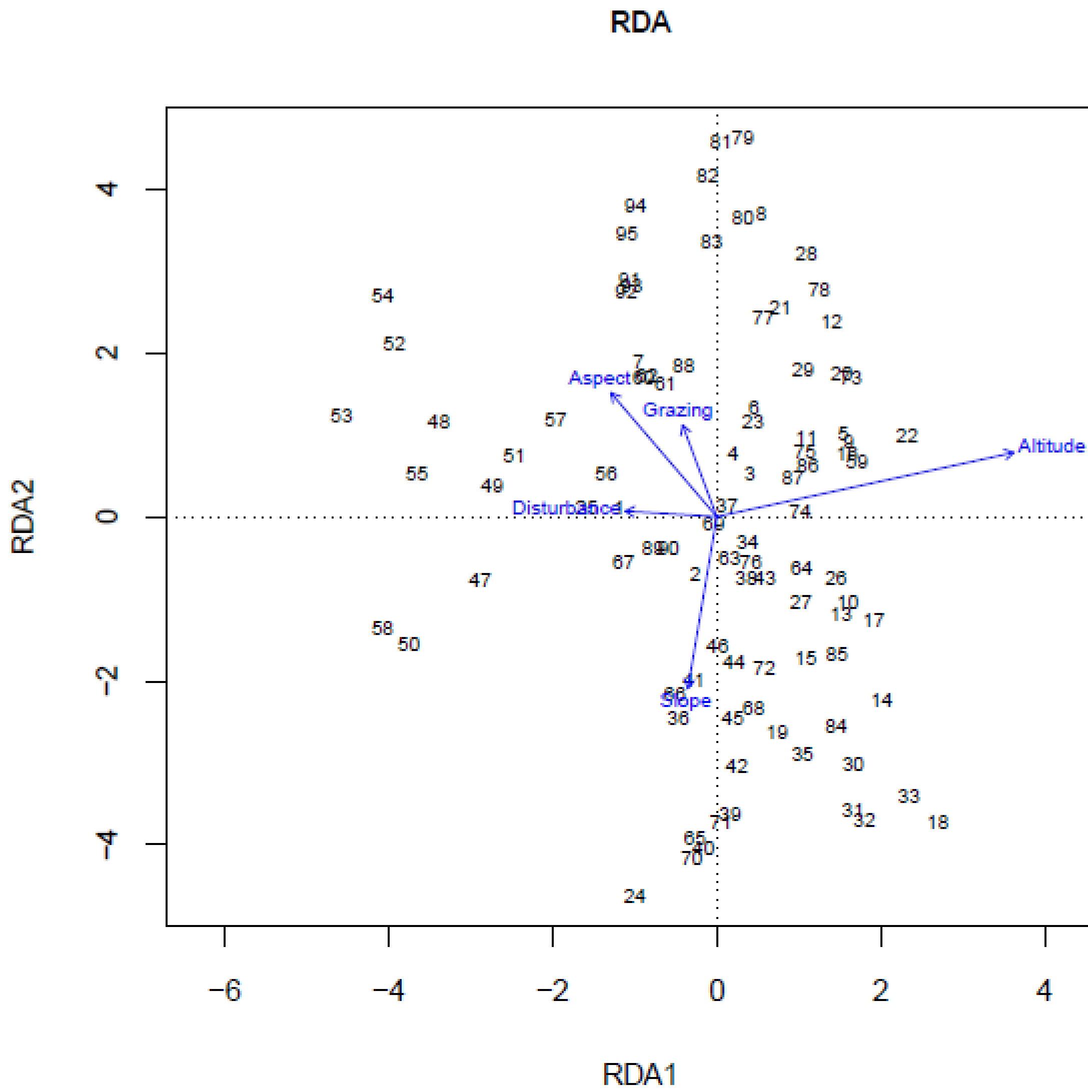


Figure 13. Biplot of RDA/PCA where environmental factors fitted into unconstrained ordination

Figure 14 represents RDA with colored sites of clusters to display plant communities on the ordination space. The colored clusters represent the respective plant community types.

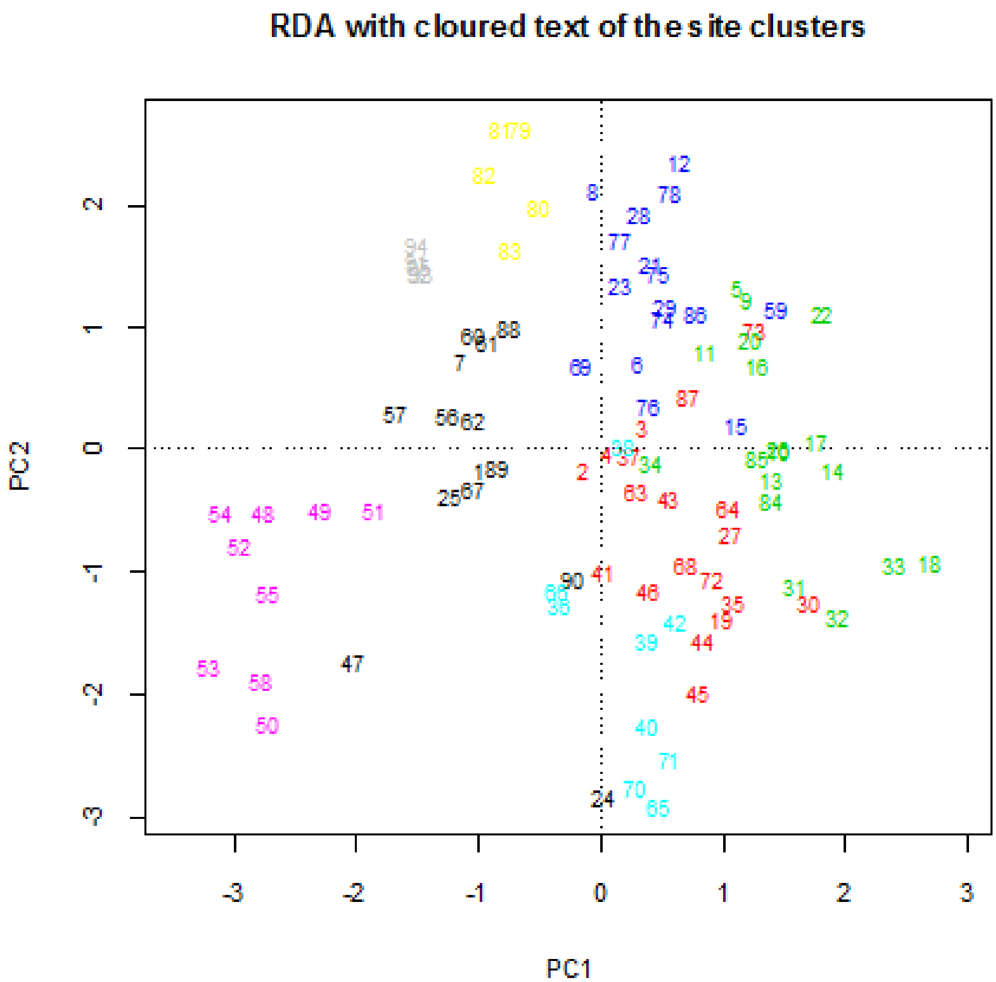


Figure 14. RDA with colored sites of clusters to display plant communities

Results of RDA with colored clusters and constrained with species scores scaled by Eigen values using library vegan are given in Figure 15. From the graphs, it can be interprated that plant communities 1 and 2 are constrained by aspect, disturbance and grazing in the second and third quadrat. Similarly, plant community 3 is constrained by aspect and grazing in the second quadrat. Moreover, plant community 4 is constrained by altitude, aspect and grazing in the first and second quadrat. On the other hand, plant community 5 is constrained by altitude, slope and disturbance in the first, second and fourth quadrat whereas plant community 6 is constrained by altitude, slope and disturbance in the third and fourth quadrat. Furthermore, plant community 7 and 8 are constrained by altitude, slope and grazing in the first and fourth quadrats.

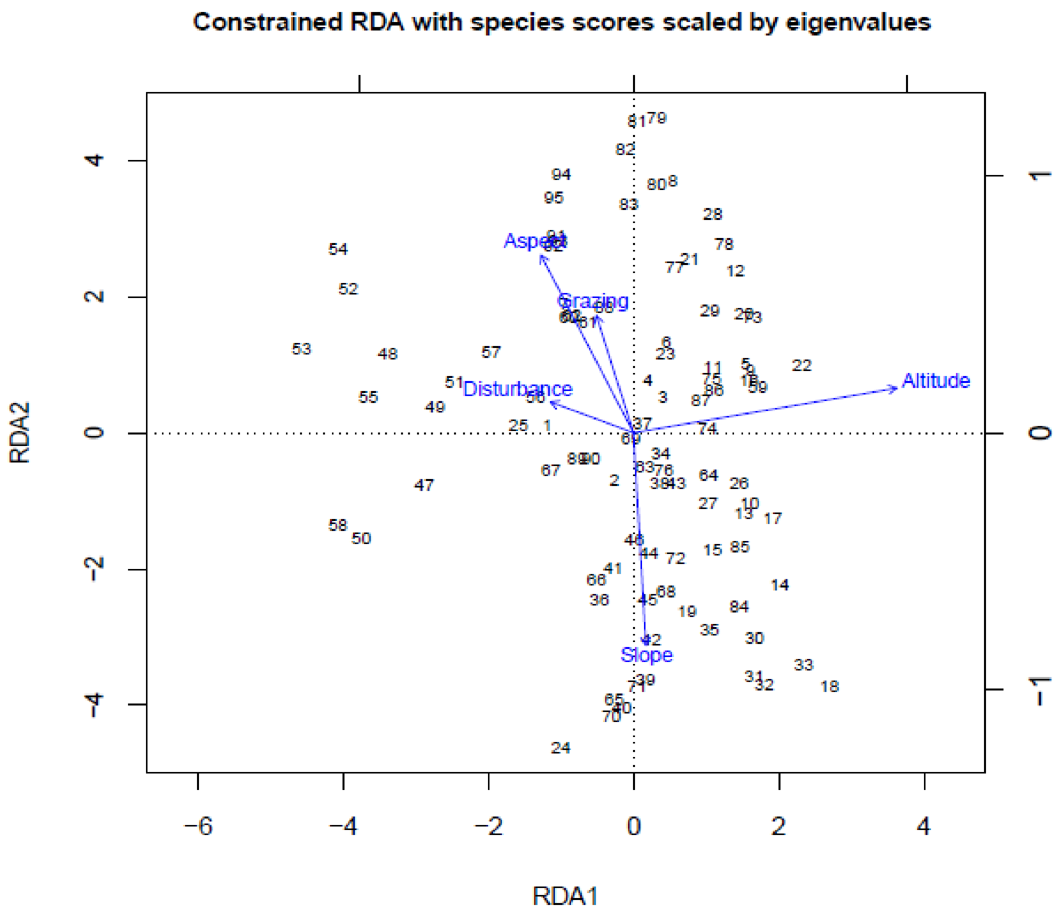


Figure 15. Constrained RDA using library vegan

Similarly, constrained RDA with cluster groups identified with colored texts to display plant communities on the ordination space is indicated in Figure 16.

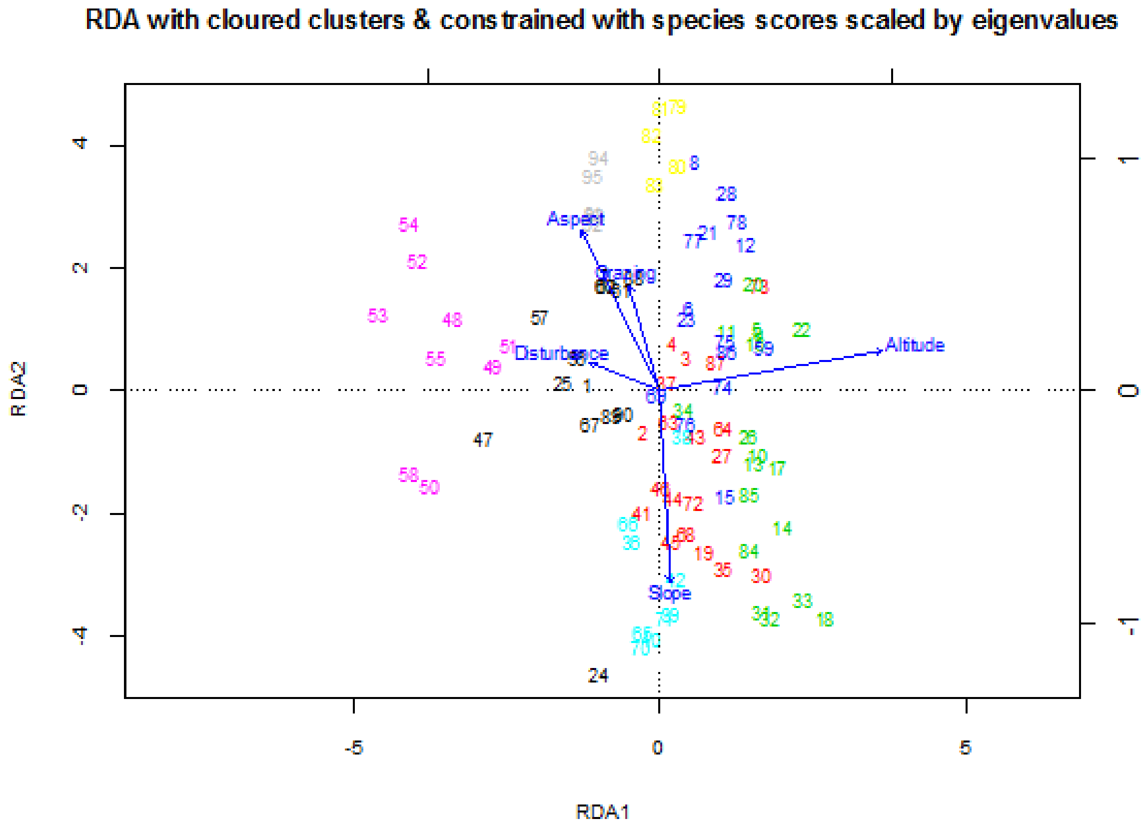


Figure 16. Constrained RDA with cluster groups identified with colored texts

Details of colored clusters and their respective plant communities are given in Table 9.

Table 9. Ordered clusters and their respective plant communities, RDA

Ordered	Communities	Plots as displayed on ordination space/colored groups/	N*	%
1	**5**	2, 3, 87, 4, 19, 27, 30, 35, 37, 44, 63, 68, 43, 64, 41, 45, 46, 72, 73	19	20
2	**7**	5, 9, 10, 26, 20, 22, 11, 34, 13, 85, 31, 18, 33, 32, 84, 14, 16, 17	18	19
3	**8**	6, 21, 8, 78, 15, 69, 76, 77, 23, 59, 86, 12, 74, 75, 28, 29	16	17
4	**1**	1, 24, 25, 47, 56, 57, 7, 67, 88, 60, 89, 90, 61, 62	14	15
5	**2**	48, 49, 50, 51, 54, 55, 58, 52, 53	9	9.5
6	**6**	36, 66, 38, 39, 42, 40, 65, 70, 71	9	9.5
7	**3**	91, 92, 93, 94, 95	5	5.3
8	**4**	79, 81, 80, 82, 83	5	5.3

N*=Cluster size

Results of Canonical Correspondence Analysis (CCA) for test of fitness

Validation of significant vectors (***VECTORS) using direct gradient analysis using CCA is represented in Table 10 confirming that all constraining variables are very significant.

Table 10. Results of test for fitness of environmental variables, CCA

Variables	CCA1	CCA2	r^2	Pr(>r)	Code	Significance
Altitude	0.991	0.137	**0.994**	0.001	***	Yes (very high)
Slope	0.102	-0.995	0.117	0.007	**	Yes (high)
Aspect	-0.380	0.925	**0.851**	0.001	***	Yes (very high)
Grazing	-0.376	0.927	0.156	0.001	***	Yes (very high)
Disturbance	-0.671	0.742	0.372	0.001	***	Yes (very high)

4.1.5. Diversity Analysis

Beta (β_w) diversity

Results of Beta diversity for the whole data frame or beta diversity of vegetation data with no specific gradient (β_w=14.30) implies very high beta diversity. Note that $\beta_w < 1$ are rather low and $\beta_w > 5$ can be considered high. Results of Beta diversity of pair wise comparisons or mean value of beta diversity between the sample plots is equal to 0.79 and this is the Sørensen index of dissimilarity for plots. Results of plotting the species accumulation curve (to indicate whether the study area was sufficiently sampled or not) using the exact method is indicated as follows (Figure 17).

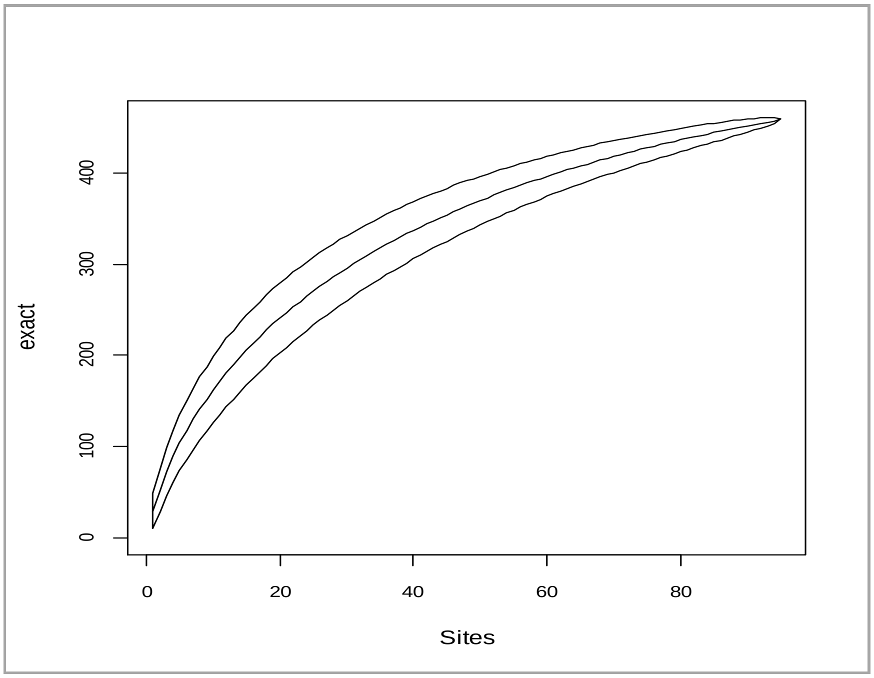


Figure 17. Species accumulation curve

Alpha (α) diversity

Results of Shannon-Wiener Diversity and Simpson diversity indices represent the overall diversity of the study area. Hence, the Sahannon-Wiener diversity index is H'=3.41 and the Simpson diversity index is Simpson =1-P= 0.96, P =0.04. Hence, invSimpson=1/P=25.25. Results of the Shannon-Wiener Diversity for each plot in the whole data frame are also given in Appendix 4. Results of the Shannon-Wiener Diversity Index of clusters are: Beta Diversity for the whole clusters (between clusters) = 2.56 and Beta Diversity of Whittaker for clusters (within clusters beta diversity or pair wise comparisons of clusters) = 0.72 and this is also the Sørensen index of dissimilarity for clusters. Similarly, results of diversity indices for clusters are indicted in Table 11. Different values between the Shannon-Wiener evenness and the Simpson evenness indices were obtained and the reason was explained in the discussion section of this document.

Table 11. Diversity indices for clusters

Key: C=Clusters/Community, H=Diversity, ShE=ShannonEvenness, D= Simpson index, SE=SimpsonEvenness

C*	Richness	Shannon-Wiener (H)	Shannon-Wiener Evenness	Simpson(D)	SE
1-**1**	216	4.77	0.89	76.40	0.35
2-**5**	199	4.23	0.80	39.14	0.20
3-**7**	170	4.04	0.79	32.45	0.19
4-**8**	170	4.13	0.80	33.77	0.20
5-**6**	126	3.91	0.81	27.92	0.22
6-**2**	113	4.18	0.89	47.04	0.42
7-**4**	20	2.61	0.87	10.73	0.54
8-**3**	16	2.59	0.94	11.76	0.74

*=ordered cluster based on its appearance on the dendrogram clustering output for easier interpretation

4.1.6. Plant Species Distributions

Results of species distributions among wild, homegardens, cultivation and plantations represented in Figure 18.

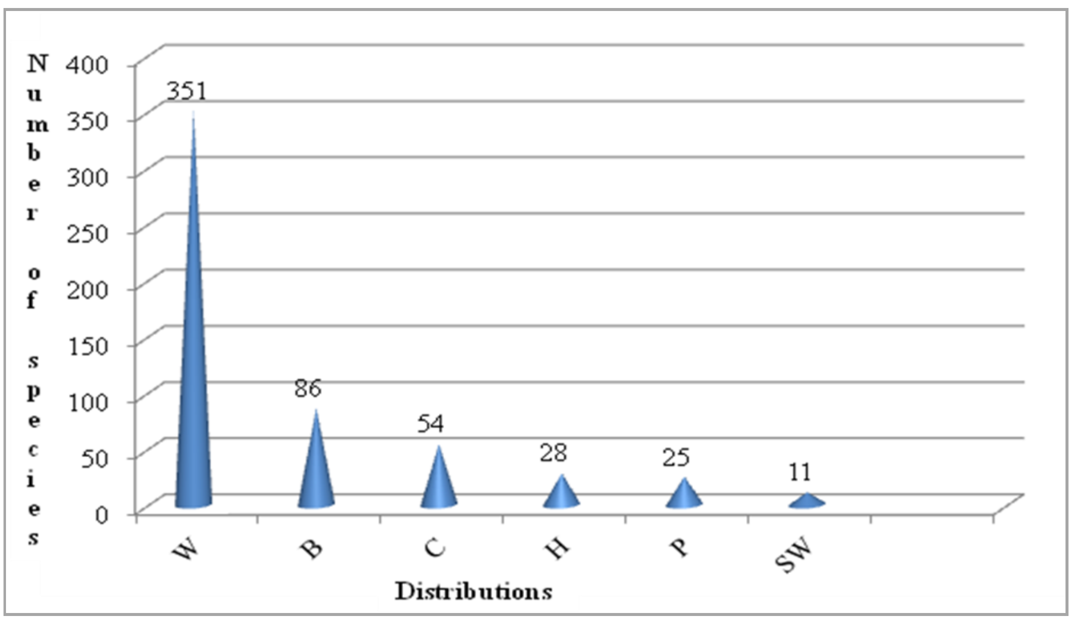


Figure 18. Habitat distribution of plants collected from the study area

NB: W= wild= those observed only in the wild habitats, H=Homegarden = those observed only in homegardens and usually human managed, B= Both = those observed in both wild and homegarden habitats as normal distribution, SW= semi wild= those mostly observed in wild habitats but rarely seen in homegardens or vice versa either as escapes from farm lands, homegardens or life fences but not human managed, C= Cultivated or planted = those cultivated either in farmlands or in homegardens or planted as street ornaments and hence human managed, P= Plantation = Planted as ornamental plant, street tree or garden plant or large scale plantation.

4.2. Ethnobotany

4.2.1. General Use Category of Plants Used in the Study Area

Fourteen major use categories of plants recorded from the study area (Appendix 1). Out of the total 555 plant species belonging to 341 genera and 115 families that were reported for their ethnobotanical importance, only 11 plant species with use value totaled equals to 30 and above were indicated in Table 12.

Based on informants' ranking and classification, about 14 plant use categories were identified from the study area and these fourteen plant use categories were also further broken down/divided into major and minor use categories. These use categories include:

(a) **Medicinal plants (M)**: These are plants used in traditional medicine in the area. About 266 medicinal plants belonging to 192 genera and 74 families were recorded from the study area distributed in forests, homegardens and other habitats (roadsides, wetlands, agricultural lands, epiphytic on large trees) in the study area.

(b) **Food plants (F)**: These include both plants used as wild foods as well as the domesticated ones. The wild foods include large trees with edible fruits such as *Syzyguim guineense subsp. afromontanum, Manilkara butugi, Ficus sur*. Woody shrubs or shrubby climbers include *Rubus steudneri* (berry fruits edible), *Embelia schimperi* (both the leaf and the fruits edible). Plants whose young sprouts (shoots) are edible include *Arundinaria* *alpina* whereas herbaceous plants whose rhizomes are eaten are *Colocasia esculenta* and *Manihot esculenta*. Ninety three (93, 16.8%) of the plant species collected were reportedly used as food plants of which 34 (6.13%) of them are wild edible plants.

(c) **Plants used as sources of beverages/drinks (D)**: These plants include all plant species either cultivated or non-cultivated and used either directly or indirectly (processed or unprocessed). Sixteen (16, 2.9%) of the plants collected from the study area were reportedly used as source of beverage or drinks.

(d) **Plants used as source of firewood (FW)**: These plants include all plant species used as fire wood under special circumstances even though they have other major use values (timber, construction and tools) and those plant species that are very suitable for use mainly as fire wood. A total of 101 (18.20%) of the total plant species recorded from the study area were reportedly used as source of firewood.

(e) **Plants used as source of charcoal (CL)**: These plants are similar to those discussed under point (d) but must have enough trunks for the preparation of charcoal. Forty four (7.9%) of the total plant species recorded from the study area were reportedly used as sources of charcoal and charcoal making.

(f) **Shade plants (SD)**: These are plants that play vital role in various aspects of community life. Shade plants constituted 69 (12.4%) of the species collected from the study area were reportedly used as shade plants.

(g) **Plants used as raw materials for construction and tools (CT)**: These are among the most utilized plant uses and usually considered among the most threatening human activities to vegetation resources. These include species of *Cordia africana, Pouteria adolfi-firiedericii, Syzygium guineense subsp. afromontanum, Cyathea manniana, Manilkara butugi, Olea welwitshi, Arundinaria alpina* and many more species. Onehundred twenty eight (128, 23.1%) of the total species collected from the study area were reportedly used as a raw materials for construction and tools including farm implements.

(h) **Commercial plants (CM)**: These include plants of great economic value in local, national and international markets. They include *Coffea arabica, Piper capense, Curcuma domestica, Zingeber officinale, Aframomum corrorima, Arundinaria alpina*. About 88 (15.9%) of the total species collected from the study area were reportedly great commercial value.

(i) **Livestock feed/fodder plants (FD)**: These include plants used as the main livestock feed or fodder. However, it does not mean that plants which are the main sources of food for humans are not food sources for livestock and vice versa. These include *Ensete ventricosum, Zea mays, Acanthus eminens, Satureja paradoxa (endemic), Carduus leptacanthus, Carex johnstonii, Carex thomasii* and many others. A total of 57 (10.27%) of the total species collected from the study area were reportedly used as fodder plants.

(j) **Bee forage plants (BF)**: These are all plants of great apicultural value. The major ones include *Schefflera abyssinica, Manilcara butugi, Dombeya torrida, Apodytes dimidiata, Combretum molle, Syzygium guineense subsp. afromontanum, Ilex mitis, Ekebergia capensis, Olea welwitschi* and others. About 263 (47.4%) of the plant species collected from the study area were reportedly used as bee forage and it is the second next to medicinal use of plants in terms of number of species.

(k) **Culture and ritual plants (CR)**: Some plant species have been given by the local community special attention attached to cultural beliefs, religious attributes or socially recognized merits. The majority of the tree species found in the GUDO (religious) forests belong to culture and ritual plant species. About 25 (4.5%) of the total species recorded from the study area were reportedly used as culture and ritual plants and usually deliberately planted around houses, in gardens, graves or protected in their natural habitat in sacred forests.

(l) **Ornamental plants (OL)**: These include plant species such as *Dracaena steudneri*, *Dracaena fragrance*, *Canna indica*, *Asparagus africanus*, *Euphorbia pulcherima* and many more species. About 78 (14.10%) of the plant species collected from the study area were reportedly used as ornamental plants.

(m) **Plants used as life fences (LF)**: Some multipurpose plants are also used as life fences. Such plant species include *Brugmansia suaveollens, Caesalpinia decapetala, Erythrina abyssinica, Eucalyptus globulus, Eucalyptus tereticorns, Euphorbia ampliphylla, Euphorbia tirucalli, Ficus thonningii, Jatropha curcas, Justicia schimperiana* and many more. About 24 (4.3%) of the total plant species collected from the study area were reportedly used as life fences.

(n) **Others (OT)**: use categories of plants that are not mentioned in anyone of the above uses but encountered in other uses. For instance, species such as *Ficus asperifolia* and *Ficus vallis-choudae* are used as glass paper for softening wood or as spiral iron for washing ditches in kitchens. The bark of *Hibiscus* species is used for making rope. Wetland species like *Oenanthe palustris* are used for making skins and hides in traditional tanning. About 83 (15%) of the total species recorded from the study areas were reportedly with no specific uses but they are useful in at least one or more ways in their natural environment.

Table 12. Matrix of general use categories of plants in Sheka

Key: UVs= Use Vlues, medicinal (MD), food (F), drinks (D), fire wood (FW), charcoal (CL), shade (SD), construction and tools (CT), commercial (CM), animal fodder (FD), bee forage (BF), culture and rituals (CR), ornamental (OL), life fence (LF) and others (OT). Values indicate top 11 plant species with use totaled value ≥ 30 (n=555). *= endemic species, all the remaining are indigenous species.

SN	Species	Family	M	F	D	FW	CL	SD	CT	CM	FD	BF	CR	OL	LF	OT	UVs
1	*Syzygium guineense subsp. afromontanum*	Myrtaceae	2	1	0	6	6	4	13	7	0	1	3	0	0	0	43
2	*Croton macrostachyus Del.*	Euphorbiaceae	20	0	0	3	2	4	11	0	0	1	0	0	0	0	41
3	*Manilkara butugi*	Sapotaceae	2	2	0	3	4	4	10	0	0	10	2	0	0	0	37
4	*Ekebergia capensis Sparrm.*	Meliaceae	3	0	0	5	5	5	15	0	0	1	0	0	0	0	34
5	*Ilex mitis (L.) Radlk.*	Aquifoliaceae	5	0	0	6	5	4	13	0	0	1	0	0	0	0	34
6	*Olea welwitschii*	Oleaceae	5	0	0	6	5	4	13	0	0	1	0	0	0	0	34
7	*Arundinaria alpina K. Schum.*	Poaceae	2	2	0	0	0	0	8	3	1	0	5	11	1	0	33
8	*Prunus africana (Hook.f.) Kalkm.*	Rosaceae	11	0	0	5	4	3	9	0	0	1	0	0	0	0	33
9	*Hallea rubrostipulata*	Rubiaceae	3	1	0	5	4	4	12	0	0	1	0	0	0	0	30
10*	*Millettia ferruginea (Hochst.) Bak.*	Fabaceae	6	0	0	4	4	5	10	0	0	1	0	0	0	0	30
11	*Schefflera abyssinica*	Araliaceae	4	0	0	6	3	4	12	0	0	1	0	0	0	0	30

4.2.2. Medicinal Plants

A total of 266 plant species belonging to 192 Genera and 74 Families were identified to have medicinal value in the area. These species were used primarily to treat major health problems of both human and livestock. The medicinal plants in question may be used to treat human, livestock or both human and livestock health problems in addition to their other ethnobotanical significance (Appendix 2). From the total 266 medicinal plants; 204 (77%) of them were used to treat human health problems; only 10 (4%) of them were used to treat livestock health problems and 52 (19%) of them were used to treat both human and livestock health problems. Results of distribution of medicinal plants within the eight plant community types are given in Table 13.

Table 13. Distribution of medicinal plants within the 8 plant community types

Clusters/position on dendrogram/	1	2	3	4	5	6	7	8
Species richness	216	113	16	20	199	126	170	170
Clusters re-ordered	1	5	7	8	6	2	4	3
Species richness re-ordered decreasing	216	199	170	170	126	113	20	16
Medicinal plant species richness	140	124	114	113	91	52	13	8
Percentage of medicinal plants	64.81	62	67	66	72	46	65	50
Percentage rank	5th	6th	2nd	3rd	1st	8th	4th	7th

Results of correlations among plant communities with respect to medicinal plant richness are represented in Table 14 based on presence absence of medicinal plant species within the respective plant community. Greater than 50% correlation is highlighted in bold.

Table 14. Correlation coefficients of clusters with respect to medicinal plant richness

Clusters	1-1	2-5	3-7	4-8	5-6	6-2	7-4	8-3
1-**1**	1.000							
2-**5**	0.293	1.000						
3-**7**	0.129	0.004	1.000					
4-**8**	0.201	0.020	0.023	1.000				
5-**6**	**0.572**	0.207	0.031	0.249	1.000			
6-**2**	**0.519**	0.227	0.058	0.275	**0.537**	1.000		
7-**4**	0.495	0.123	0.039	0.297	**0.566**	**0.505**	1.000	
8-**3**	**0.527**	0.144	0.002	0.270	**0.632**	**0.564**	**0.612**	1.000

4.2.2.1. Diversity of medicinal plant growth forms

The four major medicinal plant growth forms identified from the study area were herbs, trees, shrubs, climbers and trees. The result of analysis of diversity of medicinal plant growth forms is indicated in Figure 19.

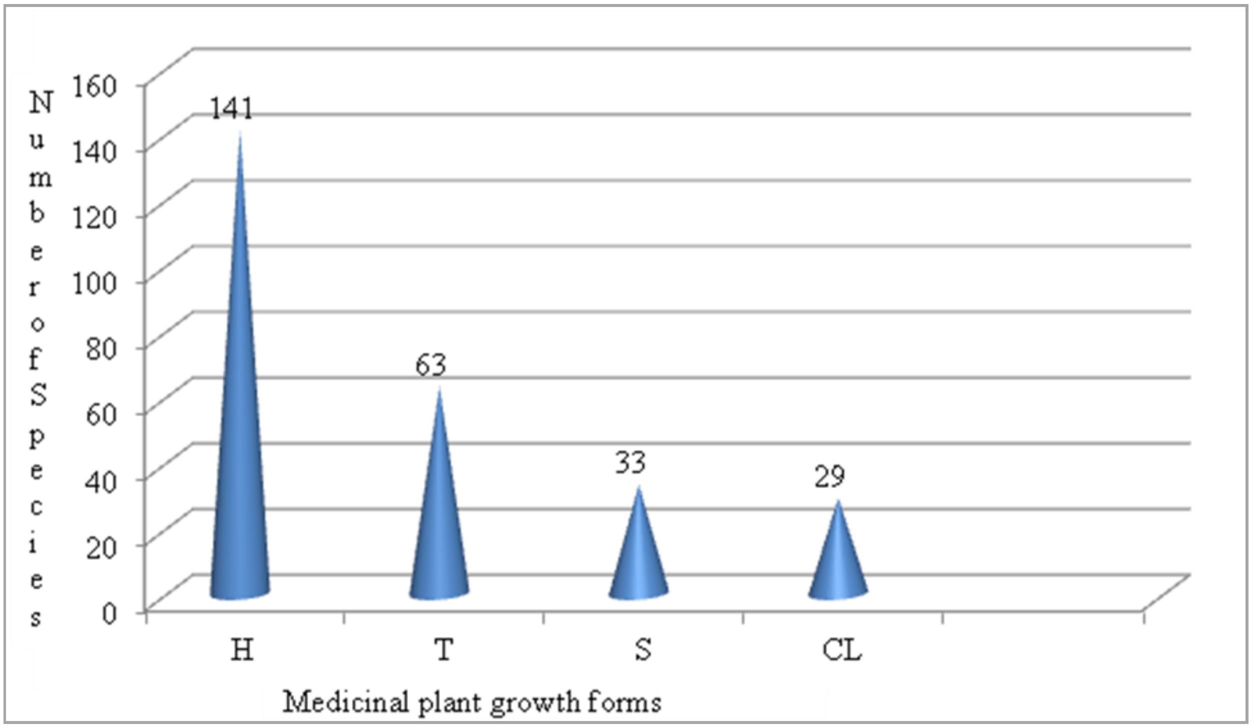


Figure 19. Distribution of medicinal plant growth forms
NB: H= Herbs, T= Trees, S= Shrubs, CL= Climbers

4.2.2.2. Medicinal plant parts used

Results of analysis of medicinal plants used in the study area indicated that 13 medicinal plant parts were identified as major parts used for treating various health problems. These are: young shoot (Sht), leaf (L), whole plant (WP), flower (Fl), seed (Se), rhizome (Rh), bark (Bk), root (R), latex (Lx), Fruit (Fr), stem (St), liquid exudates from young shoots (Lq) and resins from mature stem (Res) (Figure 20).

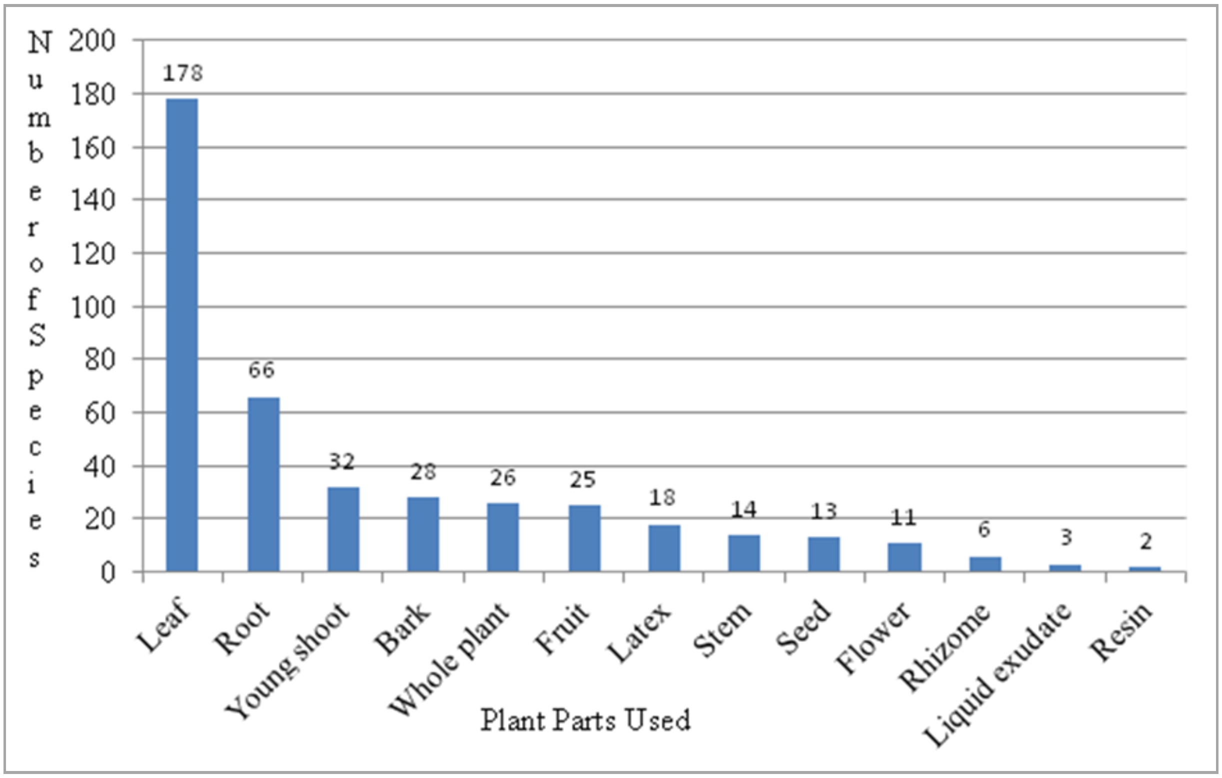


Figure 20. Distribution of medicinal plant parts used in the study area

4.2.2.3. Condition of preparation

Results of analysis for condition of preparation versus total number of citations by informants indicated that out of a total of 346 conditions of preparation reports, the majority of the medicinal plants were shown to be prepared from fresh plant materials followed by fresh or dry condition. Only few medicinal plants were prepared from dry plant material alone (Figure 21). Some medicinal plant parts show biological activities only when prepared from fresh materials while others are active if prepared either from fresh or dry plant materials. In others, it was prepared from both dry and fresh material stored for long term use without losing their healing potential.

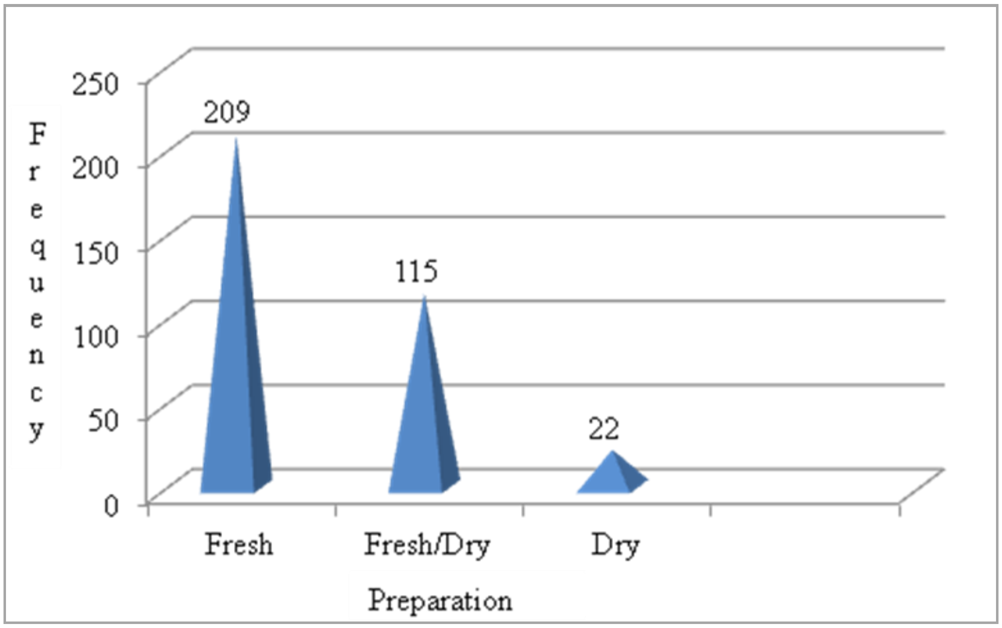


Figure 21. Condition of preparation of medicinal plant parts

4.2.2.4. Route of administration

Results of analysis of route of administration of medicinal plants revealed that the medicinal plants were administered through oral (Orl), external/rubbing (Ex/R), orophryngeal (Orgl), external/sealing (Ex/Seal), nasal (Na), ear (Er) and eye (Ey) (Figure 22). The use of terms for route of administration of medicinal plants in the context of this dissertation was:

Oral means the medicinal plant is taken orally in the form of liquid drink or solid material into stomach; External/rubbing means the medicinal plant is applied to the external part of the body in the form of liquid ointment usually to the skin; Oropharyngeal means the medicinal plant is applied to the mouth and the pharynx usually against gingivitis, tonsillitis and toothache; External/sealing means the medicinal plant preparation is used to treat wound on the body by tightly tying on the affected part of the skin; Nasal means the medicinal plant is taken through the nostrils in the form of sniff or used as an ointment around the nose cavity; Ear means the medicinal plant is applied in the form of ear drops in liquid form; Eye means the medicinal plant is applied in the form of eye drops in liquid form or chewed and spited into the eye in solid form.

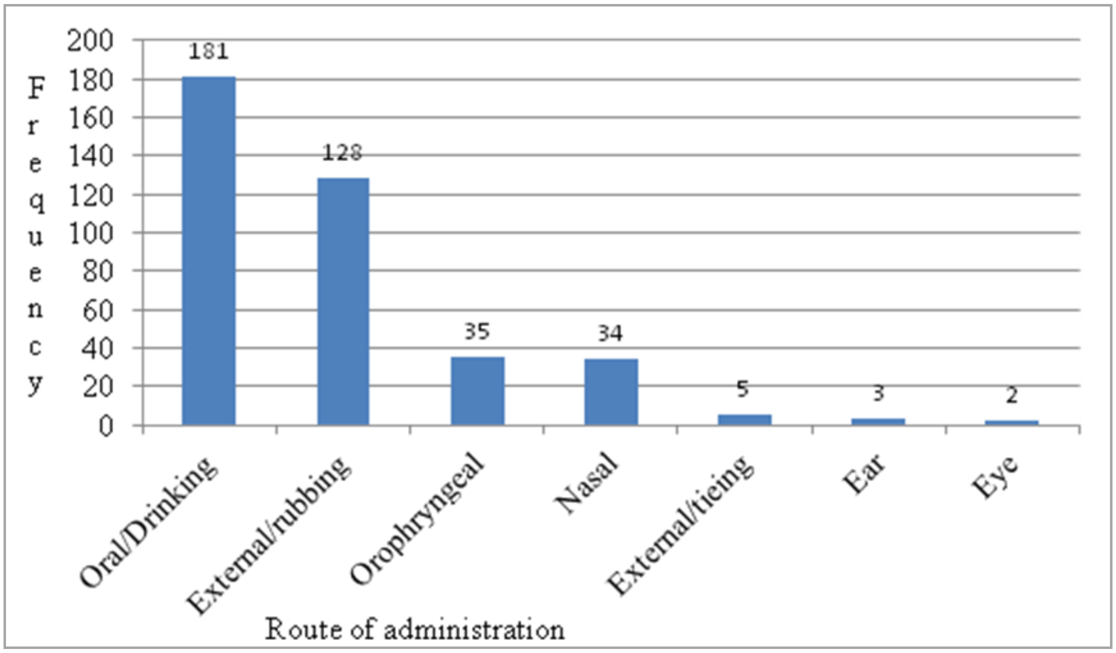


Figure 22. Route of administration of medicinal plants

4.2.2.5. Major health problems in Sheka Zone/emic versus etic perspectives/

Emic perspectives: Based on the ethnomedicinal information retrieved from the local informants, 143 health problems were shortlisted to be cross-checked with the secondary data received from the Health Division of Sheka Zone.

Etic perspectives: Secondary data sources obtained from the Sheka Zone Health Division for the fiscal years 2013 to 2015 revealed that about 31 major diseases were reportedly documented at Zone level. The distribution of these diseases among the three districts of Sheka Zone (Masha, Andracha and Yeki) is well indicated (Table 22). The document contained information (case reports) based on morbidity, both in patient division and outpatient division for all age groups.

4.2.2.6. Informant consensus factor (ICF)

The 143 different types of health problems outlined were categorized into 22 types of major disease categories locally treated with medicinal plants in the study area. The Informant Consensus Factor (ICF) values of the 22 different categories of human diseases are shown in Table 15 and that of livestock were represented in Table 17.

Table 15. ICF values of top 22 major human diseases categories

Key: nt= Number of medicinal plant species (taxa used), nur= Number of use citations, ICF= Informant consensus factor. *(Indicates 22 major categories of n=143).

*	Diseases/Categories	nt	nur	nur-nut	nur-1	ICF
1	Dermal/skin diseases/	16	399	383	398	0.96
2	Poisoning/snake, insect, other/	19	317	298	316	0.94
3	Gastrointestinal	23	293	270	292	0.92
4	Allergy	35	285	250	284	0.88
5	Viral/Rabies	14	92	78	91	0.86
6	Fungal	32	149	117	148	0.79
7	Ecto-parasites	27	105	78	104	0.75
8	Headache	23	87	64	86	0.74
9	Orophryngeal	58	179	121	178	0.68
10	Respiratory	50	147	97	146	0.66
11	Cardiac/systemic/	47	123	76	122	0.62
12	Hepatitis/Liver/	65	158	93	157	0.59
13	Opthalmia/eye/	61	143	82	142	0.58
14	Musculoskeletal	12	27	15	26	0.58
15	Renal/Kidney problems/	11	25	14	24	0.58
16	Reproductive	21	46	25	45	0.56
17	Mammary/breast diseases/	10	17	7	16	0.44
18	Otitis/ear/	14	21	7	20	0.35
19	Acute fibril illness/nerve/	9	13	4	12	0.33
20	Night evil	3	4	1	3	0.33
21	Glandular fever	6	8	2	7	0.29
22	Epilepsy	4	5	1	4	0.25

The traditional versus clinical explanations of these health problems were indicated in Table 16 for humans and Table 18 for livestock health problems.

Table 16. List of top 20 most cited human health problems in Sheka Zone

Sheka terms	Clinical terms	Clinical explanations (Elizabeth and Martin, 2010; EFMHACA, 2014, 2010)
MACHE BEWO/	*Stomachache	Any problems related to stomach either due to parasites, infections or allergy
MICHATTO	Allergy	Hypersensitive of the body to particular antigens
T'INBATE	Jaundice	A yellow discoloration of the skin or whites of the eyes
MAWO/MAC'E/MAE'	wound	Any infectious or mechanical injury to part of the body either with pus or dry
WASFATO	Ascariasis	A disease caused by infestation of *Ascaris lumbricoides*
O'TIO/SHOUKA O'TTIO	common cold	A widespread infectious virus disease causing inflammation of mucus membrane
KETTE BEWO	Tonsilitis	Inflammation of the tonsils due to bacteria or viral infection causing sore throat
MACHICHORO	Endoparasites	Parasites living in the inside of their hosts
EANGE KAJJO	Headache	Any disorder related to mental malfunctioning leading to loss of self personality
SHULIT KUNANE SHAC'O	Rabies	An acute virus disease of the central nervous system of all warm blooded animals
SHIKEKISSO	Fungal	Any health problem resulting from fungal attack or infection
BIC'O	Bloody diarrhea	Diarrhea with bloody discharge
K'OP'ARO	Cockroaches	A large brown insect with wings living in houses especially in dirt
DINGARE ATTO	Snake poison	Related to any species of snake that is dangerous to humans. It is general term
AFEE SHURITE	Eye disease	Bloodshot, watery, dry and itchy eyes/painful spot or acne on the eyelids
MAAC'EC'OT'T'O	Parasites	Any living thing that lives in another living organism
GATACH BEWO	Amoebiasis	An infection of the intestinal tract causing severe bloody diarrhea
DIGARE/T'EKARE	Snake bite	Wound resulting from snake bite through which the snake injected into the victim
CHOGARE BEWO	Gastritis	Inflammation of the lining of the stomach either acute or chronic stage
GOCHO/GOCHE BEWO/	Diarrhea	Frequent bowel evacuation or the passage of abnormally soft, liquid faeces

*=Non parasitic/non specified stomach problem. The 20 most cited is out of n=143 health problems cited by informants at zone level.

Table 17. ICF values of major livestock disease categories

Key: nt= Number of medicinal plant species (taxa used), nur= Number of use citations (reports), ICF= Informant consensus factor.

	Diseases/Categories	nt	nur	nur-nut	nur-1	ICF
1	Dermal	9	268	258	267	0.97
2	Breast diseases	2	21	19	20	0.95
3	Endoparasites	7	101	94	100	0.94
4	Wound	8	101	94	100	0.93
5	Fungal	3	26	23	25	0.92
6	Ectoparasites	2	12	10	11	0.91
7	African horse diseases	2	11	9	10	0.90
8	Rabies	4	28	24	27	0.89
9	Diarrhea	6	43	37	42	0.88
10	Eye disease	2	9	7	8	0.87
11	Abortion	3	15	12	14	0.86
12	Stomach problems	5	28	23	27	0.85
13	Cattle disease (unspecified)	2	7	5	6	0.83
14	Bone fracture	2	6	4	5	0.80
15	Bloating	4	15	11	14	0.79
16	Poisoning	4	14	10	13	0.76
17	Diseases of hen	2	5	3	4	0.75
18	Paralysis	5	10	5	9	0.56

Ten major disease of veterinary importance were indicated in Table 18 with their respective clinical explanations (Source: Sheka Zone veterinary office).

Table 18. Top 10 livestock diseases in Sheka Zone

N	Livestock diseases	Sheka	Clinical explanations
1	Bovine pasturulosis/Gorosa/	BUSHO BEWO	Bacterial diseases of respiratory system
2	Black leg	ABA GORBA	Emphysematous swelling with reduced appetite
3	Ovine pasturulosis	BOGA BEWO	Sudden death and fever of cattle
4	Mastitis/Breast diseases/	T'ENO BEWO	Inflammation of the mammary gland
5	New castle diseases	BAKO BEWO/DORO FENGIL	Viral diseases of domestic and wild birds
6	Brucellosis/Abortion/	NA'E KISSO	Zoonotic bacterial diseases
7	Basbesiasis/tick born diseases/	K'AP'O BEWO	Infectious agents transmitted by tick bites
8	Rabies	KUNA BEWO	Viral diseases of dogs & other animals
9	Lymph skin diseases	DARI BEWO	Fatal disease of cattle with nodules on skin
10	African horse sickness/AHS/	MAC'O BEWO	Infectious but not contagious viral diseases

4.2.2.7. Relative healing potential of medicinal plants, Fidelity level (FL)

The relative healing potential or fidelity levels of the major human, livestock as well as both humans and livestock diseases are given in Tables 19, 20, 21. Fidelity level of 22 medicinal plants against a given human aliment and that of 10 medicinal plant species against seven therapeutic categories of livestock aliments is shown in Table 19 while fidelity level of 20 medicinal plants species against a given human and livestock aliment is indicated in Table 21.

Table 19. Fidelity level of medicinal plants against a given human aliment

*I= Refers to all informants both key informants and non key informants (n=414). Ip= the number of informants who independently cited the importance of a species for treating a particular diseases, Iu= The total number of informants who reported the medicinal plant for any given diseases, FL= Fidelity level (relative healing potenitial).

SN	Scientific Names	Therapeutic category	*Ip	*Iu	%FL
Fidelity level of most cited medicinal plants against a given human aliment (N=204)					
1	*Solanecio mannii*	Jaundice/T'INBATO/	15	18	83.33
2	*Hagenia abyssinica*	Tapeworm	17	28	60.71
3	*Rumex abyssinicus*	Jaundice/T'INBATO/	16	27	59.26
4	*Cucurbita pepo*	Ascariasis	15	31	48.39
5	*Eragrostis tef*	Used as antidote	18	38	47.37
6	*Nigella sativa*	Asthma	19	43	44.19
7	*Leucas jamesii Bak.*	Canker sore	15	34	44.12
8	*Cynoglossum amplifolium*	Allergy/MICHATO/	25	67	37.31
9	*Cynoglossum lanceolatum*	Allergy/MICHATO/	25	67	37.31
10	*Ocimum urticifolium*	Endo-parasites	20	70	28.57
11	*Cynoglossum coeruleum*	Allergy/MICHATO/	30	115	26.09
12	*Euphorbia ampliphylla*	Ascariasis	18	76	23.68
13	*Pycnostachys eminii*	Allergy/MICHATO/	19	87	21.84
14	*Pycnostachys meyeri*	Allergy/MICHATO/	19	87	21.84
15	*Vangueria madagascariensis*	Endo-parasites	27	124	21.77
16	*Dombeya torrida*	Jaundice	15	85	17.65
17	*Peperomia retusa*	Stomachache	35	217	16.13
18	*Ruta chalepensis*	Evil eye	21	137	15.33
19	*Phytolacca dodecandra*	Rabies	24	157	15.29
20	*Ocimum lamiifolium*	Parasites	23	181	12.71
21	*Momordica foetida*	wound	21	201	10.45
22	*Prunus africana*	Jaundice/T'INBATO/	19	275	6.91

Table. 20. Fidelity level of medicinal plants against a given livestock aliment (N=10)

*I= Refers to all informants both key informants and non key informants (n=414). Ip= the number of informants who independently cited the importance of a species for treating a particular diseases, Iu= The total number of informants who reported the medicinal plant for any given diseases, FL= Fidelity level (relative healing potenitial).

SN	Scientific Names	Therapeutic category	*Ip	*Iu	%FL
1	*Pavonia urens*	Cattle diseases/cows, oxen other/	3	4	75.00
2	*Cynodon dactylon*	Eye diseases	2	3	66.67
3	*Scadoxus nutans*	worm infestation/SHAJO, lice, tick, other/	4	6	66.67
4	*Scadoxus multiflorus*	worm infestation/SHAJO, lice, tick, other/	4	7	57.14
5	*Pentas lanceolata*	stomach problem/Bloating other/	8	15	53.33
6	*Pentas schimperiana*	stomach problem/Bloating/	8	15	53.33
7	*Amorphophallus gallaensis*	Wound/any mechanical injury/	2	4	50.00
8	*Deinbollia kilimandscharica*	Stomachache/Dry dung other/	2	5	40.00
9	*Verbena officinalis*	Diarrhea/both bloody & non bloody/	2	5	40.00
10	*Datura stramonium*	worm infestation/SHAJO, lice, tick other/	5	16	31.25

Results of fidelity level of top 20 most cited medicinal plants against both a given human and livestock aliments is indicated (Table 21). The therapeutic category (TC) of the health problems indicated in the table is summarized based on the general information retrieved from the informants. The therapeutic categories were later crosschecked with the health professionals at Sheka Zone Health Division and district health centeres for correctness of medical and clinical terms. Note that some health problems are restricted to only humans while others are restricted to only livestocks. Those health problems reported as common to both humans and livestocks are either zoonotic (communicable from livestocks to livestocks) or not.

Table 21. Fidelity level of most cited medicinal plants of a given human and livestock aliment

NB: Ip = Number of informants who independently cited the importance of a species for treating a particular disease, Iu = Total number of informants who reported the medicinal plant for any given disease, FL = Fidelity level; the total number of medicinal plants used to treat both human and livestock aliments in the study area is n=52.

SN	Scientific Names	Therapeutic category	Ip	Iu	%FL
1	*Vepris dainellii*	Stomachache	11	24	46
2	*Vernonia amygdalina*	Respiratory problems	28	71	39
3	*Linum usitatissimum*	Constipation	11	32	34
4	*Ilex mitis*	African Horse Disease/AHD/	12	44	27
5	*Olea welwitschii*	Stomachache	33	133	25
6	*Pittosporum viridiflorum*	Retained placenta	22	99	22
7	*Erythrina brucei*	Eye disease	15	72	21
8	*Artemisia abyssinica*	Malaria	12	57	21
9	*Zingiber officinale*	Stomachache	19	98	19
10	*Erythrina abyssinica*	Lice	16	83	19
11	*Brucea antidysenetrica*	Stomachache	14	76	18
12	*Justicia schimperiana*	Diarrhea	11	66	17
13	*Galinierea saxifraga*	Snake poison	13	89	15
14	*Lepidium sativum*	Stomachache	12	89	13
15	*Croton macrostachyus*	Fungal diseases	31	254	12
16	*Pycnostachys abyssinica*	Allergy/MICHATO	21	183	11
17	*Peponium vogelii*	Gastritis	11	105	10
18	*Echinops kebericho*	Snake bite	17	180	9.4
19	*Prunus africana*	Jaundice/T'INBATO	19	275	6.9
20	*Lobelia giberroa*	Cockroaches/insect bite	15	237	6.3

The health problems identified include both infectious diseases (bacterial, viral, fungal, protozoan, gastrointestinal parasites) and non infectious diseases (mechanical injuries, allergic reactions, deficiency diseases, nervous and psychomotor disorders). The 20 most cited diseases according to the ethnomedicinal information retrieved from the informants include stomach problems (gastrointestinal problems), allergy, jaundice, wound, ascariasis, common cold, tonsillitis, endoparasites, headache (mental problems), rabies, fungal infection, bloody diarrhea, cockroach born diseases, snake poisoning (non bite), snake poisoning (bite), eye diseases, parasites, amoebic dysentery, gastritis and non bloody diarrhea. Similarly 10 major livestock disease is shown in Table 20 and for both human and livestock is indicated in Table 22.

Table 22. Major human & livestock diseases categories in Sheka Zone

SN	Description	Masha	Andracha	Yeki	SZHD
	Human diseases (SZHD*)				
1	All respiratory disease	x	x	x	x
2	Acute fibril illness (AFI)	x	x	x	x
3	Pneumonia	x	x	x	x
4	Mmusculo skeletal system and connective tissue	x	x	x	x
5	Urinary tract infection	x	x	x	x
6	Typhoid fever (TFI)	x	x	x	x
7	Infections of the skin and subcutaneous tissue	x	x	x	x
8	Other unspecified: skin and subcutaneous tissue	x	x	x	x
9	Trauma (injury, fracture etc.)	x	x	x	x
10	Diarrhea (non-bloody)	x	x	x	x
11	Dyspepsia	x	x	x	x
12	Helminthiasis	x	x	x	x
13	Hypertension and related disease	x	x		x
14	Other or unspecified disease of the digestive system	x		x	x
15	Dental and gum diseases	x		x	x
16	Other or unspecified infectious and parasitic diseases	x		x	x
17	Acute bronchitis	x	x	x	x
18	Epidemic typhus	x			x
19	Medical abortion without complication (safe abortion)	x		x	x
20	Diarrhea with blood (dysentery)	x	x		x
21	Other or unspecified disease of the eye and adnexa	x	x	x	x
22	Asthma	x	x		x
23	Epilepsy	x	x		x
24	Malaria all types		x	x	x
25	Otitis		x	x	x
26	Acute poliomyelitis/Acute flaccid paralysis		x		x
27	Diarrhea with dehydration		x		x
28	Other unspecified disorders of the genitourinary system		x		x
29	Other or unspecified obstetric conditions			x	x
30	Factors influencing health status and health services …	x		x	x
31	Human immunodeficiency virus (HIV)				x
	Livestock diseases (SZHD*)				
1	Bovine pasturulosis/Gorosa/		x	x	x
2	Black leg/Aba gorba/	x	x	x	x
3	Ovine pasturulosis	x	x		x
4	Mastitis/Breast diseases/	x	x	x	x
5	New castle diseases (Doro fengil/		x	x	x
6	Brucellosis/Abortion/	x	x	x	x
7	Basbesiasis/tick born diseases/	x	x	x	x
8	Rabies	x	x	x	x
9	Lymph skin diseases	x	x	x	x
10	African horse sickness/AHS/	x	x		x

SZHD*= Sheka Zone Health Division (summary of cause reports) (Sheka SZHD, 2013-2015)

4.2.2.8. Relative cultural importance (RCI) of major plant use categories

About 14 major plant use categories (medicinal, food, drink, fire wood, charcoal, shade, construction and tools, commercial, animal feed and fodder, bee forage, culture and rituals, ornamental, life fence and others) were identified during the course of the study and the values of relative cultural importance of the respective species were calculated. The results were tabulated in the Use Totaled and the three Relative Cultural Importance (RCI) Methodologies: all specific uses recorded only binary data on use categories recorded and subjective allocation of use values in the 14 use records for species 1 through 555 in the whole data set (Appendix1). The Shannon-Wiener use value diversity index for over all use values of the entire species data set with all specific uses recorded is 6.0, where S= 555 is the number of species in the entire data set and the values for the upper 15 individual plant species are indicated in Table 23.

Table 23. Use diversity indices of 15 high ranking plant species in the entire data set

Key: UVs= use value of species s, %RUVs= percentage of relative use value of species s, UVi= the relative use value of species s, lnUVs= taking the natural logarithm of UVs, ABS= taking the absolute value, UVs (lnUVs)= taking the product of UVs and lnUVs.

SN	Species	UVs	%RUVs	UVs	lnUVs	ABS(lnUVs)	UVs(lnUVs)
1	*Syzygium guineense subsp. afro*	43	1.24	0.01	-4.39	4.39	0.05
2	*Croton macrostachyus*	41	1.19	0.01	-4.43	4.43	0.05
3	*Manilkara butugi*	37	1.07	0.01	-4.54	4.54	0.05
4	*Ekebergia capensis*	34	0.98	0.01	-4.62	4.62	0.05
5	*Ilex mitis*	34	0.98	0.01	-4.62	4.62	0.05
6	*Olea welwitschii*	34	0.98	0.01	-4.62	4.62	0.05
7	*Arundinaria alpina*	33	0.96	0.01	-4.65	4.65	0.04
8	*Prunus africana*	33	0.96	0.01	-4.65	4.65	0.04
9	*Hallea rubrostipulata*	30	0.87	0.01	-4.75	4.75	0.04
10	*Millettia ferruginea*	30	0.87	0.01	-4.75	4.75	0.04
11	*Schefflera abyssinica*	30	0.87	0.01	-4.75	4.75	0.04
12	*Pouteria adolfi-firiederici*	29	0.84	0.01	-4.78	4.78	0.04
13	*Cordia africana*	29	0.84	0.01	-4.78	4.78	0.04
14	*Elaeodendron buchananii*	29	0.84	0.01	-4.78	4.78	0.04
15	*Schefflera volkensii*	29	0.84	0.01	-4.78	4.78	0.04

4.2.2.9. Validation of Relative Cultural Importance

Below is results of use records in the 14 categories for species 1 through 555 with only binary data on categories recorded where multiple specific uses within the same category ignored; and use categories for species 1 through 555 with subjective allocation methodology where score are generated as 1 for major use, 0.5 for minor use and 0 for no use for each species. Table 24 represents subjective allocation of values with only binary data on specific uses recorded (1= use, 0= no use). Similarly, subjective allocation of use values (major uses=1 and minor uses=0.5) were indicated for 13 most cited plant species in Table 25. The values in Table 26 were based on four factors (variables that evaluate users' preferences for a given species): i= management, e= preference, c= frequency of use and CF= correction factor to calculate the cultural significan index (CSI) of a species.

Table 24. RCI of top 13 plant species with only binary data on categories recorded

Key: M= medicinal, F= food, D= drink, FW= firewood, CL= charcoal, SD= shade, CT= construction and tools, CM= commercial, FD= animal feed or fodder, BF= bee forage, CR= culture and rituals, OL= ornamental, LF= life fence, OT= others, UT= uses totaled. plants with more number of use reports are also multipurpose plant species.

Species	M	F	D	FW	CL	SD	CT	CM	FD	BF	CR	OL	LF	OT	UT
Syzygium guineense	1	1	0	1	1	1	1	1	0	1	1	0	0	0	9
Mangifera indica	0	1	1	1	1	1	1	1	0	1	1	0	0	0	9
Persea americana	1	1	1	1	1	1	1	1	0	1	0	0	0	0	9
Arundinaria alpina	1	1	0	0	0	0	1	1	1	0	1	1	1	0	8
Coffea arabica	1	1	1	1	0	0	1	1	0	1	1	0	0	0	8
Eucalyptus globulus	1	0	0	1	1	1	1	1	0	1	0	0	1	0	8
Manilkara butugi	1	1	0	1	1	1	1	0	0	1	1	0	0	0	8
Cordia africana	1	1	0	1	1	1	1	0	0	1	0	0	0	0	7
Hagenia abyssinica	1	0	0	1	0	1	1	0	0	1	0	1	1	0	7
Hallea rubrostipulata	1	1	0	1	1	1	1	0	0	1	0	0	0	0	7
Ozoroa insignis	1	0	0	1	1	1	1	1	0	1	0	0	0	0	7
Schefflera volkensii	1	1	0	1	1	1	1	0	0	1	0	0	0	0	7
Trichillia dregeana	1	0	0	1	1	1	1	1	0	1	0	0	0	0	7

NB: Subjective allocation of values with only binary data on specific uses recorded; 1= use, 0= no use, S= 555

Table 25. RCI of top 11 plant species with subjective allocation methodology

Key: M= medicinal, F= food, D= drink, FW= firewood, CL= charcoal, SD= shade, CT= construction and tools, CM= commercial, FD= animal feed or fodder, BF= bee forage, CR= culture and rituals, OL= ornamental, LF= life fence, OT= others, UT= uses totaled

Species	M	F	D	FW	CL	SD	CT	CM	FD	BF	CR	OL	LF	OT	UT
Syzygium guineense	1	1	0	1	1	1	1	0.5	0	1	0.5	0	0	0	8
Catha edulis	1	1	0.5	1	0	0	1	1	1	0	0.5	0	0	0	7
Arundinaria alpina	1	1	0	0	0	0	1	1	1	0	1	1	1	0	7
Cordia africana	1	1	0	1	1	1	1	0	0	1	0	0	0	0	7
Persea americana	1	1	1	0.5	0.5	0	1	1	0	1	0	0	0	0	7
Coffea arabica	1	1	1	1	0	0	1	0.5	0	1	0	0	0	0	6
Ekebergia capensis	1	0	0	1	1	1	1	0	0	1	0	0	0	0	6
Manilkara butugi	1	0.5	0	1	1	1	1	0	0	1	0.5	0	0	0	6
Olea welwitschii	1	0	0	1	1	1	1	0	0	1	0	0	0	0	6
Ozoroa insignis	1	0	0	1	1	1	1	1	0	1	0	0	0	0	6
Schefflera volkensii	1	1	0	1	1	1	1	0	0	1	0	0	0	0	6

Subjective allocation of values: Major uses=1, Minor uses= 0.5, S= 555

4.2.2.10. The cultural significance index (CSI)

The calural significance index calculates importance through researcher determined weighted ranking of multiple factors. With respect to the 14 major use categories of plant species recorded from the study area, users' preferences were evaluated for five plant species based on management, preference and frequency of use and the results were indicated in Table 26. The table represents the values of cultural significance indices of five most preferred multipurpose plant species (*Arundinaria alpina*, *Coffea arabica*, *Cordia africana*, *Schefflera volkensi* and *Syzyguim guineense*) in the study area. The researcher determined weighed values for the variables were:- i= management: managed=2, not managed=1; e= preference: preferred for a given use=2, not preferred for a given use=1; c= frequency of use: effectively used for a given use=2, rarely used for a given use=1 (Table 26).

Table 26. Cultural significance indices of five most preferred plant species

Key: SPC= Species code, AAL=*Arundinaria alpina*, CAB=*Coffea Arabica*, CAF=*Cordia africana*, SLV=*Schefflera volkensi*, SZG=*Syzygium guineense*, NIC= Number of informant citations, WV= Weighed variables, MD= Medicinal, F=Food, D=Drink, FW=Firewood, CL=Charcoal, SD=Shade, CT= Construction and tools, CM=Commercial, FD=Animal feed or fodder, BF=Bee forage, CR= Culture and rituals, OL=Ornamental, LF=Life fence, OT=Other uses, i= management, e= preference, c= frequency of use, CF=Correction factor, CSI=Cultural significance index, SU=Specific uses for the entire species data set.

Species (SPC)	NIC	WV	Specific uses (SU) for the entire species data set														Sum		
			MD	F	D	FW	CL	SD	CT	CM	FD	BF	CR	OL	LF	OT	i*e*c	CF	CSI
Arundinaria alpina (AAL)	27	i	2	1	0	0	0	0	2	2	1	0	2	2	2	0	0	0	0
		e	2	1	0	0	0	0	2	2	1	0	2	2	1	0	0	0	0
		c	2	1	0	0	0	0	2	1	1	0	1	1	1	0	0	0	0
		i*e*c	8	1	0	0	0	0	8	4	1	0	4	4	2	0	32	0.4	14
Coffea arabica (CAB)	62	i	2	2	2	2	0	0	2	2	0	2	0	0	0	0	0	0	0
		e	2	1	2	1	0	0	1	2	0	1	0	0	0	0	0	0	0
		c	2	1	2	2	0	0	1	2	0	1	0	0	0	0	0	0	0
		i*e*c	8	2	8	4	0	0	2	8	0	2	0	0	0	0	34	1	34
Cordia africana (CAF)	11	i	1	1	0	2	2	2	2	0	0	2	0	0	0	0	0	0	0
		e	1	1	0	2	2	2	2	0	0	2	0	0	0	0	0	0	0
		c	1	1	0	1	1	2	2	0	0	1	0	0	0	0	0	0	0
		i*e*c	1	1	0	4	4	8	8	0	0	4	0	0	0	0	30	0.2	5.4
Schefflera volkensii (SLV)	30	i	1	1	0	1	1	1	2	0	0	1	0	0	0	0	0	0	0
		e	2	1	0	2	1	1	2	0	0	1	0	0	0	0	0	0	0
		c	2	1	0	2	1	1	2	0	0	1	0	0	0	0	0	0	0
		i*e*c	4	1	0	4	1	1	8	0	0	1	0	0	0	0	20	0.5	9.6
Syzygium guineense subsp.afromontanum (SZG)	25	i	2	1	0	1	1	2	2	1	0	1	1	0	0	0	0	0	0
		e	2	1	0	2	2	2	2	1	0	1	1	0	0	0	0	0	0
		c	2	1	0	2	2	2	2	1	0	1	1	0	0	0	0	0	0
		i*e*c	8	1	0	4	4	8	8	1	0	1	1	0	0	0	36	0.4	14

4.2.2.11. Priority species

Results of comparison of most commonly reported medicinal plant species are shown in Table 27. The results show ranking of 10 medicinal plants used against gastrointestinal problems by 10 (R1-R10) key informants. Most preferred= 10, least preferred= 1.

Table 27. Simple preference ranking of 10 medicinal plants against gastrointestinal problems

	Respondents (R)											
Medicinal plants	1	2	3	4	5	6	7	8	9	10	Total	Rank
Celosia schweinfurthiana	6	8	10	7	7	9	5	6	8	3	69	5th
Coffea arabica	3	2	5	8	5	5	6	5	10	4	53	6th
Croton macrostachyus	5	10	9	6	9	4	8	9	5	10	81	1st
Lepidotrichilia volkensii	1	1	4	4	4	1	1	3	3	1	23	10th
Lobelia giberroa	4	7	6	10	6	8	9	7	6	8	71	4th
Olea welwitschii	2	3	1	5	1	3	2	4	4	5	30	8th
Peperomia retusa	8	6	7	9	8	6	10	8	9	7	78	3rd
Peponium vogelii	7	4	2	2	2	2	3	1	1	2	26	9th
Prunus africana	10	9	8	3	10	7	7	10	7	9	80	2nd
Vangueria madagascariensis	9	5	3	1	3	10	4	2	2	6	45	7th

4.2.2.12. Paired comparison

Results of test for consistency and transitivity through paired comparison for top five medicinal plants against gastrointestinal problems was obtained by simple preference ranking. Results of paired comparison of the five medicinal plants against gastrointestinal problems as obtained from ten respondents (R1-R10) are indicated in Table 28.

Table 28. Results of paired comparison of five medicinal plants against gastrointestinal problems

	Respondents (R)											
Medicinal plants	1	2	3	4	5	6	7	8	9	10	Total	Rank
Celosia schweinfurthiana (CS)	0	2	1	0	3	0	1	0	0	1	8	5th
Croton macrostachyus (CM)	4	3	4	3	2	3	4	3	3	4	33	1st
Lobelia giberroa (LG)	1	1	0	2	4	2	0	1	2	0	13	4th
Peperomia retusa (PR)	2	0	3	4	0	1	2	2	1	2	17	3rd
Prunus africana (PA)	3	4	2	1	1	4	3	3	4	3	28	2nd

4.2.2.13. Respondents' distance from health centres versus frequency of medicinal plant use

Table 29. Statistical summary of Pearson product moment correlation coefficients

Key: N= Number of samples (sample size) for respective cluster sites; N*=Number of missing values if any; SR1, n1=Masha-Kanga; SR2, n2=Masha-Yep'o; SR3, n3=Masha-K'arina; SR4, n4=Masha-C'awak'a; SR5, n5=Gecha-Gebina; SR6, n6=Gecha-Shakbedo; SR7, n7=Gecha-Gamadro; SR8, n8=Gecha-Yukic'ici; SR9, n9=Tepi-Ermic'i; SR10, n10=Tepi-Yeki; SR11, n11=Tepi-Bak'o; SR12, n12=Tepi-Alamo localities, α= 0.05

Varib.	N	N*	Mean	SE Mean	StDev	Minim	Q1	Median	Q3	Maxim	r*	P-value
SR1	32	0	8.750	0.710	4.016	5.000	5.000	10.000	10.000	15.000	**0.740**	0.001
n1	32	0	5.438	0.580	3.282	3.000	3.000	5.000	8.750	12.000		
SR2	32	0	10.000	0.710	4.016	5.000	5.000	10.000	15.000	15.000	**0.844**	0.044
n2	32	0	6.094	0.572	3.236	1.000	4.000	6.000	8.750	13.000		
SR3	32	0	8.906	0.624	3.532	5.000	5.000	10.000	10.000	15.000	**0.550**	0.001
n3	32	0	3.844	0.409	2.316	1.000	2.000	3.000	5.000	10.000		
SR4	32	0	7.813	0.410	2.320	5.000	5.000	8.000	10.000	10.000	0.196	0.002
n4	32	0	5.469	0.599	3.389	1.000	3.000	5.000	8.000	14.000		
SR5	32	0	10.000	0.674	3.810	5.000	5.000	10.000	15.000	15.000	**0.571**	0.002
n5	32	0	5.188	0.485	2.741	1.000	3.000	4.500	6.750	12.000		
SR6	32	0	16.880	1.300	7.380	5.000	10.000	20.000	25.000	25.000	**0.775**	0.000
n6	32	0	6.469	0.580	3.282	1.000	3.250	6.500	9.000	13.000		
SR7	32	0	11.875	0.919	5.198	5.000	6.250	10.000	15.000	20.000	**0.834**	0.000
n7	32	0	7.813	0.613	3.468	3.000	5.000	7.000	10.000	17.000		
SR8	32	0	15.160	1.130	6.410	5.000	10.000	15.000	20.000	25.000	0.446	0.000
n8	32	0	5.188	0.497	2.811	1.000	3.000	4.500	7.000	11.000		
SR9	32	0	7.969	0.588	3.326	5.000	5.000	7.500	10.000	15.000	0.397	0.000
n9	32	0	3.063	0.277	1.564	1.000	2.000	3.000	4.000	6.000		
SR10	32	0	8.750	0.502	2.840	5.000	5.000	10.000	10.000	15.000	**0.510**	0.001
n10	32	0	4.125	0.473	2.673	1.000	2.000	4.000	6.000	10.000		
SR11	32	0	7.344	0.448	2.535	5.000	5.000	5.000	10.000	10.000	0.273	0.029
n11	32	0	2.875	0.283	1.601	1.000	2.000	2.500	4.000	7.000		
SR12	32	0	8.125	0.664	3.757	5.000	5.000	5.000	10.000	15.000	0.253	0.001
n12	32	0	3.281	0.371	2.098	1.000	2.000	3.000	4.750	9.000		

r*= Values in bold represent greater than 50% correlation coefficients; n= frequency of medicinal plant use

The Table 29 represents the values of statistical summary for SR1, n1 through SR12, n12 and the Pearson product moment correlation coefficients (r) for the relationships between respondents' average distance (SR) from health centres and the average number or frequencies (n) of medicinal plants cited by respective respondents for the 12 cluster sites at α=0.05.

4.1.3. Wild Edible Plants (WEP)

4.1.3.1. Percentage summary of wild edible plant families

The informants in the study area were identified 35 plant species belonging to 32 genera and 24 families as wild edible plants. The families Asteraceae and Solanaceae were relatively the most frequent of the wild edible plants in terms of the number of species (Table 30).

Table 30. Summary of percentage families of wild edible plants

SN	Family	N*	Percent	SN	Family	N*	Percent
1	Araceae	2	5.71	13	Piperaceae	2	5.71
2	Araliaceae	1	2.86	14	Poaceae	1	2.86
3	Arecaceae	1	2.86	15	Resedaceae	1	2.86
4	Asteraceae	4	11.43	16	Rhamnaceae	1	2.86
5	Boraginaceae	1	2.86	17	Rosaceae	2	5.71
6	Cucurbitaceae	1	2.86	18	Rubiaceae	2	5.71
7	Euphorbiaceae	1	2.86	19	Rutaceae	1	2.86
8	Lamiaceae	1	2.86	20	Sapindaceae	1	2.86
9	Moraceae	1	2.86	21	Sapotaceae	2	5.71
10	Myrsinaceae	1	2.86	22	Solanaceae	3	8.57
11	Myrtaceae	2	5.71	23	Tiliaceae	1	2.86
12	Passifloraceae	1	2.86	24	Zingiberaceae	1	2.86

N* = Number of species in each family of wild edible plants

4.1.3.2. Parts eaten of wild edible plants

Results of wild edible plant parts eaten were categorized into 11 categories and indicated (Figure 23). These categories include fruit only, berry, leaf only, leaf and fruit, leaf and flower, nectar, parasitic shoot, root only, shoot and fruit only, whole plant and young shoots.

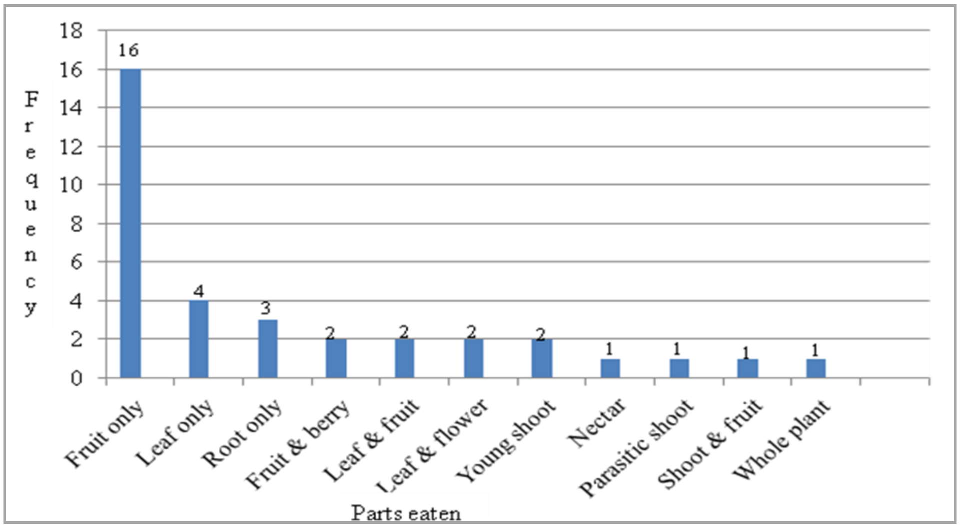


Figure 23. Parts eaten of wild edible plants

4.1.3.3. Consumption types of wild edible plants

Results of types of consumption of wild edible plants were summarized and shown (Figure 24). There were five use diversities identified with respect to the edible values of wild edible plants. These include their use as food and spice, food only, drink only, dring and aditives to beverages as well as dring and spice.

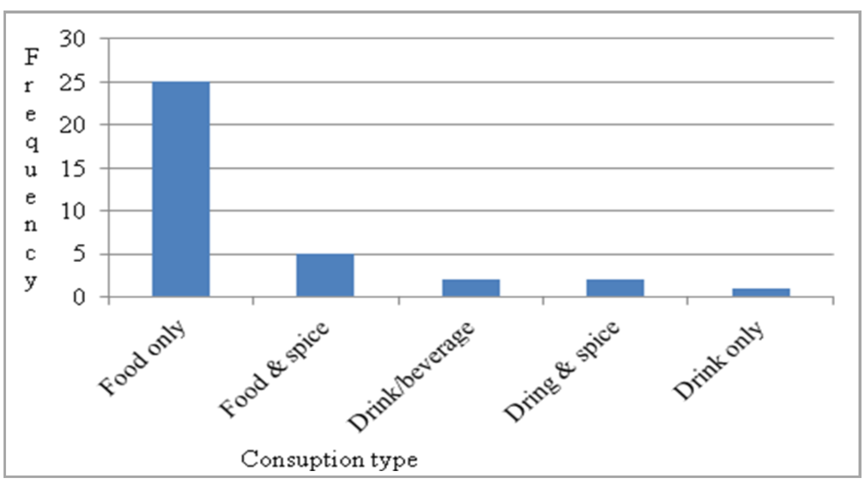


Figure 24. Summary of consumption types of wild edible plants

Results of three informants (I_1 through I_3) against 14 use values of 10 most cited plant species (Table 31). Use values assigned as 0= no use for the assigned significance and 14= best use for the assigned significance.

Table 31. Direct matrix ranking of ten multipurpose plant species against 14 use values

*Key: UV= Use values, M= medicinal, F= food, D= Drinks, FW= firewood, CL= Charcoal, SD= Construction and tools, CM= commercial, FD= animal feed or fodder, BF= Bee forage, CR= culture and rituals, OL= ornamental, LF=life fence, OT= other uses, IT= informants' total, GT= grand total, RK= rank. Ten most cited multipurpose plant species in the study area was coded as: SZG= *Syzyguim guineense*, AAL= *Arundinaria alpina*, PAM =*Persea americana*, CAB= *Coffea arabica*, CAF= *Cordia africana*, EGL= *Eucalyptus globulus*, HAB= *Hagenia abyssinica*, HRB= *Hallea rubrostipulata*, MIN= *Mangifera indica*, MBT= *Manilkara butugi.*

*UV	SZG			AAL			PAM			CAB			CAF			EGL			HAB			HRB			MIN			MBT		
	I_1-I_3			I_1-I_3			I_1-I_3			I_1-I_3			I_1-I_3			I_1-I_3			I_1-I_3			I_1-I_3			I_1-I_3			I_1-I_3		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
M	7	6	10	11	9	7	10	12	11	13	14	12	11	9	8	10	13	11	12	10	9	11	12	9	00	00	00	13	11	9
F	6	7	8	5	4	3	14	14	14	4	3	2	3	2	1	00	00	00	00	00	00	7	6	8	14	14	14	12	10	12
D	00	00	00	00	00	00	14	14	14	14	14	14	00	00	00	00	00	00	00	00	00	00	00	00	14	14	14	00	00	00
FW	13	14	13	00	00	00	9	8	7	9	8	6	13	12	14	14	13	13	9	7	10	13	14	14	6	5	6	14	13	13
CL	12	10	9	00	00	00	5	6	4	00	00	00	11	9	11	5	2	1	00	00	00	12	13	14	5	3	5	9	10	7
SD	11	9	6	00	00	00	11	12	10	00	00	00	12	11	12	4	1	2	13	11	10	11	10	9	14	14	14	14	14	13
CT	14	13	14	14	14	12	6	7	5	8	7	9	14	14	14	14	13	13	14	14	14	14	14	14	9	7	6	14	14	12
CM	8	5	7	10	12	10	14	14	14	14	14	14	00	00	00	9	7	5	00	00	00	00	00	00	14	14	14	00	00	00
FD	00	00	00	6	7	5	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
BF	10	8	12	00	00	00	3	4	5	12	10	8	10	11	10	6	5	4	8	5	7	3	2	3	3	2	2	14	14	13
CR	9	4	11	13	10	9	00	00	00	13	12	11	00	00	00	00	00	00	00	00	00	00	00	00	2	3	2	7	5	6
OL	00	00	00	12	8	6	00	00	00	00	00	00	00	00	00	00	00	00	14	13	14	00	00	00	00	00	00	00	00	00
LF	00	00	00	7	5	4	00	00	00	00	00	00	00	00	00	12	13	12	11	12	9	00	00	00	00	00	00	00	00	00
OT	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
IT	80	76	90	78	69	56	86	91	84	87	82	76	74	68	70	74	67	61	81	72	73	71	71	71	81	76	77	97	91	85
GT	246			203			261			245			212			202			226			213			234			273		
RK	3rd			9th			2nd			4th			8th			10th			6th			7th			5th			1st		

NB: only 3 out of 10 key informants were randomly selected to rank the 10 most cited plant species against the 14 use values for the sake of time, mony, energy & space.

4.2. Emic/Etic Classification of Landscapes and Vegetation

4.2.1. Traditional ecological knowledge (TEK) of Sheka/emic versus etic perspectives/

Landscapes: Traditionally, the people of Sheka classify landscapes as follows.

T'ELO/TETO: Plain land or land that includes all lands with no ups and downs or hill; BAMBO: Refers to cliffs and valleys and not suitable for farming or plough; GEPO: Refers to mountainous areas highly uplifted from the surrounding lands; DUGILLO: Refers to sloppy land or areas susceptible to erosion if ploughed; KEYAGIYO: Refers to undulating and highly rugged land with ups and downs; GANGARO: Refers to block mountains with continuous hilly land; TUGO: Refers to landscapes with hilly areas; YIMANO: Refers to plan land suitable for farming, grazing and play ground (Refer to Appendix 8 for Shakinano Alphabets).

Vegetation: Traditionally, they classify vegetation as follows.

MIT'O: Trees that include all plant growth forms belonging to both small/big trees; GISHISHI MIT'O: Refers to small trees; OGOGA MIT'O: Refers to big trees or jungles; KUPO: Refers to small and shrubby vegetation or plant habits; SHUBO: Refers to all herbaceous plants including grasses and sedges; MOC'O: Refers to grasses only; DINBARO: Refers to both open and closed forests; MAJA DINBARO: Refers to closed or intact forests; K'AC'AMA DINBARO: Refers to open or non intact forests; OSCHO: Refers to scrub lands, areas of forest margins with shrubs and small trees.

4.2.2. Agro-ecology and titles given to clan leaders for administrative purposes

Agro-ecology: Traditionally, the local people of Sheka classify their agro-ecological zones.

WARABBO/WORABO/: Refers to tropical or lowland areas below 1500masl; ANISHO: Refers to midland areas between 1500-2000 masl; MASHO: Refers to highland areas above 2000masl.

Titles: Special merits given to clan leaders, administrators, healers and musicians. These are: MARARASHA: The top official of the Sheka community with better economic status, knowledgeable person and hence nominated as the clan leader of that community; MANJARASHA: The top official of the Manja community with better economic status, knowledgeable person and hence nominated as the clan leader; WALTA/WALTARASHA: Equivalent to landlord/the wealthiest person in his community; WEDARASHA: Refers to the governor, lawyer, court man well known in his community who is authorized to conflict resolution, governance and passing issues beyond his scope to the top officials (up to government bodies) for decision making; ARMACHERASHA: Person authorized as chairman, general manager of his village; SHATEGUDO: Person who is authorized to control others in his village and also has a unique ability to play traditional musical instruments/the KIRARIST/.

4.2.3. Cultural Forest management based on the GUDO and KOBO system

Cultural Forests: The **GUDO**; These are forests found relatively near the villages and on hilly or mountainous landscapes hence culturally protected under the GUDO customary right; The **KOBO**; these are forestlands that are found at relatively far places from settlement areas but under the KOBO customary right where its management is according to the right and obligations of the individual who inherited the forestland from his ancestors hence protected forest.

4.2.4. Cultural forest management based on resources and habitat beliefs

There is a belief that people who violate the powerful beliefs, rituals, sprits attached to forests will die and even socially isolated from the society based on decisions passed on him by the GEPITATO and the SHEKITATO who are authorized persons to lead their clan and their communities. Such traditions have given the forest of Sheka special respect contributing to its conservation.

4.2.5. Traditions attached to titles versus forest conservation practices

The GUDO: refers to cultural forests used as worship sites; The DEDO: refers to larger trees under which praying or religious ceremonies are conducted; The SHEKITATO: refers to the king of the Shekacho people to whom the power is given as an authorized person to lead all the clan leaders; The GEPITATO: refers to the clan leaders who act as administrators as well as ritual leaders in their society.

4.2.6. Implications for biodiversity conservation and sustainable use

For the people of Sheka, forests are everything of their life meaning that they both directly and indirectly sources of food, medicines, honey, spices and condiments, raw materials for construction and tools, habitat for the wild fauna and flora, site for their religious worship and ceremonies and grave yard for their body where it permanently rest for ever. They strongly believe that their forests are their golden property to be inherited by their children along with the cultural believes attached to it.

Oral communications with key informants: during guided field walk showed that for the people of Sheka, forests are not only the sources of everything necessary for their livelihoods but also they are their major treatment centres as clinics, health centres. They believe that forests are where the nearby residents can get first line help against any health problem. They are considered natural pharmacies for the people living near them. Hence, even in the presence of modern medical facilities, they have full trust on the healing power of their wild medicines provided that the medicines are carefully administered by well experienced traditional healers.

Quotes by few key informants

Shaweno Dasho said: "*You had better take away the whole of my life instead of removing even a single leaf of a tree from my cultural or KOBO forests or any other else without convincing reasons and responsible replacement of seedlings because forests are all of my life. I cursed all my children and grand children not to do so too*." Shaweno Dasho is traditional healer at Yina locality of Sheka Zone taking about conservation.

Lema Edamo said: "*For any diseases, there is relieve created by God. In my words, there are seventy five diseases of humans for which there are seventy four medicines. So for which diseases do you want heal, ask me and let me tell you my best experiences in traditional medicine, however, I also believe that prevention is the best medicine for all diseases*." Lemma Edamo is a traditional healer at Bashifa locality of Sheka Zone talking about health.

Worku Awasho: "*My contribution here as a development agent is not to discourage the traditional knowledge base accumulated by the Sheka people for generations rather to play a catalytic role or as a zest which add value in knowledge integration. Every saying in Sheka has some meaning related to the life and livelihoods of the Sheka people; SHAKBEDO means, for instance, the villages of Sheki people and hence reflects their residence place or origins*." Worku Awasho is a development agent worker at Andracha District Agriculture and Rural Development Office of Sheka Zone. He is a key informant talking about the role of knowledge integration in conservation as well as the history of the vegetation found between Gecha Town and Shekbedo localities of Andracha District.

Therefore, what we understand from the above sayings is that the local people have rich knowledge of their natural environment and the way they cope up with their problems in their environment particularly healthcare, food security and their environmental wellbeing. Traditional processing of useful plants involves single or multiple component plant material preparations which is a common experience by the people of Sheka Zone. For instance, the preparation of C'EMO which is a common practice in the Sheka tradition is typical example. It involves preparation by mixing different plant ingredients extracted from different plant parts usually the leaves. It is used as food supplement, drink and best medicine to cure any health problem. The C'EMO is prepared by mixing a range of plant species with spices and condiments, well boiled, decanted and consumed. *Coffea arabica* and *Bassella alba* are the main ingredients. It is also used both as preventive and curative medicine. Taking a cup of C'EMO is equivalent to just buying and taking aspirin (pain killer) from the nearby pharmacy or taking a prophylaxis against malaria parasite or any diseases in modern medicine.

4.3. Cultural beliefs and terms associated with traditional healthcare system

The people of Sheka have accumulated knowledge coupled to cultural beliefs regarding traditional healthcare system and other social problems. In most cases, the local people of Sheka can name the plants in their vicinity by their local names. However, in some instances, when there are difficulties to get the exact match or vernacular name for a given plant species (usually herbs) while the plant is still in traditional use either directly or indirectly, the names given to the medically important plant species is derived from the type of illness the plant used to cure the patient. For the people of Sheka, all plants named by adding the suffix "ATTO" to the root word (name of the health problem) for which the plant is used as a remedy in their locality have medininal value and hence named accordingly. In Sheka tradition, the suffix "ATTO" is to mean medicine for certain health disorder. Similarly, all health problems named by adding the suffix

"BEWO" to a given organ of the body is referring to the diseases of that organ of the body. Hence, in Sheka tradition, the suffix "BEWO" is to mean diseases of or aliment of that body organ in question. Some of the ways of naming medicines and diseases include: MAC'O BEWO: meaning diseases of abdomen or referring to abdominal pain; C'INDO BEWO: meaning diseases of the skin or referring to dermal problems; YIK'E BEWO: meaning disease of the spinal cord or referring to back pain; T'ENO BEWO: meaning diseases of breast or referring to breast pain; NIBE BEWO: meaning diseases of the heart or referring to cardiovascular disorder; AFE BEWO: meaning diseases of the eye; CHUAE BEWO: meaning disease of the intestine/referring to gastro intestinal problems; SHIT'T'O BEWO: meaning diseases of the nose and many more.

Moreover, the associated medicines are named by adding the suffix ATTO which is also referring to the name of the medicinal plant used to treat the diseases. Hence, MICHATTO: meaning medicine for allergy or hypersensitivity of the body; MAC'O BEWO ATTO: meaning medicine for the abdominal pain; T'ENO BEWO ATTO: meaning medicine for breast pain; NIBE BEWO ATTO: meaning medicine for heart problems; GASHE BEWO ATTO: meaning medicine for disease of the teeth; DINGARE ATTO: meaning medicine for snake bite or snake poisoning; K'ORACHI BEWO ATT: meaning medicine for the evil eye/evil sprit; MAC'PT'TO ATTO: meaning medicine for parasites/usually gastrointestinal; MARZO ATTO: meaning medicine for poisoned body parts; MAWO ATTO: meaning medicine for wound on the body and many more.

4.4. Major Threats to the Vegetation of the Study Area

Eight major threats to vegetation of Sheka were identified. Results of responses from ten respondents (R_1-R_{10}) on priority ranking of the eight factors that are perceived as threats to vegetation of Sheka based on their degree of destructiveness with 1= least destructive and 8= most destructive is given in Table 32.

Table 32. Results of priority ranking of threats to vegetation based on their destructiveness

*Threats	Respondents (R)										
	1	2	3	4	5	6	7	8	9	10	Total	Rank
CA	7	8	6	8	7	7	8	6	8	7	72	2nd
CT	6	5	4	6	4	6	4	5	6	4	50	4th
IP	8	7	8	7	8	8	7	8	7	8	78	1st
FW	5	6	7	5	5	5	6	7	4	6	56	3rd
CM	4	3	5	4	6	4	5	4	5	5	45	5th
HF	2	4	2	3	1	2	2	3	3	2	24	6th
ES	1	2	1	2	3	1	3	1	1	1	16	8th
GZ	3	1	3	1	2	3	1	2	2	3	21	7th

*Key: commercial agriculture (CA), construction and tools (CT), increasing population (IP), firewood collection (FW), charcoal making (CM), habitat loss and fragmentation (HF), exotic species (ES) and Grazing (GZ).

4.5. Floristic Similarity

Comparison of eleven floristic studies with the current study was given in Table 34.

Table 34. Floristic similarity of the vegetation of Sheka with other similar forests/vegetation

Key: MAF = Moist Afromontane Forest, DAF =Dry Afromontane Forest, ER (m) =Elevation Range in meters, BMN=Bale Mountain National Park, N= Total number of species compared, a= number of species common to site 1 and site 2 compared, b= number of species found only at site 1, c= number of species found only at site 2, Ss= Sørensen's index of coefficient of similarity, *=*Acacia commiphora* woodland

*Secondary Data Source	Forest/Vegetation Type	ER (m)	N	a	b	c	Ss
Kumilachew Yeshitela *et al.* (2003)	Masha-Andracha Forest/ MAF	1250-2700	107	91	367	16	0.32
Dereje Danu (2006)	Bibita Forest/ MAF	900-2200	196	111	347	85	0.34
Haile Yinger *et al.* (2008a)	BMN Forest/DAF	3010-3410	222	51	407	171	0.15
Mirutse Giday (2007)	Sheko vegetation/ MAF	1500-2500	263	157	301	106	0.44
Motuma Didita *et al.* (2010)	Dello Menna/ Woodland*	800-2000	171	32	426	139	0.10
Abiyou Tilahun *et al.* (2011)	Menagesha Forest/ DAF	2574-2948	219	91	367	128	0.27
Abreham Assefa *et al*. (2013)	Masha Forest/ MAF	1300-3000	130	97	361	33	0.33
Haileab Zegeye *et al* (2013)	Tara Gedam Forest/ DAF	2062-2496	96	53	405	43	0.19
Abyot Dibaba *et al*. (2014)	Sire Beggo/ Woodland	1247-1841	185	60	398	125	0.19
Tadesse Beyene (2015)	Erob & Gulomeheda/ DAF	248-3299	121	60	495	61	0.20
Admassu Addi *et al.* (2016)	Agama Forest/ MAF	1700-2370	160	103	355	57	0.33
Current study	Sheka vegetation/ MAF	950-2800	458	458	0	0	1.00

*= The original data is available in the works of the respective authors indicated in the first column of the table.

CHAPTER FIVE

5. Discussions, Conclusions and Recommendations

5.1. Discussion

5.1.1. Plant Diversity

The vegetation of Sheka is rich in plant diversity and floristic composition resulting in the documentation of vascular plant taxa with high taxonomic diversity 555 species, 341 genera, and 115 families. The rich plant diversity and floristic composition may be due to great altitudinal range and topographic diversity as well associated environmental factors. Theauthenticity of these taxa has been checked with the list of Ethiopian plants provided in Hedberg *et al*., (2009a). The accounts and keys found in the relevant volumes of the Flora of Ethiopia and Eritrea (Hedberg and Edwards, 1989; Edwards, *et al*., 1995; Hedberg and Edwards, 1995; Phillips, 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*., 2009b) provided to be very helpful in the determination of the identity of each taxon. Studies also confirmed that there is high floristic richness and diversity in southwesten Ethiopian vegetation such as the Agama Forest (Admasu Addi *et al*., 2016).

5.1.2. Floristic Composition

A little more than half (56.52%) of the families collected from the area are represented by two and more species while the rest (50 families) are represented by a single species each. The 15 most frequent plant families identified from the study area comprise 57.66% of the total families recorded and the remaining 100 plant families comprised of only 42.34% of the total. Moreover, the top 15 most common plant families in the area also included many families of high economic, household medicinal and other importance. The majority of the plant families in the area were associated with multiple purposes.

The Asteraceae, which yielded 62 (11.17%) of the total species recorded, is one of the few species rich families in the flora of Ethiopia and Eritrea (Mesfin Tadesse, 2004; Ensermu Kelbessa and Sebsebe Demissew, 2014). The Asteraceae constitutes important oil crops including *Guizottia abyssinica* and *Helianthus annuus* that are of high economic value. It is also a very diverse family in the Ethiopian Flora. The Fabaceae that came as the second species rich family had 51 (9.19%) species was long recognized as contains species of great economic importance which include pulse crops, forage plants as well as plants of great significance for charcoal and timber production, medicinal plants, ornamental plants and plants having the ability of fixing atmospheric nitrogen in association with symbiotic bacteria (Thulin, 1989).

Moreover, family Poaceae constitutes essential species of cereal crops that provide food for most of the world's population (Phillips, 1995) and hence is a family of great economic significance in Sheka Zone too. Ryding (2006) noted that the family Lamiaceae contains the medicinal and aromatic plants, hence play great role in contributing to traditional medicine. Friis (2006) also reported that family Solanaceae includes a number of highly important food plants and stimulants. It is well known that family Rubiaceae contains *Coffea arabica*, a commercial species, which play vital role in the Ethiopian economy both for domestic usage as well as export commodity to world trade, hence very useful family in the study area. Recent studies (Dereje Danu, 2006) in southwesten Ethiopia also revealed that family Rubiaceae, Asteraceae, Euphorbiaceae, Acanthaceae and Fabaceae were the most dominant families of Bibita forest in southwestern Ethiopia. A number of possible factors could explain the dominance of plant families in their respective habitas. It could be disturbance, natural absence or range limitations. Hence, the vegetation of Sheka Zone is rich in all of the above economically and medicinally important plant families and needs conservation, management and sustainable use priorities.

5.1.3. Occurrence and Abundance

The values of occurrence, relative occurrence and mean abundances for the 458 species recorded from the 95 plots in the whole data set helped to identify species with the highest and lowest frequencies of occurrences in the area. Those species found to be occurred with the lowest frequencies of occurrences were considered rare species in the study are and need special attention. In other words, rare species could be susceptible to local extinctions due to over usage particularly the multipurpose species.

For instance, plant species such as *Manilkara butugi, Combretum molle, Ozoroa pulcherima, Podocarpus falcatus, Pouteria altissima and Antiaris toxicaria* were with relatively higher mean abundance values but with very low frequency of occurrences in the study area. Moreover, species such as *Ozoroa pulcherima* are highly marketable in the local markets due to the fumigant value of the wood which threatens the future of the species. The low frequency of occurrence is a good implication of the rarity of the species in the study area. Such rare species need conservation, management and sustainable use priorities.

Similarly, plant species such as *Acalypha marissima* (endemic species), *Crotalaria roseni* (endemic species), *Teclea nobilis*, *Clematis longicauda* (endemic species), and *Chionanthus mildibraedii* are with very low mean abundance values and frequency of occurrences in the study area implying rarity of the species. These species also need special consideration for conservation, management and sustainable use priorities.

The relatively higher frequency of occurrences of some species is also a good indicator of their disturbance tolerance and high rate of regeneration. They also frequently occur in a wide range of altitudes both in intact forests as well as disturbed habitats where human encroachment is very high. Moreover, species such as *Croton macrostachyus* and *Maesa lanceolata* highly dominated at forest margins where human impact is more intense replacing other species representing fast rate of regeneration.

However, it is worth noting that species with highest relative frequency does not always be represented with highest mean abundance values and vice versa. This is because mean abundance value of a species depends on its canopy size while frequency of occurrence depends on driving environmental factors and the species ecological or altitudinal range. For instance, *Maesa lanceolata* occurred in 53 plots with relative frequency of 55.79% but with mean abundance value of only 2.66 and *Vernonia auriculifera* occurred in 52 plots with relative frequency of about 54.74% but with mean abundance value of only 1.44.

Hence, for the current study, it was found that species such as *Croton macrostachyus*, *Ilex mitis, Schefflera abyssinica, Syzygium guineense, Ekebergia capensis, Prunus africana, Ficus sur, Polyscias fulva* and *Pouteria adolfi-friedericii* were those with relatively highest frequencies of occurrence as well as relatively higher mean abundance values whereas species such as *Cussonia holistii, Mimusops kummel, Oncoba spinosa* were found to be those with relatively lowest frequency as well as relatively lower mean abundance values.

5.1.3.1. Indicator, Consistency and Importance values Indices of plant species

The indicator value of a species is the product of the relative frequency and relative average abundance of plant species in their respective clusters. Constancy value, on the other hand, is the fractional occurrence of each species in every type or cluster groups and then it calculates twice the sum of the absolute value of the constancy minus 0.5 the output of which is a long list of species with unique values that reflect their constancy (Zerihun Woldu in press).

Similarly, importance value of species is the average abundance of species, ignoring zero values, and it is used in vegetation classification to present the characteristic species of interest in the clusters under consideration (Giliba *et al*., 2011). In the current study, woody species with importance value (IVI) of greater than or equal to twenty were considered to compare the ecological significance of the species

5.1.3.2. The Importance Value Index (IVI) of a species and its implications

In the current study, plant species such as *Schefflera abyssinica*, *Pouteria adolfi-firiedericii*, *Ekebergia capensis* and other 17 more species were found to be with importance value index of greater than 20. These plant species comprised about 25.2% of the total importance values and they are relatively, both ecologically and culturally, significant species with relatively higher importantce value index. The implication is that these plant species are the most important ones in terms of their ecological contribution to the vegetation of the study area. This is due to the fact that the ecological significance of a species in a given ecosystem is measured by the importance value index (IVI) of the species. The IVI value of a species measures different features and characteristics of the species in its habitat (Giliba *et al*., 2011). In the current study, the three species mentioned above and many other were characterized by relatively large canopy dominance in the vegetation of the area and hence their relative ecological significance as well as their contribution was also found to be high.

Moreover, it was noted that the IVI value of a species is a reasonable measure to asses the over all significance of the species in a vegetation (Curtis and McIntosh, 1950 in Tauseef *et al*., 2012). Similarly, Abreham Assefa *et al.* (2013) reported that plant species such as *Pouteria adolfi-friedericii*, *Schefflera abyssinica*, *Dracaena afromontana*, *Arundinaria alpina* are the most important species occurring in the forest of Masha, hence, with great ecological significance. Hence, the current study was also inline with the above findinding in that plant species with relativel IVI value reported by Abreham Assefa *et al.* (2013) were also reported also the methods used in computing the index was different in the two cases. That is the basal area was used in the earlier study while the canopy cover was used in the current study to compute IVI values.

5.1.4. Plant Communities

5.1.4.1. Visual vegetation classes

Visual vegetation classification is very useful to undertake preferential sampling method as it helps to understand what the whole study area looks like. It also helps to group vegetation of the study area into major sites generating homogenous representative groups. The homogenous representative vegetation groups are suitable for preferential sampling. In the current study, the village settlements were also grouped into 12 major centres for simultaneous sampling of vegetation ethnobotanical data.

5.1.4.2. Factors determininig the distribution of plant communities

The eight plant communities identified were affected by a number of environmental factors: physical (rain fall, temperature, altitude, slope, aspect, disturbance, grazing); chemical (soil properties and soil chemistry) (Kkumelachew Yeshitela and Tamirat Bekele, 2002); biological (interaction between the biotic and abiotic components of the environment as well as the biotic responses to these enivonmental variables). For the current study, a wide range of altitude coupled to climatic variability across Sheka Zone is responsible for the presence of different plant community types. Plant community 1, for instance, is affected by elevation and it is also the most species rich community of all.

As it can be observed from the climate diagrams of Seka Zone, there was great climatic variability between hot and cold; wet and dry; high precipitation with unimodal rainfall across the entire Zone of Sheka. At the lowest elevations such as Tepi, the climate was characterized by a wide range of both daily and monthly average maximum and minimum temperature with annual average of 22.4°c temperature and 1547 mm rainfall. January and February are the only two dry months of the year with the remaining ten moths rainy all year round. At the mid altitudes of Sheka Zone such as part of Masha and Andracha Districts, there is moderate climate with no dry season at all and the rain is all the year round. At the highest elevations of Sheka Zone in the other parts of Masha and Andracha Districts, the climate is even cooler with heavy rain fall all year round with annual average temperature of 16.9°c and 2190 mm average annual rainfall. Such climatic variability in addition to other factors best explains the formation of different plant community types and associations in the vegetation of Sheka Zone.

Plant community 2, for example, was found at lowest elevation with relatively narrower range (1000 m to 1550 masl) of altitude. Hence, rainfall, temperature and disturbance were the major factors affecting this plant community type. Plant community 3 on the other hand belongs to the wetland vegetation of Sheka Zone at relatively varying elevation range (1800 m to 2490 masl). It was highly influenced by moisture and grazing animals as it supports huge herds of domestic cattle all the year round. Although this plant community type is the least species rich community, it is good source of forage resources for grazing animals. Plant community 4 occupied the highest elevation (2375 m to 2800 masl) in the zone. It was characterized by pure stands of *Arundinaria alpina* and few scattered woody species of *Lepidotrichilia volkensii* and herbaceous layer of Urticaceae. It also forms an area where there is heavy rainfall all year round in the Masha-Andracha Districts of Sheka Zone. It can be observed from the climate diagram of Masha that the climate of Masha and Andracha Districts are characterized by relatively narrower range (10.1°c to 24.8°c) monthly average temperature and relatively higher annual average rain fall (2190 mm) as compared to Yeki District. The climate of Yeki district was characterized by relatively wide range (13.0°C to 33.3°C) monthly average temperature and relatively lower annual average rain fall (1547 mm). The *Arundinaria alpina*- *Lepidotrichilia volkensii* plant community types belong to the uplifted undulating landscape connecting the three districts of Sheka Zone.

On the other hand, plant community 5 was highly affected by aspect and altitude. It was also the second most species rich community. It was found subjected to the climatic condition of Masha and Andracha Districts that is characterized by higher rain fall and lower temperature as compared to that of Yeki District in Sheka Zone. Plant community 6 was at better conservation status since it is part of the Core Zone of the Sheka Biosphere Reserve. It was found on the east-west facing slope near Gecha Town and the surrounding areas. It was relatively better species rich plant community due to low disturbance. Plant community 7 was the third most species rich community with relatively less disturbance impacts. It belongs to the Masha-Kanga and Gecha-

Shekbedo dense forests dominated by large canopies of *Schefflera abyssinica*, *Syzygium guineense* subsp. afromontanum, *Pouteria adolfi-firiedericii* and *Cyathea manniana*. It was found within relatively narrow ranges (2200 m to 2575 masl) of altitude but has relatively higher species richness. It was also part of the Sheka Biosphere Reserve and hence at btter conservation status. Similarly, plant community 8 was also the third most species rich community. The elevation range for this plant community is also wider and it is the third next to plant community 1 and plant community 5 with lower disturbance. The main environmental variables here were aspect, slope and precipitation.

In summary, microclimatic factors and the biotic responses to these factors are responsible for the plant species composition and plant community structure in Sheka Zone. These environmental factors could be physical (rainfall, temperature, altitude, slope, aspect, disturbance and grazing); chemical (soil properties and soil chemistry) (Kumelachew Yeshitela and Tamirat Bekele, 2002, 2003); biological (interactions between the biotic components of the environment) as well as biotic responses to these environmental variables. Hence, a wide range of altitude coupled to climatic variability across Sheka Zone was responsible for the formation of plant community types and different plant associations. Altitude was found to be the most influential environmental variable for the current study.

Previous studies in the southwestern Ethiopia also reported that significant differences were observed in slope, aspect, sodium exchange, potassium exchange, cation exchange capacity and availability of phosphorous (Kumelachew Yeshitela and Tamirat Bekele, 2002, 2003). They further noted that altitude makes the major discrimination among plant community types. Moreover, Urban *et al*. (2002) reported that plant community distribution is the manifestation of physical gradients such as altitude, heterogeneity of soil and microclimate; biotic responses to these environmental gradients and history of disturbance. Abreham Assefa *et al.,* (2013) also reported that human influence and effect of local climatic variations of the vegetation might contribute to the variations in plant community types. Similar study in southwest Ethiopia by Admasu Addi *et al.,* (2016) also reported that plant communities showed significant differences with respect to altitude, slope, soil texiture and number of species.

These plant community types are also discussed with regard to their plant species richness and percentage composition of medicinal plants present in each plant community type. The highest plant species richness of plant community 1 was attributed to wide range of altitude (1050 m to 2325 masl) and minimum disturbance intensity. Moreover, this plant community belonged to the core zone of the Sheka Biosphere Reserve and hence at better conservation status. However, during the actual field work, it was observed that there were illegal human encroachments by settlers in the most remote part of Sheka Zone such as the GOJA and SHEKBEDO localities. Hence, attention should be given to this plant community before it is going to be prone to extreme disturbance.

Similarly, the next most species richness of plant community 5 was also attributed to its relatively wide range (1650 m to 2450 masl) of elevation coupled to relatively lower intensity of disturbance. It was due to the fact that plant community 5 belonged to the buffer zone of the Sheka Biosphere Reserve which was also at relatively better conservation status. Similar to plant community 1, there were early warning signs of human encroachment to plant community 5 which calls for special attention. Study localities such as the MODI KEBELE area which was part of the Gecha-Gamadro sampling localities were prone to disturbance. Moreover, this plant community contained endemic taxa such as *Erythrina brucei* and *Crotalaria roseni* with 62% of its species composition belonging to medicinal plant species which calls for priority attention.

Althogh plant community 6 stood the 5th rank in terms of total plant species richness; it stood first rank in terms of its percentage of medicinal plant species composition. The high percentage of medicinal plant species composition of plant community 6 was attributed to the fact that this plant community belong to the three zones (core zone, buffer zone and peripheral zone) of the Sheka Biosphere Reserve. It means that the majority of the medicinal plant growth forms were recorded from the study area (141 medicinal plant species) belonged to the herbaceous layer. In other words, it was due to the fact that herbs coul get less chance of being dominated by large canopies in diverse habitat ranges and hence their dominance as medicinal plant species in plant communit 6 increasing its medicinal plant species composition. Therefore, plant community 6 was found to be the major medicinal plant repository and hence need priority attention.

Plant community 7 and 8 were at equal status with respect to total species richness. But with respect to percentage composition of medicinal plant species, plant community 7 stood second next to plant community 6 followed by plant community 8. The implication was that similar to plant community 6, these plant communities (7 and 8) were also belonging to the three zones of the Sheka Biosphere Reserve in a wide range of habitat for high chance of herbaceous species. The fact that these plant communities were also prone to disturbance despite their higher percentage of medicinal plant species composition calls for priority attention for medicinal plant conservation, management and sustainable use.

Hence, plant communities 6, 7, 8, 4, 1 and 5 contained greater than 60% of their total plant species composition medicinal representing they were priority plant communities. Furthermore, these plant communities were found to be suggested as target communities for additional ethnomedicinal research and information retrieval. Moreover, although the remaining plant community types 3 with 50% and 2 with 46% were found to be with relatively lower percentages of medicinal plant species composition as compared to the previous six plant communities, the figures were still significant and cannot be negligible. The values of the spearman's correlation coefficients plant communities with respect to their total plant species richness and the corresponding medicinal plant species richness revealed that mant of the plant communities (communies 8 and 5, 8 and 7, 5 and 1, 7 and 5, 8 and 6, 6 and 5, 8 and 1, 6 and 1, as well as 7 and 6) were found to be with greater than 50% correlation. This implies that many of the plant communities share significant number of medicinal plants in common. Such information was found to be very useful for designing optimum *in situ* conservation plans for medicinal plants.

5.1.4.3. Relative proximity (Similarities) among plant communitis

The distance or dissimilarity measure index (Manhattan) standard equation defined as:

$djk = \sum |xij - xik|$, where dij represents the absolute value of the distance matrix or dissimilarity between any pair of clusters (C1 through C8) in the i, j and k dimensions. Thus, summary of the relative proximity of clusters to each other considering only the lowest and the highest values for six parameters is discussed below.

Based on the distance measures, the complete intra-cluster diameter was highest for community 6 and lowest for community 8. Therefore, the relative proximity was less for community 6 and more for community 8. On the other hand, the average intra-cluster diameter was highest for community 6 and lowest for community 7 indicating that community 6 was less compact while community 7 was more compact. Moreover, the single inter-cluster linkage was highest for community communities 5 and 6 but lowest for communities 2 and 3 representing that communities 2 and 3 are less proximate to each other whereas communities 5 and 6 are more proximate to each other.

Furthermore, the complete inter-cluster linkage was maximum for communities 3 and 6 but minimum for communities 7 and 8. Hence, communities 3 and 6 were less close to each other whereas communities 7 and 8 were closer to each other in tems of total species richness. Similarly, the average inter-cluster linkage was lowest for communities 3 and 6 but highest for communities 7 and 8 representing that communities 3 and 6 were less proximate to each other while communities 7 and 8 were more proximate to each other. Finally, the Hausdorff metrics inter-cluster linkage had the lowest values for community 3 and 6 but had the highest values for communities 7 and 8. Hence, communities 3 and 6 were less compact whereas communities 7 and 8 were more compact to each other. Similar explanations could be given to the intermediate values of the respective plant community types.

Validation of cluster groups means, in other words, validation of plant community types which could be constrained by a range of possible environmental factors. The pakage clv in R could be used to validate plant communities making them more sensible (Zerihun Woldu in press). It could help to image an ordination space rather than simply a dendrogram to get appreciation of the distances and hence dissimilarities among plant communities.

5.1.5. Environmental Factors and Plant Community Types

All the five environmental variables were valid in determining plant community types and floristic composition of the study area for both indirect and direct gradient analysis using RDA and CCA ordination. However, RDA was found to be the most appropriate ordination method in explaining the relationship between environmental factors and plant communities for this study. Backward and forward selection of environmental variables for constrained analysis based on their p-value and Akaike Information Criterion (AIC) where the variable with the lowest AIC value is the most influential variable showed that altitude is the most influential at AIC= 531.01 for RDA ordination and AIC=645.89 for CCA ordination.

Test for significance of environmental variables showed that altitude and aspect were very significant at p=0.005 (99.5%), disturbance and slope were highly significant at p=0.010 (99%) and grazing was moderately significant at p=0.035 (96.5%) for indirect gradient analysis using RDA ordination. The significant values were coded for p-values as: "(***)" for $0 \leq P \leq 0.001$=very highly significant, "(**)" for $0.001 < P \leq 0.01$=highly significant, "(*)" for $0.01 \leq P < 0.05$= moderately significant, "(.)" for $0.05 \leq P < 0.1$= very low significance, $P > 0.1$= not significant variable and hence candidate for rejection. Further validation by backward and forward selection of variables confirmed that altitude, aspect and disturbance were highly significant at P=0.005 (99.5%), slope was moderately significant at P=0.02 (98%) and grazing was moderately significant at P=0.025 (97.5%) accordingly.

Similarly, the anova.cca test for indirect gradient analysis using CCA ordination indicated that altitude, disturbance and aspect were significant at p=0,005 (99.5%) whereas grazing was significant at p=0.05 (95%). Furthermore, the anova.cca value for sequential test for terms showed that altitude, slope and aspect were significant at p=0.01 (99%) while grazing was significant at p=0.04 (96%) for indirect gradient analysis using CCA ordination.

5.1.5.1. Test of significance of environmental variable (F)

The ordination step in the forward direction with R^2 adjusted values indicated that altitude was highly significant at R^2=0.098, aspect was highly significant at R^2=0.020, disturbance was highly significant at R^2=0.015, slope was moderately significant at R^2=0.012, grazing was moderately significant at R^2=0.008. The adjusted R^2 denoted by R^2adj, is smaller than R^2 and it takes into account the fact that when n (number of data pairs) and k (number of independent variables) are approximately equal, the value of R may be artificially high due to sampling error rather than a true relationship among variables and hence, both R^2 and R^2adj are usually reported in a multiple regression analysis (Bluman, 2012).

5.1.5.2. The variance inflation factor (vif.cca)

Decision whether to reject environmental variable or not is based on the stepwise selection with variance inflation factor in conjunction with canonical correspondence analysis (*vif.cca*). It helps to test for collinearity of variables and hence useful for decision to whether to retain or reject the environmental variable in question. On that note, vif.cca values for altitude=1.20, aspect=1.22, slope=1.81, grazing=3.18 and disturbance=2.63 for indirect gradient analysis using RDA ordination. Hence, since all the values for the respective variable are less than 5, they are non-collinear. They are all significant and cannot be rejected. The variables that are collinear and therefore candidates for elimination will have vif.cca values higher than 5. R is multiple correlation coefficient with values between 0 to +1 where the closer to +1 the stronger the correlation and the closer to 0 the weakest the relationship (Bluman, 1998). Similarly, the vif.cca values under reduced model for CCA ordination were altitude=1.22, slope=1.86, aspect=1.25, grazing=2.85 and disturbance=2.31. Since none of the values are higher than 5, they are non collinear. All of the variables are significant and cannot be rejected.

5.1.5.3. Canonical Correspondence Analysis (CCA)

The values in Appendix 10 represents summary of the values of test for fitness of environmental variables, CCA, for significant vectors. Hence, altitude is very highly significant at r^2=0.994, p=0.001 (99.9%), slope is highly significant at r^2=0.117, p=0.007 (99.30%), aspect is very highly significant at r^2=0.851, p=0.001 (99.9%), grazing is very highly significant at r^2=0.156, p=0.001 (99.9%) and disturbance is very highly significant at r^2=0.372, p=0.001 (99.9%). Therefore, all the five environmental variables considered in this particular study were very significant in relation to plant community types.

5.1.6. Diversity of Growth Forms

High number of herbs (47%) recorded from the vegetation of Sheka Zone was attributed to the preferential sampling technique used to include all the possible life forms in a wide range of habitats. As studies indicated elsewhere in Ethiopia (Dereje Danu, 2006; Abiyou Tilahun *et al*., 2011; Abyot Dibaba, *et a*l., 2014; Admasu Addi *et al.*, 2016), including the Ethiopian flora, herbs constituted the major growth forms and this is also true in the case of Sheka vegetation. On the other hand, trees constituted the next number of growth forms next to herbs indicating that forest tree species were dominating the vegetation of Sheka Zone than shrubby plant species. The dominant growth forms for trees than shrubs may also attribute to the better conservation status of the vegetation so that selective tree cutting which may encourage high number of shrubby species is at its minimum. Large tree canopies with herbaceous layer are characteristic feature of the vegetation of Sheka Zone contributing to the dominance of the two growth forms.

5.1.7. Diversity

The mean value of beta diversity between sample plots (pairwise comparisons) indicated that there was high level of similarity among the samples. Similarly, the mean value of beta diversity within clusters (pairwise comparison of clusters) also showed that there was high level of similarity within clusters and hence the plant communities. However, between clusters beta diversity was relatively high indicating that there was low level of similarity between the plant community types. The implication was that there was species turn over among plant communities.

From the plot of species accumulation curve, it can be observed that the curve rises sharply during the early stage of sampling then began to decline slowly beyond the later stage of sampling (after 95th plot). Hence, no more new additions of species observed showing that study area is sufficiently sampled (Figure 17). Moreover, beta diversity for the whole data frame (β = 14.30) indicates high beta diversity. High beta diversity means there is species turnover among habitats. Site based species accumulation curves yield cluster results to the classical algorithms based on random approach (Kindt and Coe, 2005; Kindt *et al*., 2006). Oksanen (1989, 2015) also added that species accumulation and species pool models try to analyze the collection of sites with their respective species richness thereby calculating the exact method of site based species accumulation curves. Site based species richness and relative species abundance values (evenness) are combined to generate diversity indices.

Diversity indices can be looked at different scales namely Alpha (α), Beta (β) and Gama (γ) diversity. Alpha diversity is diversity is at small scales usually between samples whereas beta diversity relatively at larger scale or habitat diversity. A larger scale of measure of diversity is Gama diversity which is even at regional or global scale.

5.1.7.1. *Alpha (α) diversity*

For the current study of the vegetation of Sheka Zone, the Shannon-Wiener diversity index (H') is H'=3.41 with and Simpson=1-P=0.96 on average where $P = \sum(pi * pi)$. The value of inverse Simpson (invSimpson) is 1/P = 25.25. The H' value for the vegetation of Sheka is comparatively higher and it is closer to the value reported for similar Moist Evergreen Afromontane Forest by Abreham Assefa *et al*. (2013) as H'= 3.84 but lower than the values reported for the Dry Evergreen Afromontane Forest as H'= 4.07 (Ermias Lulekal, 2014).

The value of H'=3.41 for Sheka vegetation and this is the overall Shannon-Wiener diversity index of the study area. Similarly, the Shannon-Wiener equitability (J) is the overall equitability (J) for S=458 in this case is J=0.56 which is the degree of equitability. Kindt and Coe (2005) noted that an alternative approach is to report 1-Simpson index or to analyze the reciprocal value of Simpson index since larger Simpson index will indicate lower diversity. Hence, alternative approach recommends reporting the values for $P = sum(pi * pi)$, Simpson=1-P and inverse Simpson (invSimpson) =1/P to be 25.25 for the current study. Moreover, different values of evenness indices were obtained for the Shannon-Wiener and the Simpson diversity indices for the current study. It was due to the fact that Simpson index emphasizes on the most abundant species. The Shannon-Wiener index takes into accounts the degree of evenness in species abundances (species richness and evenness) as the two aspects of diversity which also often viewed as disadvantage since it makes interpretation difficult (Magurran, 2004; Kent, 2012).

5.1.7.2. Beta (β) diversity

The Sørensen index of similarity for the vegetation of Sheka Zone according to the current study was found to be $\beta w=14.30$ and it is the beta diversity (βw) of the whole data frame. Similarly, the beta diversity (βw) of paired comparison of sample plots was found to be $\beta w=0.79$. Hence, beta diversity measures the changes in diversity of species between sets of habitats or simply it is habitat diversity (Zerihun Woldu in press). Whittaker (1960, 1972) had noted that high beta diversity ($\beta w>5$) indicates low level of similarity between habitats whereas low beta diversity ($\beta w<1$) indicates high level of similarity between sets of habitats. It was further added that a good justification for changes among beta diversity between sets of habitats is that species turn over between cluster groups is higher than species turn over between sample plots of the original data and hence higher species turn over will show higher beta diversity and vice versa (Whittaker, 1972).

Therefore, for the present study of the vegetation of Sheka Zone, the beta diversity of the whole data frame was found to be $\beta w=14.0$ indicating that $\beta w>5$ and hence it is high. Similarly, the beta diversity of paired comparison of plots was found to be $\beta w=0.79$ and this is the Sørensen index of similarity for plots. On the other hand, the beta diversity of between clusters was found to be $\beta w=2.56$ whereas that of within clusters was found to be $\beta w=0.72$ implying that species turnover among cluster groups is higher than species turn over within sample plots (Table 11, Appendix 4).

The over all diversity (H'=3.41) of the study area was also relatively higher and it was closer to the values reported by other researchers for the Moist Afromontane Fores of the southwestern Ethiopia which ranged in between 3.31 to 4.18 (Miritse Giday, 2007; Abreham Assefa *et al*., 2013; Fikadu Gurmessa *et al*., 2013; Admasu Addi *et al*., 2016). However, compared to the recent study in the Dry-evergreen Afromontane Forest (H'=4.07) (Ermias Lulekal, 2014), the over all diversity of the study area was relatively lower. It was good implication of the fact that floristic richness and diversity of southwestern Ethiopia in general and that of the study area in particular is lower than the Shewa floristic region (Friis, 2009). On the contrary, the over all evenness of the study area was relatively lower at J= 0.56 indicating that only few plant species were dominating the vegetation of Sheka Zone.

5.1.8. Plant Species Distributions

The distribution of the total 555 plant species collected from the study area were classified based on criteria set for collecting both floristic (ecological) and ethnobotanical data collection, human management activities which were latter used in the analysis of the cultural significance index of a given species and wilderness area. These are wild (W=351), homegarden (H=28), both wild and homegarden (B=86), semi wild (SW=11), cultivated (C=54) and plantation (P=25) (Figure 18). Species that considered as wild (W) are those plant species observed only in the wild habitats during data collection and homegarden (H) are those plant species observed only in homegardens and are usually managed by humans. On the other hand, species considered as both (B) are those plant species observed both in the wild as well as in the homegarden habitats whereas, semi wild (SW) species are those plant species mostly observed in wild but rarely seen in homegardens or vice versa either as escapes from farmlands, homegardens or used as life fences but usually not managed by humans. Cultivated (C) species on the other hand are those plant species cultivated either in farm lands or in gardens or planted as street ornaments and hence usually human managed but not necessarily indicating large scale plantations, plantations while species considered as plantation (P) are those plant species such as eucalyptus or garden ornaments or large scale plantations for commercial purposes and hence they are highly managed by humans. Hence records of the total species list included all plant species encountered in plots and outside plots as well as species as being reported by informants for ethnobotanical and cultural significance in the area (S=555). However, cluster and diversity analysis was based on only species collected from plots and have cover abundance values that is only for the 458 plant species (S=458). For the ethnobotanical data analysis such as use value calculations and determination of relative cultural significance index, the whole species data set (S=555) was used.

5.1.9. Ethnobotany

There was a wide range ethnobotanical knowledge in Sheka Zone. Analysis and interpretation of the ethnobotanical information retrieved from the informants revealed that the people of Sheka Zone have a wide range of ethnobotanical knowledge base that they have accumulated over generations. These knowledge arrays include the use of plants in health, food, various other livelihood services, as well as traditional natural resource management practices. Elsewhere in Ethiopia, traditional management of human ailments for instance is a common practice (Tesfaye Awas, 2007; Haile Yinger *et al*., 2008b). Such practices were also common in Sheka Zone. Hence, it was a good implication to the need for knowledge integration into science which could be a good opportunity in the context of Sheka Zone.

The Sheka people have special place for any plant species in general and sacred forests in particular so that it is a taboo to cut trees from the jungle improperly and unreasonably because forests are linked every aspects of their lives. The forests are sources as well as living homes for their bees and bee products, sources of their wild medicines, sources of their wild edible plants, sources of their spices and condiments such as wild *Aframomum corrorima* and *Piper capense*, shelter for their domestic animals and the people themselves, burial place for their ghost which is permanent resting site for their body and many more. The above realities were justified by detailed analysis based on the Cultural Significance Index (CSI) of each species in question thereby interpreting the values given by the local people to such particular species. The cultural significance index (CSI) of a species is used to record the role of plants in a culture (Turner, 1998 in Silva *et al.,* 2006). The major contribution of species in question in the context of the Sheka people was also seen from the aspect of the Relative Cultural Importance (RCI) of that species in a given locality.

5.1.10. General Use Categories of Plants

Most food plants recorded from the vegetation of Sheka Zone are also medicinal plants either directly or indirectly in one or more ways. However, as compared to the total number of medicinal plants collected from the study area, the number of wild edible plants is relatively very low. Similarly, the majorities of plants that are use as raw materials for the preparation of local drinks/beverages are also medicinal plants and play great roles as herbal remedies. For instance, *Olea welwitshii* and *Rhamnus prinoides* both used in the preparation of local drink (TELLA), or mead (TEJ) (local drink prepare from honey mixed with some plant ingredients) and both cultural drinks as well as recommended by traditional healers either as a supplement to or antidote to the medicines they prescribe for their patients. The same is true for *Vernonia amygdalina* leaf extract which is added to local bear and drunk against stomach problems.

In case a given plant species is multipurpose, the people rate all the use values of a particular species and prefer best use for best service. This is a common practice concerning plants used as firewood in the study area. For instance, a plant may be an excellent timber plant and still an excellent firewood plant. Under such circumstances, it is only the by-products (left over parts) such as the branches, the leaves and the bark of the plant that should be used as firewood and the main trunk is preferred for timber, construction and tools as well as farm implements.

Similarly, the highly commercial plant, *Coffea arabica* is also well known as the major source of firewood in the area but this use of the plant is only after the plant completed its whole life cycle and died or only the removed branches during pruning are used as firewood. This is the way the local people value their tree and other vegetation resources in their vicinity. Priorities and preferences for multipurpose plant species discussed for plants used as source of firewood also work for plants that are used as a major source of charcoal. Usually, the underground parts (roots) of large dead trunks are dug out of the soil and used for charcoal preparation so that such method is believed to minimize the impacts of charcoal making on the life of living and multipurpose tree.

Shade trees are among the useful plant species of the area play vital role in providing social, environmental and cultural services. They serve as shelter against heat radiation from tropical overhead sun for both humans and animals. They help to balance the surrounding temperature when planted around living homes creating the most hospitable environment for the residents of the house. They help as a resting place for both humans and animals wherever they are in gardens, roadsides, street sides, farmlands, grazing lands, cultivations. They are good shade trees for coffee plantations for better yielding. They are best resting places for elders for discussing social matters, conflict resolutions, cultural celebrations, wedding ceremonies, funeral ceremonies. They serve as good playground for people where they freely prepare food and drinks, coffee ceremonies and enjoy. People of the area usually prefer enjoying such events outside their homes under such shade trees as it gives them more comfort than their living rooms.

Plants used as raw materials for construction and tools are the most threatened plant species in the study area and most of them are timber plants. Construction and tools are human demands and sometimes even it is beyond the capacity of the vegetation of an area to support such demands. Timber products, homemade utensils, and other related wood products have high commercial value and this pose great pressure on plant resources in areas where legal re-enforcement on the proper utilization and conservation activities is relatively weak.

The wild habitat of Sheka Zone also is well flourished with valuable plant species of commercial value such as species of *Coffea arabica*, *Aframomum correrima*, *Piper capense* and *Arundinaria alpina*. Factors that are threatening other vegetation resources of the area are also treats to such commercial species in their wild state. The wild habitat of *Arundinaria alpina*, for instance, is highly encroached by human activity as this species is highly wanted both in the rural and urban areas for making of beautiful and precious homemade tools. In addition, *Arundinaria alpina* is preferred as major raw material for constructing fence by the people of Sheka. Although attempt is made by the Ethiopian Biodiversity Institute to conserve the species, practical implementation and legal enforcement is very weak and the species is under serious threat.

Fodder plants are other groups of useful plants in the area. The utilization of a given plant as livestock feed or human food may depend on the parts of the plant itself. For instance, *Ensete ventricosum* is a plant of great cultural value for the Sheka people and hence it is the main cultural food for humans when the rhizome and the stem are well chopped, fermented and processed. On the other hand, the leaf of this plant is used as animal feed by the local people of Sheka. The fiber is also very important for making rope and baskets.

Bee forage plants constitute the second largest number of species in the area next medicinal plants. Bee forage is among the most encouraging practices as a non-timber forest product (NTFP) since it is possible to generate huge amount of money from honey selling without destroying the tree for timber, firewood than simply utilizing the timber tree directly for various purposes. It is the easiest way of livelihood making for farmers in living in and around the forest because a single tree can support a number of beehives from where huge sum of honey can be collected and sold in local markets. Such practice of honey harvesting is a common practice by the people of Sheka in their specially protected KOBO (cultural) forests located at relatively far away from their living homes or villages.

Culture and ritual plant species are usually associated with sacred sites, worships that any merits given to the plant and the surrounding areas attached to the benevolence of God so that it is forbidden to cut trees or take away plant materials from such places. There is a belief attached to such places that plant materials collected from there have some healing power and hence serve as sources of herbal remedies only if collected by the authorized person. The above belief is hand in hand with the works of Aerts *et al*. (2016) on the contribution of church forests in the conservation and management practices. There are also causes when water fetched from springs under such trees considered holly water and hence has psychotheraptic value. Species such as *Ekebergia capensis*, *Manilkara butugi*, *Ficus cycomorus*, *Cordia africana* are among such species with special cultural and ritual significance. On the reverse, some plant species such as *Prunus africana* are not well encouraged to grow in gardens or near living homes because there is a belief that *Prunus africana* has the ability to attract lighting and hence it would be dangerous for the family during rainy season as the lighting may come and destroy the house and the family too. Farmers do not allow growing of *Prunus africana* seedlings within certain distances around their houses. The bark of *Antiaris toxicaria* is used for making traditional clothes and leaf of *Ensete ventricusum* is used as sleeping mattress in rural areas.

The beauty of gardens around homes is maintained by plants of great ornamental values. The people of Sheka are well experienced in such practices and they plant both indigenous and exotic species around their homes, in gardens, as boundary marking around their farm lands, as life fences, as shade trees as well as street ornamental in towns. The multipurpose value of such plant species is that they not only add aesthetic value to the mind but also some other environmental significances to the areas where they are well practiced. Some species are important sources of foods, medicines, serve as wind breaks apart from the objective for which they are planted. These ornamental plants can also include plant species that are used as life fences as well as planted as boundary demarcation in the meantime providing aesthetic and spiritual value to humans.

There are many plant species the use of which are not directly mentioned here but have great contribution to everyday life of the people of Sheka Zone. They categorized here as other useful plants of Sheka. Therefore, it is obvious that any given plant species in its natural ecosystem has its own use value in at least one or more ways either directly or indirectly and hence it is better to understand the term useful plants as contextual and location specific. Every species is useful and none is considered non-useful in its natural ecosystem.

5.1.11. Medicinal Plants

The vegetation of Sheka Zone is rich in medicinal plant diversity and floristic composition. A total of 266 (48%) of the total plant species recorded from the area were found to have medicinal values in one or more ways either directly or indirectly indicating that the vegetation of Sheka is good reservoir of plant species of medicinal values. These medicinal plants are distributed among forests, homegardens, river basins, stream sides, road sides, along valleys, wetlands, farmlands, coffee and tea cultivations, epiphytic on large tree trunks. Traditional healers know the location of these valuable medicinal plant species and through intense guided field walk they can directly locate them. With great care and patience, it becomes the task of the researcher to unbiased ethnobotanical information from the local healers keeping the top secrecy of their cultural beliefs and medicinal plant knowledge.

The medicinal plant species recorded from Sheka Zone were used to treat humans 204 (77%), livestock 10 (4%) and both humans and livestock 52 (19%) health problems. The thirteen plant parts were identified as parts used to treat about 143 health problems which further categorized into 22 types of diseases locally treated by traditional healers. The most frequently cited medicinal plants such as *Croton macrostachyus*, *Prunus africana*, *Rumex nepalensis*, *Justicia schimperiana*, *Achyranthes aspera* and many others are also reported by many researches conducted in other parts of Ethiopia. For instance, 25 of the medicinal plants used to treat human ailments and 8 of the medicinal plants used to treat both human and livestock ailments recorded in the current study are also reported by Fiseha Mesfin (2009). Similarly, 29 of the medicinal plants recorded as threating human ailments in the current study are also reported by Hussien Adal (2014). Moreover, Solanaceae, Asteraceae, Lamiaceae, Fabaceae and Euphorbiaceae are medicinal plant families with the highest number of plant species used in the treatment of human and livestock ailments in Erobe and Gulomeheda Districts of Tigray (Tadesse Beyene, 2015).

5.1.11.1. Diversity of medicinal plant growth forms and parts used as medicine

The vast majority of the medicinal plants 141 (53%) collected from the study area belonged to herbaceous species. They account for more than 50% of the total medicinal plants. They were major reservoirs of medicines for local people of Sheka Zone. High usage of herbs as sources of herbal remedies might attribute to their relative abundance and ease of accessibility to healers. Study conducted by Mirutse Giday (2007), Mirutse Giday *et al*. (2009) in southwestern Ethiopia reported that high usage of herbaceous medicinal plants was attributed to their relative abundance as compared to other plant growth forms and history of settlement the people using it. Moreover, the patterns of growth could also contribute the high frequency of usage of herbaceous plant species due to the fact that herbs are the dominant plant growth forms in the Ethiopian flora.

Large numbers of medicinal plants in the study area were also found to be used to treat only human health problems and only few of them were reported to be used to treat livestock ailments. The possible reasons could be attributed to the relative preference to and emphasis of the people on human health problems as compared to livestock health problems. Moreover, relatively larger number of medicinal plants were used for treating both human and livestock ailments. Availability of veterinary clinics could also be a factor as reported by Mirutse Giday

(2007) because people prefer modern healthcare services for their livestock in the presence of such services in their vicinity.

5.1.11.2. Plant parts used as source of medicines and implications

Some plant parts particularly the root, leaf and bark are sensitive to harvesting so that affecting them could directly or indirectly affect the life of the whole plant. This is due to the fact that these plant parts play vital role in the whole life cycle of the plant species under question. Rare species for instance may be susceptible to local extinction due to over usage and pressure posed on its sensitive organs in care is not taken. Typical example is the case of *Echinops kebericho* whose root was highly marketable in local markets of Sheka Zone. It is obvious that uprooting the species could kill the individual plant leading to reducing its availability in its natural populations. Studies elsewhere in Ethiopia also indicated that over usage is a threat posing pressure on plant species in general and medicinal plants in particular (Hussien Adal, 2014). Medicinal plant parts used could also serve as target organs for further medicinal plant profiling, promoting and drug development.

5.1.11.3. Preparation and application of medicinal plants

In the current study, greater than 60% of the medicinal plant preparations were fresh plant material. Traditional healers claim that some medicinal plants lose their healing potential if not used in fresh condition. The implication was that there was limited practice of dry storage for future use. It means that there could be increasing frequency of harvesting which may affect the medicinal plant in use or its parts. Similar studies also confirmed that freshly harvested medicinal plant parts were frequently used in the preparation of plant derived remedies (Mirutse Giday, 2007; Ermias Lulekal, 2014).

5.1.11.4. Route of administration of medicinal plants and implications

According to the current study, the majority of the routes of administrations of the medicinal plants were internal through oral intake. However, there is no guarantee about the side effects of such type of medicinal plant intake. There may be high chance of health complications to arise creating both short term and long term problems on the life of the patient. Mirutse Giday (2007), for instance, reported that relatively less risk of being poisoned by improper use of herbal remedies was external/skin application as compared to internal/oral applications. The implication was the presence of problems of dosage, standardization, side effects, validity and the susceptibility of delicate body parts of the patient above all. Hence, there is a need to give priority attention to the establishment of standardized traditional treatment guidelines for medicinal plants by well known traditional healers.

5.1.11.5. Dossage determination of medicinal plants and implications

Traditionally, healers use different methods as means of dosage determination. Among these were finger strips of little finger, finger nails of little finger, glass, coffee cup and teaspoon based on the age and sex of the patient. Moreover, they use different preparations (mixed plant extracts), milk, honey, meat soup, bread of red teff as antidote against the side effects. However, there is a high chance of the patient to be victim of the side effects of the medicinal plant in use and it is obvious that the scenario is even true in modern medical care services if great care is not taken. For that matter, the Food, Medicine and Health Care Administration and Control Authority (EFMHACA) of Ethiopia, for instance, has already established standard treatment guidelines at various levels of health facilities (health centres, primary hospitals and general hospitals) (EFMHACA, 2014) for multi stage treatment services. Yet the traditional treatment practices have a number of gaps in it despite its vital role in primary healthcare services.

5.1.11.6. The Informant Consensus Factor (ICF) values and its implications

For the current study, strong agreement among informants (greater than 50%) was observed for 16 of the 22 human health problems. The ICF value for epilepsy was only 25% for the current study. Informant consensus values normally range between 0 to 1 (Andrade-Cetto and Heinrich, 2011). High informant consensus factor values were observed for treating both human and livestock ailments in the study area. The implication was that only few medicinal plant species were reportedly used by very high proportion of informants to threat a given category of health problems. That means there was strong agreement among informants over which medicinal plant to use a in the traditional treatment of a given health problem. Low ICF values show informants' disagreement over which medicinal plant species to use for treating a given category of health problem. Andrade-Cetto and Heinrich (2011) noted that ICF is used to identify plants of particular intercultural relevance. Hence, it would be necessary to group health problems into wide diseases categories.

Interpretation of the values of ***Informant consensus factor*****:** The ICF values for the 22 major human diseases categories range in between 0.25 to **0.96** with average value of **0.62** as indicated in Table 15 of the results section. Since the values of informant consensus factor normally ranges between 0.00 at its lowest and 1.00 at its highest (Andrade-Cetto and Heinrich, 2011), it implies that there is strong agreement among informants (>50%) for the **16** of the health problems. High informant consensus factor values imply strong agreement of informants on which medicinal plant to use to cure specific type of aliment. Low informant consensus factor values on the other hand imply strong disagreement of informants on which medicinal plant to use to cure specific diseases. It means that if ICF value is high, few medicinal plants species are reported to be used by high number of informants to threat a particular category of health problem and vice versa. Hence, more than 90% of informant consensus factor was obtained for skin diseases (**96%**), poisoning/snake, insect bite (**94**%), and gastrointestinal (92%).

Parasitic infections such as scabies, pediculosis and oncocerciasis were the commonest health complaints followed by bacteria and fungal infections in southwestern Ethiopia (Figueroa *et al*., 1998). However, care should be taken while using such outdated literature sources and up-to-date research findings about the current ststus of various health problems should be referred. Oncocerciasis, for instance, was almost under control in Ethiopia no significant case reports available in the current situation. Recent research findings show that more than 40% of tropical health problems including malaria were caused by gastrointestinal parasites in developing countries (Kucik, *et al.*, 2004; Traore *et al*., 2013). In Ethiopia, common helminthic infections for which traditional remedies were highly prescribed include Tapeworm, Ascariasis, Hookworm and Pinworms (Dawit Abebe *et al*., 2003). A study conducted around Tepi Town of Sheka Zone also revealed that Ascariasis and Trichuris trichiura were the most coomon helminthes in the area (Esmael Besufikad *et al*., 2017).

5.1.11.7. Fidelity level (FL) of medicinal plants and its implications

The fidelity level of medicinal plants represents the relative healing potential of medicinal plants against a given ailment. In the current study The relative healing potential or fidelity level (FL) of most sited medicinal plants with relatively higher fidelity level values for treating human, livestock as well as both human and livestock aliments were identified and discussed. Relatively high fidelity levels were observed for medicinal plants the medicinal plant species have have relatively high healing potential against the respective health problems mentioned. In other words, plants with high FL values could be target species prioritized for conservation, management and sustainable use after their bioactivities were properly evaluated and confirmed. They could also contribute to medicinal plant data base. Andrade-Cetto and Heinerich (2011) reported that lower fidelity level indicates a given medicinal plant species could have more number of mentions by the informants than medicinal plant species that have high fidelity level.

Considerable number of medicinal plants in Sheka Zone need further chemical profiling to assure their validity and efficacy. Heinrich (2000) noted that systematic evaluation of indigenous therapeutic methods and practices so as to improve healthcare in marginalized regions became an important element of the agenda of international and national organizations. Validation of therapeutic claims help to increase confidence, generate income creating opportunity for marketing of herbal medicine (Tabuti *et al*., 2003).

The relative importance of a given medicinal plant within a culture in which it is found to be significant is evaluated through the application of quantitative ethnobotanical methods and data comparisons among diverse cultural groups within a given fragment of social groups or community. Quantitative ethnobotanical methods and approaches such as the use of informant consensus factor, relative healing potential, relative cultural importance, cultural significance index, ranking and scoring are among the indices used in the systematic evaluation of the medicinal plant in need. Moreover, use variability of medicinal plants of interest in search of their bioactive compounds can be estimated by using the informant consensus factor (ICF) values. Hence, plants with the greatest bioactivity are considered to have the highest ICF values and are better candidates for bioprospecting and further profiling (Canales *et al*., 2005; Rahaman and Karmakar, 2015). Hence, the considerable number of medicinal plants recorded from Sheka Zone need further profiling to assure their validity and efficacy.

5.1.11.8. Major health problems in Sheka Zone/Emic versus etic perspectives/

The etic/emic approach helps to visualize the way local people try to perceive their surroundings thereby seeking solutions to major practical problems in health, food security, social integrity and environmental sustainability. Modern science has much to learn from traditional practices as the traditional practice has to learn a lot from modern science in all aspects of life related to the issues outlined above. For instance, it is a known fact that long before the discovery of modern healthcare systems and drugs, antient people traditionally used to get self medication by trial and error. Such traditional therapy was what traditional healers of today still engaging in although the way they are doing it is closer to moderinity. Hence, knowledge integration becomes among important aspects for the success of science. Social beliefs and taboos associated with diseases or any health problems and the associated herbal remedies used to treat such diseases have something to do with the mutual relationships between traditional healthcare system and modern healthcare services. However, relying on traditional healthcare system has yet its own advantages and disadvantages.

On one hand, traditional healthcare system is believed to be very cost effective, easily accessible and highly trusted by the patients who get the services if it is carefully performed by well experienced traditional healers. Just as a medical doctor treats his/her patients psychologically well in addition to other medical services, both the traditional healers and the patients in Sheka who are going to get traditional medication have a common belief that God has created the natural medicine, the herbs, and shared his medical knowledge to the authorized person, the traditional healer, so that they confidentially visit the herbalist in their locality to get medication. The healers also believe that God does not refuse them to care for their patients when they give the medicine on behalf of him. Such well gifted people in Sheka are usually nominated as clan leaders and have specially recognized places in all social aspects in the culture and believe of the Sheka people. They even participate in governance, conflict resolution and related issues in their society.

On the other hand, there is no evidence about the dosage determination, route of administration of medicinal plants and the associated short term as well as long term side effects although traditional healers in Sheka are well adopted in treating patients. Hence, the issues of validity, standardization and side effects are questionable so that there is a risk of committing life threatening events. Even it is well obvious that in a well tested and confirmed modern medical services; there are events where life threatening cases may occur. These events are related to dosage, patient's health history, improper prescription of medicines and related mistakes during multistage treatment options.

The Food, Medicine and Health Care Administration and Control Authority of Ethiopia for instance prepared standard treatment guidelines for health institutions at various levels (EFMHACA, 2014) which can serve as a standard reference for health professionals. EFMHACA further noted that irrational use of drugs has been one of the major problems in the Ethiopian healthcare system for a long time. It was emphasized that medicines should only be prescribed when necessary, and the benefit-risk ratio of administering the medicine should always be considered prior to prescribing where the prescription should be through the well understanding between the prescriber, the pharmacist and the patient (EFMHACA, 2010, 2014). The above scenario calls for the need for integrating traditional healthcare system with modern medical services thereby validating, standardizing and certifying traditional medication and the knowledgeable persons who are giving the service to the society.

5.1.11.9. Relative Cultural Importance and Cultural Significance Index (CSI)

The cultural significance designates the importance of a species in a given culture (Hunn, 1982in Silva, 2006). Hence, by using a given plant for a specific use, the user considers not only its availability but also its utility in relation to presence/absence of certain characteristics. Therefore, the relationship between use citations of a given plant species and the agreement between the informants about the knowledge were aggregated to the CSI using the correction factor (CF). CF was computed by dividing use citations for respective species by the most cited species in the group (Albuquerque *et al*., 2006; Silva, *et al*., 2006).

Hoffman and Gallaher (2007) noted that many relative cultural importance indices pool the unique uses of plant species mentioned by informants into major use categories. Moreover, the authors recognized that standardized categorization facilitates compilation, comparison as well as efficient presentation of the whole data sets identifying which plant species is relatively the most important and which plant species is relatively the most preferred. They further emphasized that plants frequently cited for uses that differ only slightly thereby receiving exaggerated outlier of relative cultural importance values. Under such circumstances, it is better to break the data into use categories which help to avoid outlier of relative cultural importance values. The cultural significance index (CSI) was therefore used to quantify the importance of useful species for traditional groups (Albuquerque *et al.,* 2014).

Therefore, use records of species 1 through 555 in the fourteen different use categories analyzed using the relative cultural importance indices by use category methods. These use category methods were use totaled, subjective allocation and cultural significance index methodology for the current study. They help in checking for consistency and priority ranking of species. The cultural significance index of five most preferred plant species in Sheka Zone based on informants subjective allocation methodology revealed the relative usefulness of the respective species per use. Hence, the five pant species Arundinaria alpine, Coffee Arabica, Cordia Africana, Schefflera volkensii and Syzyguim guineense indicated a high degree of cultural significance regard to management, preference and frequency of use of the species for a given use. It shows that these species are the most preffered species in Sheka Zone. The implication of the whole scenario here is that species with relatively higher values of relative cultural index (RCI) value and cultural significance index (CSI) value will be given priority for conservation, management and sustainable use.

5.1.11.10. High ranking medicinal plants

High ranking medicinal plant species are priority species for further profiling against gastrointestinal problem efficacy and safety. Quantitative analytical tools such as ranking and scoring are among the quantitative ethnobotanical approaches used to generate scientifically rigorous results (Martin, 1995; Coton, 1996). The authors further noted that pair wise matrix of medicinal plants in relation to a given aliment selected based on the results of ranking and scoring are use to test for the consistency of the relationships of preferences as well as transitivity of results.

Furthermore, pair wise comparison of top five medicinal plants against gastrointestinal problems as obtained from the ten respondents (R_1 through R_{10}) also show that *Croton macrostachyus* ranked first followed by *Prunus africana*, *Peperomia retusa*, *Lobelia giberroa* and *Celosia schweinfurthiana* respectivelty in this order confirming consistency of relationships and transitivity of results. It implies that the above plant species were found to be culturally important in the study area due to their wide use by a large number of users of the plants due to their curative properties.

These species are priority species in view of their relatively high economic value on one hand and focal species for none managed ones such as *Manilkara butugi, Hagenia abyssinica, Hallea rubrostipulata, Cordia africana* and *Syzygium guineense* on the other hand for conservation, management and sustainable use. The implication of direct matrix ranking is that is important to identify potential threats associated use values of any useful species.

Hence, harvesting impacts on multipurpose plant species can be tested by ranking and scoring (Martin, 1995; Cunningham, 2001). It is obvious that there are instances where the most utilized species is going to be most threatened one in its locality if appropriate conservation, management and sustainable use measures are not taken. This is clear from the point of view of whether the rate at which the species is utilized in the area is much greater than the rate at which it is replacing itself or not in its natural habitats (Cunningham, 2008). The worst problem arises when such events are so latent that even it is going to be difficult to take immediate conservation measures to save the rare species. Even species which are not multipurpose but known for their single use value such as medicinal purpose may be at risk of extinction under such circumstances. For instance, medicinal plant species such as *Echinops kebericho* and *Vangueria madagascariensis* were found to be highly wanted species in Sheka Zone for their high medicinal value but they were found to be very rare in their occurrences and distributions in the area and hence they are typical examples.

5.1.11.11. Correlation between distance and medicinal plant use frequency

The current study confirmed that there is correlation between respondents' average distance from health centers and the frequency of medicinal plant use (citations) by informants in Sheka. This was justified by estimating the Pearson product moment correlation coefficients with their associated p-values for the 12 sample sites. The highest correlation was observed for the Masha-Yep'o locality ($r = 0.844$, $p = 0.044$) followed by the Gecha-Gamadro locality ($r = 0.834$, $p = 0.000$). The implication is that there is the highest frequency of dependence on medicinal plants in these two localities as compared to the remaining 10 sites. Similarly, relatively higher correlation was observed for the Gecha-Shakbedo ($r = 0.775$, $p = 0.000$) and the Masha-Kanga ($r = 0.740$, $p = 0.001$) localities. These two localities are among the remotest sites in Sheka Zone. However, the respondents' average distances from the nearby health centers are relatively lower as compared to the previous two sites.

On the other hand, three sites; Gecha-Gebina ($r = 0.571$, $p = 0.002$), Masha-K'arina ($r =0.550$, $p = 0.001$) and Tepi-Yeki ($r = 0.510$, $p = 0.001$) have between 50% to 60% correlations with very significant p-values. The remaining five sites; Gecha-Yukic'ic'i ($r = 0.446$, $p = 0.000$), Tepi-Ermich ($r = 0.397$, $p = 0.000$), Tepi-Bak'o ($r = 0.273$, $p = 0.029$), Tepi-Alamo ($r = 0.253$, $p =$

0.001) and Masha-Chewak'a ($r = 0.196$, $p = 0.002$) have less than 50% correlation. The least correlation was observed for the Masha-Chewak'a locality. However, it is worth noting here that the p-values are very highly significant for the 12 sites with each greater than 99.9% confidence. This implies that the people of Sheka have rich knowledge of medicinal plants. They extensively use the medicinal plants in solving their day to day health problems. It is also a good confirmation for the huge number 266 (47.93% of the total species recorded) of medicinal plants collected from the area.

5.1.12. Wild Edible Plants

Wild edible plants play a vital role in supplementing food diversification and livelihood maintenance by the people of Sheka. However, compared to the huge number of medicinal plants collected from the area (266), the number of wild edible plants recorded during the current study is lower. They constitute only 13% of the total medicinal plants collected from the three districts of Sheka Zone. But is very appreciable that 30 (85.71%) of the total wild edible plants are also belong to the medicinal plant lists of the area. This implies that there is a strong relationship between what types of plant species the Sheka people prefer as sources of medicines for their healthcare services and the type of food they utilize to sustain their daily life.

5.1.13. High ranking multipurpose plant species/Ethnobotanical perspectives

In the context of Sheka Zone, direct matrix ranking of ten most cited multipurpose plant species based on their relative cultural importance (RCI) scores against the fourteen major use values showed that *Manilkara butugi* ranked first followed by *Persea americana* and *Syzygium guineense subsp. afromontanum* in the group. However, there were no feasible management practices available for the two indigenous species; *Manilkara butugi* and *Syzygium guineense* despite their frequent use in the area. Such plant species need priority attention. Although they were widely distributed in their respective wild ecological range ouer usage may threaten the future of the species. Moreover, *Manilkara butugi* relatively is found in a very narrow ecological range in the area despite it stood first rank in its multipurpose function. Hence, it is good implication that special attention is needed for the conservation, management and sustainable use of species with narrow range of ecological distribution but wide range of ethnobotanical profile.

5.1.14. Major Threats to the Vegetation in the Study Area

Although it is obvious that the vegetation resources for the entire country, Ethiopia, have more or less similar threats most of which are anthropogenic in nature, each locality in the country has variable intensity of different threats. Similar to elsewhere in Ethiopia, the vegetation of Sheka Zone is also threatened by a range of factors. Although it is at a relatively better conservation and management status as compared to other vegetation in the country (except for the protected areas) due to the presence of the Sheka Biosphere Reserve, random information retrieval from informants revealed that there are still unresolved conservation issues in the area.

On one hand, although the local people are well aware of the need to conserve and manage the vegetation resources of the area, they claim that they expect immediate short-term benefits that can fulfill their livelihood needs. However, they believe that the undergoing conservation activities are targeted to long-term advantages and do not fulfill their expectations. Moreover, they claim that they are unhappy with the ever increasing Coffee and tea investment activities in the locality which they believe it takes away their forest resources in the meantime they benefited much less than their expectations from the Coffee and tea investment activities. Hence, there is a triangulated human-nature-investment conflict between local community, investment and legal enforcement which is very latent in its nature in the area. Conservation action plans were suggested to involve multiple strategies (Tabuti, 2009).

On the other hand, there is a promising conservation and management activities undergoing in the area. These activities are undertaken by both local and national organization as well as the government supported activities. Typical examples are: the work by the Melca Mahiber (Movement for Ecological Learning through Community Action) targeted to promoting sustainable management of the environment and conservation of indigenous knowledge and culture (Tadesse Woldemariam *et al*, 2012); the Non-Timber Forest Products (NTFP) Research and Development Project aimed at stimulating both forest conservation and livelihood improvements in the region (oral communication with Yingalign Bizuayehu, staff member of the NTFP project). There are also local NGOs working on livelihood diversification, honey harvesting (apiculture) to minimize pressure on human induced changes on vegetation. Moreover, enhancement of eco-friendly and agro ecologically compatible development options in the context of rural Ethiopia are key measure to tackle threats to vegetation resources as well as climate change adaptation and mitigation. Among the best beginnings in this regard is the appreciable Ethiopia's Climate Resilient Green Economy Strategy (ECRGE, 2011; ECC, 2015) which is promising development option if properly implemented.

The major threats to the vegetation of Sheka Zone include commercial agriculture (CA), construction and tools (CT), increasing population (IP), firewood collection (FW), charcoal making (CM), habitat loss and fragmentation (HF), exotic species (ES) and Grazing (GZ). Practical observation during the actual field work indicated that encroachment of invasive alien species such as *Parthenium hystrophorus, Mimosa invisa* and *Lantana trifolia* in the Yeki and

Andracha Distracts; *Lantana camara* in Masha District are among the early warning signs of the threats to the vegetation of the area. Moreover, since *Eucalyptus* is a very fast growing commercial plant relative to other indigenous species, it was observed in the three districts that people are clearing the natural vegetation and planting *Eucalyptus* both in forests and forest margins which is also among the major threats to vegetation of the area if not properly managed in the future.

5.1.15. Implications of Emic/Etic Classification of Landscapes and Vegetation

Traditional ecological knowledge (TEK) of Sheka/emic versus etic perspectives/: The Sheka people have unique traditional or indigenous ecological knowledge (TEK/IEK) that plays important role in natural resource management, conservation, administration and the like. The major ones are: the approaches they use to classify landscapes, vegetation, agro-ecology and the titles given to the clan leaders, administrators and musicians for community management purposes. Their TEK contributes to their land use systems and traditional conservation.

Traditional classification of nature by the Sheka people has its own implications in conservation, management and sustainable use of natural resources and hence the biodiversity too. Hence, the emic/etic approach help to visualize the way people perceive nature (Morris *et al*., 1999) thereby applying to solving practical problems in their surrounding. For instance, beliefs and taboos have played great role for plant preservation and hence spiritual and religious beliefs of the Sheka people have developed strong effects on conservation and use of vegetation resources (Tadesse Woldemariam and Masresha Fetene, 2012; Seada Yasin *et al*., 2015). Traditional forest management practices by the Sheka people follows the integration of these powerful beliefs, rituals, sprits and taboos adopted by ethinic groups hence among the best local traditions for biodiversity conservation and sustainable environment.

Problems with population influx associated cultural changes and its implications

Since Sheka Zone is known for it's among high investment areas in Ethiopia there is periodic population increase due to high number of immigrants in search of available job opportunity in coffee and tea plantation activities. Tadesse Woldemariam and Masresha Fetene (2012) emphasized that reduction in public respect to cultural forests have come due to diminishing respect to traditional beliefs and sacred sites. Moreover, it was noted that there are high violation of traditional rules by dowlers that come from other parts of Ethiopia (Seada Yasin *et al.*, 2015). In the meantime, there is a diminishing traditional resources management practices in the area as a result of diminishing respect to beliefs and taboos coupled to lack of ownership as well as reduced role of clan leaders due to the ever expanding private sector investment activities for short term benefits. However, long term benefits raised from vegetation conservation is more important than short term ones for sustainable environment in general and combating climate change in particular where community based investment and conservation activities are very important.

5.1.16. Floristic similarity

The similarities and dissimilarities observed among these vegetation types may be attributed to the width of altitude range covered, the main theme of the study and the sampling frame followed by the respective researchers and the vegetation type compared where the studies were carried out. More similarities were observed with respect to Sheko vegetation, Bibita forest and Masha forest is due to the fact that they all found in the same vegetation type, the Moist

Evergreen Afromontane vegetation (MAF) in a very close proximity. Similarly, study conducted on vegetation of Sheko (Mirutse Giday, 2007, 2009) is also similar in its theme to the present study in that it focused on medicinal plants diversity and their distributions. Moreover, both Sheko and Sheka are adjacent localities to each other within the same vegetation type that is the Moist ever green montane forest ecosystem. On the other hand, the lowest similarities with respect to Dello Mena, Bale National Park forest and Tara Gedam forest are attributed to the fact that these studies belong to a different vegetation type. Dello Mena belongs to the woodland vegetation type where as the Bale National Park Forest and Tara Gedam forest belongs to the Dry Afromontane (DAF) type of vegetation. Hence, it is important to take account of the various factors contributing to the values of similarity indices while one is comparing floristic similarities.

5.1.17. Synthesis of the main findings: Floristic versus ethnobotanical

Since the science of ethnobotany is a multidisciplinary subject integrating concepts from different areas of science, its research output is also an important component of applications at various levels of knowledge. In the context of the present study, the whole scenario is that when one thinks floristic in vegetation studies, simultaneous thinking of the mechanisms of vegetation conservation, management as well as sustainable use is important. In doing so, complete information about each and every plant species is needed as each species is naturally useful contributing its part to nature balance. Retrieval of relevant information about the plants is where the application of ethnobotanical methods, concepts and principles needed. Hence, the science of vegetation and the science of ethnobotany are inseparable subjects. Therefore, the whole contents and contribution of this study can be synthesized under the following key points: plant species composition; complete flora information; conservation, management and sustainable use; further ethnobotanical profiling of high ranking useful plants.

1. Plant species composition: Ethnobotanical applications help to maximize the complete survey of the species composition of a given area since it integrates methods from various disciplines of science. This can be justified by the extra 97 plant species recorded in addition to the 458 plant species collected during the actual vegetation sampling method used for the current study. Hence, when looking for ethnobotanical information from certain social groups, there is a higher chance of recording more species due to their ethnobotanical importance as reported by the informants than the actual method of vegetation sampling.
2. Complete Flora information: It is useful for the conservation, management and sustainable use practices if available ethnobotanical information is incorporated into the Flora information. Therefore, when one studies the floristic composition of a given area, the chance of recording more species is higher when the researcher deliberately includes recording complete ethnobotanical information in the objectives of the study. However, amount of available resources: time, money and energy are limiting factors to do so. Hence, studies with objectives targeted to recording complete ethnobotanical information should also be an important component of vegetation science.
3. Conservation, management and sustainable use of plants: Information and knowledge integration about the study of vegetation of an area is vital for effective natural resource management. That is also where the key roles of ethnobotanical studies are targeted. Community based conservation practices, for instance, cannot be effective without

knowledge integration from both modern science and traditional practices which looked at Sheka Zone in this research. Therefore, provision of relevant ethnobotanical information is the task of the science of ethnobotany and study objectives targeted to ethnobotanical research out comes.

4. Further profiling of high ranking priority plant species: Ethnobotanical profiling of plant species not only help proper and effective utilization of species in question but also help in identification of endangered and rare species in their in-situ range. Based on such profiling, the status of target plant species can easily be known to take appropriate conservation, management and sustainable use measures. This is also very useful for the protection of locally endangered species.
5. Modern drug research and development can benefit much from the ethnobotanical research out comes if properly make use of it. It is obvious that a number of ethnobotanical researches out puts on medicinal plants are available in higher learning institutes of Ethiopia. However, there is no complete list of the number of Ethiopian medicinal plants compiled together. A piece of ethnobotanical information about medicinal plants is found here and there and some even remained on shelf where they cannot be accessible to the scientific community. Therefore, vegetation scientists, ethnobotanists and health professionals are required to work in harmony to avail such fragment of information to a wide audience by preparing standardized medicinal plant monographs for future use in drug research and development purposes. Hence, the contribution of this work is also very vital.

5.2. Conclusions

Considerable number (555 species, 341 genera and 115 families) of plant species are recorded from the three districts of Sheka Zone. The implication is that the study area is very rich in plant species diversity and floristic composition. Plant species such as *Acalypha marissima* (endemic), *Aframomum corrorima*, *Ajuga integrifolia* (medicinal), *Alastonia boonei (*medicinal*)*, *Amorphophallus gallaensis* (endemic), *Clematis longicauda* (endemic), *Combretum molle*, *Manilkara butugi* (multipurpose) and many more occurred in only few number of plots (less than 5 plots). The occurrence of the species in fewer numbers of plots is a good implication of their rarity in the study area despite the fact that these plant species are highly wanted by humans for various purposes.

Plant communities are affected by a range of environmental factors: physical: elevation, slope, aspect, grazing, disturbance and microclimates (rainfall and temperature); chemical: soil pH, soil chemistry; biological: interaction between biotic components of the environment just to mention a few. Disturbance is among the physical environmental variables having significant impact in determining plant community types. Validation of clusters for plant communities using intra-cluster or within cluster diameters and inter-cluster or between clusters distances showed that some communities are more compact than others meaning that greater similarity is observed among them. In other words, smaller distance values indicate more proximate communities while large distance values indicate less proximate (greater dissimilarities) among communities in the ordination space.

Significant p-values ranging from $p = 0.005$ to $p = 0.05$ were observed for the five environmental variables (altitude, aspect, slope, disturbance and grazing) considered to be significant in determining the plant community types. Furthermore, the Akaike Information Criterion (AIC) value is the lowest for altitude confirming that elevation is the most influential environmental variable for the current study. The values of variance inflation factor (vif) for the five environmental variables under consideration are less than 5 implying that none of the environmental variables is candidate for rejection.

All the eight plant communities identified in the study area are rich in medicinal plant species composition. They contain 46% to 72% of their species composition medicinal plant species and this figure is considerable percentage. Plant communities 6, 7 and 8 had relatively higher percentages of medicinal plant species and thus deserve priority attention for the purpose of medicinal plant conservation, management and sustainable use.

Plant species such as *Schefflera abyssinica, Pouteria adolfi-firiedericii, Ekebergia capensis, Syzygium guineense subsp. afromontanum, Ficus sur* and other 15 species have importance value indices of greater than 20 in the list. The implication is that these high ranking species in terms of their IVI values are the most important ones in the vegetation of Sheka for their greater contribution of biomass productivity to the forest. They are also priority species in the study area in terms of their ecological contribution.

Analysis of plant diversity of Sheka Zone indicates that the overall Shannon-Wiener diversity index of the study area is H’=3.41 with average equitability, J=0.56. The implication is that the vegetation of Sheka Zone is rich in plant diversity and floristic composition. A total of 351 (63%) of the plant species were collected only from the wild state and did not observed anywhere including homegardens. This indicates that the wild habitat of Sheka Zone is very rich in plant species composition. In addition to the 458 plant species recorded from the 95 plots, 97 more species were also additionally recorded during ethnobotanical data collection. It indicates that integrated use of ecological and ethnobotanical methods in vegetation studies help to record more species with complete ethnobotanical information. The implication here is that it helps to produce a complete flora with the necessary information recorded for each and every plant species of an area.

Fourteen major plant use categories were identified from Sheka Zone based on information provided by the informants. The people of the area have rich ethnobotanical knowledge of the multipurpose functions of ethnobotanical high ranking plant species. They have also detail knowledge about the traditional management practices. But random information retrieval from some informants confirmed that they better stick to short term benefits obtained from vegetation resources than the long term ones. This implies that there is certain misunderstanding about the long term benefits of forests which needs awareness creation through education and community based conservation. However, this does not mean that it applies to all people of Sheka as the majority of them know the values of forests very well.

A total of 266 (47.9% of total species collected) medicinal plants belonging to 192 genera and 74 families recorded from the three districts of Sheka Zone. The wild edible plants constituted about 85% of the medicinal plants. This figure indicates that the vegetation of Sheka is reservoir of medicinally important plant species including the wild edible ones. Most of the plant parts used as medicines are the leaves 174 (42.2), root 66 (15.6) and young shoot 32 (7.6%) and the remaining 10 plant parts accounting 34% all together. The previous three plant parts play vital role in the life cycle of the plant for continuous functioning. However, over harvesting of these parts have serious effects on the life of the plant. Moreover, the majority of medicinal plant parts 209 (60%) are prepared fresh condition. Hence, traditional healers should frequently rely on fresh plant material. In the meantime, this increases the frequency of use daily or hourly. Therefore, over harvesting can put pressure on locally rare medicinal plant species leading to ultimate extinction.

The route of administration and dosage of medicinal plant plants is usually based on haphazard applications except for few well experienced and knowledgeable traditional healers. Even well qualified healers are not perfect. The implication of such scenario is that improper use of the medicinal plants can have both short term and long term serious impacts on the health of the patient and sometimes life threatening.

There are relatively high ranking medicinal plants of higher fidelity level in Sheka Zone. They are used to treat humans (204 species), livestock (10 species) and both humans and livestock (52 species) health problems. These high ranking medicinal plants are candidates for further phytochemical profiling in drug research and development.

There is high correlation between respondents' average distance from health centers and the frequency of medicinal plant use or citations. This implies that the people of Sheka have rich knowledge of medicinal plants and they use these medicinal plants as medicines to solve their practical health problems. Sampling localities such as the Masha-Yep'o and the Gecha-Gamadro localities have greater than 80% correlation coefficients. These localities are priority areas for further ethnobotanical information retrieval for medicinal plant profiling.

Although the number of wild edible plants recorded from the three districts of Sheka is very low (only 35 wild edible plant species) compared to the total number of medicinal plants (266 medicinal plant species) recorded from the same area, 30 (85.7%) of the wild edible plants are also medicinal plants. Implication is there is some association between plant species used as medicine and plant species preferred as food supplement to sustain livelihood by the people of Sheka.

The fourteen major plant use categories recorded together with medicinal and wild edible use from the study area are based on their relative cultural importance as provided by the informants. Use value index of each species was also calculated for the entire data set using RCI values. Hence, the Shannon-Wiener use diversity index for the whole species 1 through 555 plant species 6.0. This value indicates that the use diversity of plants in the study area is high.
Priority ranking of multipurpose plant species using the relative cultural importance (RCI) methodology revealed that species such as *Arundinaria alpina*, *Manilkara butugi*, *Cordia africana*, *Hagenia abyssinica*, *Hallea rubrostipulata*, *Ozoroa pulcherima* and *Trichillia dregeana* are among high ranking species with regard to the 14 major plant use categories based on RCI scores. However, most of these plant species are found in the narrow range of occurrences in the study area. It indicates that the range of species distribution is much lower than the rate at which they are utilized for their multipurpose roles. *Ozoroa insgnisi* for instance, the chopped wood is highly marketable throughout Sheka Zone local markets due to its high quality of use as a fumigant. However, the range of distribution is restricted to only the Alamo locality of Yeki District. The implication is that there is a high chance of the species to be extinct from the locality due to over harvesting in the near future in appropriate measure is not taken.

The same is true for other locally rare species in Sheka Zone. Similarly, priority ranking using the cultural significance index (CSI) scores of multipurpose plant species in the area showed that very few high ranking species are considered for conservation, management and sustainable use. Even those under consideration for management purposes are not properly managed.

Major treats to biodiversity of Sheka Zone was identified by priority ranking of major threats to the vegetation. Priority ranking of major threats to vegetation revealed that increasing population ranked first followed by commercial agriculture and firewood collection. These three high ranking threats to vegetation are anthropogenic in nature and need immediate measures to be taken to save the vegetation of the area. There is a need for seeking options and opportunities for livelihood options that can minimize human induced pressure on vegetation resources.

5.3. Recommendations

The following recommendations are drawn from the results:

- There is an urgent need to mitigate the latent threat to vegetation through community based conservation, education, incentives and increased livelihood opportunities;
- Well managed botanic gardens should be established in Sheka for conservation, management and sustainable use of plant diversity in-situ;
- Well known traditional healers of the area should be supported by education, training and finance to have their own mini botanic gardens for medicinal plant conservation because they know the plants including their uses, conservation and management;
- Concerned NGOs who are actively working on indigenous and ecosystem based conservation activities should be encouraged;
- Clan leaders or the GEPITATOs who have acceptability in their community should be encouraged, empowered and made to feel the sense of ownership to their cultural and KOBO forests so that the tripartite conflict between nature, people and investment activities in the area will be minimized and even resolved;
- Chemical profiling of potenitially effective medicinal plants (such as *Solanecio mannii*, *Rumex abyssinicus* and *Prunus africana* all against jaundice) is needed so that it will be used as an input for the preparation of local as well as national medicinal plant monographs of the country for future use in drug research and development;
- Work on alternative livelihood strategies and biodiversity options to minimize pressure on vegetation resources for the sake of biomass energy sources and income generation activities is needed; these include:

- ✓ Livelihood options: Encourage use of non-timber forest products such as honey harvesting as means of income generation mechanism;
- ✓ Energy options: encourage expansion of renewable energy sources such as hydropower generation and solar energy harvesting through expansion of mini grids of micro power plants and photo voltaic (solar energy harvesting) for villages fulfilling their energy needs through rural electrification to avoide firewood collection and charcoal making; encouraging financing opportunities on eco-friendly and agro-ecologically compatible renewable energy exploitation options;
- ✓ Training and education: encouraging community based conservation through regular awareness creation through community education;
- ✓ Integration: Encouraging integration between traditional resource management practices and modern conservation activities;

- Implementation: proper implementation of Ethiopia's climate resilient green economy development policies.
- Morestudies in the most remote and inaccessible areas of the southwestern and other parts of Ethiopia are needed to document the available biodiversity and associated ethnobotanical knowledge to help the building of the floristic composition and ethnobotanical assets of Ethiopia.

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Appendices

Appendix 1: **Floristic and Ethnobotanical data summary**: List of species recorded from Sheka Zone (Masha, Andracha and Yeki Districts)
NB: Record includes all species from plots as well as outside of plots(homegardens, roadsides etc as being reported by their ethnobotanical importance)
Importance Indices in Ethnobotany: Use Totaled, Relative Cultural Importance (RCI) Methdology. Use records in 14 categories for species
1 through 555 with all specific uses recorded: Numerical values=A ll specific use records available, Zero values= No specific use use records available
Key: Cl= Climber, H= Herb, Li= Liana, S= Shrub, T= Tree, M= Medicinal, F= Food, D= Drink, FW= Firewood, CL= Charcoal, Cl= Climber,
CT=Construction and Tools, CM=Commercial, FD= Animal feed or fodder, BF= Bee forage, CR= Culture and rituals, OL= Ornamental, SD= Shade
OT=Others, UVs=The over all use value of species s, LF=Life fence,

SN	Species	Family	Ha	**M**	**F**	**D**	**FW**	**CL**	**SD**	**CT**	**CM**	**FD**	**BF**	**CR**	**OL**	**LF**	**OT**	**UV**	Coll.No.
1	*Acacia mearnsii* De Wild.	Fabaceae	T	0	0	0	2	0	5	6	0	0	2	0	12	0	0	27	ZK218
2	*Acacia polyacantha* Willd.	Fabaceae	T	0	0	0	5	9	0	2	0	0	8	0	0	0	0	24	ZK251
3	*Acalypha acrogyna* Pax	Euphorbiaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	ZK254
4	*Acalypha marissima* M.Gilbert	Euphorbiaceae	S	1	0	0	0	0	0	0	0	0	0	0	0	0	1	2	ZK348
5	*Acalypha psilostachya* Hochst.	Euphorbiaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	ZK154
6	*Acanthus eminens* C.B.Clarke	Acanthaceae	S	1	0	0	0	0	0	0	0	4	8	2	0	0	0	15	ZK022
7	*Achyranthes aspera* L.	Amaranthaceae	H	1	0	0	0	0	0	0	0	2	1	0	0	0	0	4	ZK040
8	*Achyrospermum parviflorum* S.Moore	Lamiaceae	H	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK101
9	*Achyrospermum schimperi* (Hochst. ex Briq.) Perkins	Lamiaceae	H	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK371
10	*Acmella caulirhiza* Del.	Asteraceae	H	6	0	0	0	0	0	0	0	1	1	0	0	0	0	8	ZK145
11	*Adiantum poiretii* Wikstr.	Adiantaceae	H	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	ZK662
12	*Aeschynomene abyssinica* (A. Rich.) Vatke	Fabaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK018
13	*Aeschynomene americana* L.	Fabaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK199
14	*Aframomum corrorima* (Braun) Jansen	Zingiberaceae	H	4	1	0	0	0	0	0	2	0	0	0	0	0	0	7	ZK196
15	*Ageratum conyzoides* L.	Asteraceae	H	3	0	0	0	0	0	0	0	0	1	0	0	0	0	4	ZK390
16	*Ajuga integrifolia* Buch.-Ham.ex D.Don	Lamiaceae	H	5	0	0	0	0	0	0	0	0	1	0	0	0	0	6	ZK048
17	*Ajuga leucantha* Lukhoba	Lamiaceae	H	5	0	0	0	0	0	0	0	0	1	0	0	0	0	6	ZK100
18	*Alangium chinense* (Lour.) Harms	Alangaceae	T	0	0	0	4	0	0	7	0	0	0	0	0	0	0	11	ZK118
19	*Albizia grandibracteata* Taub.	Fabaceae	T	2	0	0	4	2	4	9	0	0	1	0	0	0	0	22	ZK238
20	*Albizia gummifera* (J.F.Gmel) C.A.Sm.	Fabaceae	T	2	0	0	4	2	4	9	0	0	1	0	0	0	0	22	ZK182
21	*Albizia schimperiana* Oliv.	Fabaceae	T	2	0	0	4	2	4	9	0	0	1	0	0	0	0	22	ZK111
22	*Alchemilla cryptantha* A. Rich.	Rosaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK177
23	*Alchemilla fischeri* Engl.	Rosaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK069
24	*Alchemilla kiwuiensis* Engl.	Rosaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK095
25	*Alisma plantago-aquatica* L.	Alismataceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK602
26	*Allium cepa* L.	Alliaceae	H	0	2	0	0	0	0	0	2	0	0	0	0	0	0	4	ZK528
27	*Allium porum* L.	Alliaceae	H	0	2	0	0	0	0	0	2	0	0	0	0	0	0	4	ZK527
28	*Allium sativum* L.	Alliaceae	H	3	2	0	0	0	0	0	2	0	0	0	0	0	0	7	ZK526
29	*Allophylus abyssinicus* (Hochst.) Radlk.	Sapindaceae	T	2	0	0	3	0	0	8	0	0	0	0	0	0	0	13	ZK315
30	Allophylus macrobotrys Gilg	Sapindaceae	T	0	0	0	3	0	0	8	0	0	0	0	0	0	0	11	ZK221
31	*Aloe kefaensis* Gilbert & Sebsebe	Aloaceae	H	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK460
32	*Alstonia boonei* De Wild.	Apocyanaceae	T	1	0	0	3	0	2	7	0	0	0	0	0	0	0	13	ZK236
33	*Amaranthus caudatus* L.	Amaranthaceae	H	2	1	0	0	0	0	0	0	0	1	0	2	0	0	6	ZK164

Appendix 1. Continoued…

34	*Amaranthus dubius* Thell.	Amaranthaceae	H	3	0	0	0	0	0	0	0	0	1	0	0	0	0	4	ZK427
35	*Amaranthus graecizans* L.	Amaranthaceae	H	3	0	0	0	0	0	0	0	0	1	0	0	0	0	4	ZK603
36	*Amaranthus hybridus* L.	Amaranthaceae	H	3	0	0	0	0	0	0	0	0	1	0	0	0	0	4	ZK255
37	*Amaranthus viridis* L.	Amaranthaceae	H	3	0	0	0	0	0	0	0	0	1	0	0	0	0	4	ZK468
38	*Amorphophallus gallaensis* (Engl.) N.Br.	Araceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK551
39	*Amphicarpa africana* (Hook.f.) Harms	Fabaceae	Cl	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK612
40	*Ananas comosus* (L.) Merr.	Bromeliaceae	H	1	1	1	0	0	0	0	2	0	0	0	0	0	0	5	ZK520
41	*Anethum graveolens* L.	Apiaceae	H	1	2	0	0	0	0	0	0	0	1	0	0	0	0	4	ZK411
42	*Annona senegalensis* Pers.	Annonaceae	T	0	1	0	0	0	0	0	1	0	0	0	0	0	0	2	ZK519
43	*Antiaris toxicaria* Lesch.	Moraceae	T	0	0	0	3	0	3	11	0	0	1	2	0	0	0	20	ZK237
44	*Apodytes dimidiata* E.Mey. ex Arn.	Icacianaceae	T	0	0	0	5	3	3	10	0	0	1	0	0	0	0	22	ZK086
45	*Arisaema schimperanum* Schott	Araceae	H	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK039
46	*Artemisia absenthium L.*	Asteraceae	H	1	1	0	0	0	0	0	1	0	0	0	0	0	0	3	ZK393
47	*Artemisia abyssinica* Sch. Bip. ex A. Rich.	Asteraceae	H	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8	ZK413
48	*Artemisia afra* Jacq. ex Willd.	Asteraceae	H	6	1	0	0	0	0	0	1	0	0	0	0	0	0	8	ZK409
49	*Artemisia annua* L.	Asteraceae	H	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4	ZK459
50	*Artemisia schimperi* Sch. Bip.ex Engl.	Asteraceae	H	4	1	0	0	0	0	0	1	0	0	0	0	0	0	6	ZK418
51	*Arthropteris monocarpa* (Cordem.) C.Chr.	Oleandraceae	H	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK400
52	*Artrocarpus heterophyllus* Lam.	Moraceae	T	0	1	0	0	0	2	0	0	0	0	0	0	0	0	3	ZK531
53	*Arundinaria alpina* K. Schum.	Poaceae	T	2	2	0	0	0	0	8	3	1	0	5	11	1	0	33	ZK037
54	*Arundo donax* L.	Poaceae	H	0	0	0	0	0	0	5	3	0	0	4	0	0	0	12	ZK554
55	*Asparagus africanus* Lam.	Asparagaceae	S	8	0	0	0	0	0	0	0	0	0	0	1	0	0	9	ZK047
56	*Asparagus racemosus* Willd.	Asparagaceae	S	8	0	0	0	0	0	0	0	0	0	0	1	0	0	9	ZK082
57	*Asparagus setaceus* (Kunth) Jessop	Asparagaceae	S	8	0	0	0	0	0	0	0	0	0	0	1	0	0	9	ZK031
58	*Aspilia africana* (Pers.) C.D. Adams	Asteraceae	H	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	ZK204
59	*Aspilia mossambicensis* (Oliv.) Wild.	Asteraceae	S	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	ZK303
60	*Azadirachta indica* A.Juss.	Meliaceae	T	0	0	0	0	0	2	0	0	0	1	0	2	1	0	6	ZK518
61	*Baphia abyssinica* Brummmitt	Fabaceae	T	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	ZK569
62	*Barleria ventricosa* Hochst. ex Nees	Acanthaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK341
63	*Basella alba* L.	Basellaceae	Cl	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4	ZK268
64	*Bersama abyssinica* Fresen.	Melianthaceae	T	1	0	0	0	0	0	4	0	0	0	0	0	0	0	5	ZK092
65	*Bidens biternata* (Lour.) Merr. & Sherff.	Asteraceae	H	0	0	0	0	0	0	0	0	2	1	0	0	0	0	3	ZK547
66	*Bidens ghedoensis* Mesfin	Asteraceae	H	1	0	0	0	0	0	0	0	2	1	0	0	0	0	4	ZK548
67	Bidens pilosa L.	Asteraceae	H	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK543
68	*Bidens prestinaria* (Sch. Bip.) Cufod.	Asteraceae	H	0	0	0	0	0	0	0	0	2	1	0	0	0	0	3	ZK604
69	*Borassus aethiopum Mart.*	Arecaceae	T	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	ZK491
70	*Bothriocline schimperi* Oliv. & Hiern ex Benth.	Asteraceae	S	5	0	0	0	0	0	0	0	0	1	0	0	0	0	6	ZK128
71	*Brachycorythis* pubescens Harv.	Orchidaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK227
72	*Brassica carinata* A.Br.	Brassicaceae	H	2	2	0	0	0	0	0	2	0	1	0	0	0	0	7	ZK588
73	*Brassica nigra* (L.) Koch	Brassicaceae	H	0	2	0	0	0	0	0	2	0	1	0	0	0	0	5	ZK589
74	*Brassica oleracea* L.	Brassicaceae	H	0	1	0	0	0	0	0	1	0	1	0	0	0	0	3	ZK670

Appendix 1. Continoued…

75	*Bridelia micrantha* (Hochst.) Baill.	Euphorbiaceae	T	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK406
76	*Brucea antidysenetrica* J.F.Mill.	Simaroubaceae	T	7	0	0	0	0	0	0	0	0	0	0	0	0	0	7	ZK017
77	*Brugmansia suaveollens* (Humb. & Bonpl. ex Willd.) Bercht. & Presl	Solanaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	ZK291
78	*Buddleja polystachya* Fresen.	Loganiaceae	T	0	0	0	3	0	0	4	0	0	1	0	0	1	0	9	ZK130
79	*Caesalpinia decapetala* (Roth) Alston	Fabaceae	Cl	1	0	0	0	0	0	0	0	0	1	0	0	1	0	3	ZK198
80	*Calistemone citrinus* (Curtis) Skeels	Myrtaceae	T	0	0	0	0	0	1	0	0	0	1	0	2	0	0	4	ZK591
81	*Calpurnia aurea* (Ait.) Benth.	Fabaceae	S	0	0	0	2	0	0	5	0	0	1	0	0	0	0	8	ZK672
82	*Canaria abyssinica* Engl.	Campanulaceae	Cl	1	0	0	0	0	0	0	0	0	0	0	1	0	0	2	ZK492
83	*Canna indica* L.	Cannaceae	H	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	ZK616
84	*Canthium oligocarpum* Hiern	Rubiaceae	T	0	0	0	2	0	0	6	0	0	0	0	0	0	0	8	ZK026
85	*Capparis erythrocarpos* Isert	Capparidaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	ZK530
86	*Capparis tomentosa* Lam.	Capparidaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	ZK572
87	*Capsicum annuum* L.	Solanaceae	H	4	2	0	0	0	0	0	2	0	1	0	0	0	0	9	ZK577
88	*Capsicum frutescens* L.	Solanaceae	H	3	2	0	0	0	0	0	2	0	1	0	0	0	0	8	ZK582
89	*Cardiospermum halicacabum* L.	Sapindaceae	Cl	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	ZK429
90	*Carduus leptacanthus* Fresen.	Asteraceae	H	2	0	0	0	0	0	0	0	1	1	0	0	0	0	4	ZK317
91	*Carex johnstonii* Böck.	Cyperaceae	H	0	0	0	0	0	0	0	3	2	0	3	0	0	0	8	ZK669
92	*Carex thomasii* Nelms	Cyperaceae	H	0	0	0	0	0	0	0	3	2	0	3	0	0	0	8	ZK668
93	*Carica papaya* L.	Caricaceae	T	0	1	1	0	0	0	0	2	0	1	0	0	0	0	5	ZK516
94	*Casimiroa edulis* La Llave	Rutaceae	T	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK667
95	*Cassipourea malosana* (Baker) Alston	Rhizophoraceae	T	0	0	0	0	0	0	7	0	0	0	0	0	0	0	7	ZK275
96	*Casuarina cunninghamiana* Miq.	Casuarinaceae	T	0	0	0	0	0	0	7	0	0	0	0	0	0	0	7	ZK571
97	*Catha edulis* (Vahl) Forssk. Ex Endl.	Celstraceae	T	0	1	2	0	0	0	0	2	0	0	0	0	0	0	5	ZK576
98	*Caylusea abyssinica* (Fresen.) Fisch. & Mey.	Resedaceae	H	1	1	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK043
99	*Ceiba pentandra* (L.) Gaertn.	Bombacaceae	T	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	ZK241
100	*Celosia schweinfurthiana* Schinz	Amaranthaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK420
101	*Celtis africana* Burm.f.	Ulmaceae	T	1	0	0	3	0	3	5	0	0	0	0	0	0	0	12	ZK265
102	*Celtis toka* (Forssk.) Happer & Wood	Ulmaceae	S	0	0	0	0	0	0	4	0	0	0	0	0	0	0	4	ZK234
103	*Celtis zenkeri* Engl.	Ulmaceae	S	0	0	0	0	0	0	4	0	0	0	0	0	0	0	4	ZK123
104	*Centella asiatica* (L.) Urban	Apiaceae	H	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK096
105	*Chamaecrista nigricans* (Vahl)Greene	Fabaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK176
106	*Cheilanthes bergiana* Schltdl.	Sinopteridaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK003
107	*Chenopodium opulifolium* Schrader ex Koch & Ziz.	Chenopodaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK375
108	*Chionanthus mildbraedii* (Gilg & Schellenb.) Stearn	Oleaceae	T	1	0	0	0	0	0	6	0	0	0	0	0	0	0	7	ZK183
109	*Chlorophytum macrophyllum* (A. Rich.) Asch.	Anthericaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	ZK666
110	*Cirsium dender* Friis	Asteraceae	H	4	0	0	0	0	0	0	0	0	1	0	0	0	0	5	ZK004
111	*Citrus aurantifolia* (Christm.) Swingle	Rutaceae	T	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK523
112	*Citrus limon* (L.) Burm.f.	Rutaceae	T	2	1	0	0	0	0	0	1	0	1	0	0	0	0	5	ZK522
113	*Citrus medica* L.	Rutaceae	S	0	1	0	0	0	0	0	2	0	1	0	0	0	0	4	ZK208
114	*Citrus simensis* (L.) Osb.	Rutaceae	T	0	1	1	0	0	0	0	2	0	1	0	0	0	0	5	ZK521
115	*Clausena anisata* (Willd.) Benth.	Rutaceae	T	5	1	0	0	0	0	4	0	0	1	3	0	0	0	14	ZK158

Appendix 1. Continoued…

116	*Clematis hirsuta* Perr. & Guill	Ranunculaceae	Cl	3	0	0	0	0	0	2	0	0	0	0	0	0	0	5	ZK367
117	*Clematis longicauda* Steud ex A. Rich.	Ranunculaceae	Cl	3	0	0	0	0	0	2	0	0	0	0	0	0	0	5	ZK049
118	*Clematis simensis* Fresen.	Ranunculaceae	Cl	3	0	0	0	0	0	2	0	0	0	0	0	0	0	5	ZK665
119	*Clerodendrum myricoides* (Hochst.) Vatke	Lamiaceae	S	3	0	0	0	0	0	3	0	0	1	3	0	0	0	10	ZK454
120	*Clerodendrum umbellatum* Poir.	Lamiaceae	S	3	0	0	0	0	0	3	0	0	1	0	0	0	0	7	ZK057
121	*Coccinia abyssinica* (Lam.) Cogn.	Cucurbitaceae	H	0	1	0	0	0	0	0	1	0	0	0	0	0	0	2	ZK496
122	*Coccinia grandis* (L.) Voigt	Cucurbitaceae	Cl	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	ZK537
123	*Coffea arabica* L.	Rubiaceae	S	5	2	3	3	0	0	3	3	0	1	0	0	0	0	20	ZK415
124	*Colocasia esculenta* (L.) Schott	Araceae	H	1	1	0	0	0	0	0	2	0	0	0	1	0	0	5	ZK151
125	*Combretum molle* R.Br. ex G.Don	Combretaceae	T	0	0	0	4	4	2	4	0	0	1	0	0	0	0	15	ZK252
126	*Combretum paniculatum* Vent.	Combretaceae	T	1	0	0	2	0	0	4	0	0	1	0	0	0	0	8	ZK108
127	*Commelina benghalensis* L.	Commelinaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK664
128	*Commelina diffusa* Burm.f.	Commelinaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK557
129	*Conyza pyrrhopappa* Sch. Bip. ex A. Rich.	Asteraceae	H	4	0	0	0	0	0	0	0	0	1	0	0	0	0	5	ZK284
130	*Conyza sumatrensis* (Retz.) E.H.Walker	Asteraceae	H	3	0	0	0	0	0	0	0	0	1	0	0	0	0	4	ZK175
131	*Cordia africana* Lam.	Boraginaceae	T	1	1	0	4	4	5	13	0	0	1	0	0	0	0	29	ZK274
132	*Coriandrum sativum* L.	Apiaceae	H	1	1	0	0	0	0	0	2	0	0	0	0	0	0	4	ZK395
133	*Crassocephallum crepidioides* (Benth.) S.Moore	Asteraceae	H	1	2	0	0	0	0	0	0	2	1	0	0	0	0	6	ZK165
134	*Crassocephallum rubens* (Juss. ex Jacq.) S. Moore	Asteraceae	H	1	2	0	0	0	0	0	0	2	1	0	0	0	0	6	ZK007
135	*Craterispermum schweinfurthii* Hiern	Rubiaceae	T	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK267
136	*Crinum ornatum* (Ait.) Bury	Amaryllidaceae	H	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	ZK615
137	*Crotalaria gillettii* Polhill	Fabaceae	Cl	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK352
138	*Crotalaria hyssopifolia* Klotzsch	Fabaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK353
139	*Crotalaria incana L. subsp.purpurascens* (Lam.) Milne-Redh.	Fabaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK320
140	*Crotalaria laburnifolia* L	Fabaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK019
141	*Crotalaria quartiniana* A. Rich.	Fabaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK170
142	*Crotalaria rosenii* (Pax) Milne-Redh. ex Polhill	Fabaceae	S	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK385
143	*Croton macrostachyus* Del.	Euphorbiaceae	T	20	0	0	3	2	4	11	0	0	1	0	0	0	0	41	ZK494
144	*Cryptotaenia africana* (Hook.f.) Drude	Apiaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	ZK167
145	*Cucumis dipsaceus* Ehrenb. ex Spach	Cucurbitaceae	Cl	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	ZK482
146	*Cucumis ficifolius* A. Rich.	Cucurbitaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK590
147	*Cucurbita pepo* L.	Cucurbitaceae	H	2	3	0	0	0	0	0	2	0	1	0	0	0	0	8	ZK524
148	*Cupressus lusitanica* Mill.	Cupressaceae	T	0	0	0	3	0	4	6	0	0	0	0	0	1	0	14	ZK421
149	*Curcuma domestica* Valeton	Zingiberaceae	H	1	1	0	0	0	0	0	3	0	0	0	0	0	0	5	ZK472
150	*Cussonia holstii Harms* ex Engl.	Araliaceae	T	0	0	0	3	0	0	3	0	0	0	0	0	0	0	6	ZK044
151	*Cyanotis barbata* D. Don	Commelinaceae	T	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK558
152	*Cyathea manniana* Hook.	Cyatheaceae	H	1	0	0	3	2	0	10	0	0	0	0	0	0	0	16	ZK002
153	*Cyathula cylindrica* Moq.	Amaranthaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK006
154	*Cyathula polycephala* Bak.	Amaranthaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK020
155	*Cyathula uncinulata* (Schrad.) Schinz	Amaranthaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK370
156	*Cymbopogon saesius* (Hook. & Arn.) Stapf	Poaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK392

Appendix 1. Continoued…

157	*Cynodon aethiopicus* Clayton & Harlan	Poaceae	H	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	ZK662
158	*Cynodon dactylon* (L.) Pers.	Poaceae	H	1	0	0	0	0	0	0	0	2	0	0	0	0	0	3	ZK513
159	*Cynoglossum amplifolium* Hochst. ex A.DC. inDC.	Boraginaceae	H	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4	ZK285
160	*Cynoglossum coeruleum* Hochst. ex A.DC. inDC.	Boraginaceae	H	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6	ZK397
161	*Cynoglossum lanceolatum* Forssk.	Boraginaceae	H	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4	ZK451
162	*Cyperus dereilema* Steud.	Cyperaceae	H	0	0	0	0	0	0	0	2	2	0	2	0	0	0	6	ZK661
163	*Cyperus dichroöstachyus* A. Rich.	Cyperaceae	H	0	0	0	0	0	0	0	2	2	0	2	0	0	0	6	ZK081
164	*Cyperus latifolius* Pior.	Cyperaceae	H	0	0	0	0	0	0	0	2	2	0	2	0	0	0	6	ZK141
165	*Cyperus sesquiflorus* (Torr.) Mattf. & Kük.	Cyperaceae	H	0	0	0	0	0	0	0	2	2	0	2	0	0	0	6	ZK191
166	*Cyphomandra betacea* (Cav.) Sendtner	Solanaceae	T	0	1	0	0	0	0	0	0	0	1	0	1	0	0	3	ZK441
167	*Cyphostema adenocaule* (Steud. ex A. Rich.) Desc. ex Wild & Drumr	Vitaceae	Cl	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK544
168	*Cyphostema dembianense* (Chiov.) Vollesen	Vitaceae	Cl	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK307
169	*Dalbergia lactea* Vatke	Fabaceae	T	0	0	0	2	0	0	3	0	0	1	0	0	0	0	6	ZK210
170	*Datura stramonium* L.	Solanaceae	H	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK480
171	*Daucus carota* L.	Apiaceae	H	0	1	0	0	0	0	0	2	0	0	0	0	0	0	3	ZK614
172	*Deinbollia kilimandscharica* Taub.	Sapindaceae	T	1	0	0	2	0	0	4	0	0	1	0	0	0	0	8	ZK220
173	*Delonix regia (* Boj. ex Hook.) Raf.	Fabaceae	T	0	0	0	4	0	5	4	0	0	1	0	3	1	0	18	ZK540
174	*Desmodium salicifolium* (Pior.) DC.	Fabaceae	Cl	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK378
175	*Dichrostachyus cinerea* (L.) Wight & Arn.	Fabaceae	T	0	0	0	5	0	0	0	0	0	0	0	0	0	0	5	ZK202
176	*Dicranopteris linearis* (Burn.f.) Underw.	Gleicheniaceae	H	2	0	0	0	0	0	0	0	0	0	0	3	0	0	5	ZK660
177	*Dicrocephala integrifolia* (L.f.) Kuntze	Asteraceae	H	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK116
178	*Dioscorea alata* L.	Dioscoraceae	H	1	1	0	0	0	0	0	3	0	0	0	0	0	0	5	ZK554
179	*Diospyros abyssinica* (Hiern) F.White	Ebenaceae	T	0	0	0	4	2	3	5	0	0	1	0	0	0	0	15	ZK184
180	*Diospyros mespiliformis* Hochst. ex A.DC.	Ebenaceae	T	0	0	0	4	2	3	5	0	0	1	0	0	0	0	15	ZK659
181	*Discopodium penninervium* Hochst.	Solanaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK287
182	*Dombeya aethiopica* Gilli	Sterculiaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK592
183	*Dombeya torrida* (J.F. Gmel.) P. Bamps	Sterculiaceae	T	5	0	0	3	0	4	4	0	0	1	0	0	0	0	17	ZK028
184	*Dorstenia soerensenii* Friis	Moraceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK062
185	*Dovyalis caffra* (Hook.f. & Harv.) Hook.f.	Flacourtiaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	ZK647
186	*Dracaena afromontana* Mildbr.	Dracaenaceae	S	1	0	0	0	0	0	3	0	0	1	0	2	1	0	8	ZK053
187	*Dracaena fragrans* (L.) Ker Gawl.	Dracaenaceae	S	0	0	0	0	0	0	2	0	0	1	0	2	1	0	6	ZK228
188	*Dracaena steudneri* Engler	Dracaenaceae	T	1	0	0	2	0	0	4	0	0	1	0	2	1	0	11	ZK298
189	*Echinops kebericho* Mesfin	Asteraceae	H	11	0	0	0	0	0	0	4	0	1	0	0	0	0	16	ZK529
190	*Ehretia cymosa* Thonn.	Boraginaceae	T	1	0	0	2	2	0	5	0	0	1	0	0	0	0	11	ZK117
191	*Ekebergia capensis* Sparrm.	Meliaceae	T	3	0	0	5	5	5	15	0	0	1	0	0	0	0	34	ZK024
192	*Elaeodendron buchananii* (Loes.) Loes.	Celstraceae	T	0	0	0	5	4	5	14	0	0	1	0	0	0	0	29	ZK122
193	*Elatostema monticolum* Hook.f.	Urticaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK163
194	*Eleusine floccifolia* (Forssk.) Spreng.	Poaceae	H	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	ZK646
195	*Embelia schimperi* Vatke	Myrsinaceae	Li	3	2	0	0	0	0	0	0	0	0	0	0	0	0	5	ZK046
196	*Ensete ventricosum* (Welw.) Cheesman	Musaceae	H	4	2	0	0	0	0	0	3	3	0	10	0	0	0	22	ZK477
197	*Eragrostis botryodes* W.D. Clayton	Poaceae	H	1	0	0	0	0	0	0	0	2	0	0	0	0	0	3	ZK402

Appendix 1. Continoued…

198 *Eragrostis tef* (Zucc.) Trotter	Poaceae	H	1	1	0	0	0	0	0	2	2	0	0	0	0	0	6	ZK658
199 *Eriosema jurionianum* Staner & De Craene	Fabaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK657
200 *Eriosema robustum* Bak.	Fabaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK656
201 *Eriosema scioanum* Avetta	Fabaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK655
202 *Erythrina abyssinica* Lam. ex DC.	Fabaceae	T	8	0	0	0	0	0	4	0	0	1	0	2	1	0	16	ZK474
203 *Erythrina brucei* Schweinf.	Fabaceae	T	5	0	0	3	0	4	6	0	0	1	0	0	1	0	20	ZK087
204 *Erythroccoca abyssinica* Pax	Euphorbiaceae	S	1	0	0	0	0	0	3	0	0	0	0	0	0	0	4	ZK463
205 *Erythroccoca trichogyne* (Muell Arg.) Prain	Euphorbiaceae	T	0	0	0	3	0	0	3	0	0	1	0	0	0	0	7	ZK186
206 *Ethulia gracilis* Del.	Asteraceae	H	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK126
207 *Eucalyptus globulus* Labill.	Myrtaceae	T	2	0	0	6	3	2	9	0	0	1	0	0	1	0	24	ZK498
208 *Eucalyptus tereticorns* Smith	Myrtaceae	T	0	0	0	6	2	0	8	0	0	0	0	0	1	0	17	ZK499
209 *Euphorbia ampliphylla* Pax	Euphorbiaceae	T	7	0	0	2	0	0	7	0	0	0	0	0	1	0	17	ZK501
210 *Euphorbia dumalis* S.Carter	Euphorbiaceae	H	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK094
211 *Euphorbia pulcherrima* Klotzsch.	Euphorbiaceae	S	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	ZK484
212 *Euphorbia tirucalli* L.	Euphorbiaceae	T	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2	ZK534
213 *Ficus asperifolia* Miq.	Moraceae	Cl	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK345
214 *Ficus dicranostyla* Midbr.	Moraceae	T	0	0	0	4	0	3	7	0	0	0	0	0	0	0	14	ZK618
215 *Ficus exaspertata* Vahl	Moraceae	T	0	0	0	4	0	3	7	0	0	0	0	0	0	0	14	ZK259
216 *Ficus glumosa* Del.	Moraceae	T	0	0	0	4	0	3	7	0	0	0	0	0	0	0	14	ZK260
217 *Ficus mucuso* Ficalho	Moraceae	T	0	0	0	4	0	3	7	0	0	0	0	0	0	0	14	ZK239
218 *Ficus ovata* Vahl	Moraceae	T	0	0	0	4	0	3	7	0	0	0	0	2	1	0	17	ZK595
219 *Ficus sur* Forssk.	Moraceae	T	7	1	0	4	0	3	7	0	0	0	0	0	0	0	22	ZK136
220 *Ficus sycomorus L. subsp. gnaphalocarpa* (Miq.) C.C.Berg	Moraceae	T	0	0	0	4	0	3	7	0	0	0	3	0	0	0	17	ZK253
221 *Ficus sycomorus L. subsp. sycomorus F. chanas* Forssk.	Moraceae	T	0	0	0	4	0	3	7	0	0	0	3	0	0	0	17	ZK254
222 *Ficus thonningii* Blume	Moraceae	T	0	0	0	4	0	0	7	0	0	0	0	2	0	0	13	ZK231
223 *Ficus umbellata* Vahl	Moraceae	T	0	0	0	4	0	3	7	0	0	0	0	0	0	0	14	ZK230
224 *Ficus vallis-choudae* Del.	Moraceae	T	0	0	0	3	0	0	0	0	0	0	0	0	0	1	4	ZK261
225 *Ficus vasta* Forssk.	Moraceae	T	0	0	0	4	0	3	7	0	0	0	0	0	0	0	14	ZK610
226 *Foeninculum vulgare* Miller	Apiaceae	H	4	2	0	0	0	0	0	0	0	0	0	1	0	0	7	ZK217
227 *Galinierea saxifraga* (Hochst.) Bridson	Rubiaceae	S	6	1	0	3	0	0	6	0	0	1	0	0	0	0	17	ZK038
228 *Galinsoga parviflora* Cav.	Asteraceae	H	0	0	0	0	0	0	0	0	2	1	0	0	0	0	3	ZK148
229 *Galinsoga quadriradiata* Ruiz & Pavon	Asteraceae	H	0	0	0	0	0	0	0	0	2	1	0	0	0	0	3	ZK359
230 *Galium simense* Fresen.	Rubiaceae	H	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	ZK168
231 *Gardenia ternifolia* Schumach. & Thonn.	Rubiaceae	T	0	0	0	3	0	0	5	0	0	0	0	0	0	0	8	ZK561
232 *Geranium arabicum* Forssk.	Geraniaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK422
233 *Girardinia bullosa* (Steudel) Wedd.	Urticaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	2	3	ZK653
234 *Girardinia diversifolia* (Link) Friis	Urticaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK138
235 *Glycine wightii* (Wight & Arn.) Verdc.	Fabaceae	Cl	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK351
236 *Gnaphalium rubriflorum* Hilliard	Asteraceae	H	0	0	0	0	0	0	0	0	2	1	0	0	0	0	3	ZK443
237 *Gossypium barbadense* L.	Malvaceae	S	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	ZK541
238 *Gouania longispicata* Engl.	Rhamnaceae	Cl	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK140

Appendix 1. Continoued…

239	*Grevillea robusta* R.Br.	Proteaceae	T	0	0	0	4	0	4	6	0	0	0	0	0	1	0	15	ZK479
240	*Grewia trichocarpa* Hochst. ex A. Rich.	Tiliaceae	S	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK142
241	*Guizotia abyssinica* (Vis.) Chiov.	Asteraceae	H	0	1	1	0	0	0	0	2	2	1	0	0	0	0	7	ZK654
242	*Guizotia scabra* (Vis.) Chiov.	Asteraceae	H	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK347
243	*Guizotia schimperi* Sch. Bip. ex Walp.	Asteraceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK384
244	*Hagenia abyssinica* (Brace) J.F.Gmel.	Rosaceae	T	2	0	0	5	0	4	12	0	0	1	0	2	1	0	27	ZK302
245	*Hallea rubrostipulata* (K.Schum.) J.F.Leroy	Rubiaceae	T	3	1	0	5	4	4	12	0	0	1	0	0	0	0	30	ZK305
246	*Helianthes anuus* L.	Asteraceae	H	0	1	1	0	0	0	0	2	0	1	0	0	0	0	5	ZK505
247	*Helichrysum argyranthum* O.Hoffm.	Asteraceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK085
248	*Helichrysum elephantinum* Cufod.	Asteraceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK070
249	*Helichrysum foetidum* (L.) Moench.	Asteraceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK408
250	*Helichrysum horridum* (Sch.Bip.) A. Rich.	Asteraceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK084
251	*Helichrysum qurtinianum* A. Rich.	Asteraceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK132
252	*Hibiscus berberidifolius* A. Rich.	Malvaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	2	3	ZK596
253	*Hibiscus cannabinus* L.	Malvaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	2	3	ZK597
254	*Hibiscus crassinervius* Hochst. ex A. Rich.	Malvaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	2	3	ZK382
255	*Hibiscus ludwigii* Eckl.. & Zeyh.	Malvaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	2	3	ZK075
256	*Hibiscus macranthus* Hochst.ex A. Rich.	Malvaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	2	3	ZK598
257	*Hibiscus micranthus* L.f.	Malvaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	2	3	ZK600
258	*Hibiscus panduriformis* Burm.f.	Malvaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	2	3	ZK601
259	*Hibiscus rosa-sinensis* L.	Malvaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK535
260	*Hippocratea africana* (Willd.) Loes.	Celstraceae	Li	0	0	0	0	0	0	4	2	0	0	0	0	0	0	6	ZK574
261	*Hippocratea gaetzei* Loes.	Celstraceae	Li	0	0	0	0	0	0	4	2	0	0	0	0	0	0	6	ZK166
262	*Hippocratea pallens* Planch. ex Oliver	Celstraceae	Li	0	0	0	0	0	0	4	2	0	0	0	0	0	0	6	ZK575
263	*Hordeum vulgare* L	Poaceae	H	1	1	0	0	0	0	0	2	3	0	0	0	0	0	7	
264	*Huperzia dacrydioides* (Baker) Pic.Serm.	Lycopodiaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK652
265	*Huperzia verticillata* (L.f.) Trevis.	Lycopodiaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK190
266	*Hygrophila schulli* (Hamilt.) M.R. & S.M.Almeida	Acanthaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK388
267	*Hymenocardia acida* Tulasne	Euphorbiaceae	T	0	0	0	0	0	3	0	0	0	0	0	2	0	0	5	ZK553
268	*Hyparrhenia cymbaria* (L.) Stapf	Poaceae	H	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	ZK648
269	*Hyparrhenia rufa* (Nees) Stapf	Poaceae	H	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	ZK651
270	*Hypericum peplidifolium* A. Rich.	Guttiferae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK125
271	*Hypericum quartianum* A. Rich.	Guttiferae	S	0	0	0	0	0	0	0	0	0	1	3	0	0	0	4	ZK266
272	*Hypericum revolutum* Vahl	Guttiferae	S	0	0	0	0	0	0	0	0	0	1	3	0	0	0	4	ZK129
273	*Hypoestes forskaolii* (Vahl) R.Br.	Acanthaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK162
274	*Hypoestes triflora* (Forssk.) Roem & Schult.	Acanthaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK465
275	*Hypolepis sparsisora* (Schrad) Kuhn	Hypolepidaceae	H	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	ZK327
276	*Ilex mitis* (L.) Radlk.	Aquifoliaceae	T	5	0	0	6	5	4	13	0	0	1	0	0	0	0	34	ZK045
277	*Impatiens ethiopica* Grey-Wilson	Balsaminaceae	H	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	ZK209
278	*Impatiens hochstetteri* Warb.	Balsaminaceae	H	3	0	0	0	0	0	0	0	0	1	0	0	0	0	4	ZK188
279	*Impatiens rothii* Hook.f.	Balsaminaceae	H	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	ZK550

Appendix 1. Continoued…

280 *Impatiens tinctoria* A. Rich.	Balsaminaceae	H	2	0	0	0	0	0	0	1	0	0	0	0	0	0	3	ZK432
281 *Indigofera garckeana* Vatke	Fabaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK406
282 *Ipomoea aquatica* Forssk.	Convolvulaceae	H	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK649
283 *Ipomoea batatas* (L.) Lam.	Convolvulaceae	H	0	1	0	0	0	0	0	2	0	0	0	0	0	0	3	ZK433
284 *Ipomoea cairica* (L.) Sweet var indica Hall. f.	Convolvulaceae	Cl	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK536
285 *Ipomoea purpurea* (L.) Roth.	Convolvulaceae	Cl	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	ZK606
286 *Ipomoea tenuirostris* Choisy	Convolvulaceae	H	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	ZK607
287 *Iresine herbistii* Lindl.	Amaranthaceae	H	1	0	0	0	0	0	0	0	0	0	0	1	0	0	2	ZK467
288 *Isodon schimperi* (Vatke) J.K.Morton	Lamiaceae	H	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4	ZK203
289 *Isoglossa punctata* (Vahl) Brummitt & Wood	Acanthaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK059
290 *Isoglossa somalensis* Lindau	Acanthaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK363
291 *Jacaranda mimosifolia* D.Don	Bignoniaceae	T	0	0	0	4	0	4	6	0	0	0	0	1	0	0	15	ZK493
292 *Jasminum abyssinicum* Hochst. ex DC.	Oleaceae	Cl	0	0	0	0	0	0	2	0	0	0	0	1	0	0	3	ZK064
293 *Jasminum schimperi* Vatke	Oleaceae	Cl	0	0	0	0	0	0	0	0	0	1	0	1	0	1	3	ZK271
294 *Jatropha curcas* L.	Euphorbiaceae	S	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	ZK229
295 *Justicia bizuneshiae* Ensermu	Acanthaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK181
296 *Justicia ladanoides* Lam.	Acanthaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK560
297 *Justicia schimperiana* (Hochst. ex Nees) T.Anders.	Acanthaceae	S	4	0	0	0	0	0	0	0	0	1	0	0	1	0	6	ZK099
298 *Kalanchoe densiflora* Rolfe	Crassulaceae	H	5	0	0	0	0	0	0	0	0	1	0	0	0	0	6	ZK565
299 *Kalanchoe petitiana* A. Rich.	Crassulaceae	H	5	0	0	0	0	0	0	0	0	1	0	0	0	0	6	ZK564
300 *Kalanchoe quartiniana* A. Rich.	Crassulaceae	H	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5	ZK435
301 *Kalanchoe shimperiana* A. Rich.	Crassulaceae	H	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5	ZK562
302 *Kniphofia pumila* (Ait.) Kunth	Asphodelaceae	H	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK436
303 *Lactuca inermis* Forssk.	Asteraceae	H	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK173
304 *Lagenaria siceraria (*Molina) Standl.	Cucurbitaceae	H	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3	ZK525
305 *Laggera alata (*D.Don) Oliv.	Asteraceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK608
306 *Laggera crispata* (Vahl) Happer & Wood.	Asteraceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK146
307 *Laggera elatior* R.E.Fries	Asteraceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK139
308 *Laggera tomentosa* (Sch. Bip. ex A. Rich.) Olive. & Hiern	Asteraceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK453
309 *Landolfia buchanani* (Hall.f.) Stapf	Apocyanaceae	Li	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	ZK225
310 *Lantana camara* L.	Verbenaceae	S	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	ZK488
311 *Lantana trifolia* L.	Verbenaceae	S	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	ZK650
312 *Laportea aestuans* (L.) Chew	Urticaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK619
313 *Leonotis ocymifolia* (Burm.f.) Iwarsson	Lamiaceae	S	1	0	0	0	0	0	0	0	0	1	0	1	0	0	3	ZK503
314 *Lepidium sativum* L.	Brassicaceae	H	6	1	0	0	0	0	0	2	0	0	0	0	0	0	9	
315 *Lepidotrichilia volkensii* (Gürke) Leroy	Meliaceae	T	4	0	0	3	2	0	5	0	0	0	0	0	0	0	14	ZK192
316 *Leucaena leucocephala* (Lam.) De Wit	Fabaceae	T	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	ZK570
317 *Leucas jamesii* Bak.	Lamiaceae	H	3	0	0	0	0	0	0	0	0	1	0	0	0	0	4	ZK008
318 *Linum usitatissimum* L.	Linnaceae	H	3	1	1	0	0	0	0	2	2	0	0	0	0	0	9	ZK446
319 *Lippia adoensis* Hochst ex Walp. var adoensis	Verbenaceae	S	1	0	0	0	0	0	0	0	0	1	0	1	0	0	3	ZK304
320 *Lippia adoensis var koseret* Sebsebe	Verbenaceae	S	1	1	0	0	0	0	0	3	0	1	0	0	0	0	6	ZK194

Appendix 1. Continoued…

321	*Lobelia giberroa* Hemsl.	Lobeliaceae	H	11	0	0	0	0	0	0	0	0	0	2	1	0	0	14	ZK076
322	*Lolium temulentum* L.	Poaceae	H	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	ZK609
323	*Lycopersicon esculentum* Mill.	Solanaceae	H	0	1	0	0	0	0	0	1	0	0	0	0	0	0	2	ZK578
324	*Lycopodiella cernua* (L.) Pic.Serm.	Lycopodiaceae	H	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	ZK189
325	*Lycopodium clavatum* L.	Lycopodiaceae	H	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	ZK067
326	*Macaranga capensis* (Baill.) Sim	Euphorbiaceae	T	1	0	0	3	3	3	4	0	0	0	0	0	0	0	14	ZK023
327	*Maesa lanceolata* Forssk.	Myrsinaceae	T	3	0	0	3	2	0	3	0	0	0	3	0	0	0	14	ZK080
328	*Malva verticillata* L.	Malvaceae	H	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK027
329	*Mangifera indica* L.	Anacardiaceae	T	0	1	0	3	2	3	4	3	0	1	0	0	0	0	17	ZK533
330	*Manihot esculenta* Crantz.	Euphorbiaceae	H	0	1	0	0	0	0	0	0	0	0	0	2	0	0	3	ZK258
331	*Manilkara butugi* Chiov.	Sapotaceae	T	2	2	0	3	4	4	10	0	0	10	2	0	0	0	37	ZK155
332	*Marattia fraxinea* Sm.	Marratiaceae	H	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	ZK219
333	*Maytenus arbutifolia* (A. Rich.) Wilczek.	Celstraceae	T	3	0	0	2	0	0	3	0	0	0	0	0	0	0	8	ZK339
334	*Maytenus gracilipse* (Welw. ex Oliv.) Exell.	Celstraceae	S	4	0	0	0	0	0	0	0	0	1	0	0	0	0	5	ZK010
335	*Maytenus obscura* (A. Rich.) Cuf.	Celstraceae	T	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5	ZK620
336	*Maytenus sengalensis* (Lam.) Exell.	Celstraceae	T	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4	ZK235
337	*Maytenus undata* (Thumb.) Blakelock	Celstraceae	T	3	0	0	3	0	0	5	0	0	0	0	0	0	0	11	ZK295
338	*Melia azedarach* L.	Meliaceae	T	0	0	0	0	0	3	0	0	0	1	0	2	1	0	7	ZK517
339	*Melilotus suaveolens* Ledeb.	Fabaceae	H	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK206
340	*Melinis tenuissima* Stapf	Poaceae	H	0	0	0	0	0	0	0	0	2	0	0	0	0	1	3	ZK112
341	*Micractis bojeri* DC.	Asteraceae	H	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK083
342	*Microglossa pyrifolia* (Lam.) Kuntze	Asteraceae	Cl	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK462
343	*Mikaniopsis clematoides* (Sch. Bip. ex A. Rich.)	Asteraceae	Cl	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK369
344	*Milicia excelsa* (Welw.) C.C.Berg.	Moraceae	T	5	0	0	1	5	4	11	0	0	1	0	0	0	0	27	ZK243
345	*Millettia ferruginea* (Hochst.) Bak.	Fabaceae	T	6	0	0	4	4	5	10	0	0	1	0	0	0	0	30	ZK137
346	*Mimosa invisa* Mart. ex Colla	Fabaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK449
347	*Mimosa pigra* L.	Fabaceae	Cl	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	ZK105
348	*Mimulopsis solmsii* Schweinf.	Acanthaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK131
349	*Mimusops kummel* A.DC.	Sapotaceae	T	0	1	0	4	0	0	5	0	0	0	0	0	0	0	10	ZK611
350	*Momordica foetida* Schumach.	Cucurbitaceae	Cl	10	0	0	0	0	0	0	0	0	1	0	1	0	0	12	ZK153
351	*Moringa stenopetala* (Bak.f.) Cufod.	Moringaceae	T	15	1	2	0	0	2	0	3	0	0	0	2	0	0	25	ZK538
352	*Morus alba* L.	Moraceae	T	0	1	0	0	0	0	0	0	0	0	0	2	0	0	3	ZK486
353	*Morus mesozygia* Stapf	Moraceae	T	0	0	0	4	0	2	8	0	0	0	0	0	0	0	14	ZK573
354	*Mukia maderaspatana* (L.) M.J.Roem.	Cucurbitaceae	Cl	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK153
355	*Musa x paradisiaca* L.	Musaceae	H	0	1	0	0	0	0	0	3	0	0	0	0	0	0	4	ZK478
356	*Nicandra physaloides* (L.) Gaertn.	Solanaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK508
357	*Nicotiana tabacum* L.	Solanaceae	H	1	0	0	0	0	0	0	2	0	0	0	0	0	0	3	ZK489
358	*Nigella sativa* L.	Ranunculaceae	H	2	1	0	0	0	0	0	2	0	0	0	0	0	0	5	
359	*Ocimum americanum* L.	Lamiaceae	H	3	2	0	0	0	0	0	3	0	1	0	0	0	0	9	ZK394
360	*Ocimum basilicum var basilicum* L.	Lamiaceae	S	4	2	0	0	0	0	0	3	0	1	0	0	0	0	10	ZK403
361	*Ocimum lamiifolium* Hochst. ex Benth.	Lamiaceae	S	11	0	0	0	0	0	0	0	0	1	0	0	0	0	12	ZK481

Appendix 1. Continoued…

362	*Ocimum urticifolium* Roth	Lamiaceae	S	5	0	0	0	0	0	0	0	0	1	0	0	0	0	6	ZK195
363	*Ocotea kenyensis* (Chiov.) Robyns & Wilczek	Lauraceae	T	0	0	0	4	4	4	5	0	0	0	0	0	0	0	17	ZK586
364	*Oenanthe palustris* (Chiov.) Norman	Apiaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK442
365	*Olea capensis* L.	Oleaceae	T	0	0	0	3	0	0	4	0	0	0	0	0	0	0	7	ZK245
366	*Olea europaea* L. subsp.cuspidata (Wall. ex G.Don) Cif.	Oleaceae	T	1	0	0	6	0	3	8	5	0	1	0	0	0	0	24	ZK593
367	*Olea welwitschii* (Knobl.) Gilg & Schellenb.	Oleaceae	T	5	0	0	6	5	4	13	0	0	1	0	0	0	0	34	ZK107
368	*Oncinotis tenuiloba* Stapf	Apocyanaceae	Cl	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK333
369	*Oncoba routledgei* Sprague	Flacourtiaceae	S	2	0	0	0	0	0	5	0	0	1	0	0	0	0	8	ZK269
370	*Oncoba spinosa* Forssk.	Flacourtiaceae	T	0	0	0	3	0	0	5	0	0	1	0	2	0	0	11	ZK404
371	*Oplismenus hirtellus* (L.) P. Beauv.	Poaceae	H	0	0	0	0	0	0	0	0	2	0	0	0	0	1	3	ZK621
372	*Oreosyce africana* Hook.f.	Cucurbitaceae	Cl	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK379
373	*Ozoroa insignis* Del.	Anacardiaceae	T	2	0	0	6	6	3	4	4	0	1	0	0	0	0	26	ZK248
374	*Ozoroa pulcherrima* (Schweinf.) R. & A.Fern.	Anacardiaceae	T	2	0	0	6	6	3	4	4	0	1	0	0	0	0	26	ZK247
375	*Parochaetus communis* D.Don	Fabaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK461
376	*Parthenium hysterophorus* L.	Asteraceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK476
377	*Passiflora edulis* Sims	Passifloraceae	Cl	0	1	0	0	0	0	0	0	0	1	0	2	1	0	5	ZK292
378	*Pavetta gardeniifolia* A. Rich.	Rubiaceae	S	0	0	0	0	0	0	3	0	0	1	0	0	0	0	4	ZK032
379	*Pavetta oliveriana* Hiern	Rubiaceae	S	0	0	0	0	0	0	3	0	0	1	0	0	0	0	4	ZK102
380	*Pavonia urens* Cav.	Malvaceae	S	1	0	0	0	0	0	0	0	0	0	0	0	0	1	2	ZK326
381	*Pennisetum thunbergii* Kunth	Poaceae	H	2	0	0	0	0	0	0	2	1	0	0	0	0	0	5	ZK555
382	*Pentas caffensis* Chiov.	Rubiaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK035
383	*Pentas lanceolata* (Forssk.) Deflers	Rubiaceae	H	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK280
384	*Pentas schimperiana* (A. Rich.) Vatke	Rubiaceae	S	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK349
385	*Peperomia retusa* (L.f.) A.Dietr.	Piperaceae	H	7	0	0	0	0	0	0	0	0	0	0	0	0	0	7	ZK211
386	*Peponium vogelii* (Hook.f.) Engl.	Cucurbitaceae	Cl	6	6	0	0	0	0	0	0	0	0	0	0	0	0	12	ZK622
387	*Persea americana* Mill.	Lauraceae	T	1	1	1	2	2	0	3	3	0	1	0	0	0	0	14	ZK483
388	*Persicaria nepalensis* (Meisn.) Miyabe	Polygonaceae	H	3	0	0	0	0	0	0	0	0	1	0	0	0	0	4	ZK510
389	*Persicaria senegalensis* (Meisn.) Soják	Polygonaceae	H	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK511
390	*Persicaria setosula* (A. Rich.) K.L.Wilson	Polygonaceae	H	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK512
391	*Phaseolus lunatus* L.	Fabaceae	Cl	1	1	0	0	0	0	0	2	0	0	0	2	0	0	6	ZK623
392	*Phoenix dactylifera* L.	Arecaceae	T	0	1	0	0	0	0	0	0	0	0	0	3	0	0	4	ZK539
393	*Phoenix reclinata Jacq.*	Arecaceae	T	1	1	0	0	0	0	13	0	0	1	5	4	0	0	25	ZK506
394	*Phragmanthera macrosolen* (A. Rich.) M.Gilbert	Loranthaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK161
395	*Physalis lagascae* Roem. & Schult.	Solanaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK583
396	*Physalis peruviana* L.	Solanaceae	H	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK147
397	*Phytolacca dodecandra* L'Hèrit.	Phytolaccaceae	S	10	0	0	0	0	0	0	0	0	0	0	0	0	0	10	ZK016
398	*Pilea bambuseti* Engl.	Urticaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK440
399	*Pilea rivularis* Wedd.	Urticaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK193
400	*Piper capense* L.f.	Piperaceae	H	2	1	0	0	0	0	0	2	0	0	0	0	0	0	5	ZK052
401	*Piper umbellatum* L.	Piperaceae	H	2	1	0	0	0	0	0	2	0	0	0	0	0	0	5	ZK624
402	*Pisum sativum* L.	Fabaceae	H	0	1	0	0	0	0	0	2	2	1	0	0	0	0	6	ZK625

Appendix 1. Continoued…

403	*Pittosporum viridiflorum* Sims	Pittosporaceae	T	5	0	0	3	2	0	10	0	0	1	0	0	0	0	21	ZK119
404	*Plantago africana* Verdc.	Plantaginaceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK466
405	*Plantago lanceolata* L.	Plantaginaceae	H	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK626
406	*Plantago palmata Hook.f.*	Plantaginaceae	H	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK066
407	*Platycerium elephantotis* Schweinf.	Polypodiaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK627
408	*Plectranthus barbatus* Andrews	Lamiaceae	H	4	0	0	0	0	0	0	0	0	1	0	0	0	0	5	ZK310
409	*Plectranthus edulis* (Vatke) Agnew	Lamiaceae	H	0	1	0	0	0	0	0	2	0	1	0	0	0	0	4	ZK585
410	*Plectranthus laxiflorus* Benth.	Lamiaceae	H	1	0	0	0	0	0	0	0	0	1	0	1	0	0	3	ZK628
411	*Plectranthus punctatus* (L.f.) L'Hér.	Lamiaceae	H	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	ZK311
412	*Pneumatopteris unita* (Kunze) Holttum	Thelypteridaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK398
413	*Podocarpus falcatus* (Thunb.) R.B. ex. Mirb.	Podocarpaceae	T	1	0	0	5	0	3	12	0	0	0	3	2	0	0	26	ZK374
414	*Polyscias farinosa* (Del.) Harms	Araliaceae	T	0	0	0	5	0	0	9	0	0	1	0	0	0	0	15	ZK337
415	*Polyscias fulva* (Hiern) Harms	Araliaceae	T	1	0	0	5	4	4	9	0	0	1	0	0	0	0	24	ZK500
416	*Pouteria adolfi-friederici (* Engl.) Baehni	Sapotaceae	T	0	0	0	6	5	4	12	0	0	2	0	0	0	0	29	ZK296
417	*Pouteria altissima* (A.Chev.) Baehni	Sapotaceae	T	0	0	0	6	5	4	10	0	0	1	0	0	0	0	26	ZK214
418	*Prunus africana* (Hook.f.) Kalkm.	Rosaceae	T	11	0	0	5	4	3	9	0	0	1	0	0	0	0	33	ZK088
419	*Prunus persica* (L.) Batsch	Rosaceae	S	0	1	0	0	0	0	0	3	0	1	0	0	0	0	5	ZK485
420	*Prunus x domestica* L.	Rosaceae	S	0	1	0	0	0	0	0	3	0	1	0	0	0	0	5	ZK566
421	*Pseudechinolaena polystachya* (Kunth) Stapf	Poaceae	H	0	0	0	0	0	0	0	0	2	0	0	0	0	1	3	ZK629
422	*Psidium guajava* L.	Myrtaceae	T	0	1	0	0	0	0	0	3	0	1	0	0	0	0	5	ZK344
423	*Psophocarpus grandiflorus* Wilczek	Fabaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK559
424	*Psychotria orophila* Pett	Rubiaceae	T	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK054
425	*Psychotria peduncularis* (Salisb.) Steyerm.	Rubiaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK471
426	*Pteridium aquilinum* (L.) Kuhn	Polypodiaceae	H	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	ZK617
427	*Pteris dentata* Forssk.	Pteridaceae	H	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	ZK631
428	*Pteris pteridioides* (Hook.) Ballard	Pteridaceae	H	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	ZK632
429	*Pteris tripartita* Sw. in Schrad.	Pteridaceae	H	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	ZK633
430	*Punica granatum* L.	Lythraceae	S	0	0	0	0	0	0	0	0	0	1	0	2	0	0	3	ZK532
431	*Pycnostachys abyssinica* Fresen.	Lamiaceae	S	11	0	0	0	0	0	0	0	0	1	0	1	0	0	13	ZK156
432	*Pycnostachys eminii* Gürke	Lamiaceae	S	6	0	0	0	0	0	0	0	0	1	0	1	0	0	8	ZK005
433	*Pycnostachys meyeri* Gürke	Lamiaceae	S	6	0	0	0	0	0	0	0	0	1	0	1	0	0	8	ZK324
434	*Ranunculus multifidus* Forssk.	Ranunculaceae	H	7	0	0	0	0	0	0	0	0	1	0	0	0	0	8	ZK179
435	*Rhabdotosperma scrophulariifolia* (Hochst. A. Rich.)	Scrophulariaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK157
436	*Rhamnus prinoides* L'Herit.	Rhamnaceae	S	2	0	3	0	0	0	0	2	0	1	0	0	0	0	8	ZK495
437	*Ricinus communis* L.	Euphorbiaceae	H	4	0	0	0	0	0	0	1	0	0	0	0	0	0	5	ZK174
438	*Rosa x richardii* Rehd.	Rosaceae	S	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	ZK396
439	*Rosmarinus officinalis* L.	Lamiaceae	S	1	1	0	0	0	0	0	1	0	1	0	0	0	0	4	ZK216
440	*Rothmannia urcelliformis* (Hiern) Robyns	Rubiaceae	T	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK121
441	*Rubus apetalus Poir.*	Rosaceae	Cl	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK473
442	*Rubus spp*	Rosaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK455
443	*Rubus steudneri Schweinf.*	Rosaceae	Li	1	1	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK015

Appendix 1. Continoued…

444	*Rumex abyssinicus* Jacq.	Polygonaceae	H	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK313
445	*Rumex nepalensis* Spreng.	Polygonaceae	H	7	0	0	0	0	0	0	0	0	0	0	0	0	0	7	ZK089
446	*Rumex nervosus* Vahl	Polygonaceae	S	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	ZK078
447	*Ruta chalepensis* L.	Rutaceae	H	5	4	0	0	0	0	0	4	0	1	0	0	0	0	14	ZK416
448	*Rytigynia neglecta* (Hiern) Robyns	Rubiaceae	S	0	0	0	3	0	0	5	0	0	0	0	0	0	0	8	ZK124
449	*Saccharum narenga* (Nees ex Steud.) Hack.	Poaceae	H	0	1	0	0	0	0	0	2	2	0	0	0	0	0	5	ZK634
450	*Salix subserrata* Willd.	Salicaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK120
451	*Salvia leucantha* Cav.	Lamiaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK346
452	*Salvia nilotica Jacq.*	Lamiaceae	H	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK063
453	*Salvia splendens Sellow ex Roem. & Schult.*	Lamiaceae	S	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	ZK613
454	*Sapium ellipticum (Krauss) Pax*	Euphorbiaceae	T	1	0	0	3	4	3	5	0	0	1	0	0	0	0	17	ZK115
455	*Satureja paradoxa (Vatke) Engl. Ex Seybold*	Lamiaceae	H	2	0	0	0	0	0	0	0	2	1	0	0	0	0	5	ZK312
456	*Satureja simensis (Benth.) Briq.*	Lamiaceae	H	0	0	0	0	0	0	0	0	2	1	0	0	0	0	3	ZK041
457	*Scadoxus multiflorus (Martyn) Raf.*	Amaryllidaceae	H	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK093
458	*Scadoxus nutans (*Friis & I.Bjørnstad) Friis & Nordal	Amaryllidaceae	H	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK014
459	*Schefflera abyssinica* (Hochst. Ex A. Rich.) Harms	Araliaceae	T	4	0	0	6	3	4	12	0	0	1	0	0	0	0	30	ZK635
460	*Schefflera myriantha* (Bak.) Drake	Araliaceae	Li	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK290
461	*Schefflera volkensii* (Engl.) Harms	Araliaceae	T	4	1	0	6	3	3	11	0	0	1	0	0	0	0	29	ZK034
462	*Schinus molle* L.	Anacardiaceae	T	0	0	0	0	0	3	0	0	0	1	0	2	0	0	6	ZK542
463	*Schoenoplectus corymbosus* (Roem. & Schult.) Rayn.	Cyperaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK072
464	*Schoenoplectus lateriflorus* (Gmel.) Lye	Cyperaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK073
465	*Selaginella kraussiana* (Kunze) A.Braun	Selaginellaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK636
466	*Senecio hadiensis* Forssk.	Asteraceae	Li	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK637
467	*Senecio lyratus* Forssk.	Asteraceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK552
468	*Senna didymobotrya* (Fresen) Irwin & Brneby	Fabaceae	S	0	0	0	0	0	0	0	0	0	1	0	2	0	0	3	ZK475
469	*Senna obtusifolia* (L.) Irwin & Barneby	Fabaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK568
470	*Senna occidentalis* (L.) Link	Fabaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK340
471	*Senna petersiana* (Bolle) Lock	Fabaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK567
472	*Senna septemtrionalis* (Viv.) Irwin & Barneby	Fabaceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK201
473	*Sericostachys scandens* (Gilg & Lopr.	Amaranthaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK187
474	*Sesbania sesban* (L.) Merr.	Fabaceae	T	0	0	0	0	0	0	0	0	2	1	0	2	0	0	5	ZK309
475	*Setaria atrata* Hack.	Poaceae	H	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	ZK671
476	*Setaria megaphylla* (Steud.) Th. Dur. & Schinz	Poaceae	H	3	0	0	0	0	0	0	0	2	0	0	0	0	0	5	ZK114
477	*Setaria verticillata* (L.) P.Beauv.	Poaceae	H	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	ZK563
478	*Sida collina* Schlechtend.	Malvaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK386
479	*Sida rhombifolia* L.	Malvaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK381
480	*Sida schimperiana* Hochst. Ex A. Rich.	Malvaceae	S	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK270
481	*Sida tenuicarpa* Vollesen	Malvaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK272
482	*Snowdenia polystachya* (Fresen.) Pilg.	Poaceae	H	0	0	0	0	0	0	0	0	2	1	0	0	0	0	3	ZK079
483	*Solanecio gigas* (Vatke) C.Jeffrey	Asteraceae	S	3	0	0	0	0	0	0	0	0	1	0	0	0	0	4	ZK545
484	*Solanecio mannii* (Hook.f.) C.Jeffrey	Asteraceae	S	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK055

Appendix 1. Continoued…

485	*Solanum americanum* Miller	Solanaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK580
486	*Solanum anguivi* Lam.	Solanaceae	H	2	0	0	0	0	0	0	0	0	0	0	0	0	1	3	ZK581
487	*Solanum campylacanthum* Hochst. ex A. Rich.	Solanaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK299
488	*Solanum giganteum* Jacq.	Solanaceae	T	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK109
489	*Solanum incanum* L.	Solanaceae	S	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK497
490	*Solanum marginatum* L.f.	Solanaceae	S	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK144
491	*Solanum schimperianum* Hochst. ex. A. Rich.	Solanaceae	S	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	ZK001
492	*Solanum tuberosum* L.	Solanaceae	H	0	1	0	0	0	0	0	2	0	0	0	0	0	0	3	ZK579
493	*Solanum villosum* Mill.	Solanaceae	H	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK150
494	*Sonchus asper* (L.) Hill	Asteraceae	H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	ZK673
495	*Sonchus bipontini* Asch.	Asteraceae	H	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	ZK077
496	*Sorghum bicolor* (L.) Moench	Poaceae	H	0	2	0	0	0	0	0	3	2	0	0	0	0	0	7	ZK605
497	*Spathodea campanulata* P. Beauv.	Bignoniaceae	T	0	0	0	3	0	4	6	0	0	1	0	3	0	0	17	ZK487
498	*Sphaeranthus suaveolens* (Forssk.) DC.	Asteraceae	H	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK470
499	*Sporobolus africanus* (Poir.) Robyns & Tournay	Poaceae	H	1	0	0	0	0	0	0	0	2	0	0	0	0	0	3	ZK134
500	*Stellaria mannii* Hook.f.	Caryophyllaceae	H	2	0	0	0	0	0	0	0	2	0	0	0	0	0	4	ZK226
501	*Stellaria media* (L.) Vill.	Caryophyllaceae	H	7	0	0	0	0	0	0	0	2	0	0	0	0	0	9	ZK458
502	*Stellaria sennii* Chiov.	Caryophyllaceae	H	2	0	0	0	0	0	0	0	2	0	0	0	0	0	4	ZK103
503	*Stephania abyssinica* (Dillon & A. Rich.) Walp.	Menispermaceae	Cl	1	0	0	0	0	0	0	0	0	0	0	0	0	1	2	ZK515
504	*Stephania cyanatha* Welw. ex Hiern	Menispermaceae	Cl	3	0	0	0	0	0	0	0	0	0	0	1	0	0	4	ZK638
505	*Synadenium compactum* N.E.Br.	Euphorbiaceae	T	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK639
506	*Syzygium guineense subsp. afro* F.White	Myrtaceae	T	2	1	0	6	6	4	13	7	0	1	3	0	0	0	43	ZK025
507	*Syzygium guineense subsp.maro* (Engl.) F.White	Myrtaceae	T	2	1	0	6	6	4	13	7	0	1	3	0	0	0	43	ZK640
508	*Tacazzea apiculata* Oliv.	Asclepiadaceae	Cl	0	0	0	0	0	0	2	0	0	1	0	0	0	0	3	ZK058
509	*Tacazzea conferta* N.E,Br.	Asclepiadaceae	Cl	2	0	0	0	0	0	2	0	0	1	0	0	0	0	5	ZK013
510	*Tagetes minuta* L.	Asteraceae	H	1	0	0	0	0	0	0	0	0	1	0	1	0	0	3	ZK314
511	*Teclea nobilis Del.*	Rutaceae	T	1	0	0	3	2	0	3	0	0	0	0	0	0	0	9	ZK387
512	*Tephrosia linearis* (Wild.) Pers.	Fabaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK171
513	*Tephrosia pumila* (Lam.) Pers.	Fabaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK641
514	*Terminalia brownii Fresen.*	Combretaceae	T	0	0	0	3	0	3	4	0	0	1	0	0	0	0	11	ZK223
515	*Terminalia laxiflora* Engl. & Diels	Combretaceae	T	0	0	0	3	0	3	4	0	0	1	0	0	0	0	11	ZK257
516	*Terminalia schimperiana* Hochst.	Combretaceae	T	0	0	0	3	0	3	4	0	0	1	0	0	0	0	11	ZK224
517	*Thalictrum rhynchocarpum* Dill. & A. Rich.	Ranunculaceae	H	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5	ZK051
518	*Thea sinensis* L.	Theaceae	T	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3	ZK336
519	*Thymus schimperi* Ronniger	Lamiaceae	H	1	0	2	0	0	0	0	2	2	1	0	0	0	0	8	ZK444
520	*Trachyspermum ammi* (L.) Sprague ex Turrill	Apiaceae	H	2	1	0	0	0	0	0	3	0	0	0	0	0	0	6	ZK642
521	*Trema orientalis* (L.) Bl.	Ulmaceae	S	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3	ZK242
522	*Trichillia dregeana* Sond.	Meliaceae	T	1	0	0	4	4	4	7	5	0	1	0	0	0	0	26	ZK262
523	*Trichillia prieuriana* A. Juss.	Meliaceae	T	0	0	0	0	0	0	7	0	0	0	0	0	0	0	7	ZK263
524	*Trifolium baccarinii* Chiov.	Fabaceae	H	0	0	0	0	0	0	0	0	2	1	0	0	0	0	3	ZK143
525	*Trifolium burchellianum* Ser.	Fabaceae	H	0	0	0	0	0	0	0	0	2	1	0	0	0	0	3	ZK097

Appendix 1. Continoued…

526	*Trilepisium madagascarense* DC.	Moraceae	T	1	0	0	4	3	3	8	0	0	1	0	0	0	0	20	ZK185
527	*Tristemma mauritianum* J.F.Gmelin	Melastomataceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK555
528	*Triumfetta rhomboidea* Jacq.	Tiliaceae	H	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK068
529	*Tylosema fassoglensis* (Kotschy ex Schweinf.) Torre & Hillc.	Fabaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK350
530	*Typha latifolia* L.	Typhaceae	H	1	0	0	0	0	0	0	0	0	0	2	0	0	0	3	ZK504
531	*Urera hypselodendron* (A. Rich.) Wedd.	Urticaceae	Cl	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4	ZK546
532	*Urtica simensis* Steudel	Urticaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK490
533	*Vangueria madagascariensis* Gmel.	Rubiaceae	T	6	0	0	3	2	0	5	0	0	0	0	0	0	0	16	ZK098
534	*Vepris dainellii* (Pic.Serm.) Kokwaro	Rutaceae	T	2	0	0	3	2	0	4	0	0	0	0	0	0	0	11	ZK091
535	*Verbena officinalis* L.	Verbenaceae	H	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK030
536	*Vernonia adoensis* Sch. Bip.ex Walp.	Asteraceae	S	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK244
537	*Vernonia amygdalina* Del.	Asteraceae	T	5	0	0	3	0	0	5	0	3	1	0	0	0	0	17	ZK169
538	*Vernonia auriculifera* Hiern	Asteraceae	T	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK464
539	*Vernonia biafrae* Oliv. & Hiern	Asteraceae	Cl	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	ZK074
540	*Vernonia hochestetteri* Sch. Bip. ex Walp.	Asteraceae	S	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK012
541	*Vernonia hymenolepsis* A. Rich.	Asteraceae	S	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK011
542	*Vernonia karaguensis* Oliv. & Hiern	Asteraceae	S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK036
543	*Vernonia thomsoniana* Oliv. & Hiern ex Oliv.	Asteraceae	T	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK012
544	*Vernonia urticifolia* A. Rich.	Asteraceae	S	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK321
545	*Vernonia wollastoni* S.Moore	Asteraceae	Cl	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	ZK553
546	*Vicia faba* L.	Fabaceae	H	1	1	0	0	0	0	0	2	2	1	0	0	0	0	7	ZK514
547	*Viola abyssinica* Oliv.	Violaceae	H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	ZK180
548	*Vittaria guineensis* Desv.	Vittariaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK643
549	*Vittaria volkensii* Hiern.	Vittariaceae	H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK644
550	*Withania somnifera* (L.) Dunal	Solanaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK584
551	*Zantedeschia aethiopica* (L.) K.P.J.Sprengel.	Araceae	H	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	ZK152
552	*Zea mays* L.	Poaceae	H	0	2	0	0	0	0	0	2	2	1	0	0	0	0	7	ZK509
553	*Zehneria minutiflora* (Cogn.) C. Jeffrey	Cucurbitaceae	Cl	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK448
554	*Zehneria scabra* (Linn.f.) Sond.	Cucurbitaceae	Cl	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	ZK135
555	*Zingiber officinale* Roscoe	Zingiberaceae	H	3	1	1	0	0	0	0	3	0	0	0	0	0	0	8	ZK594

Summary

Total species recorded from 95 plots = 458

Total species recorded outside of plots =97

Total species recorded from zone = In plots (458)+out of plots (97) =555

Total medicinal species medicinal to humans = 204

Total medicinal species medicinal to animals=10

Total species medicinal to both humans & animals= 52

Total medicinal species = 204+10+52= 266

Appendix 2. Summary of medicinal plants and their ethnomedicinal applications

Appendix 2: **Ethnobotany**: Summary of medicinal plants collected from Sheka Zone and their ethnomedicinal applications

KEY: HBT= Habit, T=Tree, S=Srub, H=Herb, PU=Parts used, L=Leaf, R=Root, Bk=Bark, Se=Seed, Fl=Flower, Fr=Fruit, Lx=Latex, Res=Resin, St=Stem, Sht=Shoot

WP=Whole plant, UT=Used to treat, Hu=Human, An=Animals, B=Both, CP=Condition of preparation, Frs=Fresh, Dr=Dry, Lq=Liquid

RA=Route of administration, Ex=External, Dm=Dermal, O=Oral, Na=Nasal, Er=Ear, TMC=Total number of medicinal citations

LN=Local names, Sh=Shekinano, Kf=Kefinano, Or= Afan Oromo, Am=Amharic, Sk=Sheko, Mjr=Mejengir, DT=Disease Treated

Scientific Names/Family/LN	HBT	PU	UT	CP	RA	DT	Traditional/indigenous preparation and applications
M.Gilbert Euphorbiaceae	S	Sht	Hu	Frs	Orl	Tonsilitis	Young shoot of Momordica foetida and Acalypha marissima are mixed and the little finger strip size of the extract is given to children.
C.B.Clarke Acanthaceae	S	L	Hu	Frs	Ex	Insect bite (KOSHKOSHE)	Leaf of Acanthus eminens and leaf of Phytolacca dodecandra are grinded together finely rolled and roasted in fire or ho ash and then tied to the affected part of the body ususally fingers, toes and nails. Note: The insect commonly known as "KOSHKOSHE" in local language is very dangerous and poisonous. A person biten by the insect may phase the probability of losing his attacked organ if not treated immediately.
L. Amaranthaceae	H	L	Hu	Frs	Ex	Cold sores	Leaf is crushed or mashed into pieces and the liquid part is applied to the affected part of the body by gentle wiping or rubbing.
S.Moore	H	L	Hu	Frs	Orl	Stomachache	Leaf is pounded and drunk taking care of dossage.
Lamiaceae	H	L	Hu	Frs	Orl	Gastritis	Leaf extract is added to daily foodstaff and eaten whenever there is sever pain.
(Hochst. ex Briq.) Perkins	H	L	Hu	Frs	Orl	Stomachache	Leaf is pounded and drunk taking care of dossage.
Lamiaceae	H	L	Hu	Frs	Orl	Gastritis	Leaf extract is added to daily foodstaff and eaten whenever there is sever pain.
Del. Asteraceae	H	WP	B	Frs	Ex/Orl	'TINBETO Tonsilitis	Fresh leaf and flower are chwed and swallowed against "TINBETO", a serious stomachache followed by diarrhea, tonsilitis and sore troat.
						Eye disease	Fresh leaf and flower are chewed and spited into the affected eye of cattle
			Hu	Frs	Orl	Gingivitis	Fresh plant is chewed against Gingivitis. Gingivitis is inflamation of the gums.
		Fl	Hu	Frs	Orl	Stomachache	Fresh flowers are eaten alone first and water is drunk after
						Hunger	Flowers are eaten directly to stop hunger.
(Braun) Jansen Zingiberaceae	H	Se	Hu	Frs/Dr	Orl	Stomachache	The seed is chopped together with Rhizome of Zingiber officinale and other spices such as Capsicum species and condiments and eaten.
		Se	Hu	Dr	Orl	Antinausa	Soup is prepared from chopped fruit, boiled and drunk hot.
		Rh	Hu	Frs	Orl	Amoebiasis	Rhazome grinded together with leaf of Peponium vogelii, Vernonia amygdalina and rhazom of Bothriocline schimperi well coocked and eaten.
		L	Hu	Frs	Ex	Acne/ skin warts	Leaf of Setaria megaphylla, leaf of Aframomum corrorima and whole plant of Peperomia retusa are mashed together and gently rubbed on the affected skin.
L. Asteraceae	H/S	L	Hu	Frs	Ex	Headache	Fresh leaf is mashed and put in the nosetrils and the smell is nasally inheled.
Buch.-Ham.ex D.Don Lamiaceae	H	L	Hu	Frs	Ex/Orl Na	MICHATO	Leaf infusion is rubbed on the affected part of the body. It is also taken nasal drop by drop and oral with coffee cup.
						Stomachache	Leaf infusion is drunk alone with coffee cup until the pain disappears.
					Ex	BILI'CE	2-3 Drops from leaf infusion are applied to treat BILI'CE, a pusy spot on the eyelids with cutanous inflamation on the eye and its surrounding.
		Sht	Hu	Frs	Orl	Bloody diarrhea	Young leafy shoots of Lepidotichilia volkensi, Ajuga species, Erythrina brucei

Appendix 2. Continoued…

								and Allophylus abysiinicus are grinded together and prepared into soup. Then depending on age and sex of individuals: childern- one teaspoon, females and elders-1 coffee cup and young adults- 1 glass drunk with honey for 2-3 days.
			L	Hu	Frs/Dr	Orl	Stomachache	Yong shoot from the leaf together with that of Nicotiana tabacum and Rumex nepalensis root are chewed together with salt and swallowed.
			L	Hu	Frs	Orl	Stomachache	Leaf of Ajuga species, root of Rumex nepalensis, root of Nicotiana tabacum are mixed together and chewed. Ajuga species is also chewed alone with rock salt.
			L/R	Hu	Frs	Orl	Diarrhea	Leaf and root of Ajuga integrifolia is chewed with rock salt.
Lamiaceae	Lukhoba	H	L	Hu	Frs	Ex/Orl Na	MICHATO	Leaf infusion is rubbed on the affected part of the body. It is also taken nasal drop by drop and oral with coffee cup.
							Stomachache	Leaf infusion is drunk alone with coffee cup until the pain disappears.
						Ex	BILIC'E	2-3 Drops from leaf infusion are applied to treat BILI'CE, a pusy spot on the eyelids with cutanous inflamation on the eye and its surrounding.
			Sht	Hu	Frs	Orl	Bloody diarrhea	Young leafy shoots of Lepidotichilia volkensi, Ajuga species, Erythrina brucei and Allophylus abysiinicus are grinded together and prepared into soup. Then depending on age and sex of individuals: childern- one teaspoon, females and elders-1 coffee cup and young adults- 1 glass drunk with honey for 2-3 days.
			L	Hu	Frs/Dr	Orl	Stomachache	Yong shoot from the leaf together with that of Nicotiana tabacum and Rumex nepalensis root are chewed together with salt and swallowed.
			L	Hu	Frs	Orl	Stomachache	Leaf of Ajuga species, root of Rumex nepalensis, root of Nicotiana tabacum are mixed together and chewed. Ajuga species is also chewed alone with rock salt.
			L/R	Hu	Frs	Orl	Diarrhea	Leaf and root of Ajuga leucantha is chewed with rock salt.
Fabaceae	Taub.	T	Bk/l	Hu	Frs/Dr	Ex/Dm	worms infestation	when any wound on the external body of a person is severly infested with worms bark and leaves of Albizia species are grinded together and sprinkled on wound.
			Bk	Hu	Frs	Ex/Dm	Acne/head warts	Inner bark is poundedand roasted in fire or hot ash. The hair is then removed from the head/cranium to expose the skin attacked with acne. The prepared bark is then tied on the exposed head with clean clothe or plastic bag for four days. After four days, the bind is removed and the wound is again washed with water well rinsed with soap and then rubbed with fresh butter as an ointment to prevent skin crack.
Fabaceae	(J.F.Gmel) C.A.Sm.	T	Bk/l	Hu	Frs/Dr	Ex/Dm	worms infestation	when any wound on the external body of a person is severly infested with worms bark and leaves of Albizia species are grinded together and sprinkled on wound.
			Bk	Hu	Frs	Ex/Dm	Acne/head warts	Inner bark is poundedand roasted in fire or hot ash. The hair is then removed from the head/cranium to expose the skin attacked with acne. The prepared bark is then tied on the exposed head with clean clothe or plastic bag for four days. After four days, the bind is removed and the wound is again washed with water well rinsed with soap and then rubbed with fresh butter as an ointment to prevent skin crack.
Fabaceae	Oliv.	T	Bk/l	Hu	Frs/Dr	Ex/Dm	worms infestation	when any wound on the external body of a person is severly infested with worms bark and leaves of Albizia species are grinded together and sprinkled on wound.
			Bk	Hu	Frs	Ex/Dm	Acne/head warts	Inner bark is poundedand roasted in fire or hot ash. The hair is then removed from the head/cranium to expose the skin attacked with acne. The prepared bark is then tied on the exposed head with clean clothe or plastic bag for four days. After four

Appendix 2. Continoued…

							days, the bind is removed and the wound is again washed with water well rinsed with soap and then rubbed with fresh butter as an ointment to prevent skin crack.
Rosaceae	A. Rich.	H	L	Hu Frs	Orl	Gastritis	Leaf from young shoots of Alchemilla species together with leaf from young shoots of persicaria species pounded together. The jelly liquid extract from the two ingridients looks like honey and it is taken orally. Since the ingridient has no any side effects, no need of worrying about dossage.
Rosaceae	Engl.	H	L	Hu Frs	Orl	Gastritis	Leaf from young shoots of Alchemilla species together with leaf from young shoots of persicaria species pounded together. The jelly liquid extract from the two ingridients looks like honey and it is taken orally. Since the ingridient has no any side effects, no need of worrying about dossage.
Rosaceae	Engl.	H	L	Hu Frs	Orl	Gastritis	Leaf from young shoots of Alchemilla species together with leaf from young shoots of persicaria species pounded together. The jelly liquid extract from the two ingridients looks like honey and it is taken orally. Since the ingridient has no any side effects, no need of worrying about dossage.
Aliaceae	L.	H	R	Hu Frs/Dr	Orl	common cold	Root bulb is eaten row alone or together with other spices against "OTESO" "OTESO" is local name for common cold disease
			Wp	Hu Frs	Orl	any disease (C'EMO)	Variegated leaves of Coffea arabica, leaf of Ocimum basilicum, whole plant of Ruta chalepensis, whole plant of Cymbopogon saesius, whole plant of Allium sativum, fruits of Coriandrum sativum, whole plant of Foeninculum vulgare, leves of plectranthus barbatus, pounded fruits of Capsicum frutescens and pounded fruits of Capsicum annuum are well mixed together and boiled then a cup full of the hot ingridien is drunk against any health disorders. C'EMO: is a traditional drink by the Sheka ethnic group and it is prepared from a mixiture of plant materials as indicated above. In is not only serve as a medicne for any health disorders but also a food supplement in their daily ditches. It is believed that when people daily take "C'EMO"as part of their foodstaff, they become more resitant to disease and any health disorders. Antidotes: Honey or milk is used against side effects if any.
			WP	B Frs/Dr	Orl	Stomachache	Mixed together with other spices and condiments pounded together and eaten along with other foodstaff.
Sapindaceae	(Hochst.) Radlk	T	Sht	Hu Frs	Orl	Bloody diarrhea	Young leafy shoots of Lepidotichilia volkensi, Ajuga species, Erythrina brucei and Allophylus abysiinicus are grinded together and prepared into soup. Then depending on age and sex of individuals: childern- one teaspoon, females and elders-1 coffee cup and young adults- 1 glass drunk with honey for 2-3 days.
			Sht	Hu Frs	Orl	Bloody diarrhea	Young leafy shoots of Allophylus abyssinicus and Rubus steudneri are pounded together and small coffee cup size measured with finger strip of little finger is drunk
	Gilbert & Sebsebe	H	Lx	Hu Frs	Ex	wound	Liquid from the succulent plant is oozed onto the wound.
Aloaceae		H	Lx	Hu Frs	Ex	Fire burn	Liquid from the succulent plant is oozed onto the affected part of the body.
Apocyanaceae	De Wild.	T	Lx	Hu Frs	Orl	Tooth carries	Fresh latex is directly applied to the affected teeth.

Appendix 2. Continoued…

	L.	H	Fl/L	Hu	Frs/Dr	Orl	Hunger	Flower and leaf are used as famine food during time of sever hunger.
Amaranthaceae			Fl/L	An	Dr	Orl	Diarrhea	Flower is grinded into fine powder baked into bread and given to cattle as feed.
Amaranthaceae	L.	H	L	Hu	Frs	Ex/Na	Headache	Fresh leaf of Amaranthus species together with leaf of Ranunculus multifidus are mashed together and the smell is inhaled through nostrills.
			L	Hu	Frs	Orl	Hunger/Gastritis	The leafy vegetable is used as famine food during the time of emergency and extreme hunger. It is a relieve for gastrointestinal problems due to the famine.
Amaranthaceae	L.	H	L	Hu	Frs	Ex/Na	Headache	Fresh leaf of Amaranthus species together with leaf of Ranunculus multifidus are mashed together and the smell is inhaled through nostrills.
			L	Hu	Frs	Orl	Hunger/Gastritis	The leafy vegetable is used as famine food during the time of emergency and extreme hunger. It is a relieve for gastrointestinal problems due to the famine.
Amaranthaceae	L.	H	L	Hu	Frs	Ex/Na	Headache	Fresh leaf of Amaranthus species together with leaf of Ranunculus multifidus are mashed together and the smell is inhaled through nostrills.
			L	Hu	Frs	Orl	Hunger/Gastritis	The leafy vegetable is used as famine food during the time of emergency and extreme hunger. It is a relieve for gastrointestinal problems due to the famine.
Amaranthaceae	Thell.	H	L	Hu	Frs	Ex/Na	Headache	Fresh leaf of Amaranthus species together with leaf of Ranunculus multifidus are mashed together and the smell is inhaled through nostrills.
Araceae	(Engl.) N.Br.	H	R	An	Frs/Dr	Ex	wound	Root rhizome is pounded and applied to cattle wound to eliminate worms
Bromeliaceae	(L.) Merr.	H	R	Hu	Frs	Orl	Intestinal parasite	Direct eating of the fleshy undrground protects against endoparasites.
Apiaceae	L.	H	L	Hu	Frs	Orl	Stomach problems	Used as among the ingredients in the preparation of medicines such as C'EMO. that used to treat universally a number of health problems.
Araceae	Schott	H	Rh	Hu	Frs	Ex	Tumor	Fresh root is pounded and tied on the affected part of the body.
			Rh	Hu	Frs	Ex	Hemorrhoids	Fresh root is pounded and tied on the affected part of the body.
Asteraceae	L.	H	L	Hu	Frs/Dr	Ex/Orl	Stomachache	Leaves together with leaves of Artemisia species, Echnops kebericho, Lepidium sativum, Rosmerinus officinalis, Tagetes minuta, Lippia adoensis are mixed together and used as both medicine and perfume substitute by females.
Asteraceae	Sch. Bip. ex A. Rich.	H	Wp	Hu	Frs/Dr	Ex/Orl	Malaria	Leaves of A.abyssinica, A.anuwa, are mixed with seeds of Lepidiumsativum grinded together and orally takan with coffee cup against malaria.
							Typhoid fever	Smell from Artemisia abyssinica is nasally inhaled directly against typhoid.
			L	An	Frs/Dr	Na	Cow disease	Leaf infusion is administered through nosetrills.
			L	Hu	Frs/Dr	Ex/Orl	Allergy	Leaf extract is sniffed through nostrills. Smell from the plant is inhaled.
			L	Hu	Frs/Dr	Ex/Orl	Headache	Leaf extract is sniffeded through nostrills. Smell from the plant is inhaled.
			L	Hu	Frs/Dr	Ex	poison/wound	Leaf extract is droped onto the affected part of the body/warts, ulcers.
			L	Hu	Frs/Dr	Na	Typhoid fever	Pounded leaf or any part of the plant is inserted into the nostrills.
			L	An	Frs/Dr	Orl	Cattle diseases	Signs and symptoms: Shivering, deep sleep, dry nose, dry dung, lose of apetite Traditiona treatment: Root of Echnops kebericho, fruits of Capsicum species whole plant of Artemisia abyssinica, leaf of Typha latifolia, leeaf of Pycnostachys species, leaf of Ilex mitis, leaf of vernonia species, leaf of Pavonia urens are mixed together, added to fire and smoked to the animal. Again the same mixiture of the

Appendix 2. Continoued…

								plants except Pavonia urens are well pounded together and the liquid extract is given to the animal in the form of drink. This relieves the dry stomch and dung.
	Jacq. ex Willd.	H/S	L	Hu	Frs/Dr	Ex/Na	Headache	Smell from the plant is used nasal against headache and evel eye.
Asteraceae							Evel eye	Powder from the plant is smoked to the patient against evel eye.
							Stomachache	Leaf infusion is taken in small drops against stomachache
			L	Hu	Frs/Dr	Ex/Orl	Stomachache	Leaves together with leaves of Artemisia species, Echnops kebericho, Lepidium sativum, Rosmerinus officinalis, Tagetes minuta, Lippia adoensis are mixed together and used as both medicine and perfume substitute by females.
			L	Hu	Frs/Dr	Oral	renal problems	Leaf extract is consumed together with dailly diet.
							Hypertension	Leaf extract is consumed together with dailly diet.
							Cardiac problems	Leaf extract is consumed together with dailly diet.
	L.	H	Wp	Hu	Frs/Dr	Ex/Orl	Malaria	Leaves of A.abyssinica and A.anuwa, are mixed with seeds of Lepidiumsativum grinded together and orally takan with coffee cup against malaria.
Asteraceae								
			L	Hu	Frs/Dr	Oral	renal problems	Leaf extract is consumed together with dailly diet.
							Hypertension	Leaf extract is consumed together with dailly diet.
							Cardiac problems	Leaf extract is consumed together with dailly diet.
	Sch. Bip.ex Engl.	H	L	Hu	Frs/Dr	Ex/Orl	Stomachache	Leaves together with leaves of Artemisia species, Echnops kebericho, Lepidium sativum, Rosmerinus officinalis, Tagetes minuta, Lippia adoensis are mixed together and used as both medicine and perfume substitute by females.
Asteraceae								
			L	Hu	Frs/Dr	Oral	renal problems	Leaf extract is consumed together with dailly diet.
							Hypertension	Leaf extract is consumed together with dailly diet.
							Cardiac problems	Leaf extract is consumed together with dailly diet.
	(Cordem.) C.Chr.	H	L	An	Frs/Dr	Orl	Bloating	Leaf together with of Lobelia giberroa are pounded together and given to calves.
Olandreaceae			L	An	Frs/Dr	Orl	Diarrhea	Leaf together with of Lobelia giberroa are pounded together and given to calves.
	K. Schum.	S/T	R	Hu	Frs/Dr	Ex	ANGETO	Root is finley crushed and tightly tied on the affected part of the body "ANGATO" means neck disease, a type of tumour attacking the neck region. Signs and symptoms: Swelling spots in the neck region, very hardened in its early stage and progressive softenig followed by formation of leisions and redish or brownish inflammation of nearby tissues in its latter stages.
Poaceae								
			R	Hu	Frs	Ex	Unwanted pregnan	The fiberous root of Arundinaria alpina locally known as HOYEC'AMO is inserted into the female genital for about five minutes and then removed. Following this action, the fetus immediately comes out of the womb and abortion follows.
	Lam.	S	L	Hu	Frs/Dr	Ex	BILIC'E	Pounded fresh leaf or dry powder of the leaf preparation is mixed with butter and pasted on the affected part of the eyelid or the skin.
Asparagaceae								
			R	Hu	Frs/Dr	Or	Stomachache	Mixed with 12 different medicinal plant species roots: Piper species, Brucea, Pycnostachyus, Lobelia, Vernonia auriculifera, Carduus, Solanacio manni, Hibiscus species, Plantago species, Malva vericilata, and Ranunculus multifidus; prepared as soup then drunk every morning empty stomach.
			R	Hu	Frs/Dr	Orl	Common cold	Root together with root of Echnops kebericho, Solanacio gigas, Asparagus, Cirsium dender, Hallea rubrostipulata pounded together, boiled and drunk.
			L	Hu	Frs/Dr	Orl	Jaundice	Leveaves of Pittosporum virdiflorum, Dombeya torrida, Carduus leptacanthus,

Appendix 2. Continoued…

							(T'INBATO)	Maytenus gracilipse, Rubus steudneri, Cordia africana(bark), and Asparagus are pounded together with mortar and pistil, soaked in water, decanted then 3 glasses per day (morning-1, noon-1 and night-1) drunk.
			R	An	Frs/Dr	Orl	Cow disease	Root is pounded and given to cows.
			Wp	B	Frs/Dr	Ex	Skin problems	Whole plant is well pounded, soaked in water and used as a washing agent to the body of the affected human or animal. Powder from the grinded dry material of the plant is mixed with fresh butter and used as skin ointment daily on the skin of humans or animals.Note that the local/general name for common skin problems characterized by blisters & leisions is "SHAJO". It is believed that person who is attacked by "SHAJO" due to contact from spider's urine, intoxication & allergy.
			R	Hu	Frs	Orl	Malaria	Root of Ricinus communis, root of Croton macrostachyus, bark of Schefflera volkensii, root of Asparagus species are pounded together, squeezed in coffee cup and drunk three times a day. Antidote: Dry liver of sheep or any cattle is eaten right after the third dossage. Liver should be ready dry ahead of time.
			R	Hu	Frs/Dr	Orl	Back pain/spinal p	Root of Solanacio gigas, bark of Ekebergia capensis and root of Asparagus species are pounded together mixed with honey comb and eaten.
Asparagaceae	Willd.	S	L	Hu	Frs/Dr	Ex	BILIC'E	Pounded fresh leaf or dry powder of the leaf preparation is mixed with butter and pasted on the affected part of the eyelid or the skin.
			R	Hu	Frs/Dr	Orl	Common cold	Root together with root of Echnops kebericho, Solanacio gigas, Asparagus, Cirsium dender, Hallea rubrostipulata pounded together, boiled and drunk.
			L	Hu	Frs/Dr	Orl	Jaundice (T'INBATO)	Leveaves of Pittosporum virdiflorum, Dombeya torrida, Carduus leptacanthus, Maytenus gracilipse, Rubus steudneri, Cordia africana(bark), and Asparagus are pounded together with mortar and pistil, soaked in water, decanted then 3 glasses per day (morning-1, noon-1 and night-1) drunk.
			R	An	Frs/Dr	Orl	Cow disease	Root is pounded and given to cows.
			Wp	B	Frs/Dr	Ex	Skin problems	Whole plant is well pounded, soaked in water and used as a washing agent to the body of the affected human or animal. Powder from the grinded dry material of the plant is mixed with fresh butter and used as skin ointment daily on the skin of humans or animals.Note that the local/general name for common skin problems characterized by blisters & leisions is "SHAJO". It is believed that person who is attacked by "SHAJO" due to contact from spider's urine, intoxication & allergy.
			R	Hu	Frs	Orl	Malaria	Root of Ricinus communis, root of Croton macrostachyus, bark of Schefflera volkensii, root of Asparagus species are pounded together, squeezed in coffee cup and drunk three times a day. Antidote: Dry liver of sheep or any cattle is eaten right after the third dossage. Liver should be ready dry ahead of time.
			R	Hu	Frs/Dr	Orl	Back pain/spinal p	Root of Solanacio gigas, bark of Ekebergia capensis and root of Asparagus species are pounded together mixed with honey comb and eaten.
Asparagaceae	(Kunth) Jessop	S	L	Hu	Frs/Dr	Ex	BILIC'E	Pounded fresh leaf or dry powder of the leaf preparation is mixed with butter and pasted on the affected part of the eyelid or the skin.
			R	Hu	Frs/Dr	Orl	Common cold	Root together with root of Echnops kebericho, Solanacio gigas, Asparagus, Cirsium dender, Hallea rubrostipulata pounded together, boiled and drunk.

Appendix 2. Continoued…

		L	Hu	Frs/Dr	Orl	Jaundice (T'INBATO)	Leveaves of Pittosporum virdiflorum, Dombeya torrida, Carduus leptacanthus, Maytenus gracilipse, Rubus steudneri, Cordia africana(bark), and Asparagus are pounded together with mortar and pistil, soaked in water, decanted then 3 glasses per day (morning-1, noon-1 and night-1) drunk.
		R	An	Frs/Dr	Orl	Cow disease	Root is pounded and given to cows.
		Wp	B	Frs/Dr	Ex	Skin problems	Whole plant is well pounded, soaked in water and used as a washing agent to the body of the affected human or animal. Powder from the grinded dry material of the plant is mixed with fresh butter and used as skin ointment daily on the skin of humans or animals.Note that the local/general name for common skin problems characterized by blisters & leisions is "SHAJO". It is believed that person who is attacked by "SHAJO" due to contact from spider's urine, intoxication & allergy.
		R	Hu	Frs	Orl	Malaria	Root of Ricinus communis, root of Croton macrostachyus, bark of Schefflera volkensii, root of Asparagus species are pounded together, squeezed in coffee cup and drunk three times a day. Antidote: Dry liver of sheep or any cattle is eaten right after the third dossage. Liver should be ready dry ahead of time.
		R	Hu	Frs/Dr	Orl	Back pain/spinal p	Root of Solanacio gigas, bark of Ekebergia capensis and root of Asparagus species are pounded together mixed with honey comb and eaten.
L.	Cl	R	B	Frs/Dr	Ex/Orl	Tumour	Root bark is crushed and tied on the affected part of the body
Basellaceae						Heomorrage	Root bark is crushed and tied on the affected part of the body
		L		Frs/Dr		Any	Leaf is bioled together with coffee and spices then drunk for various diseases
		L	Hu	Dr	Orl	Antinausa	Soup is prepared from chopped leaf together with seeds of Trachyspermum , fresh leaves of Coffee arabica, rhizome of Zingiber boiled well and drunk hot. Traditional Use: Soup prepared in the form of the above ingridients is locally known as "C'EMO" which is also believed to be good medicine for any health disorders and associated problems including common cold. Antidotes: Milk or honey is used against side effects if any.
Fresen.	T/S	Sht	Hu	Frs	Orl	Stomachache	Fresh shoot is directly chewed.
Melianthaceae							
Mesfin Asteraceae	H	L	Hu	Frs	Ex	Ear with pus	Ypung shoot of Lobelia giberroa, Croton macrostachyus and leaf of Bidens ghedoensis are mashed together and fresh liquid is dropped into the affected ear drop by drop untill the pus disappears.
L. Asteraceae	H	L	Hu	Frs	Ex	Wound	Fresh leaf is mashed between pulms of hands and tied on the wound. Fresh leaf extract is rubbed/dropped on the exposed part of wound.
Oliv. & Hiern ex Benth Asteraceae	S	L	Hu	Frs	Orl	Diarrhea	Pounded leaf is drunk with coffee cup once. Dossage may varry based on age and sex of the patient. Frequency of administration may also varry accordingly
		L	Hu	Frs	Orl	Amoebiasis	Leaf grinded together with leaf of Peponium vogelii, Vernonia amygdalina and rhazom of Aframomum corrorima well coocked and eaten.
		L	Hu	Frs	Ex	Ear disease	Leaf of Euphorbia dumalis, young shoot of Vrnonia amygdalina and leaf of Bothriocline schipmeri are pounded together and the leaf extract is applied drop by drop into the affected ear.
		L	Hu	Frs	Ex	Wound	Leaf extract is applied to the affected part of the body usually legs and toes.

Appendix 2. Continoued…

			L	Hu	Frs	Ex	Fire burn	Lleaf infusion is rubbed as first aid for children against fire danger.
	A.Br.	H	Se	Hu	Dr	Ex/Orl	Fire burn	seed powder is rubbed onto the affected part of the body
Brassicaceae			Se	Hu	Dr	Ex/Orl	Stomachache	Seed powder is stirred in warm wated and a glass of the soup is drunk with salt.
	J.F.Mill.	S	R	Hu	Frs/Dr	Orl	Stomachache	Finely pounded, soaked in water, decanted then drunk with MEAD or TELA
Simaroubaceae			Bk				Stomachache	Finely pounded, soaked in water, decanted then drunk with MEAD or TELA
								NB: Mead or"TEJI"- in Amharic is also known as "BITABITO" in Shakinono.
			L	An		Ex	Lice	Pounded in mortar with pistil, soaked in water and used to wash the body of
			Fr	An		Ex	SHAJO	the affected animal especially calfs. "SHAJO" is skin disease for animals.
			R	Hu	Frs	Orl	Stomachache	Fresh root together with salt is chewed against stomachache.
			St	Hu	Frs	Orl	Stomachache	Fresh young shoot of Chionanthus mildbraediitogether that of Brucea antidysentrica are rolled in Ensete ventricosum fiber and chewed.
			L	Hu	Frs/Dr	Orl	Amoebiasis	Little finger strip size of pounded leaf extract is drunk for three consequative days Caution: A feeling of heavy thirst appears following medication. The patient should avoide drinking water in that case to avoide dilution of the medication. Antidotes: Meat should be eaten against the side effects.
			R	Hu	Frs/Dr	Orl	Diarrhea	Pounded root is drunk with honey. When calfs are attacked with lice followed by
			L/Fl	An	Frs/Dr	Ex	Ectoparasites	sever skin wounds with ulcers and bilisters commonly known as SHAJO, pounded
			Bk	An	Frs/Dr	Ex		plant materials (leaf, root, bark and flowers) is soaked in water and used as a washing agent to get ride of the ectoparasites.
			R	An	Frs/Dr	Orl	Bloody diarrhea	Pounded root is mixed with Ethiopian roack salt (AMOLE) and given to cattle.
Fabaceae	(Roth) Alston	S	Fr/S	Hu	Frs/Dr	Orl	Tracoma/vaccine/	Thee seeds of Caesalpinia decapetala are swallowed at a time. This also serves as a vaccine against the disease even for three years. For more prevention say ten years or more one can swallow ten seeds. Number of seeds is proportional to the years of prevention according to the local belief.
Campanulaceae	Engl.	Cl	Lx	Hu	Frs	Orl	Tonsilitis	Latex is applied to the throat drop by drop against tonsilitis.
Solanaceae	L.	H	Fr	Hu	Frs	Orl	any disease (C'EMO)	Variegated leaves of Coffea arabica, leaf of Ocimum basilicum, whole plant of Ruta chalepensis, whole plant of Cymbopogon saesius, whole plant of Allium sativum, fruits of Coriandrum sativum, whole plant of Foeninculum vulgare, leves of plectranthus barbatus, pounded fruits of Capsicum frutescens and pounded fruits of Capsicum annuum are well mixed together and boiled then a cup full of the hot ingridien is drunk against any health disorders. C'EMO: is a traditional drink by the Sheka ethnic group and it is prepared from a mixiture of plant materials as indicated above. In is not only serve as a medicne for any health disorders but also a food supplement in their dailly ditches. It is believed that when people daily take "C'EMO"as part of their foodstaff, they become more resitant to disease and any health disorders. Antidoes: Milk or honey is used against side effects if any.
			Fr	An	Frs/Dr	Orl	Cattle diseases	Signs and symptoms: Shivering, deep sleep, dry nose, dry dung, lose of apetite Traditiona treatment: Root of Echnops kebericho, fruits of Capsicum species whole plant of Artemisia abyssinica, leaf of Typha latifolia, leeaf of Pycnostachys

Appendix 2. Continoued…

							species, leaf of Ilex mitis, leaf of vernonia species, leaf of Pavonia urens are mixed together, added to fire and smoked to the animal. Again the same mixiture of the plants except Pavonia urens are well pounded together and the liquid extract is given to the animal in the form of drink. This relieves the dry stomch and dung.
		L	Hu	Frs/Dr	Orl	Paralysis (K'ORSO)	Bark of Hallea rubrostipulata, leaf of Capsicumfrutescens, and leaf of Rothmannia urcelliformis are pounded together and a glass of the mixiture is drunk with MEAD dossage does not matter and the patient can continou until he relieves. Note that in local language, K'ORSO means a type of disease paralysing the leg extremities.
		L	Hu	Frs	Ex	KOSHKOSHE	Fresh leaves of Capsicum species and Colocasia esculenta are mashed together roasted in fire or hot ash warmed and then tied on the affected part of the body. KOSHKOSE is local name for insect bite, possibly a type of coleopteran larvae (worm) with redish or redish brown color. Habitat: dust particles, soil, sessile to tree trunk. Mode of poisoning: The insect releases venomic discharge from its body in the form of sting when one suddenly come in contact with its body. Signs and symptoms: It severly attacks mostly fingers and toes by swelling, inflamation, itching, fluid filled tissues finally leading to the cutting away of the whole part of the attacked organ if not treated properly.
Solanacaea	L. H	Fr	Hu	Frs	Orl	any disease (C'EMO)	Variegated leaves of Coffea arabica, leaf of Ocimum basilicum, whole plant of Ruta chalepensis, whole plant of Cymbopogon saesius, whole plant of Allium sativum, fruits of Coriandrum sativum, whole plant of Foeninculum vulgare, leves of plectranthus barbatus, pounded fruits of Capsicum frutescens and pounded fruits of Capsicum annuum are well mixed together and boiled then a cup full of the hot ingridien is drunk against any health disorders. C'EMO: is a traditional drink by the Sheka ethnic group and it is prepared from a mixiture of plant materials as indicated above. In is not only serve as a medicne for any health disorders but also a food supplement in their dailly ditches. It is believed that when people dailly take "C'EMO"as part of their foodstaff, they become more resitant to disease and any health disorders. Antidoes: Milk or honey is used against side effects if any.
		R	An	Frs/Dr	Orl	Cattle diseases	Signs and symptoms: Shivering, deep sleep, dry nose, dry dung, lose of apetite Traditiona treatment: Root of Echnops kebericho, fruits of Capsicum species whole plant of Artemisia abyssinica, leaf of Typha latifolia, leeaf of Pycnostachys species, leaf of Ilex mitis, leaf of vernonia species, leaf of Pavonia urens are mixed together, added to fire and smoked to the animal. Again the same mixiture of the plants except Pavonia urens are well pounded together and the liquid extract is given to the animal in the form of drink. This relieves the dry stomch and dung.
		L	Hu	Frs	Ex	KOSHKOSHE	Fresh leaves of Capsicum species and Colocasia esculenta are mashed together roasted in fire or hot ash warmed and then tied on the affected part of the body. KOSHKOSE is local name for insect bite, possibly a type of coleopteran larvae (worm) with redish or redish brown color. Habitat: dust particles, soil, sessile to tree trunk. Mode of poisoning: The insect releases venomic discharge from its

Appendix 2. Continoued…

							body in the form of sting when one suddenly come in contact with its body. Signs and symptoms: It severly attacks mostly fingers and toes by swelling, inflamation, itching, fluid filled tissues finally leading to the cutting away of the whole part of the attacked organ if not treated properly.
Fresen. Asteraceae	H	Bk	Hu	Frs/Dr	Orl	Jaundice (T'INBATO)	Leveaves of Pittosporum virdiflorum, Dombeya torrida, Carduus leptacanthus, Maytenus gracilipse, Rubus steudneri, Cordia africana(bark), and Asparagus are pounded together with mortar and pistil, soaked in water, decanted then 3 glasses per day (morning-1, noon-1 and night-1) drunk. Antidote: Boiled/pasturized milk together with red teff bread and ETINO. ETINO (Sh), BULLA (Am) is a liquid sequeezed from Ensete ventricosum mixitures and it is eaten as porridge in Ethiopian traditional food.
		R	Hu	Frs	Orl	Jaundice	Pounded root extract is drunk with a glass or coffee cup for 3 consequetive days.
		L	Hu	Frs	Orl	Wound	Leaf extract is applied to the affected part of the body.
		R/L	Hu	Frs	Orl	T'INBATO	Root and leaf of Carduus leptacanthus, bark of Cordia africana, root of Phytolacca dodecandra, and bark of Galinerea saxifraga are pounded together, boiled. Based on age and sex of individuals, the mixiture is drunk measured with glass, coffee cup or finger strip size. Fresh milk is used as an antidote against severe side effect
(Fresen.) Fisch. & Mey. Resedaceae	H	L	Hu	Frs	Orl	Gastritis	Well coocked rouphage is eaten with dailly food just as cabbege. It is also wild edible plant serving as cabbege substitute during time of poverty/hunger.
Schinz	H	WP	Hu	Frs	Orl	Taeniasis	The whole plant is eaten raw/chewed and swallowed to expel the parasite
Amaranthaceae		L	Hu	Frs/Dr	Orl	Taeniasis	Leaf of Celosia schweinfurthiana together with roasted seeds of Horrdeum vulgare or dry bread of Ensete ventricosum mixed with Cupsicum species powder and salt and eaten as food to expell the whole parasitmia.
		L	Hu	Frs/Dr	Orl	Taeniasis	Fresh leaf is eaten just as cabbege to kill and expell the parasite.
Burm.f. Ulmaceae	T	WP	Hu	Frs/Dr	Ex	Typhoid fever	Smoke from any part of the plant is fumigated to the patient. The smoke is also used to sterilize the whole living room (house) inorder to eliminate the spread of the disease during typhoid fever outbreak in villages surroundigs.
(L.) Urban	H	L	Hu	Frs	Ex	Wound/warts	Fresh leaf is mashed and the liquid extract is dropped onto the affected body.
Apiaceae	H	L	Hu	Frs	Ex	Hemorrhoids	Fresh leaf is mashed and the liquid extract is dropped onto the affected body.
(Gilg & Schellenb.) Stearn Oleaceae	S/T	St	Hu	Frs	Orl	Stomachache	Fresh young shoot of Chionanthus mildbraediitogether that of Brucea antidysentrica are rolled in Ensete ventricosum fiber and chewed.
Friis Asteraceae	H	R	Hu	Frs/Dr	Orl	Common cold	Root together with root of Echnops kebericho, Solanacio gigas, Asparagus, Cirsium dender, Hallea rubrostipulata pounded together, boiled and drunk.
		L/R	Hu	Frs/Dr	Orl	Jaundice (T'INBATO)	Leveaves of Pittosporum virdiflorum, Dombeya torrida, Carduus leptacanthus, Maytenus gracilipse, Rubus steudneri, Cordia africana(bark), and Asparagus are pounded together with mortar and pistil, soaked in water, decanted then 3 glasses per day (morning-1, noon-1 and night-1) drunk.
		L	Hu	Frs	Ex	Wound	Leaf extract is applied to the affected part of the body.
		R	Hu	Frs	Ex	swelling	Fresh root together with fresh root of Cirsium ender are chewed with salt and swallowed then the swelling disappears immediately.
(L.) Burm.f.	S/T	Fr	Hu	Frs	Ex	Ring worm	Fruit extract is mixed with latex from young shoot of Croton macrostachyus and

Appendix 2. Continoued…

Rutaceae								rubbed onto the affected part of the body.
			Fr	Hu	Frs	Ex	Dandruff	Fruit extract is mixed with ripe fruit of Persea americana and used as hair cosmotic.
	(Willd.) Benth.	S	St	Hu	Frs/Dr	Ex	Tooth carries	Stem is used as toothpick to prevent tooth carries.
Myrsinaceae			Wp	B	Frs	Ex	cocroachs	Cocroach infestation at chesters chiken in the home is treated by chopping the whole plant soaking in water and sprinkling both on the chicken itself as well as all around in the home to totally eliminate the insect pests.
			L	Hu	Frs/Dr	Ex	common cold Thyphoid fever	Leaf or inner bark of Croton together with leaves of Pycnostachys abyssinica, Pycnostachys eminii, Pycnostachys meyeri, Clausena anisata and Dombeya torrida are usted as steam treatment after boiling together. The warm liquid from the boiled mixiture is also sprayed on the body of the patient.
			St	Hu	Frs/Dr	Ex	Gingivities	Stem is chewde or used as toothpick against any oropharyngeal problems.
Ranunculaceae	Perr. & Guill	Cl	L	Hu	Frs	Er	Earache	Fresh leaf together with fresh leaf of Maytenus obsecura are smashed between pulms, roled with clean cloth and put on the affected ear after releasing the liquid part out. Care must be taken not to insert the liquid drops into the inner as it may severly harm and lead to deafness. Only in the form of smell should the smash be kept on the outer ear. Nothing shoul be inserted into inside. Such treatment is especially for ear disease with pus (abscess).
			L	Hu	Frs/Dr	Orl	Amoebiasis	Leaf of Lobelia giberroa together with leaves of Clematis species grinded together. Water concoction of the mixiture is measured with finger strips of little finger and drunk with honey. Care must be taken about dossage.
			L	Hu	Frs/Dr	Ex/Na	Nose infection	Pounded leaf is mixed with fresh butter and gently rubbed on the infected nose. Nose infection is usually either sinusitis (infection that occurs when the nasal cavities become swollen and inflatted due to viral, fungal or bacterial infection) or staph infection (an infection from Staphylococcus bacteria that usually affect the skin particularlty the nose or the inside of the nose)
Ranunculaceae	Steud ex A. Rich.	Cl	L	Hu	Frs	Er	Earache	Fresh leaf together with fresh leaf of Maytenus obsecura are smashed between pulms, roled with clean cloth and put on the affected ear after releasing the liquid part out. Care must be taken not to insert the liquid drops into the inner as it may severly harm and lead to deafness. Only in the form of smell should the smash be kept on the outer ear. Nothing shoul be inserted into inside. Such treatment is especially for ear disease with pus (abscess).
			L	Hu	Frs/Dr	Orl	Amoebiasis	Leaf of Lobelia giberroa together with leaves of Clematis species grinded together. Water concoction of the mixiture is measured with finger strips of little finger and drunk with honey. Care must be taken about dossage.
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Ranunculaceae	Fresen.	Cl	L	Hu	Frs	Er	Earache	Fresh leaf together with fresh leaf of Maytenus obsecura are smashed between pulms, roled with clean cloth and put on the affected ear after releasing the

Appendix 2. Continoued…

								liquid part out. Care must be taken not to insert the liquid drops into the inner as it may severly harm and lead to deafness. Only in the form of smell should the smash be kept on the outer ear. Nothing shoul be inserted into inside. Such treatment is especially for ear disease with pus (abscess).
			L	Hu	Frs/Dr	Orl	Amoebiasis	Leaf of Lobelia giberroa together with leaves of Clematis species grinded together. Water concoction of the mixiture is measured with finger strips of little finger and drunk with honey. Care must be taken about dossage.
			L	Hu	Frs/Dr	Ex/Na	Nose infection	Pounded leaf is mixed with fresh butter and gently rubbed on the infected nose. Nose infection is usually either sinusitis (infection that occurs when the nasal cavities become swollen and inflatted due to viral, fungal or bacterial infection) or staph infection (an infection from Staphylococcus bacteria that usually affect the skin particularlty the nose or the inside of the nose)
	(Hochst.) Vatke	S	R	Hu	Frs	Orl	Rabies	Root is well pounded and and drunk with milk as antidote.
Lamiaceae			L	Hu	Frs	Ex	Ecezema/Acne	Pounded leaf extract is mixed with butter and carefully rubbed on the body.
			R/L	Hu	Frs	Orl	Typhoide	Pounded leaf and root extract is drunk with honey, MEAD or TELLA.
	Poir.	S	R	Hu	Frs	Orl	Rabies	Root is well pounded and and drunk with milk as antidote.
Lamiaceae			L	Hu	Frs	Ex	Ecezema/Acne	Pounded leaf extract is mixed with butter and carefully rubbed on the body.
			R/L	Hu	Frs	Orl	Typhoide	Pounded leaf and root extract is drunk with honey, MEAD or TELLA.
L. Rubiaceae		S	Fr	Hu	Dr	Orl	Amoebiasis	Roasted fruit or seeds are pounded and the powder is added to yogurt and drunk against amoebic dysentry.
			L	Hu	Dr	Orl	Antinausa	Soup is prepared from chopped leaf together with seeds of Trachyspermum , fresh leaves of Basella alba, rhizome of Zingiber boiled well and drunk hot. Traditional Use: Soup prepared in the form of the above ingridients is locally known as "C'EMO" which is also believed to be good medicine for any health disorders and associated problems including common cold. Antidote: Boiled/pasturized milk together with red teff bread and ETINO.
			Se	Hu	Dr	Orl	Bloody diarrhea	Roated seeds are grinded mixed with honey and four spoonful taken at a time.
			L	Hu	Frs	Orl	any disease (C'EMO)	Variegated leaves of Coffea arabica, leaf of Ocimum basilicum, whole plant of Ruta chalepensis, whole plant of Cymbopogon saesius, whole plant of Allium sativum, fruits of Coriandrum sativum, whole plant of Foeninculum vulgare, leves of plectranthus barbatus, pounded fruits of Capsicum frutescens and pounded fruits of Capsicum annuum are well mixed together and boiled then a cup full of the hot ingridien is drunk against any health disorders. C'EMO: is a traditional drink by the Sheka ethnic group and it is prepared from a mixiture of plant materials as indicated above. In is not only serve as a medicne for any health disorders but also a food supplement in their dailly ditches. It is believed that when people dailly take "C'EMO"as part of their foodstaff, they become more resitant to disease and any health disorders. Antidote: Milk or honey is used against side effects if any.
			L	Hu	Frs	Ex	Fire burn	Fresh leaf of Coffea arabica is chewed and spited on the affected body.
	(L.) Schott	H	L	Hu	Frs	Ex	KOSHKOSHE	Fresh leaves of Capsicum species and Colocasia esculenta are mashed together

Appendix 2. Continoued…

Araceae						roasted in fire or hot ash warmed and then tied on the affected part of the body. KOSHKOSE is local name for insect bite, possibly a type of coleopteran larvae (worm) with redish or redish brown color. Habitat: dust particles, soil, sessile to tree trunk. Mode of poisoning: The insect releases venomic discharge from its body in the form of sting when one suddenly come in contact with its body. Signs and symptoms: It severly attacks mostly fingers and toes by swelling, inflamation, itching, fluid filled tissues finally leading to the cutting away of the whole part of the attacked organ if not treated properly.
Vent. Combretaceae	Cl	St	Hu Frs	Ex	Eye disease	Fresh stem is cut and breathe pressure from the mouth is used to push out the liquid exudate from the plant which eventually used as an eye drop.
Sch. Bip. ex A. Rich.	H	L	Hu Frs	Ex	Headache	Fresh leaf is heated on fire and kept on the head/cranium of the patient then put in a liter of water and kept under mattress over night. Smell from the ingridient is also serve as medicine. Finally, the ingridient is discarded as waste early in the morning
		L	Hu Frs	Ex	Toothache	Fresh leaf together with fresh butter is mixed. Ceramic Kettle (Coffee boiler) is broken from the bottom (seat removed mechanically) and hot iron (axe) is pasted with mixiture form Conyza leaf and butter then put under the broken part of the kettle. The narrow bottle neck of the kettle is come in contact with the patient's mouth, steam from the paste is sucked onto the affected teath as steam tretment
		L	Hu Frs	Orl	Bloody diarrhea	Leaf of Conyza species together with leaf and root of Eragrostis botryodes and Sporobolus africanus are mashed together and little finger size of the extract is drunk with coffee cup.
		L	Hu Frs	Ex	YOGO (Night evil	Leaf is socked in water and used as a washing agent to the body of the patient. Note: YOGO locally, is to mean hypersensitivity to night goout. When a person go out side during night time, there are cuases when he/she is severly sick. Signs and symptoms: Severe headache followed by lose of balance to the body.
(Retz.) E.H.Walker Asteraceae	H	L	Hu Frs	Ex	Headache	Fresh leaf is heated on fire and kept on the head/cranium of the patient then put in a liter of water and kept under mattress over night. Smell from the ingridient is also serve as medicine. Finally, the ingridient is discarded as waste early in the morning
		L	Hu rs	Ex	Toothache	Fresh leaf together with fresh butter is mixed. Ceramic Kettle (Coffee boiler) is broken from the bottom (seat removed mechanically) and hot iron (axe) is pasted with mixiture form Conyza leaf and butter then put under the broken part of the kettle. The narrow bottle neck of the kettle is come in contact with the patient's mouth, steam from the paste is sucked onto the affected teath as steam tretment
		L	Hu Frs	Orl	Bloody diarrhea	Leaf of Conyza species together with leaf and root of Eragrostis botryodes and Sporobolus africanus are mashed together and little finger size of the extract is drunk with coffee cup.
Lam. Boraginaceae	T	Bk	Hu Frs/Dr	Orl	Jaundice (T'INBATO)	Leveaves of Pittosporum virdiflorum, Dombeya torrida, Carduus leptacanthus, Maytenus gracilipse, Rubus steudneri, Cordia africana(bark), and Asparagus are pounded together with mortar and pistil, soaked in water, decanted then 3 glasses per day (morning-1, noon-1 and night-1) drunk. Antidote: Boiled/pasturized milk together with red teff bread and ETINO.

Appendix 2. Continoued…

							ETINO (Sh), BULLA (Am) is a liquid sequeezed from Ensete ventricosum mixitures and it is eaten as porridge in Ethiopian traditional food.
			Bk	Hu Frs	Orl	T'INBATO	Root and leaf of Carduus leptacanthus, bark of Cordia africana, root of Phytolacca dodecandra, and bark of Galinerea saxifraga are pounded together, boiled. Based on age and sex of individuals, the mixiture is drunk measured with glass, coffee cup or finger strip size. Fresh milk is used as an antidote against severe side effect
Apiaceae		L.H	Fr	Hu Frs	Orl	any disease (C'EMO)	Variegated leaves of Coffea arabica, leaf of Ocimum basilicum, whole plant of Ruta chalepensis, whole plant of Cymbopogon saesius, whole plant of Allium sativum, fruits of Coriandrum sativum, whole plant of Foeninculum vulgare, leves of plectranthus barbatus, pounded fruits of Capsicum frutescens and pounded fruits of Capsicum annuum are well mixed together and boiled then a cup full of the hot ingridien is drunk against any health disorders. C'EMO: is a traditional drink by the Sheka ethnic group and it is prepared from a mixiture of plant materials as indicated above. In is not only serve as a medicne for any health disorders but also a food supplement in their dailly ditches. It is believed that when people dailly take "C'EMO"as part of their foodstaff, they become more resitant to disease and any health disorders. Antidots: Milk or honey is used agains side effects if any.
Asteraceae	(Benth.) S.Moore	H	L/Fl	Hu Frs	Ex/Orl	MICHATO	Fresh leaf and flower is chopped/crushed between pulms and and taken either Oral, Nasal or externally rubbed on the affected parts of the body. It is also mixed with Ensete ventricosum dough as yeast substitute for baking.
Asteraceae	(Juss. ex Jacq.) S. Moore	H	L/Fl	Hu Frs	Ex/Orl	MICHATO	Fresh leaf andflower is chopped/crushed between pulms and and taken either Oral, Nasal or externally rubbed on the affected parts of the body. It is also mixed with Ensete ventricosum dough as yeast substitute for baking.
Fabaceae	(Pax) Milne-Redh. ex Polhill	H/S	L	Hu Frs	Ex/Orl	Snake poison	Fresh leaf is finely crushed and the liquid part is sprayed on the body of the body of the patient. Very small dosage (size of small finger strip) can also be taken orally if the patient is believed strong enough to resist the side effects. Othrewise external application is enough to cure the poisoning. Signs and symptoms of the poisoning: "DINGARO" is a type of snake known for releasing its venom to the patient through breathe rather than bite. When a person is poisoned this way, body of the patient swells followed by local scleriosis of the epiderms, irritation and skin burn feeling disconfort.
Euphorbiaceae	Del.	T	WP	B Fr/Dr	Ex/Orl	Fungal	Latex from ypung shoot (bud) is sequeezed onto the affected body.
			WP	B Fr/Dr	Ex/Orl	Stomachache	Inner bark is finely powdered soaked in water, sequized with clean cloth mixed with salt and drunk together with "AREKE" or dry mead "TEJI". When a jelly fatty material is expelled in the form of diarrhea, the patient is cured.
			Bk	Hu Frs/Dr	Orl	Ascariasis	Bark is pounded soaked in water and drunk alone against the parasite.
			L	Hu Frs	Na	Headache	Fresh leaf is smashed between pulms and placed in noistrils for smelling.
			L	Hu Frsh	Ex	wound	Liqid from young shoot is added drop by drop on the affected body.
			L	Hu Frs	Orl	Ascariasis	Liqid from young shoot iscolleted and taken empty stomach early in the morning for one day.Dossage: Finger strip of litle finger is used to measure.

Appendix 2. Continoued…

L	An	Frs/Dr	Orl	Diarrhea	Leaf is pounded in mortar finely and prepared int animal feed and given.
Lx	Hu	Frs	Ex	wound	Latex from young shoot is applied to the affected body drop by drop.
L	Hu	Frs/Dr	Orl	Parasites	Leaf is finely pounded, mixed with water, decanted and measured with finger strip of litle finger and drunk to expel intestinal parasites.
L	Hu	Frs/Dr	Orl	Jaundice	Jaundice locally known as "T'INBATO" : Leaf of Croton together withleaf of Phytolacca dodecandra are pounded together roled and put in fire warmth the warm material externally kept on the affected organs of the patient.
Lx	Hu	Frs	Ex	wound	Latex from youn buds or resin from stem bark together with that of Vangueria madagascariensis applied to wound.
L	Hu	Frs	Ex	Tinea versicolor (Fungal)	Liquid from the young shoot is squeezed and rubbed onto the affected skin. Fresh pancrease of cattle also rubbed on the affected part of the body.
L/Bl	Hu	Frs/Dr	Ex	common cold Thyphoid fever	Leaf or inner bark of Croton together with leaves of Pycnostachys abyssinica, Pycnostachys eminii, Pycnostachys meyeri, Clausena anisata and Dombeya torrida are usted as steam treatment after boiling together. The warm liquid from the boiled mixiture is also sprayed on the body of the patient.
L	Hu	Frs	Ex	Tuberculosis	Leaf extract is applied to the affected organ drop by drop using traditional capillary tube made from thin stems of Guizotia species or Arundinaria alpina.
L	Hu	Frs	Ex	Bone cancer	Leaf extract is applied to the affected bone by sprinkling/spray using traditional capillary tube made from thin stems of Guizotia species or Arundinaria alpina. Application: The contents in the tube should be pushed strongly to the bone using difusive puff pressure from the mouth.
L	Hu	Frs/Dr	Orl	Ascariasis	Leaf together with leaf of Cucurbita pepo are pounded together mixed with red teff porridge and eaten
L/Bl	Hu	Frs/Dr	Orl	Stomachache	Leaf and bark are pounded together and eaten with soup. Or red tef bread.
L	Hu	Frs/Dr	Ex	Typhoid fever	Smoke from the leaf is used as a vaccine against typhoid fever.
L	Hu	Frs/Dr	Orl	Ascariasis	Grinded into fine powder and eaten together with dailly food or drunk with MEAD.
L/Sh	An	Frs	Orl	Diarrhea	Plant materials from Pycnostachys abyssinica, Croton macrostachys and Justicia schimperiana are pounded together and given to cattle as feed or drink.
Sht	Hu	Frs	Ex	Earache(any)	Ypung shoot of Lobelia giberroa and Croton macrostachyus are mashed together and fresh liquid is used as ear drop and the solid materia is put in the ear hole.
L	Hu	Frs	Ex	Ear with pus	Ypung shoot of Lobelia giberroa, Croton macrostachyus and leaf of Bidens ghedoensis are mashed together and fresh liquid is dropped into the affected ear drop by drop untill the pus disappears.
Sht	Hu	Frs	Ex	KOSHKOSHE	Young shoot of Ricinus communis, leaf of Peperromia retusa and leaf of Croton macrostachyus are pounded together bind/rolled with fresh leaf put in fire or hot ash then after few minutes it is taken out and put on the affected part of the body usually fingers and toes. Then the pain relieves.
L	Hu	Frs	Ex	Thyphoid fever	Leaf of Pycnostachys abyssinica, Pycostachys meyeri and Pycnostachys eminii Croton macrostachyus and Momordica foetida are heated together of fire and smoke from the ingridient serves as fumigant to the hoestead to repel the diseases.
L/St	Hu	Frs/Dr	Ex	Typhoid fever	Steam treatment form leaf and splited wood serve as both medicine and vaccine

Appendix 2. Continoued…

								for typhoide fever. It is believed that fumigating the homestead eliminates the spread of the disease from patients to health individuals.
			L	Hu	Frs/Dr	Orl	Ascariasis	Leaf of croton macrostachyus and bark of Vangueria madagascariensis are boiled with meat soup and eaten Ensete ventricosum bread (K'OC'O). The mixiture is also prepare in the form of porridge and eaten together with K'OC'O as food.
			R	Hu	Frs	Orl	Malaria	Root of Ricinus communis, root of Croton macrostachyus, bark of Scheflera volkensii, root of Asparagus species are pounded together, squeezed in coffee cup and drunk three times a day. Antidote: Dry liver of sheep or any cattle is eaten right after the third dossage. Liver should be ready dry ahead of time.
			R	Hu	Frs	Orl	Tumor	Root of Phytolacca dodecandra and root of Croton macrostachyus are pounded together and litle finger strip size of the mixiture is drunk. Antidote: Frsh milk should be drunk as antidote to prevent severe side effects.
Cucurbitaceae	Ehrenb.ex Spach	Cl	Fr	Hu	Frs	Ex	Dandruff	Fresh fruit sis roasted in fire or hot ash and the inner jelly liqud of the inner part of the fruit is used as ontiment on the scalp until the fungal infection disappears.
			Fr	An	Frs	Orl	Endoparasites	Fruit is roasted into fire or hot ash followed by cooling. Then split the scale to expose the inner seeds. The roasted seeds within scales are given to calfs for nine consequetive days against gastrointestinal worms. Not for other animals.
			L	Hu	Dr	Ex	Acne/head warts	Dry leaf is burnt and the ash is mixed with Allium sativum pounded together and rubbed on the wound for four consquetive days.
Cucurbitaceae	A. Rich.	Cl	R	Hu	Frs/Dr	Orl	Hypertension	Finger strip size of the root is pounded, soaked in water, decanted and then mixed with honney and drunk.
Cucurbitaceae	L.	Cl	Fr Fr/L	Hu	Frs/Dr	Orl	Ascariasis Endoparasites	Dirct consuption of the fruit kills and expels Ascaris and related parasites. Both the leaf and the fruit consumed as dailly food against gastrointestinal parasites. Traditional application: Frequent use of Cucurbita pepo in dailly food staff is believed to keep the whole amily free of intestinal parasite infection.
			L	Hu	Frs/Dr	Orl	Ascariasis	Leaf together with leaf of Croton macrostachyus are pounded together mixed with red teff porridge and eaten
Zingeberaceae	Valeton	H	Rh	Hu	Frs/Dr	Orl	any disease	Used as an ingridient in the preparation of C'EMO against any health problem. Rhzome of Curcuma domestica, Zingeber officinale together with other spices are used in the preparation of antinausa or sneezing.
Cyatheaceae	Hook.	T	L	Hu	Frs	Orl	unwanted pregnan	Youn shoot area of the leaf is pounded and a coffee cup size of the extract is drunk carefully. Caution since it may be dangerous and life threatening, care must be taken and in case of sever symptoms, milk must be drunk as antidote.
Amaranthaceae	Moq.	H	L	Hu	Frs	Ex/Orl	SHAJO	Fresh leaf of Cythula species is mashed, squeezed, mixed with fresh butter and used as an ointment on the affected skin. The liquid extract of the preparation is measured with little finger strip size of the little finger and drunk alone. SHAJO is a local name for a type of skin disorder due to spider poisoning either by biting or urinating on the body of the patient. Signs and symptoms: Skin rush with severe inflamation, itching followed by acnes and planar warsts filled with leisions which finally lead to sever wound of the epidermis and dermis.
	Bak.	H	L	Hu	Frs	Ex/Orl	SHAJO	Fresh leaf of Cythula species is mashed, squeezed, mixed with fresh butter and

Appendix 2. Continoued…

Amaranthaceae						used as an ointment on the affected skin. The liquid extract of the preparation is measured with little finger strip size of the little finger and drunk alone. SHAJO is a local name for a type of skin disorder due to spider poisoning either by biting or urinating on the body of the patient. Signs and symptoms: Skin rush with severe inflamation, itching followed by acnes and planar warsts filled with leisions which finally lead to sever wound of the epidermis and dermis.
(Schrad.) Schinz Amaranthaceae	H	L	Hu Frs	Ex/Orl	SHAJO	Fresh leaf of Cythula species is mashed, squeezed, mixed with fresh butter and used as an ointment on the affected skin. The liquid extract of the preparation is measured with little finger strip size of the little finger and drunk alone. SHAJO is a local name for a type of skin disorder due to spider poisoning either by biting or urinating on the body of the patient. Signs and symptoms: Skin rush with severe inflamation, itching followed by acnes and planar warsts filled with leisions which finally lead to sever wound of the epidermis and dermis.
(Hook. & Arn.) Stapf Poaceae		Wp	Hu Frs	Orl	any disease (C'EMO)	Variegated leaves of Coffea arabica, leaf of Ocimum basilicum, whole plant of Ruta chalepensis, whole plant of Cymbopogon saesius, whole plant of Allium sativum, fruits of Coriandrum sativum, whole plant of Foeninculum vulgare, leves of plectranthus barbatus, pounded fruits of Capsicum frutescens and pounded fruits of Capsicum annuum are well mixed together and boiled then a cup full of the hot ingridien is drunk against any health disorders. C'EMO: is a traditional drink by the Sheka ethnic group and it is prepared from a mixiture of plant materials as indicated above. In is not only serve as a medicne for any health disorders but also a food supplement in their dailly ditches. It is believed that when people dailly take "C'EMO"as part of their foodstaff, they become more resitant to disease and any health disorders. Antidots: Milk or honey is used agains side effects if any.
(L.) Pers. Poaceae	H	Wp	An Frs	Ex	Eye diseases	Fresh plant is chewed and spited into the eye of the affected animal.
Hochst. ex A.DC. inDC. Boraginaceae	H	L	Hu Frs	Ex/Na	MICHATO	Leaf smashed between pulm, liquid squeezed and applied against cutanous scleriosis
				Ex	BILIC'E	2-3 Drops from leaf infusion are applied to treat BILI'CE, a pusy spot on the eyelids with cutanous inflamation on the eye and its surrounding.
		L	Hu Frs	Ex	Hypersensitivity	Leaf extract is sprayed/rubbed on the the affected part of the body.
		L	Hu Frs	Ex	Sun burn	Leaf infusion is sniffeded through nostrills as a cure against allergic reactions due tosun burn and consuption of spicy foods in direct light itensity.
Hochst. ex A.DC. in DC. Boraginaceae	H	L	Hu Frs	Ex/Na	MICHATO	Leaf smashed between pulm, liquid squeezed and applied s against cutanous scleriosi
				Ex	BILIC'E	2-3 Drops from leaf infusion are applied to treat BILI'CE, a pusy spot on the eyelids with cutanous inflamation on the eye and its surrounding.
		R	Hu Frs	Ex/Orl	wound	when part of a body is suddenly cut with sword blade ("GEJERA"), leaf is finely smashed between hand pulms and the liquid is squeezed onto the wound. "GEJERA" or sword is a type of farm instrument as well as

Appendix 2. Continoued…

						traditional weapon known for its multipurpose function in the study area.
		Bk	Hu Frs	Orl	New borns	Inner rootbark is carefully peeled, pounded finely with mortar and pistle and finger strip size of the liquid is given to the newborn infant with fresh butter. CUATION: The butter used should not be matured(the one stored for several days or weeaks) as it is believed to harm the heart of the infant. Traditional medical appilication: The preparation used in this way is believed to clean the waste materials left in the upper resparatory system of the infant during delivery or birth. Similar application also works for the mothers.
		L	Hu Frs	Ex	Hypersensitivity	Leaf extract is sprayed/rubbed on the the affected part of the body.
		L	Hu Frs	Ex	Sun burn	Leaf infusion is sniffeded through nostrills as a cure against allergic reactions due to sun burn and consuption of spicy foods in direct light itensity.
Forssk.	H	L	Hu Frs	Ex/Na	MICHATO	Leaf smashed between pulm, liquid squeezed and applied against cutanous scleriosis
Boraginaceae						
				Ex	BILIC'E	2-3 Drops from leaf infusion are applied to treat BILI'CE, a pusy spot on the eyelids with cutanous inflamation on the eye and its surrounding.
		L	Hu Frs	Ex	Hypersensitivity	Leaf extract is sprayed/rubbed on the the affected part of the body.
		L	Hu Frs	Ex	Sun burn	Leaf infusion is sniffeded through nostrills as a cure against allergic reactions due to sun burn and consuption of spicy foods in direct light itensity.
(Steud. ex A. Rich.) Desc. ex Wil	Cl	Sht	Hu Frs	Ex	Body warts	Fresh shoot is pounded, roled with leaf and kept in fire or ash for few minutes. The warm preparation is roled with clean clothe and tied on the wart.
Vitaceae						
		Sht/l	Hu Frs	Orl	Horse disease	Young shoot and leaf is pounded, mixed with salt and given to horse as feed.
(Chiov.) Vollesen	Cl	Sht	Hu Frs	Ex	Body warts	Fresh shoot is pounded, roled with leaf and kept in fire or ash for few minutes. The warm preparation is roled with clean clothe and tied on the wart.
Vitaceae						
		Sht/l	Hu Frs	Orl	Horse disease	Young shoot and leaf is pounded, mixed with salt and given to horse as feed.
L.	H	L	An Frs	Ex	worm infestation	When cattle wound is severely infested with worms, fresh leaf is pounded and pasted onto the wound. It also used as prevention and treatment if applied ahead of time before the wound develops worms and extreme leisions.
Solanaceae						
					Toothache	Seeds are mixed with butter and heat on fire and the smoke is suked with tube.
Taub.	S/T	L	An Frs/Dr	Orl	Stomachache	Pounded, soaked in water given to cows as drink and fodder
Sapindaceae						
(Burn.f.) Underw.	H	Sht	Hu Frs	Orl	Toothache	Young shoot is directly chewed.
Gleicheniaceae		Rh	Hu Frs	Orl	Toothache	Fresh rhzome is roasted in fire or hot ash and chewed gently.
(L.f.) Kuntze	H	L	Hu Frs	Ex	Warts/wound	Frsh leaf is pounded and tied onto the affected part of the body.
Asteraceae						
L.	Cl	L	Hu Frs	Orl	Tonsilitis	Young shoots from leaf Maytenus species, Pycnostachys species and Dioscorea alata are pounded together and and the liquid is drunk.
Dioscoraceae						
(J.F. Gmel.) P. Bamps	T	L	Hu Frs/Dr	Orl	Jaundice (T'INBATO)	Leveaves of Pittosporum virdiflorum, Dombeya torrida, Carduus leptacanthus, Maytenus gracilipse, Rubus steudneri, Cordia africana(bark), and Asparagus are pounded together with mortar and pistil, soaked in water, decanted then 3 glasses per day (morning-1, noon-1 and night-1) drunk.
Sterculiaceae						
		R	Hu Frs/Dr	Ex	Snake poison	Roots of Dombeya torrida, Galinerea saxifraga, Setaria megaphyla,

Appendix 2. Continoued…

								Stephania abyssinica, Echnops kebericho are pounded together and the mix is rubbed on the body of the patient. This works only if the intensity of poison ing is by breathe rather than biting by "FUSHO" or snake. "FUSHO": A type of snake that release pousonous breathe as defense.
			L	Hu	Frs/Dr	Ex	common cold Thyphoid fever	Leaf or inner bark of Croton together with leaves of Pycnostachys abyssinica, Pycnostachys eminii, Pycnostachys meyeri, Clausena anisata and Dombeya torrida are usted as steam treatment after boiling together. The warm liquid from the boiled mixiture is also sprayed on the body of the patient.
			Sht	Hu	Frs	Ex	Snake poison	Young shoot is pounded and sprayed on the body of the patient.
			Sht/l	Hu	Frs/Dr	Ex	Snake poison (FUSHO)	Root of Setaria megaphylla together with young shoot of Dombeya torrida are pounded together and rubbed on the affected body of the patient.
			R	Hu	Frs	Orl	Snake poison (DINGARO)	Root of Setaria megaphylla, root of Dombeya torrida and root of Lobelia giberroa are pounded together and a glassful is drunk. Then the residue is rubbed onto the body of the patient. Note: DINGARO in local language is a type of snake with spots of black/yellowish brown color strip with large head (T'EKERE) believed to very poisonous and hence dangerous snake.
Dracaenaceae	Mildbr.	S/T	Sht	Hu	Frs	Ex	Gastritis	Youn shoot of Dracaena afromontana is eaten either roasted in fire or row.
Dracaenacae	Engler	T	L	Hu	Dr	Ex	Skin allergy	Dry leaf of Dracaena steudneri is pounded and the powder is mixed with butter and wiped as an ointment on the affected skin.
Asteraceae	Mesfin	H	R	B	Frs/Dr	Ex/Orl	Snake bite	Dry root is powdered and added to fire to fumigate the snake after which the snake fail into nervousness, unable to bite and can easily be killed by humans Bited person chew the root as antidote to snake poisoning
							Stomachache Parasites	Root powder is soaked in water and salt then drunk against stomachache or gastrointestinal parasites and diarrhea
			R	Hu	Frs/Dr	Orl	ANGETO/warts	Crushed in mortar, soaked in water and drunk with coffee cup. "ANGETO" is a type of disease with unexplained signs and symptoms.
			R	Hu	Frs/Dr	Orl	Common cold	Root together with root of Echnops kebericho, Solanacio gigas, Asparagus, Cirsium dender, Hallea rubrostipulata pounded together, boiled and drunk.
			R	Hu	Frs/Dr	Ex Orl	Snake poison	Roots of Dombeya torrida, Galinerea saxifraga, Setaria megaphyla, Stephania abyssinica, Echnops kebericho are pounded together and the mix is rubbed on the body of the patient. This works only if the intensity of poison ing is by breathe rather than biting. "FUSHO": A type of snake that release pousonous breathe as defense.
			R	Hu	Frs/Dr	Orl	Snake repellent	Fumigation of house repells snakes not to come to living rooms. It is among the preventive mechanisms traditionally used in rural areas to stay health.
			R	Hu	Frs/Dr	Orl	Constipation	Gastrointestinal diseases and related problems are treated buy pounding the root of E.kebericho soaking in water and drinking with salt in small dossage.
			R	Hu	Frs/Dr	Orl	Malaria	Young shoot mixed with Lepidiumsativum seeds and root of Echnops kebericho prepared in the form of soup and eaten with goat meat as an antidote.
			R	Hu	Frs/Dr	Ex	Snake poison	Root of Echinops kebericho together with root of Setaria megapylla are chewed

Appendix 2. Continoued…

								together and spited on the affected part of the body of the patient.
			R	An	Frs/Dr	Orl	Cattle diseases	Signs and symptoms: Shivering, deep sleep, dry nose, dry dung, lose of apetite Traditiona treatment: Root of Echnops kebericho, fruits of Capsicum species whole plant of Artemisia abyssinica, leaf of Typha latifolia, leeaf of Pycnostachys species, leaf of Ilex mitis, leaf of vernonia species, leaf of Pavonia urens are mixed together, added to fire and smoked to the animal. Again the same mixiture of the plants except Pavonia urens are well pounded together and the liquid extract is given to the animal in the form of drink. This relieves the dry stomch and dung.
			R	Hu	Frs	Ex	Snake poisoning (ACHA'O)	Leaf of Justicia schimperiana, Galinerea saxifraga and Echinops kebericho are pounded together and the residue is rubbed on the body of the affected patient. Note: ACHAO is a type of snake that release poisonous breathe to the body of humans or animals thereby causing sever irritation and swelling of thebody.
Boraginaceae	Thonn.	T	Sht	Hu	Frs	Orl	Gastritis	Young shoot extract is added to porridge and eaten.
Meliaceae	Sparrm.	T	Bk	An	Frs/Dr	Orl	Skin disease	Inner bark is pounded soaked into water solution and a glassful of the solution is adminstred to the affected animal.
			Bk	Hu	Frs/Dr	Orl	Toothache	Pounded or grinded inner bark is put on the affected teeth every morning for 3 days following pain. Duration of stay on the teeth is until the pain disapeears.
			Bk	Hu	Frs	Oral	Toothache	Fresh inner bark is directly chewed.
			Bk	Hu	Frs/Dr	Orl	Back pain/spinal p	Root of Solanacio gigas, bark of Ekebergia capensis and root of Asparagus species are pounded together mixed with honey comb and eaten.
Myrsinaceae	Vatke	Cl	L/Fr	Hu	Frs/Dr	Orl	Tapeworm	Leaf is choapped, mixed with porridge and swallowed 4-5 times.
			L/Fr	Hu	Frs/Dr	Orl	Tapeworm	Fresh leaf is also chewed alone just as wild food like Catha edulis.
			L	Hu	Frs	Orl	Hanger	Leaf is used as wild food during time of emergency while a person go to forest. NB: Excessive chewing of Embelia schimperi leaf results in bad smell in the mouth to avoid the smell Ruta chalepensis or Bread of Nicotiana tabacum is chewed.
			Fr	Hu	Frs	Orl	Tapeworm	Fruit is pounded, soaked in water over night and drunk with mead or TELA.
			Fr	Hu	Frs	Orl	Hypertension	Fruit of Embelia schimperi together with whole plant of Ruta chalepensis and root of Rumex abyssinicus are pounded together and the water extract is drunk with honey or any appropriate drink.
Musaceae	(Welw.) Cheesman	H	L	An	Frs	Orl	Bloody diarrhea	Leaf of Lobelia giberroa, Pycnostachys abyssinica, Solanacio gigas, wild variety Ensete ventricosum (E'CEMUNDE) and Justicia schimperiana are pounded together and the liquid extract is given to cattle as drink.
			St/R	Hu	Frs/Dr	Orl	Ascariasis	Leaf of croton macrostachyus and bark of Vangueria madagascariensis are boiled with meat soup and eaten Ensete ventricosum bread (K'OC'O). The mixiture is also prepare in the form of porridge and eaten together with K'OC'O as food.
			St/R	Hu	Frs	Ex	SHAJO(skin rush) Spider bite	Fresh liquid squeez right aftter chopping of Enset ventricosum locally called BULLA is mixed with human nasa discharge (rhinorrhoea) and fresh mixiture is rubbed on the affected skin. SHAJO is a local name for skin disorders/rush due to spider poison when the spider bite or urinate on the skin of humans. Skin inflama tion, rush followed by blisters and leisions finally leading to sever wound if not

Appendix 2. Continoued…

								properly treated intme with proper medication.
Poaceae	W.D. Clayton	H	L	Hu	Frs	Orl	Bloody diarrhea	Leaf of Conyza species together with leaf and root of Eragrostis botryodes and Sporobolus africanus are mashed together and little finger size of the extract is drunk with coffee cup.
Poaceae	(Zucc.) Trotter	H	Se	Hu	Dr	Orl	Used as antidote	Bread of Eragrostis tef especially the red variety is used as antidote against any severe side effects of herbal treatment.
Fabaceae	Lam. ex DC.	T	L Bk	B	Frs	Ex	Lice Herps zoster	Fresh leaf and bark are pounded, soaked in water and used to wash the body agains ectoparasites and herps zoster ("SHAJO") as well as various skin disorders epeciall in calf and lactating cows
			L	Hu	Frs	Ex	Eye disease	Fresh leaf is chewed and spited inted the affected eye of calf in cattle
			Bk	Hu	Frs/Dr	Or	Arm pain	Inner bark is finely powdered, added to boiling water and drunk with honey Dossage: Finger strip of little finger is used to determine dossage.
							eye scleriosis	Inner bark is chewed and spited into the eye of the affected animal.
			L	Hu	Frs/Dr	Orl	Tonsilitis	Young shoot is chewed and swallowed.
			L	Hu	Frs/Dr	Ex	worms	When wound is infested with worms, leaf powder is sprinkled on the wound.
			Bk	Hu	Frs	Orl	Tonsilitis	Bark together with young shoot of Maytenus species is chewed.
Fabaceae	Schweinf.	T	L	An	Frs	Ex	Eye disease	Young shoout from the leaf is pounded and the liquid part is added to the eye of the animal drop by drop.
			L	Hu	Frs	Ex	Eye disease	Fresh leaf is chewed and spited inted the affected eye of the patient
			L	Hu	Fr	Ex/Na	Conjactivitis	Chronic stage: leaf from young shoot of Lepidotrichilia volkensii and inner part of Erythrina brucei bark are mashed together and taken nasally in the form of smell and small amount of the liquid is spited into the eye too.
			Bk	Hu	Frs	Orl	Tooth carries	Inner bark is chewed ank kept on the affected teeth until the pain disappears.
			Sht	Hu	Frs	Orl	Bloody diarrhea	Young leafy shoots of Lepidotichilia volkensi, Ajuga species, Erythrina brucei and Allophylus abysiinicus are grinded together and prepared into soup. Then depending on age and sex of individuals: childern- one teaspoon, females and elders-1 coffee cup and young adults- 1 glass drunk with honey for 2-3 days.
			R	Hu	Frs	Orl	Tumour/warts	Root of Erythrina brucei, Girardinia species, and fruit of Lepidotichinilia volkensii are boiled together with salt and eaten. Then the swollen tumour oozes and reles leisions easily. Finally the wound dry gradually until it disappears.
Euphorbiaceae	Pax	S/T	R	Hu	Frs	Orl	T'INBATO	Root is pounded and the extract is drunk with honey.
			L				(Jaundice)	Leaf is boiled in water and steam from the hot material is inhaled in closed manner.
Asteraceae	Del.	H	L	Hu	Frs	Na/Ex	Headache	Fresh leaf is mashed and inserted into nosetrils and smell is inhaled.
			L	Hu	Frs	Na/Ex	wound	Fresh leaf is mashed and tied on the wound.
Myrtaceae	Labill.	T	L	Hu	Frs	Ex	MICHATO	Fresh leaf is boiled together with leaf of Ocimum species and the steam from the hot boiling ingridient is used to treat the patient under well sealed condition.
			L	Hu	Frs	Ex	Sever fever	Leaf is boiled and used as treatment against, fever, cold headache.
Euphorbiaceae	Pax	T	Lx	Hu	Frs	Orl	Ascariasis	Latex is mixed with egg or red Teff bread (baked together) and eaten to kill and expel the parasite taking care of dosage. The egg and the red Teff are used as antidote against the side effect of the latex on the patient.
			R	Hu		Orl		Fresh root is pounded and taken with red teff bread oral against diarrhea.

Appendix 2. Continoued…

			R	Hu	Ex	Tumour	Root is pounded filely and tied on the affected part of the body.
			Lx	Hu Frs	Ex	Eye disease	A small drop of the latex is applied to the eye as vaccine against eye disease.
			Lx	Hu Frs	Ex	ring worms	Latex directly applied to the affexted skin or part of the body.
			Lx	Hu Frs	Orl	Endoparasites	Latex is used as baking material for red teff bread which eventaually eaten against the parasite.
			R	Hu Frs	Ex	Head warts/Acne	Roots tips of of Euphorbia ampliphylla, Lobelia giberroa and Ricinus communis are pounded together between clean stones and prepaed and smell from the mixi-ture is inhaled contineously by hanging in a rolled clothe on the neck region.
			Lx	Hu Frs	Ex	Hemorrhoids	Fresh latex is rubbed on the hemorrhoids. Antidote: Leaf of Stepahania cyanatha is tied on the latex ruubed hemorrhoids to prevent severe side effects.
	S.Carter	H	Lx	Hu Frs	Ex	Hemorrhoids	Fresh latex is directly applied to the affected organ.
Euphorbiaceae			L	Hu Frs	Ex	Ear disease	Leaf of Euphorbia dumalis, young shoot of Vrnonia amygdalina and leaf of Bothriocline schipmeri are pounded together and the leaf extract is applied drop by drop into the affected ear.
			Lx	Hu Frs	Ex	Hemorrhoids	Latex from any part of the plant is collected and rubbed on the hemorrhoid by first scratching and exposing the inner part or swollen veins.
			Lx	Hu Frs	Ex	Hemorrhoids	Latex directly rubbeded on the hemorrhoids.
	L.	S	Lx	Hu Frs	Ex	Hemorrhoids	Fresh latex is rubbed gently on to the hemorrhoids.
Euphorbiaceae							
Moraceae	Forssk.	T	Lx	Hu Frs	Orl	Tonsilitis	Fresh latex from the liquid exudate of the stem bark is inserted into the sore throat against tonsilitis in very small amount.
			Lx	Hu Frs	Orl	Toothache	The liquid exudate from any part of the plant (latex) is applied to affected teeth.
			Lx	Hu Frs	Ex	Dandruff	Liquid exudate from any part of the plant is applied to the affected part of head daillly every morning untl it is completely relieved.
			Lx	Hu Frs	Orl	Gingivitis	When there is wound in the mouth or around the latex is carefully wiped on it.
			Lx	Hu Frs	Orl	Bat urine disease	There is a belief that when bats urinate on the nose/face of a person it causes serious dermal copmlexes characterized by inflamation, itching and formation of lesion. Such type of wound is treated by wiping the latex onto the affected organ.
			Lx	Hu Frs	Orl	Oropharyngeal candidiasis	Fresh liquid exudate(latex) from the plant is collected and rolled with clean clothe and inserted into the mouth and pharynx of the patient.
						Gingivitis	Fresh latex is carfully rubbed by brushing inside the mouth cavity.
	Miller	H	WP	Hu Frs/Dr	Orl/Na	Headache	Smell from the plant is taken nasal against headache
Apiaceae						Stomachache	Concoction from fresh plant is prepared and drunk with coffee cup
						Common cold	Concoction from fresh plant is mixed with other spices boiled and drunk.
			WP	Hu Frs	Orl	any disease (C'EMO)	Variegated leaves of Coffea arabica, leaf of Ocimum basilicum, whole plant of Ruta chalepensis, whole plant of Cymbopogon saesius, whole plant of Allium sativum, fruits of Coriandrum sativum, whole plant of Foeninculum vulgare, leves of plectranthus barbatus, pounded fruits of Capsicum frutescens and pounded fruits of Capsicum annuum are well mixed together and boiled then a cup full of the hot ingridien is drunk against any health disorders. C'EMO: is a traditional drink by the Sheka ethnic group and it is prepared from a

Appendix 2. Continoued…

								mixiture of plant materials as indicated above. In is not only serve as a medicne for any health disorders but also a food supplement in their dailly ditches. It is believed that when people daily take "C'EMO"as part of their foodstaff, they become more resitant to disease and any health disorders. Antidots: Milk or honey is used agains side effects if any.
Rubiaceae	(Hochst.) Bridson	S/T	R	Hu	Frs/Dr	Ex	Snake poison	Roots of Dombeya torrida, Galinerea saxifraga, Setaria megaphyla, Stephania abyssinica, Echnops kebericho are pounded together and the mix is rubbed on the body of the patient. This works only if the intensity of poison ing is by breathe rather than biting. "FUSHO": A type of snake that release pousonous breathe as defense.
			L	Hu	Frs/Dr	Orl	T'INBOTO (Jaundice)	Leaf together with root of Cordia africana and leaf of Carduus leptacanthus are prepared together by grinding finely and a water solution of the mixiture is taken oral. Dossage is determined according to age and sex of the patient. Antidote: Boiled/pasturized milk together with red teff bread and ETINO. ETINO (Sh), BULLA (Am) is a liquid sequeezed from Ensete ventricosum mixitures and it is eaten as porridge in Ethiopian traditional food.
			Sht	Hu	Frs	Orl	Stomachache	Young leafy shoot together wit root of Rumex nepalensis are chewed with salt.
			L	Hu	Frs	Ex	Snake poisoning (ACHA'O)	Leaf of Justicia schimperiana, Galinerea saxifraga and Echinops kebericho are pounded together and the residue is rubbed on the body of the affected patient. Note: ACHAO is a type of snake that release poisonous breathe to the body of humans or animals thereby causing sever irritation and swelling of thebody.
			Bk	B	Frs	Orl	Bleeding	When continous bleeding through human or animal genital, bark of Galinierea saxifraga is well pounded, boiled with honey and given to patient for four to five consequetive days. This is usually following abortion or giving birth in females.
			Bk	Hu	Frs	Orl	T'INBATO	Root and leaf of Carduus leptacanthus, bark of Cordia africana, root of Phytolacca dodecandra, and bark of Galinerea saxifraga are pounded together, boiled. Based on age and sex of individuals, the mixiture is drunk measured with glass, coffee cup or finger strip size. Fresh milk is used as an antidote against severe side effect
Urticaceae	(Steudel) Wedd.	H	R	Hu	Frs	Orl	Tumour/warts	Root of Erythrina brucei, Girardinia species, and fruit of Lepidotichinilia volkensii are boiled together with salt and eaten. Then the swollen tumour oozes and reles leisions easily. Finally the wound dry gradually until it disappears.
Urticaceae	(Link) Friis	H	R	Hu	Frs	Orl	Tumour/warts	Root of Erythrina brucei, Girardinia bullosa, and fruit of Lepidotichinilia volkensii are boiled together with salt and eaten. Then the swollen tumour oozes and reles leisions easily. Finally the wound dry gradually until it disappears.
Rhamnaceae	Engl.	Cl	L	Hu	Frs/Dr	Ex	wound	Leaf extract is applied to the affected part of the body. Preparation: Leaf is first fine grounded, treated with water, sequized, and the liquid solvent is isolated.
			L	An	Frs	Orl	Retained abortion	When animal featus is terminated but remains in the womb of cows, fresh leaf is pounded, soaked in water and adminstered in the form of feed and drink.
			L	An	Frs	Orl	Retained placenta	Same is also true for expelling retained placenta.
Tiliaceae	Hochst. ex A. Rich.	S/T	Sht	Hu	Frs	Orl	Tonsilitis	Young shout of the plant is chewed with salt.

Appendix 2. Continoued…

Asteraceae (Vis.) Chiov.	H	L	Hu Frs	Ex	wound	Fresh leaf is smashed finely and tied on the wound to stopp bleeding and further infections during time of emergency when part of a body is suddenly cut with blade or other mechanical injuries.
Rosaceae (Brace) J.F.Gmel.	T	L	Hu Frs/Dr	Orl	Tapeworm	Pounded into fine powder and drunk with a glass of water to expel the Tapeworm parasite. Well prepared food such as chicken soup is eaten as an antidote against severe side effects.
		L/Fl	Hu Fr/Dr	Orl	Endoparasites	pounded, soaked in wated, decanted and drunk.
Rubiaceae (K.Schum.) J.F.Leroy	T	R Bk	Hu Frs/Dr	Orl	Common cold	Pounded, boiled, cooled over night then drunk with honey early in the morning.
		Bk	Hu Frs/Dr	Orl	Common cold	Root together with root of Echnops kebericho, Solanacio gigas, Asparagus, Cirsium dender, Hallea rubrostipulata pounded together, boiled and drunk.
		Bk	Hu Frs	Orl	common warts	Barks of Ilex mitis Scheflera volkensi and Hallea rubrostipullata are pounded together in mortar, boiled until it is well cooked with honey then drink.
		Bk	Hu Frs/Dr	Orl	Paralysis (K'ORSO)	Bark of Hallea rubrostipulata, leaf of Capsicumfrutescens, and leaf of Rothmannia urcelliformis are pounded together and a glass of the mixiture is drunk with MEAD dossage does not matter and the patient can continou until he relieves. Note that in local language, K'ORSO means a type of disease paralysing the leg extremities.
Poaceae L.	H	Se	Hu Frs/Dr	Orl	Taeniasis	Leaf of Celosia schweinfurthiana together with roasted seeds of Hordeum vulgare or dry bread of Ensete ventricosum mixed with Cupsicum species powder and salt and eaten as food to expell the whole parasitmia.
Gutiferae A. Rich.	H	L	Hu Frs	Ex	warts on the eye	Fresh leaf is mashed and liquid is squeezed to the warts drop by drop.
Aquifoliaceae (L.) Radl	T	L	An Frs	Orl	Hourse disease	Fresh leaves together with 12 other medicinal plant species such as Ilex mitis, Scheflera volkensi, Carduus are crushed together and given to hourses. HOURSE DISEASE: Progressive weight loss and thinning of hourses which finally leads to death of the animal if not properly treated early.
		Bk	Hu Frs	Orl	Schistosomiasis	Inner bark ispounded bioled with honey and finger strip of little finger is taken orally against bloody urine.
		Bk	Hu Frs	Orl	common warts	Barks of Ilex mitis Scheflera volkensi and Hallea rubrostipullata are pounded together in mortar, boiled until it is well cooked with honey then drink.
		Bk	Hu Frs	Orl	Stomachache	Inner bark is directly chewed.
		L	An Frs/Dr	Orl	Cattle diseases	Signs and symptoms: Shivering, deep sleep, dry nose, dry dung, lose of apetite Traditiona treatment: Root of Echnops kebericho, fruits of Capsicum species whole plant of Artemesia abyssinica, leaf of Typha latifolia, leeaf of Pycnostachys species, leaf of Ilex mitis, leaf of vernonia species, leaf of Pavonia urens are mixed together, added to fire and smoked to the animal. Again the same mixiture of the plants except Pavonia urens are well pounded together and the liquid extract is given to the animal in the form of drink. This relieves the dry stomch and dung.
Balsaminaceae A. Rich.	H	Lx	Hu Frs	Ex	Schistosomiasis	The lquid from the plant is applied to the skin of the patient and rubbed.
		R	An Frs/Dr	Orl	Retained placenta	Root tuber is pounded finely mixed with salt and given to the animal as feed.
		R	An Frs/Dr	Orl	Animal fatening	Root tuber is pounded finely mixed with salt and given to the animal as feed.

Appendix 2. Continoued…

Warb.	H	Lx	Hu	Frs	Ex	Schistosomiasis	The lquid from the plant is applied to the skin of the patient and rubbed.
Balsaminaceae		R	An	Frs/Dr	Orl	Retained placenta	Root tuber is pounded finely mixed with salt and given to the animal as feed.
		R	An	Frs/Dr	Orl	Animal fatening	Root tuber is pounded finely mixed with salt and given to the animal as feed.
Hook.f.	H	Lx	Hu	Frs	Ex	Schistosomiasis	The lquid from the plant is applied to the skin of the patient and rubbed.
Balsaminaceae		R	An	Frs/Dr	Orl	Retained placenta	Root tuber is pounded finely mixed with salt and given to the animal as feed.
		R	An	Frs/Dr	Orl	Animal fatening	Root tuber is pounded finely mixed with salt and given to the animal as feed.
A. Rich. Balsaminaceae	H	R	Hu	Frs/Dr	Ex	Fungal infection & substitute to Cosmotics	Root tuber is chopped and prepared into paste to fingers and toes as well as nails which has dual functions: as a substitute for cosmotics to maintain beauty and as prevention against fungal attack to the extremities.
Forssk. Convolvulaceae	H	L	Hu	Frs	Ex/Orl	Limb infection	Fresh leaf is mashed and tied on the infected body. Few amount is pounded and drunk with honey.
						Hypertension	Fresh plant is chewed or pounded and drunk with honey. Due to the burning sensation of the plant after usage, care must be taken by reducing amount.
Lindl.	H	L	Hu	Frs	Ex	Erythromelagia	Fresh leaf is mashed and the rubbed gently on the affected leg or extremities. Erthromelagia is a rare condition that primarily affects the feet and charicterized by burning pain, redness and increased skin temperature.
(Vatke) J.K.Morton Lamiaceae	H	L	Hu	Frs	Ex	mouth sores	Fresh leaf is mashed and the liquid squeezed from it ia applied to the affected organ drop by drop or wiping in the form of ointment.
		L	Hu	Frs	Ex	Eye disease	leaf of Leucas jamesii together with leaf of Isodon schimperi are mashed between pulms of hand and rubbed on the affected eye externally.
		L	Hu	Frs	Ex	MICHATO	Leaf infusion is rubbed on face and head regions and a sniff is inhaled nasally.
		Fl	Hu	Frs	Ex	Headache	Fresh flower is mashed, rolled and put in the nostrils and smell is inhaled.
(Hochst ex. Nees) T.Anders.	S	L	An	Frs	Orl	Diarrhea	Fresh leaf is pounded and given to calfs against diarrhea.
Acanthaceae		R	Hu	Frs	Orl	Stomachache	Root is pounded in mortar and finger strip of little finger is drunk with honey.
		L	An	Frs	Orl	Diarrhea	Pounded leaf is given as feed or fodder to cows.
		L/Sh	An	Frs	Orl	Diarrhea	Plant materials from Pycnostachys abyssinica, Croton macrostachyus and Justicia schimperiana are pounded together and given to cattle as feed or drink.
		L	An	Frs	Orl	Bloody diarrhea	Leaf of Lobelia giberroa, Pycnostachys abyssinica, Solanacio gigas, wild variety Ensete ventricosum (E'CEMUNDE) and Justicia schimperiana are pounded together and the liquid extract is given to cattle as drink.
		L	Hu	Frs	Ex	Snake poisoning (ACHA'O)	Leaf of Justicia schimperiana, Galinera saxifraga and Echnops kebericho are pounded together and the residue is rubbed on the body of the affected patient. Note: ACHAO is a type of snake that release poisonous breathe to the body of humans or animals thereby causing sever irritation and swelling of thebody.
Rolfe Crassulaceae	H	L	Hu	Frs	Ex	Stomachache	Fresh leaf is put on fire untill it is warm enough and immediately kept on the stomach of the patient rght around the cord stump, a scar left on the infant's belly after the umbilical cord has been remover right after delivery or birth.
		R	Hu	Frs	Ex	Foot problems (Fungal nail, corns & calluses Athlete's foot	Common foot problems (fungal nail infection, corns & calluses, athlete's foot planar warts and the like) that cause severe injuries and warts are treated with root of Chalanchoe species. Fresh root if finely pounded and tied on the affected part of feet and toes.

Appendix 2. Continoued…

						Planar warts)	
			R	Hu Frs	Ex	Ascariasis	Fresh root is pounded and the liquid extract is drunk with honey with coffee cup
			L			Children stomach problems/ache	Fresh leaf is put on fire, warm enouph and kept on the child's stomach.
Crassulaceae	A. Rich.	H	L	Hu Frs	Ex	Stomachache	Fresh leaf is put on fire untill it is warm enough and immediately kept on the stomach of the patient rght around the cord stump, a scar left on the infant's belly after the umbilical cord has been remover right after delivery or birth.
			R	Hu Frs	Ex	Foot problems (Fungal nail, corns & calluses Athlete's foot Planar warts)	Common foot problems (fungal nail infection, corns & calluses, athlete's foot planar warts and the like) that cause severe injuries and warts are treated with root of Chalanchoe species. Fresh root if finely pounded and tied on the affected part of feet and toes.
			R	Hu Frs	Ex	Ascariasis	Fresh root is pounded and the liquid extract is drunk with honey with coffee cup
			L			Children stomach problems/ache	Fresh leaf is put on fire, warm enouph and kept on the child's stomach.
Crassulaceae	A. Rich.	H	L	Hu Frs	Ex	Stomachache	Fresh leaf is put on fire untill it is warm enough and immediately kept on the stomach of the patient rght around the cord stump, a scar left on the infant's belly after the umbilical cord has been remover right after delivery or birth.
Crassulaceae	A. Rich.	H	L	Hu Frs	Ex	Stomachache	Fresh leaf is put on fire untill it is warm enough and immediately kept on the stomach of the patient rght around the cord stump, a scar left on the infant's belly after the umbilical cord has been remover right after delivery or birth.
			R	Hu Frs	Ex	Foot problems (Fungal nail, corns & calluses Athlete's foot Planar warts)	Common foot problems (fungal nail infection, corns & calluses, athlete's foot planar warts and the like) that cause severe injuries and warts are treated with root of Chalanchoe species. Fresh root if finely pounded and tied on the affected part of feet and toes.
			R	Hu Frs	Ex	Ascariasis	Fresh root is pounded and the liquid extract is drunk with honey with coffee cup
			L			Children stomach problems/ache	Fresh leaf is put on fire, warm enouph and kept on the child's stomach.
Asphodelaceae	(Ait.) Kunth	H	R	Hu Frs	Ex	Tumor	Fresh root is roasted in fire or hot ash and tied on the affected body.
						Warts	Fresh root is pounded and tied on the warts.
Asteraceae	Forssk.	H	Lx	Hu Frs	Ex	Hemorrhoids	Fresh latex is rubbed gently on the hemorrhoids.
Asteraceae	(Vahl) Happer & Wood.	H	L	Hu Frs	Ex	BILIC'E	Leaf infusion from the fresh leaf of the plant is applied to the affected part of the eyelid drop by drop.
Lamiaceae	(Burm.f.) Iwarsson	H	L	Hu Frs	Ex/Na	MICHATO	Leaf infusion if taken nasally and the mashed residue is rubbed on the body.
Meliaceae	(Gürke) Leroy	T/S	Fr	Hu Frs/Dr	Orl	Stomachache	About 2-3 fruits are orally taken as tablet following pain.
			L	Hu Fr	Ex/Na	Conjactivitis	Acute stage: leaf from young shoot of the plant is chewed and spited into it. Chronic stage: leaf from young shoot of Lepidotrichilia volkensii and inner part of Erythrina brucei bark are mashed together and taken nasally in the form

Appendix 2. Continoued…

								of smell and small amount the liquid is spited into the eye too.
			Sht	Hu	Frs	Orl	Bloody diarrhea	Young leafy shoots of Lepidotichilia volkensi, Ajuga species, Erythrina brucei and Allophylus abysiinicus are grinded together and prepared into soup. Then depending on age and sex of individuals: childern- one teaspoon, females and elders-1 coffee cup and young adults- 1 glass drunk with honey for 2-3 days.
			L	Hu	Frs	Orl	Stomachache	Fresh leaf is directly chewed.
Brassicaceae	L.	H	Se	Hu	Frs/Dr	Ex/Orl	Stomachache	Leaves together with leaves of Artemisia species, Echnops kebericho, Lepidium sativum, Rosmerinus officinalis, Tagetes minuta, Lippia adoensis are mixed together and used as both medicine and perfume substitute by females.
			Se	H	Dr	Ex/Orl	Canker sore (MICHATO)	When an open, painful mouth ulcer with yellowish or white color surrounded by red inflamed soft tissue is seen on the inside of cheek or lip, seeds of Lepidium sativum are pounded into fine powder applied onto the affected body in the form of water solution untill the sore or the ulcer disappears.
			Se	Hu	Dr	Ex/Orl	Herpes stomatitis MICHATO)	When multiple bilisters on the gums, palate, cheeks, tangue or lip borders are seen causing difficulity of eating, drinking and swallowing due to swollen gums, Seeds of Lepidium sativum are pounded into fine powder applied onto the affected body in water solution.
			Se	Hu	Frs/Dr	Orl	Malaria	Young shoot mixed with Lepidiumsativum seeds and root of Echnops kebericho prepared in the form of soup and eaten with goat meat as an antidote.
			Se	Hu	Dr	Orl	Common cold	Roasted or raw seeds are pounded into powder and prepared into drink.
			Se	An	Dr	Orl	Cattle disease	Roasted or raw seeds are pounded into powder and prepared into drink.
Lamiaceae	Bak.	H	L	H	Frs	Ex/Orl	Canker sore (MICHATO)	When an open, painful mouth ulcer with yellowish or white color surrounded by red inflamed soft tissue is seen on the inside of cheek or lip, leaf of Leucas jamesii is well crushed into fine powder applied onto the affected body in the form of water solution untill the sore or the ulcer disappears.
			L	Hu	Frs	Ex/Orl	Herpes stomatitis MICHATO)	When multiple bilisters on the gums, palate, cheeks, tangue or lip borders are seen causing difficulity of eating, drinking and swallowing due to swollen gums, leaf of Leucas jamesii is well crushed into fine powder applied onto the affected body in water solution.
			L	Hu	Frs	Ex	Eye disease	leaf of Leucas jamesii together with leaf of Isodon schimperi are mashed between pulms of hand and rubed on the affected eye externally.
Linnaceae	L.	H	Se	Hu	Dr	Orl	Constipation	Seed powder is well stirred in a glass of water together with salt and consumed against constipation and any gastrointestinal disordes especiall when a person feels dificality or incomplete defaecation as well as abdominal pain.
			Se	Hu	Dr	Orl	Stomach problems	Used as food aditives or used as a remedy for gastrointestinal problems such as bloating or fulness of stomach and diarrhea.
			Se	An	Dr	Orl	Retained placenta	A glassful of solvent prepared from powdered seeds is mixed with well crushed Urera hypselodendron is given to cattle to expel retained placenta.
Hochst ex Walp. var adoensis Lamiaceae		S	L	Hu	Frs/Dr	Ex/Orl	Stomachache	Leaves together with leaves of Artemisia species, Echnops kebericho, Lepidium sativum, Rosmerinus officinalis, Tagetes minuta, Lippia adoensis are mixed together and used as both medicine and perfume substitute by females.

Appendix 2. Continoued…

Lamiaceae	Sebsebe	S	L	Hu	Frs/Dr	Ex/Orl	Stomachache	Leaves together with leaves of Artemisia species, Echnops kebericho, Lepidium sativum, Rosmerinus officinalis, Tagetes minuta, Lippia adoensis are mixed together and used as both medicine and perfume substitute by females.
Lobeliaceae	Hemsl.	H	WP	B	Frs/Dr	Ex	Cockroaches	Fumigation on fire or charcoal/smoking as insectcockroach repellent
							Stomachache	When there is stomachache followed by bloody diarrhea, young shoot together with young shoot of Maytenus species crushed together, soaked in water and drunk in small amount. Finger strips of little finger is used to measure/determine the dossage. yogurt, honey and bread from red "TEF", Eragrostis tef are used as antidote to prevent the side effect.
			R	Hu	Frs	Orl	Jaundice (T'INBATO)	Root of the plant together with root of Ranunculus multifidus pounded together and drunk againist hepatitis or T'INBATO.
			R	Hu	Frs/Dr	Orl	Common cold	Root together with root of Echnops kebericho, Solanacio gigas, Asparagus, Cirsium dender, Hallea rubrostipulata pounded together, boiled and drunk.
			L	Hu	Frs/Dr	Orl	Amoebiasis	Leaf of Lobelia giberroa together with leaves of Clematis species grinded together. Water concoction of the mixiture is measured with finger strips of little finger and drunk with honey. Care must be taken about dossage.
			L/Sh	Hu	Frs/Dr	Orl	Jaundice (T'INBATO)	Leaf or shoot is mashed squeezed and little finger size of the liquid is drunk. Symptoms: Soon after drinking, vomiting follows indicating relieve of disease.
			Sht	Hu	Frs/Dr	Orl	Malaria	Young shoot mixed with Lepidiumsativum seeds and root of Echnops kebericho prepared in the form of soup and eaten with goat meat as an antidote.
			St	Hu	Frs	Orl	T'INBATO	Shoot preparation is drunk taking care of the dossage.
			L	Hu	Frs	Orl	Jaundice (T'INBATO)	Leaf of Urera hypselodendron are pounded together and the liquid extract is drunk.
			L	An	Frs	Orl	Bloody diarrhea	Leaf of Lobelia giberroa, Pycnostachys abyssinica, Solanacio gigas, wild variety Ensete ventricosum (E'CEMUNDE) and Justicia schimperiana are pounded together and the liquid extract is given to cattle as drink.
			R	Hu	Frs	Ex	Head warts	Roots tips of of Euphorbia ampliphylla, Lobelia giberroa and Ricinus communis are pounded together between clean stones and prepaed and smell from the mixiture is inhaled contineously by hanging in a rolled clothe on the neck region.
			Sht	Hu	Frs	Ex	Earache(any)	Ypung shoot of Lobelia giberroa and Croton macrostachyus are mashed together and fresh liquid is used as ear drop and the solid materia is put in the ear hole.
			L	Hu	Frs	Ex	Ear with pus	Ypung shoot of Lobelia giberroa, Croton macrostachyus and leaf of Bidens ghedoensis are mashed together and fresh liquid is dropped into the affected ear drop by drop untill the pus disappears.
			R	Hu	Frs	Orl	Snake poison (DINGARO)	Root of Setaria megaphylla, root of Dombeya torrida and root of Lobelia giberroa are pounded together and a glassful is drunk. Then the residue is rubbed onto the body of the patient. Note: DINGARO in local language is a type of snake with spots of black/yellowish brown color strip with large head (T'EKERE) believed to very poisonous and hence dangerous snake.
Euphorbiaceae	(Baill.) Sim	T	L	Hu	Frs	Orl	Bloody diarrhea	Young shoot from the leaf is pounded and drunk alone or with MEAD.

Appendix 2. Continoued…

Forssk. Myrsinaceae	T/S	Res	Hu	Frs	Ex	Genital mutilation	During male genital mutilation, the redish liquid exudate from the plant is added to the wound drop by drop. The wound is easily prevented from formation of leisions, inflamation and further infection by pathogens.
		Res	Hu	Frs	Ex	Fire burn	When children are rescued from fire burn, the resin (liquid from the stem) is used used as a first line aid (treatment) for emergency. Act as alchol substitute too.
		Res	Hu	Frs	Ex	Fire burn	When the liquid/resin is put on the affected body (children), colour of the liquid changes to redish (bloody) forming mats on the wound. The wound easily relieve.
		Fr	Hu	Frs/Dr	Orl	Taeniasis	Fruit is eaten either row or boiled to kill and expel the parasite.
L. Malvaceae	H	R	B	Frs	Ex	wound	Root is pounded finely and tied on the affected part of the body to avoid rottening further infection and formation of worms as well as lesion.
		L	An	Frs/Dr	Ex	worm infestation	pounded and applied to wound to preventworms and leisions/ulcers.
Chiov. Sapotaceae	T	Fr	Hu	Frs	Orl	Stomachache	The edible fruits are believed to revive stomach pain/pain killer.
(A. Rich.) Wilczek. Celasteraceae	T/S	L	Hu	Frs	Orl	Tonsilitis	Young shoots from leaf Maytenus species, Pycnostachys species and Dioscorea alata are pounded together and and the liquid is drunk.
		St				Tumour	Young shoots from leaf Maytenus species are pounded and tied on tumour.
		L				warts	Liquid from the fresh leaf is squeezed on oozing warst on the body of patient.
(Welw. ex Oliv.) Exell. Celasteraceae	S/T	L	Hu	Frs/Dr	Orl	Jaundice (T'INBATO)	Leveaves of Pittosporum virdiflorum, Dombeya torrida, Carduus leptacanthus, Maytenus species, Rubus steudneri, Cordia africana(bark), and Asparagus are pounded together with mortar and pistil, soaked in water, decanted then 3 glasses per day (morning-1, noon-1 and night-1) drunk.
		L	Hu	Frs	Orl	Tonsilitis	Young shoots from leaf Maytenus species, Pycnostachys species and Dioscorea alata are pounded together and and the liquid is drunk.
		St				Tumour	Young shoots from leaf Maytenus species are pounded and tied on tumour.
		L				warts	Liquid from the fresh leaf is squeezed on oozing warst on the body of patient.
(A. Rich.) Cuf. Celasteraceae	T/S	L	Hu	Frs/Dr	Orl	Jaundice (T'INBATO)	Leveaves of Pittosporum virdiflorum, Dombeya torrida, Carduus leptacanthus, Maytenus gracilipse, Rubus steudneri, Cordia africana(bark), and Asparagus are pounded together with mortar and pistil, soaked in water, decanted then 3 glasses per day (morning-1, noon-1 and night-1) drunk.
		L	Hu	Frs	Er	Earache	Fresh leaf together with fresh leaf of Clematis species are smashed between pulms, roled with clean cloth and put on the affected ear after releasing the liquid part out. Care must be taken not to insert the liquid drops into the inner as it may severly harm and lead to deafness. Only in the form of smell should the smash be kept on the outer ear. Nothing shoul be inserted into inside. Such treatment is especially for ear disease with pus (abscess).
	S	L	Hu	Frs	Orl	Tonsilitis	Young shoots from leaf Maytenus species, Pycnostachys species and Dioscorea alata are pounded together and and the liquid is drunk.
		St				Tumour	Young shoots from leaf Maytenus species are pounded and tied on tumour.
		L				warts	Liquid from the fresh leaf is squeezed on oozing warst on the body of patient.
(Lam.) Exell. Celasteraceae	S	L	Hu	Frs	Orl	Tonsilitis	Young shoots from leaf Maytenus species, Pycnostachys species and Dioscorea alata are pounded together and and the liquid is drunk.

Appendix 2. Continoued…

		St				Tumour	Young shoots from leaf Maytenus species are pounded and tied on tumour.
		L				warts	Liquid from the fresh leaf is squeezed on oozing warst on the body of patient.
(Thumb.) Blakelock	T	L	Hu	Frs	Orl	Tonsilitis	Young shoots from leaf Maytenus species, Pycnostachys species and Dioscorea alata are pounded together and and the liquid is drunk.
Celasteraceae							
		St				Tumour	Young shoots from leaf Maytenus species are pounded and tied on tumour.
		L				warts	Liquid from the fresh leaf is squeezed on oozing warst on the body of patient.
Ledeb.	H	Fr/L	Hu	Frs/Dr	Orl	Sinus diseases	Fruit and leaf are pounded together and water solution is orally taken.
Fabaceae		Fr/L	Hu	Frs/Dr	Orl	Asthma	Fruit and leaf are pounded together and water solution is nasally inhaled. Well grinded powder is added to Coffee and drunk together.
DC.	H	L	Hu	Frs	Ex	wound	Fresh leaf is smashed finely and tied on the wound to stopp bleeding and further infections during time of emergency when part of a body is suddenly cut with blade or other mechanical injuries.
Asteraceae							
(Lam.) Kuntze	S/Cl	L/Sh	Hu	Frs	Orl/Na	Tonsilitis	Young shoot of the leaf is chewed alone or with salt.
Asteraceae						Headache	Smell from the mashed youg shoot and leaf is inhaled through the nostrills.
(Sch. Bip. ex A. Rich.)M	Cl	Lq	Hu	Frs	Ex	Eye disease	Liquid extract is used as eye drop.
Asteraceae							
(Welw.) C.C.Berg.	T/S	Fr	B	Frs/Dr	Orl	lactation problem	Roastes seeds drunk with coffee to increase lactation in females and cows
Moraceae							Fruit eaten against stomachache
		L	An	Frs/Dr	Orl	Bloody diarrhea	Leaf of Milicia excelsa and fruit of Vepris dainellii are pounded together and given to cattle against bloody diarrhea (BIC'O). Note: "BIC'O" in Shakinano is to mean bloody diarrhea. The reverse is "MAC'EC'ET'O" meaning non bloody diarrhea. Both signs and symptoms have their own traditional dignostics.
		Fr	Hu	Frs/Dr	Orl	Amoebiasis	Two to foour fruits are orally taken directly as tablets.
						Endoparasites	Two to foour fruits are orally taken directly as tablets to kill and expel the parasites
						Any stomachace	Two to foour fruits are orally taken directly as tablets.
(Hochst.) Bak.	T/S	R	Hu	Frs/Dr	Ex/Orl	Tooth carries	Root is chewed and kept on the affected part of tooth
Fabaceae		Bk	B	Frs	Ex	wound	The inner part of the bark is crushed and applied to stop bleeding
		Bk	Hu	Frs/Dr	Orl	Stomachache	The inner part of the bark is chewed and swallowed agaist the pain.
		Fr/L	An	Frs/Dr	Orl	Poisoning	Fish poisoning by sprinkilig the fruit/seeds and leaves into water so that it makes fishing very easiy when the animals loss their balance.
		Bk	Hu	Frs	Ex	sword wound	When a person is suddenly wounded with sword, inner bark is peeled and tied on the affected part of the body or wound.
		Fr	Hu	Frs	Ex	Jiggar flea	Fruit is grinded on stone mixed with fresh butter and used as an ointment on the body. It is used both as preventive and treatment measures.
Schweinf.	H	L	Hu	Frs	Ex/Na	Headache	Smell from fresh mashed leaf is inhaled through the nasal cavity.
Acanthaceae							
Schumach.	Cl	L	Hu	Frs	Ex	wound	Leaf is finely smashed between pulms of hands and the liquid part is squeezed on the wound and the solide remain is tightly tied on it.
Cucurbitaceae							
		L/Fr	Hu	Frs/Dr	Ex	Dyshidrotic Ecz-ema(C'INDO)	Leaf is finely grinded, mixed with fresh butter and used as an ointment on the affected body. Deep infection of the disease is treated with fine grinding the fruit and wiping on the wound or painful bilisters.

Appendix 2. Continoued…

							Blood clotting (spear or arrow poisoning)	When a person is severly injured with arrow/spear, leaf concoction of Momordica foetida is applied to the wound to stop bleeding and further infection of the wond by pathogens. This usually used as line firs aid or emergency service.
			Sht	Hu	Frs	Orl	Tonsilitis	Young shoot of Momordica foetida and Acalypha marissima are mixed and the little finger strip size of the extract is given to children.
			R/L	Hu	Frs	Ex/Orl	wound	Lis mashed (crushed) and tied on the wound.
			R/L	Hu	Frs	Ex/Orl	Jaundice (T'INBATO)	Leaf infusion mixed with root preparations is drunk with coffee cup measured with little finger strip size to maintain proper dossage.
			L/St	Hu	Frs	Orl	Common cold	Leaf is warmed on fire and coffee cup size hot leaf extract is orally taken.
			L	Hu	Frs	Ex	Blood clotting	Leaf extract is dropped on sudden wound to stop bleeding in time of emergency
			L	Hu	Frs	Orl/Ex	Tetanus	When a person is suddenly wounded with rusted iron, leaf extract is taken orally and directly applied to the fresh wond before the pain is deeprooted in the body.
			L	Hu	Frs	Ex	Thyphoid fever	Leaf of Pycnostachys abyssinica, Pycostachys meyeri and Pycnostachys eminii Croton macrostachyus and Momordica foetida are heated together of fire and smoke from the ingridient serves as fumigant to the hoestead to repel the diseases.
Moringaceae	(Bak.f.) Cufod.	T	L	Hu	Frs/Dr	Orl	Any health probler	Eaten row or coocked, alone or mixed with other foods in daily diet.
Cucurbitaceae	(L.) M.J.Roem.	Cl	L	Hu	Frs	Ex	wound	When a person is seedenly injured by sword ("GAJERA", a traditional tool used both for farming as well as a weapon, leaf infusion is applied to the wound.
Solanaceae	L.	H	L	Hu	Frs/Dr	Orl	Stomachache	Yong shoot from the leaf together with that of Ajuga species and Rumex nepalensis root are chewed together with salt and swallowed.
			L	Hu	Frs	Orl	Stomachache	Leaf of Ajuga species, root of Rumex nepalensis, root of Nicotiana tabacum are mixed together and chewed. Ajuga species is also chewed alone with rock salt.
Ranunculaceae	L.	H	Se	Hu	Dr	Orl	Asthma	Added as an ingridient to other spices and condiments for preparation home remedies against couph,sneezing and sniff treatment.
							General treatment	Added as the ingridients of C'EMO preparation against any health disorder.
Lamiaceae	L.	H	L/Fl	Hu	Frs	Orl Na	Stomachache	Preparation from the plant in th form of spice and condiment is added to the daily ditches and eaten. Fresh leaf is smashed and smelled nasal.
						Ex	Skin ointment	Powder from the plant is mixed with butter and used as cosmotics.
			L	Hu	Frs/Dr	Ex/Orl	Stomachache	Leaves together with leaves of Artemisia species, Echnops kebericho, Lepidium sativum, Rosmerinus officinalis, Tagetes minuta, Lippia adoensis are mixed together and used as both medicine and perfume substitute by females.
Lamiaceae	L.	H	L/Fl	Hu	Frs	Orl Na	Stomachache	Preparation from the plant in th form of spice and condiment is added to the daily ditches and eaten. Fresh leaf is smashed and smelled nasal.
							Common cold	Soup prepared from the plant together with other spices is taken oral.
			WP	Hu	Frs/Dr	Orl	Liver disease	Consumed as spice and condiment with dailly ditches/food.
			L	Hu	Frs	Orl	any disease (C'EMO)	Variegated leaves of Coffea arabica, leaf of Ocimum basilicum, whole plant of Ruta chalepensis, whole plant of Cymbopogon saesius, whole plant of Allium sativum, fruits of Coriandrum sativum, whole plant of Foeninculum vulgare, leves of plectranthus barbatus, pounded fruits of Capsicum frutescens and pounded fruits of Capsicum annuum are well mixed together and boiled then

Appendix 2. Continoued…

							a cup full of the hot ingridien is drunk against any health disorders. C'EMO: is a traditional drink by the Sheka ethnic group and it is prepared from a mixiture of plant materials as indicated above. In is not only serve as a medicne for any health disorders but also a food supplement in their dailly ditches. It is believed that when people dailly take "C'EMO"as part of their foodstaff, they become more resitant to disease and any health disorders. Antidots: Milk or honey is used agains side effects if any.
Hochst. ex Benth. Lamiaceae	H/S	L	Hu	Frs	Ex/Orl	Parasites	Fresh leaf is pounded, mixed with water, decanted and drunk with coffee cup to expel intestinal parasites. It is also used against stomachache and diarrhea.
		L	Hu	Frs	Ex/Orl	Ascariasis	Fresh leaf chewed directly and swallowed to kill and expel the parasite.
					Ex/Na	MICHATO	Leaf infusion is taken nasally and in the form of ointment on face and lips.
		L	Hu	Frs	Orl	Endoparasites	Leaf is pounded and soked in water decanted a glassful of the liquid part is drunk. Dossage does not matter age and sex as it is not life threatening.
		L	Hu	Frs	Ex	Cold sores	Leaf is smashed between hand pulms and rubbeded on to the affected body.
		L	Hu	Frs	Ex	Eye disease	Leaf infusionis applied to warts on the eyelids. The liqui is rubbeded on the affected part of the eye.
		L	Hu	Frs	Orl	Ascariasis	Little finger strip size of the leaf extract is given to childeren and for adults, middle finger strip size of the leaf extract is given to expel/kill the parasites.
		L	Hu	Frs	Orl	Stomachache	Fresh leaf is directly chewed or a sniff of leaf infusion is taken orally.
		L	Hu	Frs	Orl	Allergy	Fresh leaf extract is drunk with coffee cup. Inhaled througt noistrills.
		L	Hu	Frs	Orl	Ascariasis	Fresh leaf extract is drunk with coffee cup.
		L	Hu	Frs	Orl/Ex	Eye disease	Fresh leaf is mashed and a sniff of the leaf extract is taken through oral and nasal. The solid residue is rubbeded on the face and neck region of the patient.
Roth Lamiaceae	H/S	L	Hu	Frs	Orl	Endoparasites	Leaf is pounded and soked in water decanted a glassful of the liquid part is drunk. Dossage does not matter age and sex as it is not life threatening.
		L	Hu	Frs	Ex/Orl	Ascariasis	Fresh leaf chewed directly and swallowed to kill and expel the parasite.
		L	Hu	Frs	Ex	Cold sores	Leaf is smashed between hand pulms and rubbeded on to the affected body.
		L	Hu	Frs	Orl	Ascariasis	Little finger strip size of the leaf extract is given to childeren and for adults, middle finger strip size of the leaf extract is given to expel/kill the parasites.
		L	Hu	Frs	Orl	Stomachache	Fresh leaf is directly chewed or a sniff of leaf infusion is taken orally.
		L	Hu	Frs	Orl/Ex	Eye disease	Fresh leaf is mashed and a sniff of the leaf extract is taken through oral and nasal. The solid residue is rubbeded on the face and neck region of the patient.
(Wall. ex G.Don) Cif Oleaceae	T	Wp	Hu	Frs/Dr	Ex	Insect repellent	Steam from the whole plant is used to fumigate the homestead.
(Knobl.) Gilg & Schellenb. Oleaceae	T	WP	Hu	Frs/Dr	Orl	Stomachache	Whole plant is soaked with mead ("TEJI") or local beer ("TELLA") and drunk
		WP	Hu	Frs/Dr	Orl	Thyphoid fever	Smell from any part of the plant is used to treat the patient
		Bk	B	Frs/Dr	Ex	snake repellent	Bark is chopped and added to fire. A smoke released by adding the chopped bark to fire repels snake not to enter the house and harm humans or animals.
		Bk	Hu	Frs	Orl	Ascariasis	Inner bark is carefull peeled without touching with iron. It should be peeled with woog or stone then pounded, rolled in clean cloth or fiber well boiled/coocked mixed with few honey then three coffee cup is taken for three consquetive days.

Appendix 2. Continoued…

			Sht	Hu	Frs	Orl	Toothache	Fresh shoot is well mashed put in clean cloth rolled and pressed on the affected teeth for three days repeatedly until the pain disappears.
			Bk	Hu	Frs/Dr	Orl		Pounded bark is kept on the affected teeth. But not swallowed.
			Bk	Hu	Frs/Dr	Orl	Toothache	Inner part of the bark is pounded together with salt then roasted in fire or hot ash. Then warmed for few minuted and put on the affected teeth.
	Stapf	Cl	Lx	Hu	Frs	Ex	Hemorrhoids	Fresh latex is gently rubbed on the hemorrhoids.
Apocyanaceae								
	Sprague	S	L	B	Frs	Ex	wound	Fresh leaf is smashed, sequeezed and applied to the affected part of body
Flacourtiaceae			R	Hu	Frs	Orl	Diarrhea	Fresh root together with salt is smashed, soaked in water and drunk
	Del.	T	St/B	Hu	Frs/Dr	Ex/Orl	Milk preservative	Bark and splited stem are used for fumigating milk utensils act as preservative
Anacardiaceae							(yogurt)	milk stored in this way is believed to have good taste and it also facilitates yogurt formation.
							Fumigant (Pest repellent)	Split wood and bark are added into fire and used as a fumigant to get ride of insect pests from home. The smoke from the wood also has a pleasant smell that is most preferred by rural dowlers and hence used as a air freshner/sprays substitue to fumigate washed and newly bought clothes before wearing.
	(Schweinf.) R. & A.Fern.	T/S	St/B	Hu	Frs/Dr	Ex/Orl	Milk preservative	Bark and splited stem are used for fumigating milk utensils act as preservative
Anacardiaceae							(yogurt)	milk stored in this way is believed to have good taste and it also facilitates yogurt formation.
							Fumigant (Pest repellent)	Split wood and bark are added into fire and used as a fumigant to get ride of insect pests from home. The smoke from the wood also has a pleasant smell that is most preferred by rural dowlers and hence used as a air freshner/sprays substitue to fumigate washed and newly bought clothes before wearing.
	Cav.	S/H	L/R	An	Frs/Dr	Orl	Cattle diseases	Signs and symptoms: Shivering, deep sleep, dry nose, dry dung, lose of apetite
Malvaceae								Traditiona treatment: Root of Echnops kebericho, fruits of Capsicum species whole plant of Artemesia abyssinica, leaf of Typha latifolia, leeaf of Pycnostachys species, leaf of Ilex mitis, leaf of vernonia species, leaf of Pavonia urens are mixed together, added to fire and smoked to the animal. Again the same mixiture of the plants except Pavonia urens are well pounded together and the liquid extract is given to the animal in the form of drink. This relieves the dry stomch and dung.
Pennisetum thunbergii		H	Sht	Hu	Frs	Orl	Headache	Fresh shoot extract is inhaled through nostrils against headache.
Poaceae			Sht	Hu	Frs	Orl	Tonsilitis	Shoot extract is mixed with milk powder and three spoonful is taken orally.
	(Forssk.) Deflers	H	L	An	Frs	Orl	stomach problem	Fresh leaf is pounded, mixed with water and given to cattle when they eat
Rubiaceae								non digestable plastic bags retained in their stomach to expel it immediately
			L	An	Frs	Orl	Cow diseases	Fresh leaf is pounded on stone and given to cows.
	(A. Rich.) Vatke	H	L	An	Frs	Orl	stomach problem	Fresh leaf is pounded, mixed with water and given to cattle when they eat
Rubiaceae			L	An	Frs	Orl	Cow diseases	Fresh leaf is pounded on stone and given to cows.
	(L.f.) A.Dietr.	H	WP	Hu	Frs	Orl	Stomachache	pounded, soaked in water and drunk with coffee cup
Piperaceae				Hu	Frs	Orl	Stomachache	Fresh plant together with root of Brucea and salt is chewed.
				Hu	Frs	Orl	Common cold	Pounded, boiled in water and drunk.
			Wp	Hu	Frs	Orl	Stomacache	Clean plant is directly chwed following sever pain.

Appendix 2. Continoued…

			R	Hu Frs	Orl	Bloating	Root is chewed with salt against bloating or stomach fullness.
			Sht	Hu Frs	Ex	KOSHKOSHE	Young shoot of Ricinus communis, leaf of Peperromia retusa and leaf of Croton macrostachyus are pounded together bind/rolled with fresh leaf put in fire or hot ash then after few minutes it is taken out and put on the affected part of the body usually fingers and toes. Then the pain relieves.
			Sht	Hu Frs	Orl	Amoebiasis	Fresh plant is directly chewed with salt and swallowed
			L	Hu Frs	Ex	Ear pus	Fresh leaf is mashed and the liquid extract is used as ear drop.
			WP	Hu Frs	Ex	Acne/ skin warts	Leaf of Setaria megaphylla, leaf of Aframomum corrorima and whole plant of Peperomia retusa are mashed together and gently rubbed on the affected skin.
Cucurbitaceae	(Hook.f.) Engl.	Cl	Fr	Hu Frs	Orl	Gastritis	Fruit is eaten either raw or coocked.
			Fr	Hu Frs	Orl	Endoparasites	Fruit is eaten either raw or coocked. Raw is preferred for total removeal of endoparasites from the gastrointestinal tarct.
			L	Hu Frs	Orl	Amoebiasis	Leaf grinded together with leaf of Peponium vogelii, Vernonia amygdalina and rhazom of Aframomum corrorima well coocked and eaten.
			Fr	Hu Frs	Orl	Gastritis	Row fruit is eaten as dailly food gainst gastritis
			Fr	Hu Frs	Orl	Stomach parasites	Row fruit is eaten as dailly food gainst gastrointestinal parasites.
			St	Hu Frs	Orl	Stomachache	Stem of the climbing lian of Peponium vogelii is chewed and swallowed.
			Fr	Hu Frs	Orl	Retained placenta	Fresh fruit is well peeled and the inner portionis eaten row to expel placenta.
			Fr	B Frs	Orl	Retained placenta	Fresh fruit is well peeled and the inner portionis eaten row to expel placenta.
Lauraceae	Mill.	T	L	Hu Frs/Dr	Ex	Dandruff	Fresh or dry leaf is pounded and rubbed on the head after removing the hair.
			Fr	Hu Frs	Ex	Dandruff	Ripe fruit is used as an ointment or hair cosmotic directly.
Polygonaceae	(Meisn.) Miyabe	H	L	Hu Frs	Orl	Gastritis	Leaf from young shoots of Alchemilla species together with leaf from young shoots of persicaria species pounded together. The jelly liquid extract from the two ingridients looks like honey and it is taken orally. Since the ingridient has no any side effects, no need of worrying about dosage.
			L	Hu Frs	Orl	T'INBATO	Leaf together with leaves of Pittosporum virdiflorum and leaves of Solanacio manii are pounded together mixed with boiling milk and drunk.
			Wp	An Frs	Ex	Breast wound	Concoction of the plant is applied to breast wound in cows.
Polygonaceae	(Meisn.) Soják	H	L	Hu Frs	Orl	Gastritis	Leaf from young shoots of Alchemilla species together with leaf from young shoots of persicaria species pounded together. The jelly liquid extract from the two ingridients looks like honey and it is taken orally. Since the ingridient has no any side effects, no need of worrying about dosage.
			Wp	An Frs	Ex	Breast wound	Concoction of the plant is applied to breast wound in cows.
Polygonaceae	(A. Rich.) K.L.Wilson	H	L	Hu Frs	Orl	Gastritis	Leaf from young shoots of Alchemilla species together with leaf from young shoots of persicaria species pounded together. The jelly liquid extract from the two ingridients looks like honey and it is taken orally. Since the ingridient has no any side effects, no need of worrying about dosage.
			L	Hu Frs	Orl	T'INBATO	Leaf together with leaves of Pittosporum virdiflorum and leaves of Solanacio manii are pounded together mixed with boiling milk and drunk.
Fabaceae	L.	Cl	Se	Hu Dr	Orl	Bloody diarrhea	Seed is roasted, grounded finely and the powder is eaten.

Appendix 2. Continoued…

Arecaceae	Jacq.	T/S	St/R	Hu Frs	Orl	Hunger	The rhazomatous part of the plant is just processed as Ensete ventricosum and used as famine food dooring the time of emergency.
Phytolacaceae	L'Hèrit.	S/Cl	L R	Hu Frs	Orl	Rabies	Fresh root and leaf of Phytolacca dodecandra and Ricinus communis are pounded together and finger strip of the preparation is dtaken against rabies. Milk is used as antidote against severe side effects.
			R	Hu Frs/Dr	Orl	Gonorea	The whitish part of the root is pounded in mortar and finger strip of littile finger or finger nail depending on sex and age of the individual is taken. Antidote: milk, honey or meat soup used against severe side effects. Local beer "TELA" is used as a supplement for drinkink the preparation and and bread of red "TEF" or Eragrostis tef is eaten as antidote in this case.
						Eczema	Fresh leaf or fruit is pounded finely and used as washing powder for the affected part of the body. Eczema signs and symptoms: dry itchy spots on the body with flaky inflamed, inflamed skin. The small upraised bumps ooze fluid
			L	Hu Frs/Dr	Orl	Jaundice	Jaundice locally known as "T'INBATO" : Leaf of Croton together withleaf of Phytolacca dodecandra are pounded together roled and put in fire to warmth the warm material externally kept on the affected organs of the patient.
			R	Hu Frs/Dr	Ex	Dyshidrotic Ecz-ema(C'INDO)	Root is fine pounded and rubbeded on the affected part of the body "C'INDO": Fluid filled, itchy bilisters on fingers, toes, hands or feet that will eventually turn to skin cracks after several weeks of drying.
			L	Hu Frs	Ex	Insect bite (KOSHKOSHE)	Leaf of Acanthus eminens and leaf of Phytolacca dodecandra are grinded together finely rolled and roasted in fire or ho ash and then tied to the affected part of the body ususally fingers, toes and nails. Note: The insect commonly known as "KOSHKOSHE" in local language is very dangerous and poisonous. A person biten by the insect may phase the probability of losing his attacked organ if not treated immediately. The color of the poisonous insect is black or red. Habitat is in a well ploughed dusty soil or in stems of Ricinus communis. It belongs to the Coleoptera Order of insects commonly known as beetles.
			L	Hu Frs/Dr	Orl	Jaundice (T'INBATO)	Leaf is pounded or finely grinded and theliquid extract is measured with little finger strip size and drunk. Antidote: Red teff bread is eaten immediately.
			R	Hu Frs/Dr	Orl	Stomachache	Little finger strip size of root is pounded and coffee cup of root extract is drunk.
			R	Hu Frs	Orl	Rabies	Root of Phytolacca dodecandra and root of Justicia schimperiana are pounded together and litle finger strip size of the mixiture is drunk. Antidote: Teff bread is eaten following the drink. Milk is also drunk under extreme causes/symptoms.
			R	Hu Frs	Orl	Tumor	Root of Phytolacca dodecandra and root of Croton macrostachyus are pounded together and litle finger strip size of the mixiture is drunk. Antidote: Frsh milk should be drunk as antidote to prevent severe side effects.
			R	Hu Frs	Orl	T'INBATO	Root and leaf of Carduus leptacanthus, bark of Cordia africana, root of Phytolacca dodecandra, and bark of Galinerea saxifraga are pounded together, boiled. Based on age and sex of individuals, the mixiture is drunk measured with glass, coffee cup or finger strip size. Fresh milk is used as an antidote against severe side effect
			R	Hu Frs	Orl	Rabies	Root is pounded and the extract is drunk. Milk is used as an antidote.

Appendix 2. Continoued…

	L.f.	H	WP	Hu	Frs/Dr	Orl	Common cold	Plant mixed with preparations from Hallea and Brucea and drunk.
Piperaceae			WP	Hu	Frs/Dr	Orl	Breast pain	When females breast pain right after giving birth to their baby, the whole olant is well coocked alone then cooled over night. Then early in the morning, it is with fresh milk or honey and drunk empty stomach every six hours interval for two consquetive days. This also improves lactation of the mother.
	L.	H	WP	Hu	Frs/Dr	Orl	Common cold	Plant mixed with preparations from Hallea and Brucea and drunk.
Piperaceae			WP	Hu	Frs/Dr	Orl	Breast pain	When females breast pain right after giving birth to their baby, the whole olant is well coocked alone then cooled over night. Then early in the morning, it is with fresh milk or honey and drunk empty stomach every six hours interval for two consquetive days. This also improves lactation of the mother.
	Sims	T/S	L	An	Frs	Orl	Retained placenta	Pounded, soaked in water and given to cows to expel retained placenta
Pittosporaceae			L R Bk	An	Frs	Orl	Retained plastic	Root and leaf together the inner part of bark are pounded together, mixed with water and given to cattle to expel rtained plastic bags or any non-digestable materials eaten by animals
			L	Hu	Frs/Dr	Orl	Jaundice (T'INBATO)	Leveaves of Pittosporum virdiflorum, Dombeya torrida, Carduus leptacanthus, Maytenus gracilipse, Rubus steudneri, Cordia africana(bark), and Asparagus are pounded together with mortar and pistil, soaked in water, decanted then 3 glasses per day (morning-1, noon-1 and night-1) drunk.
			L	Hu	Frs	Orl	T'INBATO	Leaf together with leaves of Persecaria senegalensis and leaves of Solanacio manii are pounded together mixed with boiling milk and drunk.
			Bk	Hu	Frs	Orl	Stomachache	Pounded inner bark is prepared into soup and drunk.
			St	Hu	Frs	Orl	Ascariasis	Fresh meat is roled on wet/fresh stem of ittosorum virdiflorum and fried. In doing so, water in the stem is pulled into the fried meat and incorporated. When meat fried this way is eaten, it kills and expells the parasite out of gastrointestine soon.
Plantaginaceae	Verdc	H	L	Hu	Frs	Orl	Snake poison (DINGARO)	Fresh leaf is pounded and drunk against snake poisoning.
Plantaginaceae	L.	H	L	Hu	Frs	Ex	Wound	Fresh leaf is mashed and tied onto the wound. The liquid extract from the fresh leaf also dropped on the fresh wound to stopp bleeding.
			L	Hu	Frs	Ex	Wound	When a knife blade suddenly cuts a person, leaf is mashed and tied on wound.
	Hook.f.	H	L/R	Hu	Frs	Orl	Snake bite	Plant extract is drunk. It is also squeezed directly onto the affected organ.
Plantaginaceae			L	Hu	Frs	Orl	Snake poison	Fresh leaf is pounded and drunk against snake poisoning.
Lamiaceae	Andrews	H	L	Hu	Frs	Ex/Orl Na	MICHATO	Leaf is smashed between pulms of hands finely and smelled. The liquid from leaf infusion is taken either nasal in small drops or oral with coffee cup.
						Ex	BILIC'E	2-3 Drops from leaf infusion are applied to treat BILI'CE, a pusy spot on the eyelids with cutanous inflamation on the eye and its surrounding.
			L	Hu	Frs	Orl	any disease (C'EMO)	Variegated leaves of Coffea arabica, leaf of Ocimum basilicum, whole plant of Ruta chalepensis, whole plant of Cymbopogon saesius, whole plant of Allium sativum, fruits of Coriandrum sativum, whole plant of Foeninculum vulgare, leves of plectranthus barbatus, pounded fruits of Capsicum frutescens and pounded fruits of Capsicum annuum are well mixed together and boiled then a cup full of the hot ingridien is drunk against any health disorders.

Appendix 2. Continoued…

							C'EMO: is a traditional drink by the Sheka ethnic group and it is prepared from a mixiture of plant materials as indicated above. In is not only serve as a medicne for any health disorders but also a food supplement in their dailly ditches. It is believed that when people daily take "C'EMO"as part of their foodstaff, they become more resitant to disease and any health disorders.
							Antidots: Milk or honey is used agains side effects if any.
		L	Hu	Frs/Dr	Orl	Common cold	When a person is sick severe common cold, the plant is boiled with coffee and drunk. It is also among the ingredients of C'EMO, universal medicine.
Benth.	H	L	Hu	Frs	Ex	MICHATO	Fresh leaf is mashed and rubbed on the body of the patient. Smell from the fresh plant is inhaled through the nasal cavity.
(Thumb.) R.B. ex. Mirb. Podocarpaceae	T	Bk	Hu	Frs/Dr	Orl	Warts	Bark is well pounded soaked in water squeezed and the liquid ingredient is drunk with honey, mead or TELLA.
(Hiern) Harms Araliaceae	T	Res	Hu	Frs	Ex	Ear pus	When ear pain followed by pus, the liquid exudate from the plant or leaf infusion is dropped into the affected ear.
(Hook.f.) Kalkm. Rosaceae	T	Bk	Hu	Frs/Dr	Or	T'INBATO (Jaundice)	Inner part of bark is pounded, added to boiling water. A coffee cup per day for three consequetive days is drunk with honey or alone.
							T'INBATO is a kind of varial disease characterized by yellowish diarrhea.
		Bk	Hu	Frs/Dr	Orl	Diarrhea	Pounded/crushed between pulms and the liquid preparation is orally taken
		L	Hu	Frs	Orl	Diarrhea	with honey, milk or mead as antidotes for 2 consequetive days or more.
							Dossage: Finger strip of little finger or finger nail is used to determine.
		Bk	Hu	Frs/Dr	Orl	Stomachache	When faeces mixed with blood is seen following severe stomachache, inner bark is finely pounded, squeezed with clean cloth and drunk.
						Parasites	Bark is pounded and the powder is eaten together with raw meat.
		Bk	Hu	Dr	Or	T'INBATO (Jaundice)	Dry bark of Prunus africana is pounded into fine powder and eaten together with dailly food taking care of dossage.
		Bk/I	Hu	Fr/Dr	Orl	Amoeba	Bark and leaf are pounded togethre and eaten with goat meat as antidote.
		Sht	Hu	Frs	Orl	Amoeba	Young shoot of the plant is chewed and swallowed against amoebic dysentry.
						Liver disease	Young shoot of the plant is chewed and swallowed against liver problems.
		Bk	Hu	Dr	Orl	wound	Dried inner bark is well pounded and the powder is sprinkled onto the wound.
		Bk	Hu	Dr/Frs	Orl	Bloody diarrhea	Little finger strip size of pounded inner bark is drunk alone.
		BK	An	Dr/Frs	Ex	horse wound	Pouder from pounded bark is sprinkled on the wound.
		Bk	Hu	Dr/Frs	Orl	Jaundice	Small piece of bark is chewed directly.
		Bk	B	Frs/Dr	Ex	wound	Powder from grinded/pounded bark is applied to the wound.
		Bk	Hu	Frs/Dr	Orl	Bloody diarrhea	Bark is pounded and litle finger strip size of the preparation is drunk with coffee cup or alcohlic beverage/local gin (AREKE) cup.
Fresen.	H	L	Hu	Frs	Ex/Na	MICHATO	Leaf infusion is taken nasal and also wiped on the face and head of patient.
Lamiaceae					Orl	Stomachache	Small amount of leaf infusion is taken oral with coffee cup
		L	Hu	Frs	Orl	Schistosomiasis	Inner bark ispounded bioled with honey and finger strip of little finger is taken orally against bloody urine.
		L	Hu	Frs	Ex	Musculoskeletal	Leaf is heated on fire and the affected organ is soozed with the warm leaf.
		L	An	Frs	Ex	Musculoskeletal	The leaf is added to fire and the animal is fumigated with the smoke.

Appendix 2. Continoued…

			L	Hu	Frs/Dr	Ex	common cold Thyphoid fever	Leaf or inner bark of Croton together with leaves of Pycnostachys abyssinica, Pycnostachys eminii, Pycnostachys meyeri, Clausena anisata and Dombeya torrida are usted as steam treatment after boiling together. The warm liquid from the boiled mixiture is also sprayed on the body of the patient.
			L	Hu	Frs/Dr	Orl	Bllody diarrhea (BIC'O)	Leaf concoction is drunk with pasturized/boiled milk as antidote. Dossage: Little finger sized is measured in coffee cup for adults, teaspoonful for children.
			L	Hu	Frs	Ex	Headache	Smoke from the leaf is fumigated in the homestead. Fresh leaf mashed between pulms of hands and put in the nostrils.
			L	Hu	Frs	Na	Thyphoid fever	Leaf infusion is nasally taken. Smell from the leaf is also a remedy for thyphoid.
			L/Sh	An	Frs	Orl	Diarrhea	Plant materials from Pycnostachys abyssinica, Croton macrostachyus and Justicia schimperiana are pounded together and given to cattle as feed or drink.
			R	An	Frs/Dr	Orl	Cattle diseases	Signs and symptoms: Shivering, deep sleep, dry nose, dry dung, lose of apetite Traditiona treatment: Root of Echnops kebericho, fruits of Capsicum species whole plant of Artemesia abyssinica, leaf of Typha latifolia, leeaf of Pycnostachys species, leaf of Ilex mitis, leaf of vernonia species, leaf of Pavonia urens are mixed together, added to fire and smoked to the animal. Again the same mixiture of the plants except Pavonia urens are well pounded together and the liquid extract is given to the animal in the form of drink. This relieves the dry stomch and dung.
			L	Hu	Frs	Ex	Thyphoid fever	Leaf of Pycnostachys abyssinica, Pycostachys meyeri and Pycnostachys eminii Croton macrostachyus and Momordica foetida are heated together of fire and smoke from the ingridient serves as fumigant to the hoestead to repel the diseases.
			L	Hu	Frs	EX	Headache	Fresh leaf is put on fire for few minutes remover and put on patient's body.
	Gürke	H	L	Hu	Frs	Ex/Na	MICHATO	Leaf infusion is taken nasal and also wiped on the face and head of patient.
Lamiaceae						Orl	Stomachache	Small amount of leaf infusion is taken oral with coffee cup
			L/R	Hu	Frs/Dr	Orl	Rabies	Leaf infusion and together with pounded roout is taken orally.
			L	Hu	Frs/Dr	Ex	common cold Thyphoid fever	Leaf or inner bark of Croton together with leaves of Pycnostachys abyssinica, Pycnostachys eminii, Pycnostachys meyeri, Clausena anisata and Dombeya torrida are usted as steam treatment after boiling together. The warm liquid from the boiled mixiture is also sprayed on the body of the patient.
			L	Hu	Frs	Ex/Na	Headache	Fresh leaf is mashed between pulms of hands and inserted into the nostrills and the smell is inhaled into the nasal cavity.
			L	Hu	Frs	Ex	Thyphoid fever	Leaf of Pycnostachys abyssinica, Pycostachys meyeri and Pycnostachys eminii Croton macrostachyus and Momordica foetida are heated together of fire and smoke from the ingridient serves as fumigant to the hoestead to repel the diseases.
	Gürke	H	L	Hu	Frs	Ex/Na	MICHATO	Leaf infusion is taken nasal and also wiped on the face and head of patient.
Lamiaceae						Orl	Stomachache	Small amount of leaf infusion is taken oral with coffee cup
			L/R	Hu	Frs/Dr	Orl	Rabies	Leaf infusion and together with pounded roout is taken orally.
			L	Hu	Frs/Dr	Ex	common cold Thyphoid fever	Leaf or inner bark of Croton together with leaves of Pycnostachys abyssinica, Pycnostachys eminii, Pycnostachys meyeri, Clausena anisata and Dombeya torrida are usted as steam treatment after boiling together. The warm liquid from the boiled mixiture is also sprayed on the body of the patient.

Appendix 2. Continoued…

			L	Hu	Frs	Ex/Na	Headache	Fresh leaf is mashed between pulms of hands and inserted into the nostrills and the smell is inhaled into the nasal cavity.
			L	Hu	Frs	Ex	Thyphoid fever	Leaf of Pycnostachys abyssinica, Pycostachys meyeri and Pycnostachys eminii Croton macrostachyus and Momordica foetida are heated together of fire and smoke from the ingridient serves as fumigant to the hoestead to repel the diseases.
	Forssk.	H	Fr	Hu	Frs	Orl	Stomachache	Two fruits are chewed at a time in case of severe stomacache.
Ranunculaceae			R	Hu	Frs	Orl	T'INBATO	Root of Lobelia giberroa the together with root of Ranunculus multifidus pounded together and drunk againist hepatitis or T'INBATO.
			L	Hu	Frs	Ex	Wound	Fresh leaf is mashed between thumbs and tied on the wound.
			L	Hu	Frs	Ex	Warts	Leaf extract is sprayed on the exposed mouth/scratched part of the wart.
			L	Hu	Frs	Ex/Na	Headache	Fresh leaf of Amaranthus species together with leaf of Ranunculus multifidus are mashed together and the smell is inhaled through nostrills.
			L	Hu	Frs	Ex	Hemorrhoids	Fresh leaf is mashed and tied on the hemorrhoids.
			L	Hu	Frs	Orl	Tumor	Leaf extract is drunk with hone. Fresh root is chewed with salt.
	L'Herit.	S	L/Fr	Hu	Frs/Dr	Ex	Dandruf(Fungal)	Fruit and leaf are pounded together and used as ointment for affected body
Rhamnaceae			Fr	Hu	Frs	Ex	Ring worm	Unripe (redish) fruit of Phmnus prinoides is pounded and wipe on affected body.
		L.H	L	Hu	Frs	Orl	Rabies	Fresh root and leaf of Phytolacca dodecandra and Ricinus communis are pounded together and finger strip of the preparation is dtaken against rabies. Milk is used as antidote against severe side effects.
Euphorbiaceae			R					
			R	Hu	Frs	Ex	Head warts	Roots tips of of Euphorbia ampliphylla, Lobelia giberroa and Ricinus communis are pounded together between clean stones and prepaed and smell from the mixi-ture is inhaled contineously by hanging in a rolled clothe on the neck region.
			Sht	Hu	Frs	Ex	KOSHKOSHE	Young shoot of Ricinus communis, leaf of Peperromia retusa and leaf of Croton macrostachyus are pounded together bind/rolled with fresh leaf put in fire or hot ash then after few minutes it is taken out and put on the affected part of the body usually fingers and toes. Then the pain relieves.
			R	Hu	Frs	Orl	Malaria	Root of Ricinus communis, root of Croton macrostachyus, bark of Schefflera volkensii, root of Asparagus species are pounded together, squeezed in coffee cup and drunk three times a day. Antidote: Dry liver of sheep or any cattle is eaten right after the third dossage. Liver should be ready dry ahead of time.
Lamiaceae		L.S	L	Hu	Frs/Dr	Ex/Orl	Stomachache	Leaves together with leaves of Artemisia species, Echnops kebericho, Lepidium sativum, Rosmerinus officinalis, Tagetes minuta, Lippia adoensis are mixed together and used as both medicine and perfume substitute by females.
Rutaceae	(Hiern) Robyns	S/T	L	Hu	Frs/Dr	Orl	Paralysis (K'ORSO)	Bark of Hallea rubrostipulata, leaf of Capsicumfrutescens, and leaf of Rothmannia urcelliformis are pounded together and a glass of the mixiture is drunk with MEAD dossage does not matter and the patient can continou until he relieves. Note that in local language, K'ORSO means a type of disease paralysing the leg extremities.
Rosaceae	Pior.	Cl	L	Hu	Frs/Dr	Orl	Jaundice (T'INBATO)	Leveaves of Pittosporum virdiflorum, Dombeya torrida, Carduus leptacanthus, Maytenus gracilipse, Rubus steudneri, Cordia africana(bark), and Asparagus are pounded together with mortar and pistil, soaked in water, decanted then 3 glasses per day (morning-1, noon-1 and night-1) drunk.

Appendix 2. Continoued…

Polygonaceae	Jacq.	H	R	Hu	Frs/Dr	Orl	T'INBATO	Root of Rumex abyssinicus is pounded together with leaf of Lobelia giberroa and water extract is drunk.
			R	Hu	Frs	Orl	Hypertension	Fruit of Embelia schimperi together with whole plant of Ruta chalepensis and root of Rumex abyssinicus are pounded together and the water extract is drunk with honey or any appropriate drink.
Polygonaceae	Spreng.	H	R	Hu	Frs	Orl	Stomachache	Fresh root together with salt is chewed against stomachache.
							Abortion	Culturally, illegal abortion is performed by cuting the root of Rumex nepalensis peeling away its bark/sheath and inserting into the female genital to terminate. pregnancy. This is dangerous experience since even it is life threatenig.
			R	Hu	Frs	Orl	Vomitting	Root is peeled and the inner clean part is chewed and swallowed.
			R	Hu	Frs	Orl	Toothache	Fresh root is chewed against toothache.
			R	Hu	Frs	Orl	Ascariasis	Children: Root is fine grinded, added to fresh butter and given taking care of dossage, ussully finger strip of little finger. Butter is an antidote. Adults: Root is directly chewed with Ethiopian roack salt ("AMOLE").
			L	Hu	Frs/Dr	Orl	Stomachache	Yong shoot from the leaf together with that of Ajuga species and Rumex nepalensis root are chewed together with salt and swallowed.
			L	Hu	Frs	Ex	Antidote	When a person is in close contact with the excessive latex from Ficus sur or Euphorbia ampliphylla while working, leaf extract of Rumex nepalensis is rubbeded on the body before coming in contact with the latex. This is because the excess latex may severly harm human skin if care is not taken.
			L	Hu	Frs	Orl	Stomachache	Leaf of Ajuga species, root of Rumex nepalensis, root of Nicotiana tabacum are mixed together and chewed. Ajuga species is also chewed alone with rock salt.
			L	Hu	Frs	Ex	wound	Fresh leaf is mashed and tied on wound due to sudden blade cut to stop bleeding and further infection by microbes.
Rutaceae	L.	H	WP	Hu	Frs/Dr	Ex/Orl	Evil eye	The whole plant is pounded either fresh or dry and the smell from the preparation is used. Concoction from the plant is also taken oral.
							Stomachache	Preparation from the plant is eaten/chewed alone or together with other spices and condiments against various stomach aliments.
							Abdominal pain	The whole plant is soaked in warm water over night and infusion of the liquid is used to wash the affected part of the body especially female genital.
			WP	Hu	Frs	Orl	any disease (C'EMO)	Variegated leaves of Coffea arabica, leaf of Ocimum basilicum, whole plant of Ruta chalepensis, whole plant of Cymbopogon saesius, whole plant of Allium sativum, fruits of Coriandrum sativum, whole plant of Foeninculum vulgare, leves of plectranthus barbatus, pounded fruits of Capsicum frutescens and pounded fruits of Capsicum annuum are well mixed together and boiled then a cup full of the hot ingridien is drunk against any health disorders. C'EMO: is a traditional drink by the Sheka ethnic group and it is prepared from a mixiture of plant materials as indicated above. In is not only serve as a medicne for any health disorders but also a food supplement in their dailly ditches. It is believed that when people dailly take "C'EMO"as part of their foodstaff, they become more resitant to disease and any health disorders.

Appendix 2. Continoued…

							Antidots: Milk or honey is used agains side effects if any.
		WP	Hu	Frs	Orl	Hypertension	Fruit of Embelia schimperi together with whole plant of Ruta chalepensis and root of Rumex abyssinicus are pounded together and the water extract is drunk with honey or any appropriate drink.
		WP	Hu	Frs/Dr	Orl	Stomachache	If the plant is chewed alone or together with salt, it relieves stomach problems.
Jacq. Lamiaceae	H	L	Hu	Frs	Na	MICHATO	Fresh leaf extract is taken through the nasal cavity. And the residue is rubbed onto the body of the patient.
(Krauss) Pax Euphorbiaceae	T	Lx	Hu	Frs	OrL	Tooth carries	Latex is directly applied to the affected teeth.
(Vatke) Engl. Ex Seybold Lamiaceae	H	R/L	Hu	Frs/Dr	Orl	Resparatory or Cardiac problems	When symptom of boody sputum is seen on a patient, a mix of preparations from Stephania cyanatha, Satureja paradoxa and Vernonia amygdalina is together with pasturized milk is drunk. The milk act as antidote against side effects.
		L	Hu	Frs/Dr	Orl	Gastritis	Mixed with boiled milk and drunk.
(Martyn) Raf. Amaryllidadeae	H	R	An	Frs	Ex	worm infestation	when body of animals is infeted with worms uauslly following sever injuries or dermal infections, the root is finely grinded and applied to eliminate the worms or can also be used as a pre-treatement to avoide worm infestation.
(Friis & I.Bjørnstad) Friis & Norc Amaryllidadeae	H	R	An	Frs	Ex	worm infestation	when body of animals is infeted with worms uauslly following sever injuries or dermal infections, the root is finely grinded and applied to eliminate the worms or can also be used as a pre-treatement to avoide worm infestation.
(Hochst. Ex A. Rich.) Harms	T	Bk	An	Frs/Dr	Orl	Animal fatening	Bark is prepared as animal feed and fodder for fatenig and good quality milk.
Araliaceae		Bk	An	Frs/Dr	Orl	Endoparasites	Inner bark is kept on fire overnight, cooled, pounded together with salt then given to animals as feed or fodder. It also used for fattening animals. Similar preparation is also available in the liquid form for drinking.
		Bk	An	Frs/Dr	Oral	Endoparasites	Bark is prepared as animal feed and fodder and given against thining of animals
		L	Hu	Frs	Orl	Gonorrhea	Leaf together with leaves of Vernonia hochestateri and leaves of Malva verticilata are pounded togetrher squeezed, mixed with milk and eaten together with red teff bread as an antidote.
		Bk	Hu	Frs	Orl	Toothache	Inner bark is chewed by the affected teeth.
(Engl.) Harms Araliaceae	T	L	An	Frs	Orl	Hourse disease	Fresh leaves together with 12 other medicinal plant species such as Ilex mitis, Scheflera volkensii, Carduus are crushed together and given to hourses. HOURSE DISEASE: Progressive weight loss and thinning of hourses which finally leads to death of the animal if not properly treated early.
		L	An	Frs/Dr	Orl	Paralysis of limbs	Leaf is pounded with mortar and pistile and given as animal feed or fodder.
		Bk	Hu	Frs	Orl	common warts	Barks of Ilex mitis Scheflera volkensi and Hallea rubrostipullata are pounded together in mortar, boiled until it is well cooked with honey then drink.
		R	Hu	Frs	Orl	Malaria	Root of Ricinus communis, root of Croton macrostachyus, bark of Schefflera volkensii, root of Asparagus species are pounded together, squeezed in coffee cup and drunk three times a day. Antidote: Dry liver of sheep or any cattle is eaten right after the third dossage. Liver should be ready dry ahead of time.
(Steud.) Th. Dur. & Schinz Poaceae	H	R	Hu	Frs/Dr	Ex	Snake poison	Roots of Dombeya torrida, Galinerea saxifraga, Setaria megaphyla, Stephania abyssinica, Echnops kebericho are pounded together and the mix

Appendix 2. Continoued…

								is rubbed on the body of the patient. This works only if the intensity of poison ing is by breathe rather than biting. "FUSHO": A type of snake that release pousonous breathe as defense.
			R	Hu	Frs/Dr	Ex	Snake poison (FUSHO)	Root of Setaria megaphylla together with young shoot of Dombeya torrida are pounded together and rubbeded on the affected body of the patient.
			R	Hu	Frs/Dr	Ex	Snake poison (FUSHO)	Root of Echinops kebericho together with root of Setaria megapylla are chewed together and spited on the affected part of the body of the patient.
			R	Hu	Frs	Orl	Snake poison (DINGARO)	Root of Setaria megaphylla, root of Dombeya torrida and root of Lobelia giberroa are pounded together and a glassful is drunk. Then the residue is rubbeded on the body of the patient. Note: DINGARO in local language is a type of snake with spots of black/yellowish brown color strip with large head (T'EKERE) believed to very poisonous and hence dangerous snake.
			L	Hu	Frs	Ex	Acne/ skin warts	Leaf of Setaria megaphylla, leaf of Aframomum corrorima and whole plant of Peperomia retusa are mashed together and gently rubbed on the affected skin.
	Hochst. Ex A. Rich.	H	L	B	Dr	Ex	wound	Dry powder of the leaf is applied to the affected part of the body
Malvaceae								
	(Vatke) C.Jeffrey	S/T	R	Hu	Frs/Dr	Orl	Common cold	Root together with root of Echnops kebericho, Solanacio gigas, Asparagus, Cirsium dender, Hallea rubrostipulata pounded together, boiled and drunk.
Asteraceae								
			L	An	Frs	Orl	Bloody diarrhea	Leaf of Lobelia giberroa, Pycnostachys abyssinica, Solanacio gigas, wild variety Ensete ventricosum (E'CEMUNDE) and Justicia schimperiana are pounded together and the liquid extract is given to cattle as drink.
			R	Hu	Frs/Dr	Orl	Back pain/spinal p	Root of Solanacio gigas, bark of Ekebergia capensis and root of Asparagus species are pounded together mixed with honey comb and eaten.
	(Hook.f.) C.Jeffrey	S	L	Hu	Frs	Orl	T'INBATO	Leaf together with leaves of Pittosporum virdiflorum and leaves of Persecaria senegalensis are pounded together mixed with boiling milk and drunk.
Asteraceae								
	Lam.	S/H	Fr	Hu	Frs	Orl	Eye disease	When a person is sick eye ilness, nine fruits of Solanum anguivi are swallowed at a time just as tabletes. It can also serve as best prophylaxis if taken ahead of any eye health disorers or ilness for prevention. The fruits also used as a vaccine.
Solanaceae								
			Fr	Hu	Frs	Orl	eye vaccine	About nine fruits are taken at a time as a vaccine against eye diseaes.
	L.	S	Fr	Hu	Frs	Orl	Tonsilitis	Juice from the fruit is squeezed 3-4 drops into the throat against tonsilitis.
Solanaceae								
	L.f.	S	Fr	Hu	Frs	Orl	Tonsilitis	Liquid from the fruit is squizeed into the throat of the patient drop by drop.
Solanaceae			R		Frs/Dr		Stomachache	Root is pounded in mortar soaked in water and rdunk with honey with coffee cup taking care of dossage.
	Mill.	H	L	Hu	Frs	Orl	Gastritis	Leaf is cooked and eaten just as daily ditches/food together with other food.
Solanaceae								
	(L.) Hill	H	Lx	Hu	Frs	Ex	Wound/Hemorrhoi	Fres latex is directly applied to the affected part of the body of the patient.
Asteraceae								
	Asch.	H	Lx	Hu	Frs	Ex	Wound/Hemorrhoi	Fres latex is directly applied to the affected part of the body of the patient.
Asteraceae								
	(Forssk.) DC.	H	Fl	Hu	Frs/Dr	Orl	Stomachache	Flower is directly chewed and swalowed. Acts as emergency medicine.

Appendix 2. Continoued…

Asteraceae		L	Hu	Frs	Ex	wound	Fresh leaf is mashed and squeezed on the affected part of the body.
(Poir.) Robyns & Tournay	H	L	Hu	Frs	Orl	Bloody diarrhea	Leaf of Conyza species together with leaf and root of Eragrostis botryodes and
Poaceae							Sporobolus africanus are mashed together and little finger size of the extract is
							drunk with coffee cup.
Hook.f.	H	L	Hu	Frs	Ex	wound	Leaf is smashed between pulms of hands finely and tied on the affected body
Caryophilaceae		L	Hu	Frs	Ex	warts	Leaf is heated on fire and the liquid squeezed on the affected part of the body.
(L.) Vill.	H	L	Hu	Frs	Ex	wound	Leaf is smashed between pulms of hands finely and tied on the affected body
Caryophilaceae		L	Hu	Frs	Ex	warts	Leaf is heated on fire and the liquid squeezed on the affected part of the body.
		L	Hu	Frs	Ex	Eye disease	Leaf infusion is used as eye drop
		L	Hu	Frs	Orl	Tonsilitis	Fresh lraf is chewed with salt
		L	Hu	Frs	Ex	Athlete's foot	Fresh leaf is mashed and put between the affected toes.
		L	Hu	Frs	Orl	Toothache	Fresh leaf is gently chewed with the affected teeth. Also heated on fire and put
							on the affected teeth.
		L	Hu	Frs	Orl/Ex	Snake poison	Leaf is pounded and the liquid extract is drunk, the residue is tied on the wound.
Chiov.	H	L	Hu	Frs	Ex	wound	Leaf is smashed between pulms of hands finely and tied on the affected body
Caryophilaceae		L	Hu	Frs	Ex	warts	Leaf is heated on fire and the liquid squeezed on the affected part of the body.
Welw. ex Hiern	Cl	R/L	Hu	Frs/Dr	Orl	Resparatory or	When symptom of boody sputum is seen on a patient, a mix of preparations from
Menispermaceae						Cardiac problems	Stephania cyanatha, Satureja paradoxa and Vernonia amygdalina is together with
							pasturized milk is drunk. The milk act as antidote against side effects.
		L	Hu	Frs	Ex	Hemorrhoids	Fresh leaf of Stepahania cyanatha is tied on Euphorbia ampliphylla latex rubbed
							hemorrhoids to prevent severe side effects.
(Dillon & A. Rich.) Walp.	Cl	R	Hu	Frs/Dr	Ex	Snake poison	Roots of Dombeya torrida, Galinerea saxifraga, Setaria megaphyla,
Menispermaceae							Stephania abyssinica, Echnops kebericho are pounded together and the mix
							is rubbed on the body of the patient. This works only if the intensity of poison
							ing is by breathe rather than biting.
							"FUSHO": A type of snake that release pousonous breathe as defense.
F.White	T	L	An	Frs	Orl	Hourse disease	Fresh leaves together with 12 other medicinal plant species such as Ilex mitis,
Myrtaceae							Scheflera volkensi, Carduus are crushed together and given to hourses.
							HOURSE DISEASE: Progressive weight loss and thinning of hourses which
							finally leads to death of the animal if not properly treated early.
		Bk	Hu	Frs	Orl	Tonsilitis	Inner part of bark is ponded, soaked in water and drunk with coffee cup.
		Bk	Hu	Frs	Orl	Tonsilitis	Inner part of the bark is chewed and swalloed against the pain.
N.E,Br.	Cl	Lx	Hu	Frs	Ex	Wound	The liquid exudate from any part of the plant (latex) is applied drop by drop.
Asclepediaceae						Haemorrhoid	The liquid exudate from any part of the plant (latex) is applied drop by drop.
L.	S	L	Hu	Frs/Dr	Ex/Orl	Stomachache	Leaves together with leaves of Artemisia species, Echnops kebericho, Lepidium
Asteraceae							sativum, Rosmerinus officinalis, Tagetes minuta, Lippia adoensis are mixed
							together and used as both medicine and perfume substitute by females.
Del.	S/T	L	Hu	Frs	Orl	Stomachache	Leaf and bark are pounded, soaked in water and drunk with mead ("TEJI") or
Rutaceae		Bk					local beer ("TELA"). Dossage varries according to age and sex of patient.
Dill. & A. Rich.	H	R	B	Frs/Dr	Orl	Stomachache	Root togethr with root of E.kebericho is pounded, soaked in water and taken.
Ranuculaceae			Hu			T'INBATO	Dossage varies accordingly. Humans: Finger strip of little finger is used to

Appendix 2. Continoued…

				An			Diarrhea	determine dosage and taken antil the patient recovers. Animals: A glass full of the preparation is given once or more times.
			R	Hu	Frs/Dr	Ex/Drr	SHAJO/YET'E	Root extract and pounded leaf are are applied to the affected skin. SHAJO/YET'E: In local language is to mean spider poisoning resulting in sever skin problem. It is believed that when a person come in contact with spider urine, it causes skin become red, swell, warm and painful with bilisters feeling unwell.
			R	An	Frs/Dr	Orl	Bloody diarrhea	Pounded root is given to animals as animal feed.
Lamiaceae	Ronniger	H	WP	Hu	Frs/Dr	Orl	Common cold	Whole plant is boiled and the liquid extract is drunk with honey or sugar. Also added as an ingridient to other spices and condiments for preparation.
Apiaceae	(L.) Sprague ex Turrill	H	Se	Hu	Dr	Ex	warts	Seeds are finely grounded and the powder is sprinkled on the oozing lesions of the later stage when it feels painful with discolored skins.
			Se	Hu	Dr	Ex	Facial warts(BIRG	Pounded seeds are mixed with fresh butter and used as an ointment on face.
	Sond.	T	Se	B	Dr	Ex	Snake bite	Dried seeds added into fire and smoked in house
Meliaceae								
	DC.	T	Fr	Hu	Frs/Dr	Orl	backpain	Fruit is boiled well and the soup is mixed with honey.
Moraceae								
Tiliaceae	Jacq.	H/S	L/Fl R	Hu	Frs/Dr	Orl	Jaundice (T'INBATO)	Leaf, flower or root is grinded, well powdered & water solution is drunk coffee cup of the solution is drunk with honey.
			Lx	Hu	Frs	Ex	Body lice	The sticky liquid from the plant is used as a washing agent to eliminate lice.
Typhaceae	L.	H	L	An	Frs/Dr	Orl	Cattle diseases	Signs and symptoms: Shivering, deep sleep, dry nose, dry dung, lose of apetite Traditiona treatment: Root of Echnops kebericho, fruits of Capsicum species whole plant of Artemesia abyssinica, leaf of Typha latifolia, leeaf of Pycnostachys species, leaf of Ilex mitis, leaf of vernonia species, leaf of Pavonia urens are mixed together, added to fire and smoked to the animal. Again the same mixiture of the plants except Pavonia urens are well pounded together and the liquid extract is given to the animal in the form of drink. This relieves the dry stomch and dung.
	(A. Rich.) Wedd.	Cl	Wp	Hu	Frs	Orl	Retained placenta	Fresh plant is well crushed/pounded with ortar and pistil and given to the animal.
Urticaceae			Sht	Hu	Frs	Ex	wound	Liquid exudate from the young shoots of the plant is squeezed on the affected part of the body until the burning sensation or feelings.
			L	Hu	Frs	Ex	Fire burn	Leaf is mashed and put on the wound.
			L	Hu	Frs	Orl	Jaundice	Leaf of Urera hypselodendron are pounded and the liquid extract is drunk.
Rubiaceae	Gmel.	S	Bk	Hu	Frs/Dr	Orl	Endoparasites	Powdered, soaked in water over night and drunk empty stomach early in the morning. Antidote: Meat soup and milk should be taken simultanously to avoid hamful effect specially if it is taken overdossage.
			Bk	Hu	Frs/Dr	Orl	Ascariasis	Boiled together with meat and eaten to kill and expel the parasite.
			Lx	Hu	Frs	Ex	wound	Latex from youn buds or resin from stem bark together with that of Croton macrostachyus applied to wound.
			Bk	Hu	Frs/Dr	Orl	Taeniasis	Bark is pounded and eaten with meat soup.
			Bk	Hu	Frs/Dr	Orl	Intestinal parasite	Pounded leaf is prepared together with meat soup and eaten.
			Bk	Hu	Frs/Dr	Orl	Ascariasis	Bark is pounded and the liquid extract is drunk with soup.
			Bk	Hu	Frs/Dr	Orl	Ascariasis	Pounded inner barc is consumed with boiled meat or meat soup.

Appendix 2. Continoued…

		Bk	Hu	Frs/Dr	Orl	Ascariasis	Leaf of croton macrostachyus and bark of Vangueria madagascariensis are boiled with meat soup and eaten Ensete ventricosum bread (K'OC'O). The mixiture is also prepare in the form of porridge and eaten together with K'OC'O as food.
(Pic.Serm.) Kokwaro Rutaceae	S	L Bk	Hu	Frs	Orl	Stomachache	Leaf and bark are pounded, soaked in water and drunk with mead ("TEJI") or local beer ("TELA"). Dossage varries according to age and sex of patient.
		Fr	An	Frs/Dr	Orl	Bloody diarrhea	Leaf of Milicia excelsa and fruit of Vepris dainellii are pounded together and given to cattle against bloody diarrhea (BIC'O). Note: "BIC'O" in Shakinano is to mean bloody diarrhea. The reverse is "MAC'EC'ET'O" meaning non bloody diarrhea. Both signs and symptoms have their own traditional dignostics.
L. Verbenaceae	H	Wp	An	Frs	Orl	Diarrhea	Whole plant is pounded and water solution is given to animals with salt.
Sch. Bip.ex Walp. Asteraceae	S	Sht	Hu	Frs	Orl	Tracoma	Young shoot is cut and the bark is peeled away and chewed and swallowed. Liquid exudate from the stem is used as eye drope too.
Del. Asteraceae	T/S	R/L	Hu	Frs/Dr	Orl	Resparatory or Cardiac problems	When symptom of boody sputum is seen on a patient, a mix of preparations from Stephania cyanatha, Satureja paradoxa and Vernonia amygdalina is together with pasturized milk is drunk. The milk act as antidote against side effects.
		L	Hu	Frs	Orl	Amoebiasis	Leaf grinded together with leaf of Peponium vogelii, Vernonia amygdalina and rhazom of Aframomum corrorima well coocked and eaten.
		L	Hu	Frs	Ex	Ear disease	Leaf of Euphorbia dumalis, young shoot of Vrnonia amygdalina and leaf of Bothriocline schipmeri are pounded together and the leaf extract is applied drop by drop into the affected ear.
		L	Hu	Frs/Dr	Orl	Tumour	Pounded leaf extract is measured with little finger strip and drunk for seven consequetive days. Antidote: Meat should be eaten against side effects.
Hiern	S/T	L/R	Hu	Frs	Ex/Orl	Snake poison	A glass of leaf infusion together with pounded root is taken with honey or milk.
Asteraceae		L	Hu	Frs	Na	Snake poison	Smell from the fresh leaf is inheled through noistrills.
		Sht	Hu	Frs	Ex	Snake poison (ACHAWO)	Young shoot is pounded squeezed and the extract is mixed with fresh butter and use as a soothe treatment by carefully rubbing on the affected part of the body. ACHAWO locally has a mening equivalent to FUSHO which is to mean a snake that release poisonous breathe.
Oliv. & Hiern	Cl	L/Sh	Hu	Frs	Orl/Na	Tonsilitis	Young shoot of the leaf is chewed alone or with salt.
Asteraceae						Headache	Smell from the mashed youg shoot and leaf is inhaled through the nostrills.
Sch. Bip. ex Walp. Asteraceae	S	L	Hu	Frs	Orl	Gonorrhea	Leaf together with leaves of Vernonia hochestateri and leaves of Malva verticilata are pounded togetrher squeezed, mixed with milk and eaten together with red teff bread as an antidote.
A. Rich.	S	R	Hu	Frs	Ex	swelling	Fresh root together with fresh root of Cirsium ender are chewed with salt and swallowed then the swelling disappears immediately.
A. Rich.	H	Sht	Hu	Frs	Ex	Snake poison (ACHAWO)	Young shoot is pounded squeezed and the extract is mixed with fresh butter and use as a soothe treatment by carefully rubbing on the affected part of the body. ACHAWO locally has a mening equivalent to FUSHO which is to mean a snake that release poisonous breathe. In other words it is to mean black snake poison.
S.Moore	Cl	Lq	Hu	Frs	Ex	eye disease	Liquid from the stem of the plant is used as eye drop. 2-3 drops at once.

Appendix 2. Continoued…

Asteraceae								
	L.	H	Se	Hu	Dr	Orl	Bloody diarrhea	Seed is roasted, grounded finely and the powder is eaten.
Fabaceae								
	Roscoe	H	Rh	Hu	Frs/Dr	Orl/Ex	Stomachache	Rhizome if finly pounded and eaten/swallowed
Zingiberaceae							eye disease	Liquid from the rhizome is used as eye drop
			Rh	An	Frs/Dr	Orl	Stomachache	Pounded together with founinculum vulgare and given to the animal as feed.
			Rh	Hu	Frs/Dr	Orl	Stomachache	The rhzome is chopped together with seeds of Aframomum korerima and other spices such as Capsicum annuum, Capsicum frutescens boiled and drunk.
			Rh	Hu	Dr	Orl	Antinausa	Soup is prepared from chopped rhzome together with seeds of Trachyspermum , fresh leaves of Coffee arabica and Basella alba boiled well and drunk hot. Traditional Use: Soup prepared in the form of the above ingridients is locally known as "C'EMO" which is also believed to be good medicine for any health disorders and associated problems including common cold. Antidotes: Honey or milk is used against side effects if any.

Appendix 3: Frequencies, Relative frequencies and Importance Vlue ndex (IVI) for species from plots
KEY: F= Number of species occurrences in the 95 plots (Species Frequency)
RelF = Relative species occurrences (Relative species frequency)
MeanAbun = Mean abundance values of species for plots, **SPID = Species ID**
$indcls = The indicator values for each species to its maximum class
$maxcls = The class for which each species has maximum indicator value
Tab= Total abundance values in all the 95 plots, **Note**: MeanAbun=TAB/Occur
$pval = The probability of obtaining as high an indicator value as observed over the specific interaction, IVI = Importance Value Index, RelF= Relative Frequency, MA= Mean Abundance

SN	Species	F	RelF	Tab	MA	$maxcls	$indcls	$pval	Const	IVI
1	*Acacia mearnsii*	1	1.05	1	1	2	0.05	1.00	0.99	1
2	*Acacia polyacantha*	3	3.16	15	5	6	0.33	0.01	0.92	5
3	*Acalypha acrogyna*	2	2.11	3	1.5	6	0.22	0.02	0.95	1.5
4	*Acalypha marissima*	2	2.11	2	1	5	0.22	0.02	0.95	1
5	*Acalypha psilostachya*	1	1.05	1	1	5	0.11	0.29	0.97	1
6	*Acanthus eminens*	30	31.58	34	1.13	5	0.19	0.08	0.57	5.59
7	*Achyranthes aspera*	13	13.68	13	1	5	0.11	0.34	0.76	5
8	*Achyrospermum parviflorum*	1	1.05	1	1	3	0.06	0.80	0.99	1
9	*Achyrospermum schimperi*	3	3.16	4	1.33	3	0.08	0.42	0.96	2.5
10	*Acmella caulirhiza*	11	11.58	12	1.09	3	0.18	0.06	0.84	4.17
11	*Adiantum poiretii*	3	3.16	3	1	5	0.17	0.06	0.93	2
12	*Aeschynomene abyssinica*	4	4.21	19	4.75	3	0.06	0.68	0.95	14
13	*Aeschynomene americana*	1	1.05	1	1	2	0.05	1.00	0.99	1
14	*Aframomum corrorima*	3	3.16	11	3.67	2	0.07	0.53	0.96	7
15	*Ageratum conyzoides*	5	5.26	5	1	5	0.04	0.91	0.91	4
16	*Ajuga integrifolia*	2	2.11	2	1	1	0.04	0.72	0.97	2
17	*Ajuga leucantha*	2	2.11	2	1	1	0.04	0.69	0.97	2
18	*Alangium chinense*	5	5.26	14	2.8	1	0.17	0.06	0.92	5.33
19	*Albizia grandibracteata*	10	10.53	63	6.3	6	0.58	0.00	0.87	17.6
20	*Albizia gummifera*	24	25.26	116	4.83	5	0.21	0.05	0.61	26
21	*Albizia schimperiana*	4	4.21	22	5.5	6	0.04	0.92	0.93	17.5
22	*Alchemilla cryptantha*	3	3.16	3	1	2	0.07	0.53	0.96	2
23	*Alchemilla fischeri E*	1	1.05	1	1	4	0.06	0.61	0.99	1
24	*Alchemilla kiwuiensis*	1	1.05	1	1	2	0.05	1.00	0.99	1
25	*Alisma plantago-aquatica*	2	2.11	2	1	4	0.03	0.92	0.97	2
26	*Allophylus abyssinicus*	37	38.95	143	3.86	4	0.21	0.05	0.56	19.7
27	*Allophylus macrobotrys*	2	2.11	2	1	4	0.13	0.30	0.97	1
28	*Alstonia boonei*	3	3.16	13	4.33	6	0.33	0.01	0.92	4.33
29	*Amaranthus caudatus*	1	1.05	1	1	5	0.11	0.29	0.97	1
30	*Amaranthus dubius*	1	1.05	1	1	1	0.07	0.43	0.98	1
31	*Amaranthus graecizans*	3	3.16	3	1	6	0.17	0.05	0.93	2
32	*Amaranthus hybridus*	3	3.16	6	2	6	0.33	0.01	0.92	2
33	*Amaranthus viridis*	2	2.11	2	1	1	0.04	0.70	0.97	2
34	*Amorphophallus gallaensis*	4	4.21	4	1	1	0.06	0.59	0.92	3
35	*Amphicarpa africana*	2	2.11	2	1	1	0.04	0.75	0.97	2
36	*Antiaris toxicaria*	3	3.16	19	6.33	6	0.33	0.01	0.92	6.33
37	*Apodytes dimidiata*	21	22.11	86	4.1	2	0.12	0.28	0.67	15.9

Appendix 3. Continoued …

38 *Arisaema schimperanum*	3	3.16	3	1	4	0.19	0.02	0.95	1
39 *Artemisia abyssinica*	2	2.11	2	1	1	0.04	0.78	0.97	2
40 *Arthropteris monocarpa*	3	3.16	6	2	3	0.17	0.06	0.96	2
41 *Arundinaria alpina*	16	16.84	92	5.75	7	0.75	0.00	0.84	25.6
42 *Arundo donax*	2	2.11	5	2.5	6	0.22	0.02	0.95	2.5
43 *Asparagus africanus*	16	16.84	18	1.13	2	0.12	0.23	0.73	6.64
44 *Asparagus racemosus*	8	8.42	8	1	2	0.10	0.22	0.89	4
45 *Asparagus setaceus*	7	7.37	7	1	5	0.09	0.25	0.87	5
46 *Aspilia africana*	1	1.05	1	1	1	0.07	0.44	0.98	1
47 *Aspilia mossambicensis*	1	1.05	1	1	5	0.11	0.28	0.97	1
48 *Baphia abyssinica*	2	2.11	2	1	6	0.22	0.02	0.95	1
49 *Barleria ventricosa*	3	3.16	3	1	4	0.08	0.43	0.95	2
50 *Basella alba*	3	3.16	6	2	6	0.17	0.06	0.93	4
51 *Bersama abyssinica*	45	47.37	116	2.58	7	0.26	0.02	0.47	17.6
52 *Bidens biternata*	1	1.05	1	1	1	0.07	0.42	0.98	1
53 *Bidens ghedoensis*	3	3.16	6	2	3	0.17	0.07	0.96	2
54 *Bidens pilosa L.*	3	3.16	3	1	6	0.18	0.03	0.93	2
55 *Bidens prestinaria*	3	3.16	8	2.67	3	0.03	0.96	0.96	8
56 *Bothriocline schimperi*	7	7.37	7	1	2	0.11	0.15	0.90	2
57 *Brachycorythis pubescens*	5	5.26	5	1	6	0.23	0.05	0.88	2
58 *Bridelia micrantha*	1	1.05	1	1	3	0.06	0.80	0.99	1
59 *Brucea antidysenetrica*	25	26.32	38	1.52	2	0.13	0.28	0.61	7.18
60 *Brugmansia suaveollens*	8	8.42	10	1.25	1	0.16	0.12	0.87	3.58
61 *Buddleja polystachya*	3	3.16	8	2.67	4	0.19	0.03	0.95	2.67
62 *Caesalpinia decapetala*	5	5.26	11	2.2	1	0.04	0.86	0.90	9
63 *Calpurnia aurea*	2	2.11	4	2	6	0.22	0.02	0.95	2
64 *Canthium oligocarpum*	18	18.95	46	2.56	2	0.10	0.45	0.73	12.2
65 *Capparis erythrocarpos*	3	3.16	9	3	6	0.33	0.02	0.92	3
66 *Capparis tomentosa*	3	3.16	6	2	6	0.33	0.01	0.92	2
67 *Cardiospermum halicacabum*	4	4.21	8	2	6	0.44	0.00	0.89	2
68 *Carduus leptacanthus*	30	31.58	33	1.1	3	0.16	0.16	0.53	5.33
69 *Carex johnstonii*	6	6.32	11	1.83	8	0.44	0.00	0.80	3.67
70 *Carex thomasii*	6	6.32	7	1.17	8	0.34	0.01	0.80	2.33
71 *Cassipourea malosana*	9	9.47	24	2.67	3	0.15	0.14	0.86	10.3
72 *Caylusea abyssinica*	1	1.05	1	1	1	0.07	0.42	0.98	1
73 *Ceiba pentandra*	2	2.11	13	6.5	6	0.22	0.02	0.95	6.5
74 *Celtis africana*	8	8.42	48	6	6	0.43	0.00	0.84	11.6
75 *Celtis toka*	2	2.11	2	1	6	0.07	0.61	0.96	2
76 *Celtis zenkeri*	2	2.11	2	1	6	0.07	0.62	0.96	2
77 *Centella asiatica*	7	7.37	7	1	1	0.04	0.92	0.88	5
78 *Chamaecrista nigricans*	1	1.05	1	1	3	0.06	0.80	0.99	1
79 *Cheilanthes bergiana*	2	2.11	2	1	4	0.13	0.27	0.97	1
80 *Chenopodium opulifolium*	1	1.05	1	1	1	0.07	0.45	0.98	1
81 *Chionanthus mildbraedii*	5	5.26	9	1.8	1	0.04	0.94	0.92	8
82 *Chlorophytum macrophyllum*	3	3.16	3	1	1	0.08	0.42	0.94	2
83 *Cirsium dender*	12	12.63	13	1.08	4	0.12	0.33	0.81	5.33
84 *Clausena anisata*	23	24.21	25	1.09	5	0.13	0.28	0.58	6.75

Appendix 3. Continoued …

85	*Clematis hirsuta*	1	1.05	1	1	3	0.06	0.80	0.99	1
86	*Clematis longicauda*	3	3.16	5	1.67	1	0.03	0.91	0.96	5
87	*Clematis simensis*	8	8.42	8	1	4	0.07	0.42	0.88	3
88	*Clerodendrum myricoides*	9	9.47	9	1	2	0.08	0.31	0.86	4
89	*Clerodendrum umbellatum*	1	1.05	1	1	5	0.11	0.29	0.97	1
90	*Coccinia abyssinica*	1	1.05	1	1	1	0.07	0.44	0.98	1
91	*Coccinia grandis*	1	1.05	1	1	5	0.11	0.30	0.97	1
92	*Coffea arabica*	2	2.11	4	2	6	0.22	0.01	0.95	2
93	*Colocasia esculenta*	7	7.37	15	2.14	8	0.21	0.06	0.79	6.5
94	*Combretum molle*	3	3.16	24	8	6	0.33	0.02	0.92	8
95	*Combretum paniculatum*	3	3.16	11	3.67	2	0.07	0.49	0.96	7
96	*Commelina benghalensis*	1	1.05	1	1	5	0.11	0.29	0.97	1
97	*Commelina diffusa*	3	3.16	6	2	3	0.17	0.07	0.96	2
98	*Conyza pyrrhopappa*	2	2.11	2	1	4	0.03	0.92	0.97	2
99	*Conyza sumatrensis*	1	1.05	1	1	3	0.06	0.83	0.99	1
100	*Cordia africana*	10	10.53	51	5.1	6	0.72	0.00	0.90	11.3
101	*Crassocephallum crepidioides*	8	8.42	10	1.25	4	0.11	0.29	0.88	3.67
102	*Crassocephallum rubens*	10	10.53	12	1.2	3	0.09	0.33	0.86	4.58
103	*Craterispermum schweinfurthii*	3	3.16	6	2	6	0.17	0.06	0.93	4
104	*Crinum ornatum*	1	1.05	1	1	3	0.06	0.78	0.99	1
105	*Crotalaria gillettii*	1	1.05	1	1	3	0.06	0.79	0.99	1
106	*Crotalaria hyssopifolia*	1	1.05	1	1	2	0.05	1.00	0.99	1
107	*Crotalaria incana L. subsp.purpurasce*	1	1.05	1	1	2	0.05	1.00	0.99	1
108	*Crotalaria laburnifolia*	1	1.05	1	1	3	0.06	0.78	0.99	1
109	*Crotalaria quartiniana*	4	4.21	6	1.5	3	0.14	0.16	0.56	2.67
110	*Crotalaria rosenii*	2	2.11	2	1	5	0.22	0.03	0.95	1
111	*Croton macrostachyus*	58	61.05	275	4.74	5	0.26	0.01	0.95	28.6
112	*Cryptotaenia africana*	2	2.11	3	1.5	5	0.22	0.02	0.95	1.5
113	*Cucumis dipsaceus*	9	9.47	12	1.33	7	0.16	0.13	0.79	4.6
114	*Cucumis ficifolius*	4	4.21	6	1.5	6	0.44	0.00	0.89	1.5
115	*Cupressus lusitanica*	1	1.05	3	3	1	0.07	0.46	0.98	3
116	*Curcuma domestica*	3	3.16	9	3	6	0.33	0.01	0.92	3
117	*Cussonia holstii*	1	1.05	1	1	3	0.06	0.77	0.99	1
118	*Cyanotis barbata*	2	2.11	2	1	3	0.11	0.31	0.97	1
119	*Cyathea manniana*	33	34.74	195	5.91	3	0.42	0.00	0.86	22.4
120	*Cyathula cylindrica*	8	8.42	8	1	4	0.06	0.61	0.79	5
121	*Cyathula polycephala*	1	1.05	1	1	3	0.06	0.81	0.99	1
122	*Cyathula uncinulata*	6	6.32	6	1	4	0.04	0.90	0.90	5
123	*Cynodon aethiopicus*	3	3.16	6	2	3	0.17	0.05	0.96	2
124	*Cynodon dactylon*	1	1.05	1	1	4	0.06	0.62	0.99	1
125	*Cynoglossum amplifolium*	1	1.05	1	1	3	0.06	0.78	0.88	1
126	*Cynoglossum coeruleum*	7	7.37	7	1	4	0.07	0.49	0.99	4
127	*Cynoglossum lanceolatum*	4	4.21	4	1	4	0.06	0.63	0.94	3
128	*Cyperus dereilema*	7	7.37	22	3.14	7	0.73	0.00	0.90	6.2
129	*Cyperus dichroöstachyus*	9	9.47	30	3.33	8	0.69	0.00	0.88	8.92
130	*Cyperus latifolius*	7	7.37	25	3.57	8	0.91	0.00	0.97	6.8
131	*Cyperus sesquiflorus*	5	5.26	16	3.2	8	0.53	0.00	0.80	5.67

Appendix 3. Continoued

132	*Cyphostema adenocaule*	2	2.11	3	1.5	3	0.11	0.26	0.97	1.5
133	*Cyphostema dembianense*	1	1.05	1	1	2	0.05	1.00	0.99	1
134	*Dalbergia lactea*	3	3.16	6	2	2	0.16	0.07	0.96	2
135	*Datura stramonium*	5	5.26	5	1	1	0.07	0.67	0.92	4
136	*Deinbollia kilimandscharica*	3	3.16	7	2.33	4	0.07	0.57	0.95	5
137	*Desmodium salicifolium*	1	1.05	1	1	5	0.11	0.30	0.97	1
138	*Dichrostachyus cinerea*	1	1.05	1	1	2	0.05	1.00	0.99	1
139	*Dicranopteris linearis*	3	3.16	4	1.33	1	0.21	0.01	0.94	1.33
140	*Dicrocephala integrifolia*	4	4.21	4	1	1	0.08	0.46	0.95	3
141	*Diospyros abyssinica*	10	10.53	45	4.5	6	0.35	0.01	0.81	14.6
142	*Diospyros mespiliformis*	3	3.16	3	1	6	0.33	0.01	0.92	1
143	*Discopodium penninervium*	2	2.11	2	1	1	0.04	0.80	0.97	2
144	*Dombeya aethiopica*	3	3.16	6	2	6	0.33	0.01	0.92	2
145	*Dombeya torrida*	26	27.37	111	4.27	2	0.29	0.01	0.66	20.4
146	*Dorstenia soerensenii*	3	3.16	8	2.67	3	0.08	0.50	0.96	5
147	*Dovyalis caffra*	1	1.05	1	1	1	0.07	0.45	0.98	1
148	*Dracaena afromontana*	22	23.16	61	2.77	3	0.14	0.24	0.64	13.7
149	*Dracaena fragrans*	8	8.42	15	1.88	6	0.22	0.04	0.83	7
150	*Dracaena steudneri*	13	13.68	52	4	5	0.14	0.18	0.75	20.1
151	*Echinops kebericho*	1	1.05	1	1	1	0.07	0.43	0.98	1
152	*Ehretia cymosa*	7	7.37	18	2.57	1	0.21	0.05	0.87	8.25
153	*Ekebergia capensis*	47	49.47	285	6.06	3	0.24	0.04	0.61	36.9
154	*Elaeodendron buchananii*	10	10.53	41	4.1	1	0.14	0.16	0.80	18
155	*Elatostema monticolum*	2	2.11	5	2.5	5	0.22	0.02	0.95	2.5
156	*Eleusine floccifolia*	2	2.11	3	1.5	2	0.03	1.00	0.97	3
157	*Embelia schimperi*	13	13.68	25	1.92	4	0.12	0.31	0.78	11.5
158	*Ensete ventricosum*	26	27.37	70	2.69	5	0.17	0.14	0.50	19.2
159	*Eragrostis botryodes*	3	3.16	6	2	3	0.17	0.07	0.96	2
160	*Eriosema jurionianum*	1	1.05	1	1	3	0.06	0.82	0.99	1
161	*Eriosema robustum*	1	1.05	1	1	1	0.07	0.46	0.98	1
162	*Eriosema scioanum*	1	1.05	1	1	3	0.06	0.82	0.99	1
163	*Erythrina abyssinica*	3	3.16	5	1.67	4	0.07	0.50	0.97	3.5
164	*Erythrina brucei*	30	31.58	148	4.93	2	0.32	0.01	0.95	24.2
165	*Erythroccoca abyssinica*	2	2.11	2	1	3	0.03	1.00	0.68	2
166	*Erythroccoca trichogyne*	3	3.16	6	2	6	0.09	0.41	0.94	6
167	*Ethulia gracilis*	1	1.05	1	1	1	0.07	0.44	0.98	1
168	*Eucalyptus globulus*	2	2.11	5	2.5	2	0.11	0.33	0.97	2.5
169	*Eucalyptus tereticorns*	1	1.05	2	2	2	0.05	1.00	0.99	2
170	*Euphorbia ampliphylla*	30	31.58	124	4.13	2	0.16	0.18	0.54	23.6
171	*Euphorbia dumalis*	17	17.89	17	1	3	0.11	0.32	0.75	5
172	*Ficus asperifolia*	1	1.05	1	1	1	0.07	0.41	0.98	1
173	*Ficus dicranostyla*	3	3.16	6	2	6	0.33	0.01	0.92	2
174	*Ficus exaspertata*	6	6.32	32	5.33	6	0.67	0.00	0.92	5.33
175	*Ficus glumosa*	2	2.11	10	5	6	0.22	0.02	0.95	5
176	*Ficus mucuso*	5	5.26	32	6.4	6	0.56	0.00	0.89	6.4
177	*Ficus ovata*	3	3.16	12	4	1	0.21	0.02	0.95	4
178	*Ficus sur*	46	48.42	254	5.52	5	0.36	0.00	0.52	33.2

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Appendix 3. Continoued

179	*Ficus sycomorus L. subsp. gnaphalocai*	6	6.32	47	7.83	6	0.67	0.00	0.92	7.83
180	*Ficus thonningii*	10	10.53	33	3.3	6	0.26	0.02	0.80	13
181	*Ficus umbellata*	3	3.16	9	3	6	0.12	0.19	0.93	7
182	*Ficus vallis-choudae*	3	3.16	6	2	6	0.33	0.02	0.92	2
183	*Ficus vasta*	3	3.16	9	3	1	0.21	0.01	0.95	3
184	*Galinierea saxifraga*	34	35.79	76	2.24	7	0.30	0.01	0.97	12.4
185	*Galinsoga parviflora*	2	2.11	2	1	1	0.14	0.20	0.97	1
186	*Galinsoga quadriradiata*	2	2.11	4	2	3	0.03	1.00	0.51	4
187	*Galium simense*	3	3.16	3	1	5	0.05	0.75	0.94	3
188	*Gardenia ternifolia*	3	3.16	6	2	6	0.33	0.01	0.92	2
189	*Geranium arabicum*	1	1.05	1	1	2	0.05	1.00	0.99	1
190	*Girardinia bullosa*	9	9.47	13	1.44	5	0.06	0.71	0.85	6.67
191	*Girardinia diversifolia*	1	1.05	1	1	1	0.07	0.44	0.98	1
192	*Glycine wightii subsp.wightii*	1	1.05	1	1	2	0.05	1.00	0.99	1
193	*Gnaphalium rubriflorum*	3	3.16	6	2	4	0.03	0.88	0.96	6
194	*Gouania longispicata*	4	4.21	12	3	6	0.04	0.91	0.92	12
195	*Grevillea robusta*	2	2.11	5	2.5	2	0.11	0.35	0.97	2.5
196	*Grewia trichocarpa*	1	1.05	1	1	5	0.11	0.31	0.97	1
197	*Guizotia scabra*	9	9.47	15	1.67	2	0.08	0.52	0.86	6.75
198	*Guizotia schimperi*	1	1.05	1	1	5	0.11	0.28	0.97	1
199	*Hagenia abyssinica*	6	6.32	28	4.67	2	0.16	0.08	0.92	11.5
200	*Hallea rubrostipulata*	17	17.89	86	5.06	2	0.20	0.07	0.73	20.7
201	*Helichrysum argyranthum*	3	3.16	4	1.33	3	0.17	0.06	0.96	1.33
202	*Helichrysum elephantinum*	1	1.05	1	1	4	0.06	0.61	0.99	1
203	*Helichrysum foetidum*	1	1.05	1	1	2	0.05	1.00	0.99	1
204	*Helichrysum horridum*	1	1.05	1	1	3	0.06	0.82	0.99	1
205	*Helichrysum qurtinianum*	1	1.05	1	1	4	0.06	0.63	0.99	1
206	*Hibiscus berberidifolius*	6	6.32	6	1	4	0.09	0.26	0.90	3
207	*Hibiscus cannabinus*	1	1.05	1	1	3	0.06	0.80	0.99	1
208	*Hibiscus crassinervius*	3	3.16	5	1.67	1	0.09	0.35	0.95	3.5
209	*Hibiscus ludwigii*	1	1.05	2	2	6	0.11	0.28	0.97	2
210	*Hibiscus macranthus*	2	2.11	2	1	4	0.03	0.85	0.97	2
211	*Hibiscus micranthus*	1	1.05	2	2	2	0.05	1.00	0.99	2
212	*Hibiscus panduriformis*	2	2.11	2	1	1	0.04	0.79	0.97	2
213	*Hippocratea africana*	1	1.05	1	1	1	0.07	0.45	0.98	1
214	*Hippocratea gaetzei*	2	2.11	4	2	5	0.22	0.02	0.95	2
215	*Hippocratea pallens*	3	3.16	3	1	6	0.17	0.06	0.93	2
216	*Huperzia dacrydioides*	1	1.05	1	1	2	0.05	1.00	0.99	1
217	*Huperzia verticillata*	1	1.05	1	1	5	0.11	0.29	0.97	1
218	*Hygrophila schulli*	6	6.32	16	2.67	8	0.44	0.00	0.84	10.7
219	*Hyparrhenia cymbaria*	3	3.16	6	2	6	0.33	0.01	0.92	2
220	*Hyparrhenia rufa*	3	3.16	6	2	6	0.33	0.01	0.92	2
221	*Hypericum peplidifolium*	2	2.11	2	1	1	0.14	0.17	0.97	1
222	*Hypericum quartianum*	2	2.11	2	1	7	0.15	0.17	0.93	2
223	*Hypericum revolutum V*	5	5.26	15	3	4	0.23	0.04	0.92	4.5
224	*Hypoestes forskaolii*	1	1.05	1	1	2	0.05	1.00	0.99	1
225	*Hypoestes triflora*	1	1.05	1	1	4	0.06	0.63	0.99	1

Appendix 3. Continoued

226 *Hypolepis sparsisora*	1	1.05	1	1	2	0.05	1.00	0.99	1
227 *Ilex mitis*	57	60.00	322	5.65	4	0.24	0.01	0.73	31.6
228 *Impatiens ethiopica*	1	1.05	1	1	2	0.05	1.00	0.99	1
229 *Impatiens hochstetteri Warb.*	22	23.16	25	1.14	7	0.14	0.20	0.58	6.11
230 *Impatiens rothii Hook.f.*	1	1.05	1	1	4	0.06	0.63	0.99	1
231 *Impatiens tinctoria A.Rich.*	2	2.11	2	1	1	0.04	0.80	0.97	2
232 *Indigofera garckeana Vatke*	1	1.05	1	1	4	0.06	0.62	0.99	1
233 *Ipomoea aquatica Forssk.*	2	2.11	7	3.5	8	0.19	0.05	0.94	7
234 *Ipomoea cairica (L.) Sweet var indica I*	3	3.16	3	1	1	0.03	0.92	0.96	3
235 *Ipomoea purpurea (L.) Roth.*	3	3.16	3	1	1	0.03	0.92	0.96	3
236 *Ipomoea tenuirostris Choisy*	1	1.05	1	1	4	0.06	0.60	0.99	1
237 *Isodon schimperi (Vatke) J.K.Morton*	1	1.05	1	1	5	0.11	0.31	0.97	1
238 *Isoglossa punctata (Vahl) Brummitt &*	3	3.16	3	1	3	0.17	0.07	0.96	1
239 *Isoglossa somalensis Lindau*	1	1.05	1	1	4	0.06	0.62	0.99	1
240 *Jacaranda mimosifolia D.Don*	3	3.16	24	8	6	0.33	0.01	0.92	8
241 *Jasminum abyssinicum Hochst. ex DC.*	2	2.11	2	1	5	0.07	0.60	0.96	2
242 *Jasminum schimperi Vatke*	2	2.11	2	1	3	0.03	1.00	0.97	2
243 *Jatropha curcas L.*	4	4.21	6	1.5	6	0.30	0.02	0.90	2.67
244 *Justicia bizuneshiae Ensermu*	2	2.11	2	1	4	0.03	0.86	0.97	2
245 *Justicia ladanoides Lam.*	4	4.21	4	1	6	0.15	0.06	0.92	3
246 *Justicia schimperiana (Hochst ex. Nees*	14	14.74	15	1.07	1	0.17	0.08	0.74	6.5
247 *Kalanchoe densiflora Rolfe*	1	1.05	1	1	1	0.07	0.47	0.98	1
248 *Kalanchoe petitiana A.Rich.*	2	2.11	2	1	5	0.07	0.60	0.96	2
249 *Kalanchoe shimperiana A.Rich.*	3	3.16	3	1	3	0.17	0.05	0.96	1
250 *Kniphofia pumila (Ait.) Kunth*	2	2.11	5	2.5	1	0.03	0.87	0.97	5
251 *Lactuca inermis Forssk.*	3	3.16	3	1	1	0.03	0.95	0.95	3
252 *Laggera alata (D.Don) Oliv.*	3	3.16	3	1	3	0.08	0.45	0.96	2
253 *Laggera crispata (Vahl) Happer & Wo*	6	6.32	6	1	1	0.05	0.78	0.91	4
254 *Laggera elatior R.E.Fries*	1	1.05	1	1	4	0.06	0.62	0.99	1
255 *Laggera tomentosa (Sch. Bip. Ex A.Ric*	4	4.21	4	1	4	0.05	0.72	0.93	3
256 *Landolfia buchanani (Hall.f.) Stapf*	2	2.11	8	4	1	0.14	0.17	0.97	4
257 *Lantana camara L.*	1	1.05	1	1	4	0.06	0.63	0.99	1
258 *Lantana trifolia L.*	3	3.16	3	1	6	0.33	0.01	0.92	1
259 *Laportea aestuans (L.) Chew*	7	7.37	18	2.57	7	0.94	0.00	0.97	4.5
260 *Leonotis ocymifolia (Burm.f.) Iwarsson*	3	3.16	3	1	6	0.33	0.02	0.92	1
261 *Lepidotrichilia volkensii (Gürke) Leroy*	16	16.84	50	3.13	7	0.50	0.00	0.75	18.2
262 *Leucas jamesii Bak.*	11	11.58	11	1	4	0.08	0.44	0.81	5
263 *Lippia adoensis Hochst ex Walp. var ac*	3	3.16	3	1	1	0.10	0.33	0.95	2
264 *Lobelia giberroa Hemsl.*	28	29.47	47	1.68	2	0.09	0.76	0.48	9.57
265 *Lycopodiella cernua (L.) Pic.Serm.*	1	1.05	1	1	5	0.11	0.29	0.97	1
266 *Lycopodium clavatum L.*	10	10.53	10	1	3	0.08	0.36	0.85	5
267 *Macaranga capensis (Baill.) Sim*	41	43.16	178	4.34	4	0.25	0.03	0.65	17.9
268 *Maesa lanceolata Forssk.*	53	55.79	141	2.66	4	0.22	0.05	0.63	12.9
269 *Malva verticillata L.*	4	4.21	4	1	2	0.12	0.17	0.95	2
270 *Manihot esculenta Crantz.*	2	2.11	4	2	6	0.22	0.02	0.89	2
271 *Manilkara butugi Chiov.*	4	4.21	29	7.25	6	0.44	0.00	0.95	7.25
272 *Marattia fraxinea Sm.*	2	2.11	2	1	3	0.03	1.00	0.97	2

Appendix 3. Continoued

273	*Maytenus arbutifolia*	5	5.26	7	1.4	1	0.07	0.55	0.92	4.5
274	*Maytenus gracilipse*	25	26.32	27	1.08	3	0.14	0.27	0.61	5.67
275	*Maytenus obscura*	9	9.47	14	1.56	3	0.21	0.04	0.88	5
276	*Maytenus sengalensis*	1	1.05	1	1	1	0.07	0.44	0.98	1
277	*Maytenus undata*	5	5.26	11	2.2	3	0.10	0.27	0.93	4.33
278	*Melia azedarach*	3	3.16	4	1.33	6	0.33	0.01	0.92	1.33
279	*Melilotus suaveolens*	1	1.05	1	1	5	0.11	0.28	0.97	1
280	*Melinis tenuissima*	1	1.05	1	1	1	0.07	0.44	0.98	1
281	*Micractis bojeri*	1	1.05	1	1	3	0.06	0.80	0.99	1
282	*Microglossa pyrifolia*	3	3.16	3	1	6	0.33	0.02	0.92	1
283	*Mikaniopsis clematoides*	2	2.11	3	1.5	4	0.04	0.81	0.97	3
284	*Milicia excelsa*	7	7.37	36	5.14	6	0.59	0.00	0.90	11
285	*Millettia ferruginea*	18	18.95	80	4.44	6	0.38	0.00	0.73	18.7
286	*Mimosa invisa*	1	1.05	6	6	1	0.07	0.46	0.98	6
287	*Mimosa pigra*	3	3.16	7	2.33	2	0.07	0.49	0.96	4.5
288	*Mimulopsis solmsii*	4	4.21	22	5.5	5	0.05	0.68	0.98	17.5
289	*Mimusops kummel*	1	1.05	1	1	1	0.07	0.46	0.93	1
290	*Momordica foetida*	7	7.37	12	1.71	3	0.05	0.81	0.88	7.5
291	*Morus mesozygia*	3	3.16	6	2	6	0.33	0.01	0.92	2
292	*Mukia maderaspatana*	1	1.05	1	1	3	0.06	0.81	0.99	1
293	*Nicandra physaloides*	2	2.11	2	1	5	0.08	0.40	0.96	2
294	*Ocimum lamiifolium*	6	6.32	11	1.83	2	0.11	0.29	0.91	4.67
295	*Ocimum urticifolium*	6	6.32	12	2	2	0.10	0.38	0.90	6.75
296	*Ocotea kenyensis*	3	3.16	9	3	6	0.17	0.06	0.93	6
297	*Oenanthe palustris*	5	5.26	20	4	8	0.77	0.00	0.93	6.5
298	*Olea capensis*	2	2.11	6	3	6	0.08	0.45	0.96	6
299	*Olea welwitschii*	13	13.68	59	4.54	1	0.19	0.06	0.77	20
300	*Oncinotis tenuiloba*	2	2.11	7	3.5	1	0.14	0.17	0.97	3.5
301	*Oncoba routledgei*	2	2.11	3	1.5	3	0.04	0.85	0.97	3
302	*Oncoba spinosa*	1	1.05	1	1	5	0.11	0.32	0.97	1
303	*Oplismenus hirtellus*	2	2.11	3	1.5	1	0.14	0.13	0.97	1.5
304	*Oreosyce africana*	1	1.05	1	1	2	0.05	1.00	0.99	1
305	*Ozoroa insignis*	3	3.16	9	3	6	0.33	0.01	0.92	3
306	*OZoroa pulcherrima*	3	3.16	27	9	6	0.33	0.02	0.92	9
307	*Parochaetus communis*	2	2.11	2	1	3	0.03	1.00	0.97	2
308	*Parthenium hysterophorus*	4	4.21	12	3	6	0.44	0.00	0.89	3
309	*Passiflora edulis*	1	1.05	4	4	2	0.05	1.00	0.99	4
310	*Pavetta gardeniifolia*	1	1.05	1	1	4	0.06	0.60	0.99	1
311	*Pavetta oliveriana*	2	2.11	4	2	2	0.11	0.32	0.97	2
312	*Pavonia urens*	6	6.32	9	1.5	4	0.10	0.20	0.91	4.17
313	*Pentas caffensis*	2	2.11	2	1	4	0.03	0.86	0.97	2
314	*Pentas lanceolata*	3	3.16	6	2	3	0.17	0.08	0.96	2
315	*Pentas schimperiana*	1	1.05	3	3	3	0.06	0.80	0.99	3
316	*Peperomia retusa*	7	7.37	7	1	5	0.09	0.24	0.87	4
317	*Peponium vogelii*	1	1.05	1	1	1	0.07	0.44	0.98	1
318	*Persicaria nepalensis*	1	1.05	1	1	5	0.11	0.31	0.97	1
319	*Persicaria senegalensis*	4	4.21	8	2	8	0.57	0.00	0.89	3.33

Appendix 3. Continoued

320	*Persicaria setosula*	7	7.37	9	1.29	8	0.48	0.00	0.84	3.67
321	*Phoenix reclinata*	13	13.68	44	3.38	6	0.13	0.23	0.70	17
322	*Phragmanthera macrosolen*	1	1.05	1	1	2	0.05	1.00	0.99	1
323	*Physalis lagascae*	1	1.05	1	1	1	0.07	0.44	0.98	1
324	*Physalis peruviana*	2	2.11	2	1	1	0.04	0.75	0.97	2
325	*Phytolacca dodecandra*	14	14.74	18	1.29	3	0.08	0.57	0.75	7.23
326	*Pilea bambuseti*	2	2.11	2	1	4	0.13	0.26	0.97	1
327	*Pilea rivularis*	1	1.05	1	1	2	0.05	1.00	0.99	1
328	*Piper capense*	11	11.58	12	1.09	5	0.12	0.24	0.80	5.33
329	*Piper umbellatum*	3	3.16	3	1	6	0.33	0.01	0.92	1
330	*Pittosporum viridiflorum*	10	10.53	31	3.1	1	0.09	0.38	0.80	15.8
331	*Plantago africana*	2	2.11	2	1	3	0.03	1.00	0.97	2
332	*Plantago lanceolata*	1	1.05	1	1	4	0.06	0.61	0.99	1
333	*Plantago palmata*	4	4.21	4	1	3	0.12	0.15	0.94	2
334	*Platycerium elephantotis*	1	1.05	1	1	6	0.11	0.30	0.97	1
335	*Plectranthus barbatus*	1	1.05	1	1	2	0.05	1.00	0.99	1
336	*Plectranthus laxiflorus*	2	2.11	5	2.5	1	0.03	0.86	0.97	5
337	*Plectranthus punctatus*	1	1.05	1	1	3	0.06	0.80	0.99	1
338	*Pneumatopteris unita*	1	1.05	1	1	3	0.06	0.80	0.99	1
339	*Podocarpus falcatus*	4	4.21	28	7	1	0.29	0.02	0.93	7
340	*Polyscias farinosa*	3	3.16	4	1.33	2	0.07	0.56	0.96	2.5
341	*Polyscias fulva*	42	44.21	209	4.98	5	0.28	0.01	0.63	33.1
342	*Pouteria adolfi-friederici*	41	43.16	280	6.83	3	0.30	0.01	0.68	37.3
343	*Pouteria altissima*	5	5.26	33	6.6	6	0.56	0.00	0.89	6.6
344	*Prunus africana*	47	49.47	231	4.91	7	0.18	0.13	0.54	30.8
345	*Pseudechinolaena polystachya*	3	3.16	3	1	1	0.21	0.02	0.95	1
346	*Psidium guajava*	2	2.11	2	1	6	0.07	0.59	0.96	2
347	*Psophocarpus grandiflorus*	1	1.05	1	1	2	0.05	1.00	0.99	1
348	*Psychotria orophila*	9	9.47	11	1.22	4	0.15	0.15	0.84	6.2
349	*Psychotria peduncularis*	3	3.16	3	1	6	0.33	0.02	0.92	1
350	*Pteridium aquilinum*	6	6.32	6	1	4	0.10	0.19	0.91	3
351	*Pteris dentata*	2	2.11	3	1.5	3	0.04	0.85	0.97	3
352	*Pteris pteridioides*	1	1.05	1	1	2	0.05	1.00	0.99	1
353	*Pteris tripartita*	1	1.05	1	1	2	0.05	1.00	0.99	1
354	*Pycnostachys abyssinica*	9	9.47	9	1	1	0.07	0.39	0.85	5
355	*Pycnostachys eminii*	4	4.21	4	1	4	0.07	0.59	0.94	2
356	*Pycnostachys meyeri*	28	29.47	29	1.04	3	0.14	0.28	0.56	5.2
357	*Ranunculus multifidus*	34	35.79	44	1.29	8	0.46	0.00	0.59	8.33
358	*Rhabdotosperma scrophulariifolia*	1	1.05	1	1	2	0.05	1.00	0.99	1
359	*Rhamnus prinoides*	9	9.47	15	1.67	2	0.09	0.35	0.87	6.25
360	*Ricinus communis*	11	11.58	21	1.91	2	0.07	0.54	0.80	10.8
361	*Rothmannia urcelliformis*	5	5.26	15	3	1	0.16	0.07	0.90	7.5
362	*Rubus apetalus*	3	3.16	5	1.67	2	0.06	0.79	0.96	3.5
363	*Rubus steudneri*	33	34.74	83	2.52	3	0.13	0.39	0.44	13.5
364	*Rumex abyssinicus*	6	6.32	6	1	6	0.03	0.96	0.90	5
365	*Rumex nepalensis*	16	16.84	16	1	3	0.10	0.39	0.74	6
366	*Rumex nervosus*	3	3.16	3	1	4	0.09	0.41	0.96	2

Appendix 3. Continoued

367 *Rytigynia neglecta*	21	22.11	25	1.19	5	0.21	0.04	0.67	4.5
368 *Salix subserrata*	3	3.16	9	3	1	0.21	0.01	0.95	3
369 *Salvia leucantha*	1	1.05	1	1	2	0.05	1.00	0.99	1
370 *Salvia nilotica*	5	5.26	5	1	1	0.14	0.07	0.92	3
371 *Sapium ellipticum*	15	15.79	83	5.53	6	0.37	0.01	0.76	24.2
372 *Satureja paradoxa*	10	10.53	18	1.8	3	0.13	0.22	0.82	5
373 *Satureja simensis*	6	6.32	7	1.17	1	0.11	0.16	0.88	3.33
374 *Scadoxus multiflorus*	7	7.37	7	1	3	0.06	0.69	0.89	4
375 *Scadoxus nutans*	1	1.05	1	1	2	0.05	1.00	0.99	1
376 *Schefflera abyssinica*	53	55.79	372	7.02	3	0.30	0.00	0.67	40.3
377 *Schefflera myriantha*	1	1.05	2	2	4	0.06	0.60	0.99	2
378 *Schefflera volkensii*	30	31.58	173	5.77	3	0.31	0.01	0.76	22.6
379 *Schoenoplectus corymbosus*	3	3.16	3	1	7	0.60	0.00	0.90	1
380 *Schoenoplectus lateriflorus*	2	2.11	5	2.5	3	0.03	0.93	0.97	5
381 *Selaginella kraussiana*	2	2.11	3	1.5	2	0.03	0.90	0.97	3
382 *Senecio hadiensis*	1	1.05	1	1	4	0.06	0.58	0.99	1
383 *Senecio lytratus*	2	2.11	2	1	5	0.07	0.56	0.96	2
384 *Senna didymobotrya*	5	5.26	7	1.4	6	0.27	0.02	0.88	2.67
385 *Senna obtusifolia*	2	2.11	4	2	6	0.22	0.02	0.95	2
386 *Senna occidentalis*	1	1.05	1	1	1	0.07	0.42	0.98	1
387 *Senna petersiana*	1	1.05	1	1	5	0.11	0.30	0.97	1
388 *Senna septemtrionalis*	1	1.05	1	1	2	0.05	1.00	0.99	1
389 *Sericostachys scandens*	1	1.05	1	1	5	0.11	0.30	0.97	1
390 *Setaria atrata*	3	3.16	6	2	1	0.21	0.01	0.95	2
391 *Setaria megaphylla*	3	3.16	4	1.33	1	0.09	0.33	0.94	2.5
392 *Setaria verticillata*	3	3.16	3	1	1	0.21	0.02	0.95	1
393 *Sida collina*	3	3.16	3	1	6	0.33	0.01	0.92	1
394 *Sida rhombifolia*	3	3.16	3	1	5	0.05	0.76	0.94	3
395 *Sida schimperiana*	6	6.32	6	1	3	0.03	0.94	0.90	4
396 *Sida tenuicarpa Vollesen*	5	5.26	5	1	5	0.04	0.90	0.91	4
397 *Snowdenia polystachya*	2	2.11	2	1	4	0.03	0.93	0.97	2
398 *Solanecio gigas*	2	2.11	2	1	6	0.07	0.60	0.97	2
399 *Solanecio mannii*	8	8.42	8	1	2	0.05	0.89	0.99	4
400 *Solanum americanum*	2	2.11	3	1.5	2	0.03	0.90	0.98	3
401 *Solanum anguivi*	1	1.05	1	1	4	0.06	0.61	0.63	1
402 *Solanum campylacanthum*	1	1.05	1	1	1	0.07	0.45	0.78	1
403 *Solanum giganteum*	24	25.26	50	2.08	3	0.22	0.05	0.88	10.4
404 *Solanum incanum*	14	14.74	14	1	3	0.17	0.07	0.99	5
405 *Solanum marginatum*	1	1.05	1	1	2	0.05	1.00	0.99	1
406 *Solanum schimperianum*	1	1.05	1	1	4	0.06	0.61	0.99	1
407 *Solanum villosum*	1	1.05	1	1	3	0.06	0.79	0.96	1
408 *Sonchus asper*	2	2.11	2	1	1	0.04	0.74	0.97	2
409 *Sonchus bipontini*	2	2.11	2	1	4	0.13	0.24	0.97	1
410 *Sphaeranthus suaveolens*	5	5.26	19	3.8	8	0.54	0.00	0.86	9
411 *Sporobolus africanus*	1	1.05	1	1	1	0.07	0.44	0.98	1
412 *Stellaria mannii*	1	1.05	1	1	2	0.05	1.00	0.99	1
413 *Stellaria media*	2	2.11	7	3.5	2	0.03	1.00	0.97	7

Appendix 3. Continoued

414	*Stellaria sennii Chiov.*	1	1.05	1	1	3	0.06	0.82	0.99	1
415	*Stephania abyssinica*	2	2.11	2	1	5	0.08	0.43	0.96	2
416	*Stephania cyanatha*	1	1.05	1	1	2	0.05	1.00	0.99	1
417	*Syzygium guineense subsp. afromontan*	49	51.58	326	6.65	3	0.32	0.00	0.75	33.5
418	*Tacazzea apiculata*	3	3.16	6	2	3	0.17	0.07	0.96	2
419	*Tacazzea conferta*	6	6.32	9	1.5	3	0.04	0.85	0.90	6
420	*Tagetes minuta L.*	1	1.05	1	1	1	0.07	0.45	0.98	1
421	*Teclea nobilis Del.*	7	7.37	13	1.86	1	0.13	0.13	0.92	6.67
422	*Tephrosia linearis*	1	1.05	1	1	2	0.05	1.00	0.87	1
423	*Tephrosia pumila*	1	1.05	1	1	2	0.05	1.00	0.99	1
424	*Terminalia brownii*	2	2.11	8	4	6	0.22	0.02	0.99	4
425	*Terminalia laxiflora*	3	3.16	9	3	6	0.33	0.02	0.95	3
426	*Terminalia schimperiana*	3	3.16	10	3.33	6	0.33	0.01	0.92	3.33
427	*Thalictrum rhynchocarpum*	2	2.11	2	1	5	0.07	0.62	0.96	2
428	*Thea sinensis*	1	1.05	2	2	2	0.05	1.00	0.99	2
429	*Thymus schimperi*	1	1.05	1	1	1	0.07	0.42	0.98	1
430	*Trema orientalis*	3	3.16	3	1	6	0.33	0.02	0.92	1
431	*Trichillia dregeana*	8	8.42	50	6.25	6	0.70	0.00	0.93	13.1
432	*Trichillia prieuriana*	3	3.16	3	1	6	0.33	0.01	0.92	1
433	*Trifolium baccarinii*	1	1.05	1	1	1	0.07	0.45	0.98	1
434	*Trifolium burchellianum*	5	5.26	6	1.2	3	0.19	0.06	0.93	2.25
435	*Trilepisium madagascarense*	4	4.21	21	5.25	6	0.14	0.09	0.91	10.5
436	*Triumfetta rhomboidea*	4	4.21	4	1	4	0.25	0.03	0.94	1
437	*Tylosema fassoglensis*	2	2.11	2	1	1	0.14	0.20	0.97	1
438	*Typha latifolia*	3	3.16	13	4.33	1	0.09	0.34	0.92	7.5
439	*Urera hypselodendron*	16	16.84	28	1.75	5	0.13	0.21	0.72	6.76
440	*Urtica simensis*	1	1.05	1	1	4	0.06	0.60	0.99	1
441	*Vangueria madagascariensis*	10	10.53	22	2.2	3	0.11	0.26	0.85	7.33
442	*Vepris dainellii*	13	13.68	19	1.46	2	0.10	0.35	0.79	7.83
443	*Verbena officinalis*	2	2.11	2	1	4	0.03	0.91	0.97	2
444	*Vernonia adoensis*	1	1.05	1	1	6	0.11	0.29	0.97	1
445	*Vernonia amygdalina*	23	24.21	84	3.65	2	0.14	0.24	0.59	21
446	*Vernonia auriculifera*	52	54.74	75	1.44	3	0.31	0.00	0.53	8.14
447	*Vernonia biafrae*	5	5.26	8	1.6	3	0.10	0.24	0.93	4.67
448	*Vernonia hochestetteri*	12	12.63	19	1.58	3	0.17	0.10	0.82	6.33
449	*Vernonia hymenolepsis*	2	2.11	5	2.5	1	0.05	0.69	0.97	5
450	*Vernonia karaguensis*	1	1.05	1	1	3	0.06	0.80	0.99	1
451	*Vernonia thomsoniana*	1	1.05	1	1	3	0.06	0.78	0.99	1
452	*Vernonia urticifolia*	1	1.05	1	1	2	0.05	1.00	0.99	1
453	*Vernonia wollastoni*	1	1.05	1	1	5	0.11	0.29	0.97	1
454	*Viola abyssinica*	2	2.11	2	1	5	0.07	0.53	0.96	2
455	*Vittaria guineensis*	2	2.11	4	2	2	0.04	0.93	0.97	4
456	*Vittaria volkensii*	1	1.05	1	1	4	0.06	0.62	0.99	1
457	*Zehneria minutiflora*	1	1.05	1	1	4	0.06	0.61	0.99	1
458	*Zehneria scabra*	1	1.05	1	1	4	0.06	0.61	0.99	1

Appendix 4-Results of analysis of plot richness, species abundance and diversities per plot (plot sum) and diversity of each plot in the whole data set

Key: PID= Plot ID(identification), PLTRich= Plot richness (number of species per plot)
PLTsum= Sum of abundance values per plot, PLTRank= Plots ranked based on plot richness
LogPLTRich= Values for Logarithm of species richness, ClurID= Values of clustering vector
Richness=PLTRich=Number of species recorded in a plot or plot richness

PID	PLTRich	PLTsum	PLTRank	LogPLTRich	ClurID	H'(Diversity)	Evenness
P1	30	78	48	3.40	1	3.28	0.96
P2	37	106	27	3.61	2	3.46	0.96
P3	38	93	21	3.64	2	3.49	0.96
P4	43	90	4	3.76	2	3.57	0.95
P5	38	100	22	3.64	3	3.41	0.94
P6	24	53	74	3.18	4	2.92	0.92
P7	32	46	42	3.47	1	3.32	0.96
P8	23	52	76	3.14	4	2.84	0.91
P9	39	110	15	3.66	3	3.47	0.95
P10	37	102	28	3.61	3	3.38	0.94
P11	39	95	16	3.66	3	3.39	0.92
P12	33	86	37	3.50	4	3.14	0.90
P13	31	91	45	3.43	3	3.18	0.93
P14	40	127	12	3.69	3	3.38	0.91
P15	28	96	59	3.33	4	2.99	0.90
P16	41	112	7	3.71	3	3.51	0.95
P17	39	109	17	3.66	3	3.33	0.91
P18	37	146	29	3.61	3	3.36	0.93
P19	26	98	68	3.26	2	3.06	0.94
P20	27	91	61	3.30	3	3.07	0.93
P21	25	59	73	3.22	4	2.82	0.87
P22	40	117	13	3.69	3	3.38	0.92
P23	38	96	23	3.64	4	3.42	0.94
P24	39	132	18	3.66	1	3.35	0.91
P25	33	86	38	3.50	1	3.20	0.92
P26	29	93	54	3.37	3	3.11	0.92
P27	36	104	33	3.58	2	3.35	0.94
P28	27	77	62	3.30	4	3.07	0.93
P29	32	87	43	3.47	4	3.21	0.92
P30	39	122	19	3.66	2	3.39	0.92
P31	37	113	30	3.61	3	3.30	0.91
P32	38	122	24	3.64	3	3.36	0.92
P33	41	139	8	3.71	3	3.47	0.93
P34	30	70	49	3.40	3	3.04	0.89
P35	33	98	39	3.50	2	3.13	0.89
P36	29	76	55	3.37	5	3.02	0.90
P37	33	74	40	3.50	2	3.23	0.92
P38	37	75	31	3.61	5	3.28	0.91
P39	36	88	34	3.58	5	3.27	0.91
P40	26	81	69	3.26	5	2.90	0.89

Appendix 4. Continoued …

P41	27	84	63	3.30	2	2.97	0.90
P42	23	68	77	3.14	5	2.82	0.90
P43	17	56	82	2.83	2	2.57	0.91
P44	37	112	32	3.61	2	3.33	0.92
P45	27	105	64	3.30	2	3.15	0.95
P46	21	84	78	3.04	2	2.84	0.93
P47	31	106	46	3.43	1	3.25	0.95
P48	26	112	70	3.26	6	3.09	0.95
P49	41	119	9	3.71	6	3.55	0.96
P50	38	147	25	3.64	6	3.40	0.93
P51	29	97	56	3.37	6	3.08	0.92
P52	26	110	71	3.26	6	3.10	0.95
P53	29	125	57	3.37	6	3.14	0.93
P54	36	119	35	3.58	6	3.25	0.91
P55	30	97	50	3.40	6	3.20	0.94
P56	19	43	79	2.94	1	2.75	0.93
P57	19	62	80	2.94	1	2.70	0.92
P58	42	141	5	3.74	6	3.52	0.94
P59	45	121	3	3.81	4	3.55	0.93
P60	31	51	47	3.43	1	3.25	0.94
P61	28	50	60	3.33	1	3.05	0.91
P62	29	62	58	3.37	1	3.04	0.90
P63	30	68	51	3.40	2	3.13	0.92
P64	41	106	10	3.71	2	3.36	0.91
P65	32	113	44	3.47	5	3.20	0.92
P66	24	66	75	3.18	5	2.80	0.88
P67	52	106	1	3.95	1	3.73	0.94
P68	46	122	2	3.83	2	3.52	0.92
P69	42	89	6	3.74	4	3.47	0.93
P70	34	111	36	3.53	5	3.18	0.90
P71	33	100	41	3.50	5	3.19	0.91
P72	39	128	20	3.66	2	3.44	0.94
P73	38	110	26	3.64	2	3.31	0.91
P74	40	97	14	3.69	4	3.36	0.91
P75	30	68	52	3.40	4	3.04	0.89
P76	17	63	83	2.83	4	2.54	0.90
P77	16	48	84	2.77	4	2.41	0.87
P78	15	69	85	2.71	4	2.63	0.97
P79	13	53	87	2.56	7	2.43	0.95
P80	15	47	86	2.71	7	2.45	0.91
P81	11	45	88	2.40	7	2.23	0.93
P82	11	37	89	2.40	7	2.16	0.90
P83	11	36	90	2.40	7	2.13	0.89
P84	27	99	65	3.30	3	3.05	0.92
P85	19	75	81	2.94	3	2.74	0.93
P86	26	81	72	3.26	4	2.95	0.91
P87	30	79	53	3.40	2	3.12	0.92

Appendix 4. Continoued …

P88	41	71	11	3.71	1	3.49	0.94
P89	27	83	66	3.30	1	3.07	0.93
P90	27	110	67	3.30	1	3.15	0.96
P91	11	38	91	2.40	8	2.27	0.95
P92	10	28	92	2.30	8	2.25	0.98
P93	9	23	93	2.20	8	1.91	0.87
P94	8	35	94	2.08	8	1.90	0.91
P95	8	28	95	2.08	8	1.91	0.92

Appendix 5-List of plant Genera

N=Number of species, %G=Percentage of all genera

SN	Genera	N	%G	SN	Genera	N	%G	SN	Genera	N	%G
1	Acacia	2	0.36	121	Dombeya	2	0.36	232	Oncoba	2	0.36
2	Acalypha	3	0.54	122	Dorstenia	1	0.18	233	Oplismenus	1	0.18
3	Acanthus	1	0.18	123	Dovyalis	1	0.18	234	Oreosyce	1	0.18
4	Achyranthes	1	0.18	124	Dracaena	3	0.54	235	Ozoroa	2	0.36
5	Achyrospermum	2	0.36	125	Echinops	1	0.18	236	Parochaetus	1	0.18
6	Acmella	1	0.18	126	Ehretia	1	0.18	237	Parthenium	1	0.18
7	Adiantum	1	0.18	127	Ekebergia	1	0.18	238	Passiflora	1	0.18
8	Aeschynomene	2	0.36	128	Elaeodendron	1	0.18	239	Pavetta	2	0.36
9	Aframomum	1	0.18	129	Elatostema	1	0.18	240	Pavonia	1	0.18
10	Ageratum	1	0.18	130	Eleusine	1	0.18	241	Pentas	3	0.54
11	Ajuga	2	0.36	131	Embelia	1	0.18	242	Peperomia	1	0.18
12	Alangium	1	0.18	132	Ensete	1	0.18	243	Peponium	1	0.18
13	Albizia	3	0.54	133	Eragrostis	2	0.36	244	Persea	1	0.18
14	Alchemilla	3	0.54	134	Eriosema	3	0.54	245	Persicaria	3	0.54
15	Alisma	1	0.18	135	Erythrina	2	0.36	246	Phaseolus	1	0.18
16	Allium	3	0.54	136	Erythroccoca	2	0.36	247	Phoenix	2	0.36
17	Allophylus	2	0.36	137	Ethulia	1	0.18	248	Phragmanthera	1	0.18
18	Aloe	1	0.18	138	Eucalyptus	2	0.36	249	Physalis	2	0.36
19	Alstonia	1	0.18	139	Euphorbia	4	0.72	250	Phytolacca	1	0.18
20	Amaranthus	5	0.90	140	Ficus	13	2.34	251	Pilea	2	0.36
21	Amorphophallus	1	0.18	141	Foeninculum	1	0.18	252	Piper	2	0.36
22	Amphicarpa	1	0.18	142	Galinierea	1	0.18	253	Pisum	1	0.18
23	Ananas	1	0.18	143	Galinsoga	2	0.36	254	Pittosporum	1	0.18
24	Anethum	1	0.18	144	Galium	1	0.18	255	Plantago	3	0.54
25	Annona	1	0.18	145	Gardenia	1	0.18	256	Platycerium	1	0.18
26	Antiaris	1	0.18	146	Geranium	1	0.18	257	Plectranthus	4	0.72
27	Apodytes	1	0.18	147	Girardinia	2	0.36	258	Pneumatopteris	1	0.18
28	Arisaema	1	0.18	148	Glycine	1	0.18	259	Podocarpus	1	0.18
29	Artemisia	5	0.90	149	Gnaphalium	1	0.18	260	Polyscias	2	0.36
30	Arthropteris	1	0.18	150	Gossypium	1	0.18	261	Pouteria	2	0.36
31	Artrocarpus	1	0.18	151	Gouania	1	0.18	262	Prunus	3	0.54
32	Arundinaria	1	0.18	152	Grevillea	1	0.18	263	Pseudechinolaena	1	0.18
33	Arundo	1	0.18	153	Grewia	1	0.18	264	Psidium	1	0.18
34	Asparagus	3	0.54	154	Guizotia	3	0.54	265	Psisum	1	0.18
35	Aspilia	2	0.36	155	Hagenia	1	0.18	266	Psophocarpus	1	0.18
36	Azadirachta	1	0.18	156	Hallea	1	0.18	267	Psychotria	2	0.36
37	Baphia	1	0.18	157	Helianthes	1	0.18	268	Pteridium	1	0.18
38	Barleria	1	0.18	158	Helichrysum	5	0.90	269	Pteris	3	0.54
39	Basella	1	0.18	159	Hibiscus	8	1.44	270	Punica	1	0.18
40	Bersama	1	0.18	160	Hippocratea	3	0.54	271	Pycnostachys	3	0.54
41	Bidens	4	0.72	161	Hordeum	1	0.18	272	Ranunculus	1	0.18
42	Borassus	1	0.18	162	Huperzia	2	0.36	273	Rhabdotosperma	1	0.18
43	Bothriocline	1	0.18	163	Hygrophila	1	0.18	274	Rhamnus	1	0.18
44	Brachycorythis	1	0.18	164	Hymenocardia	1	0.18	275	Ricinus	1	0.18

Appendix 5. Continoued …

45 Brassica	3	0.54	165 Hyparrhenia	2	0.36	276 Rosa	1	0.18
46 Bridelia	1	0.18	166 Hypericum	3	0.54	277 Rosmarinus	1	0.18
47 Brucea	1	0.18	167 Hypoestes	2	0.36	278 Rothmannia	1	0.18
48 Brugmansia	1	0.18	168 Hypolepis	1	0.18	279 Rubus	3	0.54
49 Buddleja	1	0.18	169 Ilex	1	0.18	280 Rumex	3	0.54
50 Caesalpinia	1	0.18	170 Impatiens	4	0.72	281 Ruta	1	0.18
51 Calistemone	1	0.18	171 Indigofera	1	0.18	282 Rytigynia	1	0.18
52 Calpurnia	1	0.18	172 Ipomoea	5	0.90	283 Saccharum	1	0.18
53 Canaria	1	0.18	173 Iresine	1	0.18	284 Salix	1	0.18
54 Canna	1	0.18	174 Isodon	1	0.18	285 Salvia	3	0.54
55 Canthium	1	0.18	175 Isoglossa	2	0.36	286 Sapium	1	0.18
56 Capparis	2	0.36	176 Jacaranda	1	0.18	287 Satureja	2	0.36
57 Capsicum	2	0.36	177 Jasminum	2	0.36	288 Scadoxus	2	0.36
58 Cardiospermum	1	0.18	178 Jatropha	1	0.18	289 Schefflera	3	0.54
59 Carduus	1	0.18	179 Justicia	3	0.54	290 Schinus	1	0.18
60 Carex	2	0.36	180 Kalanchoe	4	0.72	291 Schoenoplectus	2	0.36
61 Carica	1	0.18	181 Kniphofia	1	0.18	292 Selaginella	1	0.18
62 Casimiroa	1	0.18	182 Lactuca	1	0.18	293 Senecio	2	0.36
63 Cassipourea	1	0.18	183 Lagenaria	1	0.18	294 Senna	5	0.90
64 Casuarina	1	0.18	184 Laggera	4	0.72	295 Sericostachys	1	0.18
65 Catha	1	0.18	185 Landolfia	1	0.18	296 Sesbania	1	0.18
66 Caylusea	1	0.18	186 Lantana	2	0.36	297 Setaria	3	0.54
67 Ceiba	1	0.18	187 Laportea	1	0.18	298 Sida	4	0.72
68 Celosia	1	0.18	188 Leonotis	1	0.18	299 Snowdenia	1	0.18
69 Celtis	3	0.54	189 Lepidium	1	0.18	300 Solanecio	2	0.36
70 Centella	1	0.18	190 Lepidotrichilia	1	0.18	301 Solanum	9	1.62
71 Chamaecrista	1	0.18	191 Leucaena	1	0.18	302 Sonchus	2	0.36
72 Cheilanthes	1	0.18	192 Leucas.	1	0.18	303 Sorghum	1	0.18
73 Chenopodium	1	0.18	193 Linum	1	0.18	304 Spathodea	1	0.18
74 Chionanthus	1	0.18	194 Lippia	2	0.36	305 Sphaeranthus	1	0.18
75 Chlorophytum	1	0.18	195 Lobelia	1	0.18	306 Sporobolus	1	0.18
76 Cirsium	1	0.18	196 Lolium	1	0.18	307 Stellaria	3	0.54
77 Citrus	4	0.72	197 Lycopersicon	1	0.18	308 Stephania	2	0.36
78 Clausena	1	0.18	198 Lycopodiella	1	0.18	309 Synadenium	1	0.18
79 Clematis	3	0.54	199 Lycopodium	1	0.18	310 Syzygium	2	0.36
80 Clerodendrum	2	0.36	200 Macaranga	1	0.18	311 Tacazzea	2	0.36
81 Coccinia	2	0.36	201 Maesa	1	0.18	312 Tagetes	1	0.18
82 Coffea	1	0.18	202 Malva	1	0.18	313 Teclea	1	0.18
83 Colocasia	1	0.18	203 Mangifera	1	0.18	314 Tephrosia	2	0.36
84 Combretum	2	0.36	204 Manihot	1	0.18	315 Terminalia	3	0.54
85 Commelina	2	0.36	205 Manilkara	1	0.18	316 Thalictrum	1	0.18
86 Conyza	2	0.36	206 Marattia	1	0.18	317 Thea	1	0.18
87 Cordia	1	0.18	207 Maytenus	5	0.90	318 Thymus	1	0.18
88 Coriandrum	1	0.18	208 Melia	1	0.18	319 Trachyspermum	1	0.18
89 Crassocephallum	2	0.36	209 Melilotus	1	0.18	320 Trema	1	0.18
90 Caterispermum	1	0.18	210 Melinis	1	0.18	321 Trichillia	2	0.36
91 Crinum	1	0.18	211 Micractis	1	0.18	322 Trifolium	2	0.36

Appendix 5. Continoued …

92 Crotalaria	6	1.08	212 Microglossa	1	0.18	323 Trilepisium	1	0.18
93 Croton	1	0.18	213 Mikaniopsis	1	0.18	324 Tristemma	1	0.18
94 Cryptotaenia	1	0.18	214 Milicia	1	0.18	325 Triumfetta	1	0.18
95 Cucumis	2	0.36	215 Millettia	1	0.18	326 Tylosema	1	0.18
96 Cucurbita.	1	0.18	216 Mimosa	2	0.36	327 Typha	1	0.18
97 Cupressus	1	0.18	217 Mimulopsis	1	0.18	328 Urera	1	0.18
98 Curcuma	1	0.18	218 Mimusops	1	0.18	329 Urtica	1	0.18
99 Cussonia	1	0.18	219 Momordica	1	0.18	330 Vangueria	1	0.18
100 Cyanotis	1	0.18	220 Moringa	1	0.18	331 Vepris	1	0.18
101 Cyathea	1	0.18	221 Morus	2	0.36	332 Verbena	1	0.18
102 Cyathula	3	0.54	222 Mukia	1	0.18	333 Vernonia	10	1.80
103 Cymbopogon	1	0.18	223 Musa	1	0.18	334 Vicia	1	0.18
104 Cynodon	2	0.36	224 Nicandra	1	0.18	335 Viola	1	0.18
105 Cynoglossum	3	0.54	225 Nicotiana	1	0.18	336 Vittaria	2	0.36
106 Cyperus	4	0.72	226 Nigella	1	0.18	337 Withania	1	0.18
107 Cyphomandra	1	0.18	227 Ocimum	4	0.72	338 Zantedeschia	1	0.18
108 Cyphostema	2	0.36	228 Ocotea	1	0.18	339 Zea	1	0.18
109 Dalbergia	1	0.18	229 Oenanthe	1	0.18	340 Zehneria	2	0.36
110 Datura	1	0.18	230 Olea	3	0.54	341 Zingiber	1	0.18
111 Daucus	1	0.18	231 Oncinotis	1	0.18	Total Species=555		
112 Deinbollia	1	0.18				Total Genera=341		
113 Delonix	1	0.18				Total Family=115		
114 Desmodium	1	0.18						
115 Dichrostachyus	1	0.18						
116 Dicranopteris	1	0.18						
117 Dicrocephala	1	0.18						
118 Dioscorea	1	0.18						
119 Diospyros	2	0.36						
120 Discopodium	1	0.18						

Appendix 6-List of plant Families

N=Number of species, %F=Percentage of all families

SN	Family	N	%F	SN	Family	N	%F	SN	Family	N	%F
1	Acanthaceae	11	1.98	45	Dioscoraceae	1	0.18	89	Ranunculace	6	1.08
2	Adiantaceae	1	0.18	46	Dracaenaceae	3	0.54	90	Resedaceae	1	0.18
3	Alangaceae	1	0.18	47	Ebenaceae	2	0.36	91	Rhamnaceae	2	0.36
4	Alismataceae	1	0.18	48	Euphorbiaceae	18	3.24	92	Rhizophorac	1	0.18
5	Alliaceae	3	0.54	49	Fabaceae	51	9.19	93	Rosaceae	11	1.98
6	Aloaceae	1	0.18	50	Flacourtiaceae	3	0.54	94	Rubiaceae	17	3.06
7	Amaranthaceae	12	2.16	51	Geraniaceae	1	0.18	95	Rutaceae	9	1.62
8	Amaryllidaceae	3	0.54	52	Gleicheniaceae	1	0.18	96	Salicaceae	1	0.18
9	Anacardiaceae	4	0.72	53	Guttiferae	3	0.54	97	Sapindaceae	4	0.72
10	Annonaceae	1	0.18	54	Hypolepidaceae	1	0.18	98	Sapotaceae	4	0.72
11	Anthericaceae	1	0.18	55	Icacianaceae	1	0.18	99	Scrophularia	1	0.18
12	Apiaceae	8	1.44	56	Lamiaceae	27	4.86	100	Selaginellac	1	0.18
13	Apocyanaceae	3	0.54	57	Lauraceae	2	0.36	101	Simaroubace	1	0.18
14	Aquifoliaceae	1	0.18	58	Linnaceae	1	0.18	102	Sinopteridac	1	0.18
15	Araceae	4	0.72	59	Lobeliaceae	1	0.18	103	Solanaceae	21	3.78
16	Araliaceae	6	1.08	60	Loganiaceae	1	0.18	104	Sterculiacea	2	0.36
17	Arecaceae	3	0.54	61	Loranthaceae	1	0.18	105	Theaceae	1	0.18
18	Asclepiadaceae	2	0.36	62	Lycopodiaceae	4	0.72	106	Thelypterida	1	0.18
19	Asparagaceae	3	0.54	63	Lythraceae	1	0.18	107	Tiliaceae	2	0.36
20	Asphodelaceae	1	0.18	64	Malvaceae	15	2.70	108	Typhaceae	1	0.18
21	Asteraceae	62	11.17	65	Marratiaceae	1	0.18	109	Ulmaceae	4	0.72
22	Balsaminaceae	4	0.72	66	Melastomataceae	1	0.18	110	Urticaceae	8	1.44
23	Basellaceae	1	0.18	67	Meliaceae	6	1.08	111	Verbenaceae	5	0.90
24	Bignoniaceae	2	0.36	68	Melianthaceae	1	0.18	112	Violaceae	1	0.18
25	Bombacaceae	1	0.18	69	Menispermaceae	2	0.36	113	Vitaceae	2	0.36
26	Boraginaceae	5	0.90	70	Moraceae	20	3.60	114	Vittariaceae	2	0.36
27	Brassicaceae	4	0.72	71	Moringaceae	1	0.18	115	Zingiberacea	3	0.54
28	Bromeliaceae	1	0.18	72	Musaceae	2	0.36		Total Species=555		
29	Campanulaceae	1	0.18	73	Myrsinaceae	2	0.36		Total Genera=341		
30	Cannaceae	1	0.18	74	Myrtaceae	6	1.08		Total Families=115		
31	Capparidaceae	2	0.36	75	Oleaceae	6	1.08				
32	Caricaceae	1	0.18	76	Oleandraceae	1	0.18				
33	Caryophyllaceae	3	0.54	77	Orchidaceae	1	0.18				
34	Casuarinaceae	1	0.18	78	Passifloraceae	1	0.18				
35	Celstraceae	10	1.80	79	Phytolaccaceae	1	0.18				
36	Chenopodaceae	1	0.18	80	Piperaceae	3	0.54				
37	Combretaceae	5	0.90	81	Pittosporaceae	1	0.18				
38	Commelinaceae	3	0.54	82	Plantaginaceae	3	0.54				
39	Convolvulaceae	5	0.90	83	Poaceae	23	4.14				
40	Crassulaceae	4	0.72	84	Podocarpaceae	1	0.18				
41	Cucurbitaceae	12	2.16	85	Polygonaceae	6	1.08				
42	Cupressaceae	1	0.18	86	Polypodiaceae	2	0.36				
43	Cyatheaceae	1	0.18	87	Proteaceae	1	0.18				
44	Cyperaceae	8	1.44	88	Pteridaceae	3	0.54				

Appendix 7- Checklist of data sheets: Ecological and ethnobotanical data sheets.

Ecological data: Plot sampling

Data Sheet1: Density and percent cover, presence absence data.

Complete one form for each plot.

Name(s) ______________________________ Date ______________________________

Description of study area (e.g., wetland) ____

____

____

Plot ID number/label ____

Description of sample plot (e.g., Forest, wetland, shady) _________________________________

____

____

Method used (density, percent cover, or both) _____________________________________

____

Species name (or description)*	Density (number of individuals in plot)	Percent cover (% of plot covered by species)

Geo-C: UTM ______________________________ P (N): ______________________________

N ______________________E____________________ Altitude: ____________________

Slope (º): …....., Aspect; ………, Disturbance intensity;……….., Grazing intensity; ……, Other; ……..

*If you don't know the name of the species, you can describe it and give it temporary name (code). You may want to take a sample of the species to later determine its name by asking an expert or using a field guide for plant specimen collection and identification. In case there is no enough space, use back of this page.

Ethnobotanical Data/: Semi structured interview.

General Informants/

Name of respondent: ………………………………………………… Lived here for ………………years.

1. Date: ………………………………… Residence/Locality/Village ………………………………
   District: ……………………………………………… kebele …………………………………..…
   Sex: …………Age: …………Marital status: ……. Occupation: …………………………………
   Religion: ………………………Education: …..............Ethnicity: …………………………………
   Traditional ways of classifying:
   Vegetation: ………………………………………………………………………………………
   Landscapes: ………………………………………………………………………………………
   M = medicinal, WEP = Wild Edible Plant, H = Human, A = Animal, B = Both
   Data sheet 2: Medicinal plants

Local plant Names/ Sc .Name/Family/Habit	Ethnobotanical use		Common diseases in your area (**H, A, B**)
	M, WEP, B	other	

Additional Notes: ………………………………………………………………………………………

Appendix 7. Continoued …

Data sheet 3: Medicinal Plants (MP) for **KEY** informants only.

R = Name of Respondents 1, 2, 3 …., H= Human, A= Animal, B = Both

Local plant name/Species/ Family	Habit	Name of disease treated (**H, A, B**)	Plant collected from
R1:			

Additional Notes:

1. What are the signs and symptoms of diseases listed in the above tables?
2. How do people prevent and control the above diseases?
3. List the types of plants used to treat the above diseases and way of administration/applications.
   3.1. Plants used to treat human diseases: Parts used condition of preparation, and dosage.
   3.2. Plants used to treat animal diseases: Parts used condition of preparation and dosage.
   3.3. Plants used to treat both human and animal diseases: Parts used, condition, dosage.
   3.4. Are there any side effects of these medicinal plants? If any, antidote?
   3.5. Are the medicinal plants easily accessible? If not why?
   3.6. What do the trend of accessibility look like compared to the past 10 years or more?
   3.7. How does medicinal plant knowledge transferred among community members?
   3.8. Is there relationship between modernization and medicinal plant use?
   3.9. Which medicinal plant is the most preferred and why?
   3.10. Are there taboos associated with medicinal plants? If yes, why?
   3.11. What are the major problems associated with medicinal plants in Sheka?
   3.12. What do you think are the solutions the problems?
   3.13. How do medicinal plants conserved in Sheka?
   3.14. Are there any other conservation efforts of medicinal plants in Sheka?
   3.15. Any information/ on non-medicinal use of the medicinal plants listed above.
4. List wild edible plants in your area together parts eaten.

Data Sheet 4: Wild Edible Plants (WEP)

Local plant name/Species/ Family	Habit	Parts eaten	Plant collected from
R1:			

Additional Notes: ……………………………………………………………………………………………...
………..

   4.1. What is public perception towards wild edible plants?

Appendix 7. Continoued …

4.2. How do wild edible plants consumed? Raw, cooked, alone, mixed with others, other/specify.
4.3. Are the wild edible plants marketable?
4.4. Are the wild edible plants easily accessible?
4.5. Are the wild edible plants available at all seasons? If no mention season of availability.
4.6. What are the factors affecting the availability of wild edible plants?
4.7. What are common problems associated with wild edible plants?
4.8. What is your opinion towards the conservation and management of the wild edible plants?

5. Generally, what are the major problems of conservation in your area?
6. What do you think the solutions to the problems of conservation in your area?

Data Sheet 5: Vegetation Data/plot or site summary sheet/-suitable for **ArcGIS** and **R** Statistical analysis. Code = serial no., photo no., etc, Ab. =Abundance, Geo cord. = N, E, UTM, elevation, etc

Sites/Samples	*Code = /Species/Family/Habit/	Ab.	Geo coordinates/Habitat Type

***=Additional Notes**: In case you cannot identify the plant on the field write its **specimen code (serial number, photo number, Vernacular Name, etc.)** for herbarium identification. Use back of page.

Data Sheet 6: Free listing of plant species against any ethnobotanical significance/ethno summary sheet/.

*Code: Vernacular names/Family/Habit/	Geo coordinates	Recorded from/locality/	HT

*=For description of specific uses and detail notes, use back of the data sheet (**major** and **minor** uses of species specified here based on informant citations).NB: HT=Habitat types = forest-F, woodland-WL, grassland-GL, riverside-RIS road side-ROS, agricultural land-AL, homegarden-HG, wetland-WTL, urban-UR, suburban-SUR.

Thank you!
Name of data collector/Researcher: ………………………………………….... sign………..Date ………

Name of field assistant ……………………………………………………….sign ..…….Date ………..

Appendix 8: Important alphabets used in the dissertation (Sh= Shakinano language and its equivalents).

(Sh= shakinano, Pronunciations, English equivalent, Amharic equivalent).

SN	Sh	Pronunciation	English equivalent	Amharic equivalent
1	A	Ao	A	አ
2	B	Bo	B	በ
3	C'	Co	C	ጮ
4	D	Do	D	ዶ
5	E	Ee	E	ኤ
6	F	Fo	F	ፎ
7	G	Go	G	ጎ
8	H	Ho	H	ሆ
9	I	Ii	I	ኢ (እ)
10	J	Jo	J	ጆ
11	K	Ko	K	ኮ
12	L	Lo	L	ሎ
13	M	Mo	M	ሞ
14	N	No	N	ኖ
15	O	Oo	O	አ
16	P	Po	P	ፖ
17	K'	K'o	-	ቆ
18	R	Ro	R	ሮ
19	S	So	S	ሦ
20	T	To	T	ቶ
21	U	Uu	U	ኡ
22	W	Wo	W	ዎ
23	Y	Yo	Y	ዬ
24	T'	T'o	-	ጦ
25	P'	P'o	-	ጶ
26	CH	Cho	-	ቾ
27	SH	Sho	-	ሾ

Appendix . 9. Values of the relative proximities of plant communities

Complete intra-cluster diameter

Clusters	1	2	3	4	5	6	7	8
Distance/Dissimilarity/	197	168	144	141	**128**	214	53	**46**

Average intra-cluster diameter

Clusters	1	2	3	4	5	6	7	8
Distance/Dissimilarity/	65.51	57.87	52.27	50.56	50.5	**78.56**	**14.30**	18.40

Results of inter-cluster/between cluster/ distances

Single inter-cluster linkage

Clusters	1	2	3	4	5	6	7	8
1	0							
2	85	0						
3	101	**57**	0					
4	78	61	71	0				
5	87	58	76	77	0			
6	101	141	146	132	**147**	0		
7	72	62	88	61	84	133	0	
8	65	79	85	71	87	118	58	0

Complete inter-cluster linkage

Clusters	1	2	3	4	5	6	7	8
1	0							
2	216	0						
3	221	175	0					
4	212	172	168	0				
5	173	165	171	175	0			
6	239	245	**263**	248	215	0		
7	183	157	161	140	146	196	0	
8	170	164	184	153	151	185	**87**	0

Average inter-cluster linkage

Clusters	1	2	3	4	5	6	7	8
1	0							
2	140.48	0						
3	153.09	121.84	0					
4	135.05	121.37	113.71	0				
5	131.16	119.61	123.94	125.74	0			
6	175.92	200.28	**213.97**	189.61	181.91	0		
7	114.43	119.53	120.41	97.05	114.13	161.62	0	
8	105.91	126.09	134.46	107.15	115.73	148.56	**70.4**	0

The Hausdorff metrics inter-cluster linkage

Clusters	1	2	3	4	5	6	7	8
1	0	142	152	145	137	191	156	155
2	137	0	123	123	126	201	139	149
3	155	105	0	114	119	**215**	150	169
4	122	110	105	0	126	198	131	142
5	126	101	104	120	0	164	123	136
6	158	183	**210**	190	185	0	179	170
7	89	89	104	**70**	104	150	0	**76**
8	78	94	102	86	102	135	**70**	0

Appendix. 10. Values of validation of environmental factors

Results of test for significance of environmental variables, RDA

Variables	Df	AIC	F-val.	N.per	Pr(>F)	Signi.codes	Significance
Altitude	1	531.01	11.1974	99	0.005	**	Yes (high)
Aspect	1	538.86	2.9348	99	0.005	**	Yes (high)
Disturbance	1	539.40	2.3931	99	0.010	**	Yes (high)
Slope	1	539.69	2.0945	99	0.010	**	Yes (high)
Grazing	1	539.99	1.7944	99	0.035	*	Yes (medium)

Results of ordination step forward selection, RDA

Variable	Df	AIC*	F	N.Per	Pr(>F)	Code	Sign.
Altitude	1	531.01	11.1974	199	0.005	**	Yes (high)
Aspect	1	538.86	2.9348	199	0.005	**	Yes (high)
Disturbance	1	539.40	2.3931	199	0.005	**	Yes (high)
Slope	1	539.69	2.0945	199	0.020	*	Yes (medium)
Grazing	1	539.99	1.7944	199	0.020	*	Yes (medium)

*=Akaike Information Criterion

Results of ordination step forward direction with R^2 adjusted values, RDA

Variables	R^2 adjusted	Df	AIC	F	N.per	Pr(>F)	Code	Sign.
All	0.133706287	1						
Altitude	0.097866400	1	531.01	11.1974	199	0.005	**	Yes (high)
Aspect	0.020168367	1	538.86	2.9348	199	0.005	**	Yes (high)
Disturbance	0.014603609	1	539.40	2.3931	199	0.005	**	Yes (high)
Slope	0.011509161	1	539.69	2.0945	199	0.020	*	Yes (medium)
Grazing	0.008379942	1	539.99	1.7944	199	0.020	*	Yes (medium)
None	0.000000000							

Results of ordination step with step.res$anova (stepwise selection with vif.cca), RDA

Variable	R^2.adj.	Df	AIC	F	N.per	Pr(>F)	Code	Sign	vif.cca*	Rej
All	0.133706	-	-	-	-	-	-		-	
Altitude	0.097866	1	531.01	11.20	199	0.00500	**	Yes	1.20	No
Aspect	0.114841	1	530.18	2.80	199	0.00500	**	Yes	1.22	No
Slope	-		-	-	-	-	-		1.81	No
Grazing	0.123390	1	530.22	1.90	199	0.01000	**	Yes	3.18	No
Disturbance	0.129506	1	530.50	1.64	299	0.01667	*	Yes	2.63	No

* All values with vif.cca < 5 are non-collinear hence significant and not rejected.

Stepwise selection of environmental variables, CCA

Variable	Df	AIC	F	N.Perm	Pr(>F)	Code	Sign.
Altitude	1	645.89	5.7506	199	0.005	**	Yes (high)
None		649.59					
Disturbance	1	649.69	1.8856	199	0.005	**	Yes (high)
Aspect	1	649.74	1.8289	199	0.005	**	Yes (high)
Grazing	1	650.38	1.1943	199	0.050	*	Yes (medium)
Slope	1	650.44	1.1305	199	0.160		

Results of anova.cca test for significance of terms added sequentially, CCA

Variable	Df	SumsOfsqs	MeanSqs	F.Model	R^2	Pr(>F)	Code	Sign
Altitude	1	3.7280	3.7280	13.6912	0.12426	0.01	**	Yes
Slope	1	0.6607	0.6607	2.4264	0.02202	0.01	**	Yes
Aspect	1	0.5604	0.5604	2.0581	0.01868	0.01	**	Yes
Grazing	1	0.5325	0.5325	1.9556	0.01775	0.04	*	Yes
Disturbance	1	0.2854	0.2854	1.0480	0.00951	0.37		
Residuals	89	24.2338	0.2723		0.80777			
Total	94	30.0007			1.00000			

Results of anova.cca to test for marginal effects

Variable	Df	Chi Square	F	Pr(>F)	Code	Sign.	Vif.cca	Reject
Altitude	1	0.4847	4.6095	0.001	***	Yes	1.216589	No
Slope	1	0.1210	1.1505	0.169			1.856940	No
Aspect	1	0.1440	1.3694	0.016	*	Yes	1.252723	No
Grazing	1	0.0934	0.8884	0.636			2.846432	No
Disturbance	1	0.0922	0.8771	0.654			2.311640	No
Residual	89	9.3594						

Appendix. 11. Field Photo Galleries

Appendix.11. 1. Field activities during ethnobotanical data collection.

Key: A= Masha-Chewaka locality, B= Gecha-Gamadro locality, C= Gecha=Gamadro locality, D= Gecha=Gebinal locality, E= Gecha-Yukchichi locality, F= Masha-Yep'o locality, G= Masha-Yep'o locality, H= Masha-Kanga locality, I= Masha-Chewak'a locality.

Appendix. 11. 2. Guided field walk

Appendix.11. 3. Plant specimen collection and preparation (plant taxonomic methods)

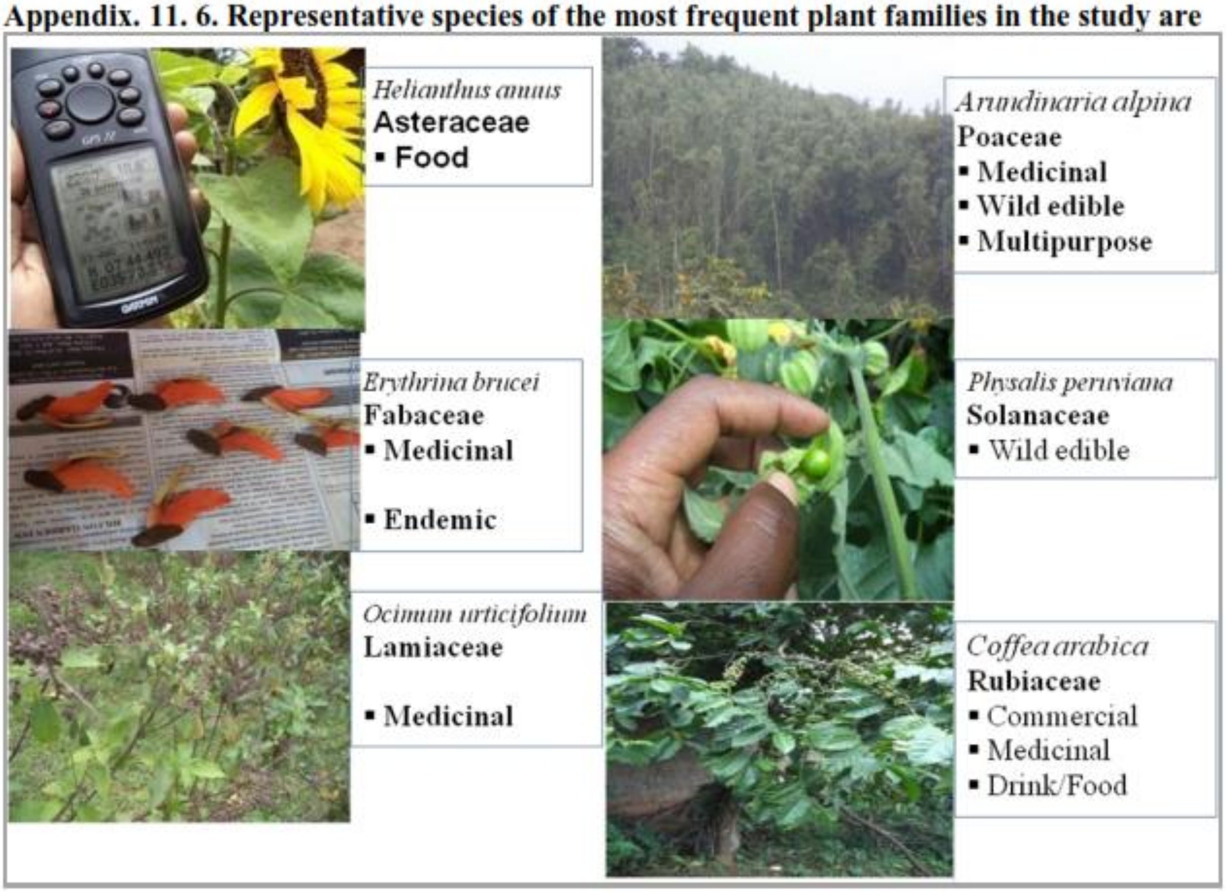
Appendix. 11. 4. Discussion with key informants and other knowledgeable persons

Key: A, B, C, D, E, F represent medicinal plant demonstrations followed by information recording

Appendix.11. 5. Representative wild edible plant species in the study area

A= *Embelia schimperi*, B= *Crassocephalum rubens*, C= *Ficus sur*, D= *Colocasia esculenta*, E= *Pho* *reclinata*, F= *Piper capense*, G= *Solanum vilosum*, H= *Rubus apetalus*, I= *Aframomum corrorima*

Appendix. 11. 6. Representative species of the most frequent plant families in the study are



Appendix. 11. 7. Picture showing the eight plant communities

Appendix. 11. 8. Market surveys and marketability of different plant derived products

Key: A= *Impatiens tinctoria* (Masha and Tepi market), B, G & L= *Phoenix reclinata* (Tepi and Mash market), C & D= *Ozoroa pulcherima* (Tepi , Gecha and Masha Markets), E= *Trichillia dregeana* (Tepi, Gecha and Masha markets), F= *Echinops kebericho,*

Appendix 11.8. Market surveys (continued)

Key: H, I, K and O = Wood products of *Cordia africana, Pouteria adolfi-firiedericii,* K= Rope made of bark of *Hibiscus ludwigii* (Malvaceae) and *Dombeya torida* (sterculaceae) species, M= Medicinal spices, N= *Ocimum basilicum*, P= Bee hive made of *Arundinaria alpina*

Appendix. 11. 9. Major threats to vegetation in the study area and the arket drivers

Key: A & B = Tree cutting for timber and wood, C = Forest clearance for Coffee and Tea plantation, D & E = Forest clearance for Eucalyptus plantation, F= Invasive alien species (*Lantana camara*), G = Fire wood market, H=Charcoal market, I= Forest fire, J = & K wood market

I the undersigned, declare that this dissertation is my original work, it has not been presented in other universities, colleges or institutions, seeking for similar degree or other purposes. All sources of the materials used in the dissertation have been only duly acknowledged.

Name: **Zewdie Kassa** Signature date 17/03/2017