WILD RELATIVES OF MONOCOTYLEDONOUS CROPS IN THE ETHIOPIAN FLORA

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June 2015

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A Thesis Submitted to

The Department of Plant Biology and Biodiversity Management

Presented in Partial Fulfillment of the Requirements for the Degree of Master of Science (Plant Biology and Biodiversity Management)

Addis Ababa University

Addis Ababa, Ethiopia

June 2015

ADDIS ABABA UNIVERSITY

GRADUATE PROGRAMS

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ABSTRACT

WILD RELATIVES OF MONOCOTYLEDONOUS CROPS IN THE ETHIOPIAN FLORA

Biniyam Asfaw Tessema, MSc Thesis

Addis Ababa University, 2015

This research focused on the current status, distribution and the uses of wild relatives of monocotyledonous crops grown in Ethiopia. The data were collected in two phases. First, data were gathered from literature and herbarium specimens and then field studies were undertaken to collect voucher specimens and ethnobotanical data by using purposive sampling technique and semi-structured interviews. The field study was conducted in six floristic regions of Ethiopia (*Gamo Gofa, Gojam, Harerge, Kefa, Shewa and Sidamo*)*. Then after, identification of the voucher specimens were made at the National Herbarium (ETH) of Addis Ababa University using keys in the Flora volumes and authenticated specimens housed at ETH and confirmed by the taxonomic experts. Data were entered in to Microsoft Excel spreadsheet, and then descriptive statistics, informant consensus and ranking exercises were employed for the analysis. From the Flora and other literature sources 17 species of monocotyledonous crop wild relatives were recorded but at the National Herbarium 16 species had voucher specimens. The field survey came up with seven (41.2%) species only, clearly showing the need for more field survey and collection. Wild Colocasia esculenta and Sorghum arundinaceum are abundant in the field while the two wild yam species (Dioscorea bulbifera and Dioscorea praehensilis) have declined through time as affirmed by informants and the finding of these species in the wild environment is very limited. More species of monocotyledonous crop wild relatives were obtained from Kefa floristic region. Informant consensus analysis showed that Sorghum arundinaceum was cited by 22 (48.89 %) informants followed by Dioscorea bulbifera and Dioscorea praehensilis 20 (44.44%) and 18 (40.00%) respectively. Dioscorea praehensilis and Dioscorea bulbifera were reported by informant as highly scarce. The main causes for the depletion of crop wild relatives according to the informants are agricultural expansion and over grazing which scored 21 and 18 respectively. The monocotyledonous crop wild relatives include species that are of high potential in crop breeding and for enhance utilization by the community.*

Key words/phrases: Crop wild relatives, domestication, ethnobotany, monocotyledons, voucher specimen.

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to my advisors Professor Zemede Asfaw and Professor Ensermu Kelbessa for their guidance, provision of literature and for their helpful encouragements and continuous follow up in the entire process of the thesis work.

I am indebted to The Department of Plant Biology and Biodiversity Management, Addis Ababa University for facilitating my research work and providing financial support and staff members of the National Herbarium (ETH) for their technical and material assistance for specimen identification.

My sincere thanks go to my friend Debela Daba for his commitment on field, proposal and thesis drafts and providing printing materials, all the respondents who helped me in the fieldwork and Zewdie Kasa for his support for making the map. I would like to use this opportunity to thank Abiy Kifle, Endashaw Yisma and Genet Zewdu who have always been with me.

Finally yet importantly, I am most deeply grateful to my parents, for helping me strive towards the realization of my potentials and all the inconveniences they have encountered during my absence and your wonderful support and patience during my stay away from home are appreciated.

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Acronyms and Abbreviations

AAU Addis Ababa University

ANP Awash National Park

CWRs Crop Wild Relatives

FCIC Federal Crop Insurance Corporation

FDRE Federal Democratic Republic of Ethiopia

GDP Gross Domestic Product

m a s l Meters Above Sea Level

MCWRs Monocotyledonous Crop Wild Relatives

NMSA National Meteorological Service Agency

PGRC Plant Genetic Resource Center

SNNPRS Southern Nation, Nationalities and Peoples Regional State

USDA United State Departiment of Agriculture

CHAPTER ONE

1 INTRODUCTION

1.1 Background of the Study

According to FDRE (2009), agriculture accounted for 46.3% of the GDP, 83.9% of exports, and 80% of the labor force in 2006/2007, compared to 44.9%, 76.9% and 80% in 2002/2003, and agriculture remains the most important sector of the Ethiopian economy. Ethiopia has great agricultural potential because of its vast areas of fertile land, diverse climate, generally adequate rainfall, and large labor pool. Ethiopians have diverse farming practices that can be grouped into three major agricultural systems: The highland mixed farming system, the low plateaux and valley mixed agriculture and the pastoral livestock production of the arid and semi-arid zones. Of the total area, which is 122 million hectares, 84 million hectares (69%) of the total area is classified as agricultural land suitable for crop and livestock production. Of this, about 14 million hectares (17%) is cultivated, whereas about 8 million hectares of it fall under major crop production (PGRC, 1995).

Today, the major crops grown in many parts of the world are far from their origins and, in fact, many regions are now dependent on alien crop species/originally domesticated at distant locations (Hancock, 2012). “Crops” may include food, fodder and forage crops, medicinal plants, condiments, ornamental and forestry species, which are plants purposefully tended and used by humankind. There are many definitions of the word “crop”. When referring to plants, United State Departiment of Agriculture (USDA) considers crops to be those plants that are cultivated either for sale or for subsistence. In order for a plant to be considered cultivated, some form of management must be applied. The intensity of the management is not critical for determining whether a plant is cultivated or not. This definition includes plants, mushrooms, or plant products harvested from “wild areas” whose populations are managed, monitored and documented to ensure long-term, sustainable production (FCIC, 2009).

Crops were derived from what was traditionally considered separate species that are widely distributed in the initial area of cultivation. The genes separating wild and cultivated forms are easily transferred, and natural hybrids can be found with combinations of wild and domesticated

characteristics (Zohary and Hopf, 2000). All our modern crops have been developed from wild plants. The domestication of a plant passes through stages from intensified usage of the wild plant to the development of a domesticate so dependent on humans that it cannot survive in the wild. There are many wild plants that are used for food, particularly in times of food shortage such as the period between seed sowing and harvest. It is hardly surprising that the majority of such plants are those used as leafy vegetables, followed by those with edible fruits, tubers or roots (Padulosi, 1999).

Any species belonging to the same genus as the crop, based on the argument that species judged to be sufficiently similar to belong to the same genus are likely to be related genetically. Also defined as crop wild relative is a wild plant taxon that has an indirect use derived from its relatively close genetic relationship to a crop; this relationship is defined in terms of the crop wild relative (CWR) belonging to gene pools 1 or 2, or taxon groups 1 to 4 of the crop (Maxted *et al.*, 2008).

There are different definitions of crop wild relatives. Being a CWR is a matter of degree, since some are more closely related than others are to the crop. Two ways of describing this relationship have been employed: gene ecological is based on the extent to which they can exchange genes with the crop and taxonomic is based on their taxonomic relationship with the crop. In general, a CWR can be defined as a wild plant species that is more or less closely related to a particular crop and to which it may contribute genetic material, but unlike the crop species has not been domesticated (Heywood and Dulloo, 2005).

Monocotyledonous plants are plants that have only one cotyledon or seed leave. They also have other characteristics, such as flower parts in multiples of threes (three, six, or nine petals). They also have adventitious roots that can grow from almost any part of the plant that is exposed to the soil, such as the stem. The leaves of monocotyledons have parallel veins with few exceptions (Simmonds, 1979).

CWRs have been used to improve yields and the nutritional quality of crops since the dawn of agriculture. A number of CWRs in the families of monocotyledons are growing in Ethiopia that have/may not have ethnobotanical functions. Even though they are many in numbers, there are

no studies of CWRs in Ethiopia since 1991. The gene bank collections of the crop wild relatives of the major crops are also incomplete. To identify high priority locations for collecting CWRs in order to fill the gaps, the researcher compared data on the distributions of these species with the locations where the species have already been collected. Therefore, this research was conducted to fill the gaps in knowledge on CWRs by comparing herbarium specimens with field collections and finding out their ethnobotanical values from the local community.

1.2 Research questions and objectives

1.2.1 Research questions

This research work answered the following main research questions:

- Which MCWRs are found in Flora volumes, National Herbarium (ETH) and which ones are found in the field visited?
- Which plant families and crop categories have high MCWRs?
- What is the status of MCWRs as compared to the early studies?
- In which floristic regions of the study area are MCWRs highly distributed?
- What are the ethnobotanical values of MCWRs?
- What are the importance of MCWRs to food security, climate change adaptation and crop improvement?

1.2.2 Objectives

1.2.2.1 General objective

- The main objective of this research was to study the current status, distribution and the ethnobotanical uses of the species of wild relatives of the crops in families within the monocotyledons in Ethiopia.

1.2.2.2 Specific objectives

- To collect voucher specimens of monocot crop wild relatives from the floristic regions identified as the target study area;
- To find out the local nomenclature and the system of naming applied;
- To compare the current status of monocotyledonous CWRs with results of early studies;
- To describe the current distribution of MCWRs in comparison with results of earlier studies;
- To find out the habitat the monocotyledonous crop wild relatives are found;
- To find out about the various uses of each CWR of monocot crops grown in Ethiopia;
- To assess the awareness of the local community about CWRs and how they are conserved;
- To describe the uses and how the CWRs differ from their cultivated crops.

CHAPTER TWO

2 LITERATURE REVIEW

2.1 Origins of Crops

The first crops were as diverse as the people and places where agriculture began. Different native plant assemblages were located in each of the early farming areas and, as a result, variant plant and animal species were domesticated in each of them. In the Middle East, there were huge natural stands of wheat and barley, and as a result, the early farmers in this region exploited these as their staple crops. In South-East Asia, wheat and barley were absent, but large-grained rice was plentiful and, as a result, rice became one of the crops of choice. Wheat, barley and rice were not present in Mesoamerica and Africa, so people exploited the locally abundant monocotyledons: sorghum in Africa and maize in Mesoamerica. No large grained species of any kind existed in South America and, as a result, the early farmers there domesticated the tuberous species potato, sweet potato and cassava and the pseudograins chenopod and amaranth (Hancock, 2012).

2.1.1 Single versus multiple origins

Researchers determine the number of origins based on multiple lines of evidence, including archaeological, genetic, and linguistic data. For crops where there is insufficient evidence in the literature to determine the number of origins, the default assumption is of a single origin, because this is the most parsimonious explanation. According to Meyer *et al*. (2012), a crop species has a ‘single origin’ when it was domesticated once from the wild ancestor(s), followed by dispersal. A crop has multiple domestication events, referred to as ‘multiple origins’, when domestication occurred independently, from the same ancestor(s), in different locations or times. A domesticated species with multiple origins can have many forms with different common names. In contrast, different species that were independently domesticated from different wild ancestors can share a common name (e.g. Asian and African rice) but are considered many single origin events. This indicates further research may, however, reveal that some presumed single origin crops did, in fact, have multiple origins.

2.2 Centers of origin and crop diversity

Vavilov defined eight centers of origin for most of our cultivated plants, each of them harboring significant genetic diversity within and between species. Most of these Vavilovian centers are situated in tropical and subtropical regions of the world, and their locations fall largely within the territories of developing countries.

Vavilov demonstrated that these centers had important factors in common (e.g. ancient agriculture and an old civilization; distributed in the tropical and subtropical regions; very diverse eco-topographic conditions) and that the distribution of the genetic diversity followed certain patterns (Vavilov 1926) as cited in Dvorak (2011). These centers are of critical importance for current and future crop improvement efforts as they harbor major parts of the genetic diversity of a given gene pool including the domesticated species as well as their wild and weedy relatives. Adaptation and selection processes in the crop gene pools are ongoing in these centers, especially in traditional agricultural production systems, where farmers continue to play an important role in the management and maintenance of this genetic diversity. In many parts of such centers, commercial agriculture has not yet been adopted and usually very diverse cultivation practices are followed, frequently based on traditional knowledge that has evolved over centuries and is passed on from one generation to the next. Most or all of the produced crops are consumed locally and traditional seed systems are an important component of these agricultural practices. However, these traditional systems are vulnerable and specific care is needed to avoid that their built in strength is undermined through outside interventions.

2.3 Crop domestication

Domesticated food crops are derived from a phylogenetically diverse assemblage of wild ancestors through artificial selection for different traits. Much of the understanding of the processes driving domestication comes from a subset of well-studied crops, particularly crops of major economic importance and model crops (i.e. crops that have had their genomes analyzed and are transformable). These crops have been critical for developing our fundamental understanding of domestication as a continuum of ongoing processes. In particular, they have been critical for revealing the underlying genetic mechanisms responsible for the suite of

phenotypic changes associated with domestication that comprise the domestication syndrome. They have also contributed to our knowledge of useful crop breeding traits, such as pathogen resistance, and of fundamental biological processes, such as polyploidization. However, information on such well-studied crops contributes disproportionately to the literature on domestication (Meyer *et al*., 2012).

2.3.1 Changes during the domestication process

Once humans began sowing seed, they began to alter plant species through both conscious and unconscious selection. The process of domestication is commonly described as occurring in three stages: hunting and gathering; cultivation of wild plants (pre-domestication cultivation); and fixation of domestication syndromes (emergence of full agriculture) (Allaby, 2010).

At the beginning of the domestication process, a number of changes began to appear in the genetic and physiological makeup of many crop species. Some of these changes were due to conscious selection, such as increases in palatability and color, but many of the others were the unconscious by-product of planting and harvesting. Harlan *et al.* (1973) recognized, a whole syndrome of traits associated with inadvertent selection due to the broadcasting and harvesting of grain crops. Harvesting resulted in the selection of the non-shattering trait, more determinate growth, more uniform ripening and increased seed production. All of these characteristics would have increased the likelihood that the seed of a genotype would be collected and subsequently planted. All of these characteristics would have increased the likelihood that the seed of a genotype would be collected and subsequently planted. Other characteristics associated with enhanced harvests would be selection towards erect types with synchronous tillering and an increase in the size of inflorescences, number of fertile florets per inflorescence and the number of inflorescences.

2.3.2 Seed shattering during domestication

During domestication, many morphological and physiological characteristics of the wild progenitors of modern crops were reshaped to meet the needs of humans by artificial selection. When ancient humans started to cultivate wild crops, one of the most notable obstacles would have been the seed shattering habit. Seeds on wild grasses shed naturally at maturity, ensuring

their natural propagation. Seed shattering, however, would have caused inefficient harvesting and large losses in grain yield for ancient humans. Hence, the non-shattering trait is likely to been placed under strong selection early in domestication. Selection for non-shattering crop plants would have greatly facilitated harvesting and improved production, and propagation of cereal crops would have become increasingly dependent on humans, a feature that distinguishes modern crops from their wild progenitors (Konishi *et al.*, 2006).

2.4 Crop cultivation in Ethiopia

Crop cultivation in Ethiopia has a long history of at least 5000 years and implements for cutting and grinding seed have been found in Stone Age sites, such as Melka Konture by the Awash River in central Ethiopia, dating back much earlier. Cereals dominate Ethiopian crop production. Cereals were grown on 73.4 % of the total area cultivated by a total of 11.2 million farmers. Together, these holders produce a yearly average of 12 million tons of cereals, which is 68 % of total agricultural production. The five major cereal crops are teff, wheat, maize, sorghum and barley. Teff accounts for 28 % of total cereal area, while maize stands for 27% of total annual cereal production. Next to cereals, pulses are the second most important crop group in terms of acreage but first from dicotyledon crops. In 2004/05-2007/08 6.4 million holders grew pulses on 12.4 percent of total area cultivated. Total pulse production averaged 1.5 million tons per year, which is 8.5 percent of total crop production. Oilseeds form the third most important crop group. It is cultivated on 6.9 percent of total area cultivated, by 3.1 million holders. They produce an average of 0.5 million ton of oil seeds yearly, i.e. 3% of the total annual production. Coffee is a major cash crop, accounting for 3% of GDP (and 19 and 35% of the quantity and value of exports respectively in that period), but occupying only 2.7% of the total area cultivated (i.e. 306 thousand hectares) (Bonger *et al.*, 2004).

Ethiopia is recognized as one of the world centres for crop evolution and origin and has long been as an important area of diversity for several major and various minor crops. There are about 175 crops are cultivated in Ethiopia. Most of them are belongs to dicots (64%) and (36%) of them belongs to monocot crops (Figure 1).

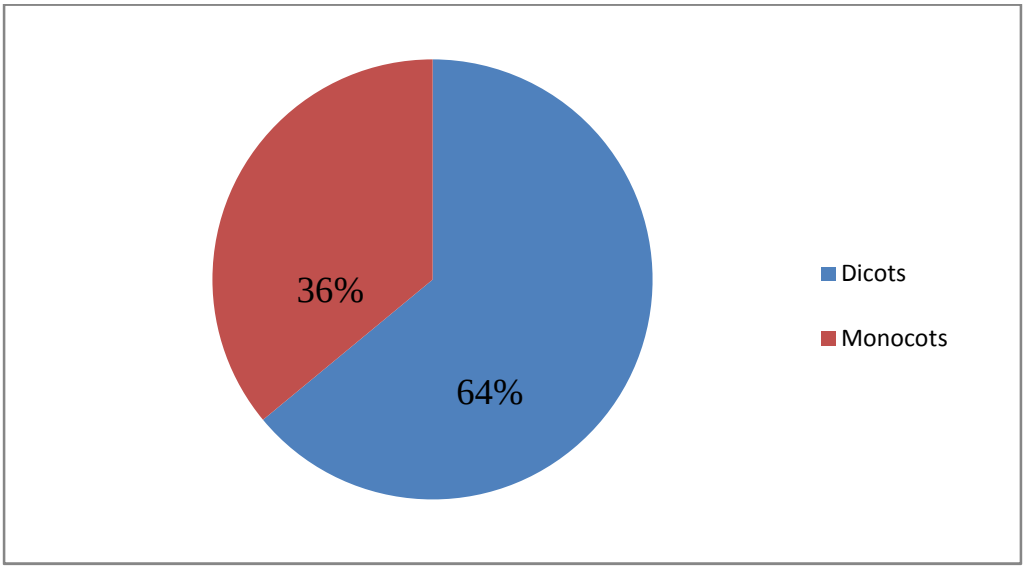

Figure 1: Proportion of monocotyledonous and dicotyledonous crops in Ethiopia

2.5 Crop wild relatives

For most domesticated species it is likely that crop wild relative populations contain far more genetic diversity than the crops themselves. This is because they have not been selected from a larger population to be domesticated, and may occur in a wide range of environments with contrasting soils, climate and other factors. In addition, wild species must continue to adapt to the environments they are found in, as climate and other environmental factors change. Whilst we can protect crop plants from pests and diseases with pesticides and from drought by irrigation, wild populations must have the genetic composition to naturally withstand all such stresses (Hopkins and Maxted, 2010).

The value of CWR is evident from the use that has been made of them in crop improvement, especially in the last few decades. In a recent review of their use Maxted and Kell (2009), cited 91 articles that reported the identification and transfer of useful traits from 185 CWRs taxa into 29 crop species. They found that the degree to which breeders had used CWRs diversity varied markedly between crops, both in terms of CWRs taxa usage and number of citations of CWRs usage reported.

The key to successful crop improvement is a continued supply of genetic variability and beneficial traits contained in this diversity (Dwivedi *et al*., 2008) and wild relatives of modern crops are the source of much of this novel diversity. It is not widely realized how high the turnover rate of cultivars is in many crops as a consequence of losing, for example, resistance or tolerance or because of the need for continued innovation.

The wild relatives of crop plants constitute an increasingly important resource for improving agricultural production and for maintaining sustainable agroecosystems. With the advent of climate change and greater ecosystem instability, CWRs are likely to prove a critical resource in ensuring food security for the new millennium. It was Nikolai Vavilov, the Russian botanist who first realized the importance of crop wild relatives in the early 20th century. Genetic material from CWRs has been utilized by humans for thousands of years to improve the quality and yield of crops. Farmers have used traditional breeding methods for millennia, wild maize (*Zea mexicana*) is routinely grown alongside maize to promote natural crossing and improve yields. More recently, plant breeders have utilized CWR genes to improve a wide range of crops like rice (*Oryza sativa*), tomato (*Lycopersicum esculentum*) and grain legumes (Edwards *et al.*, 2007).

CWRs have contributed many useful genes to crop plants, and modern varieties of most major crops now contain genes from their wild relatives. Therefore, CWRs are wild plants related to socio-economically important species including food, fodder and forage crops, medicinal plants, condiments, ornamental, and forestry species, as well as plants used for industrial purposes, such as oils and fibres, and to which they can contribute beneficial traits.

2.5.1 Crop wild relatives and food security

Our future food security is dependent upon a wide range of factors including: being less wasteful of the food we produce; maintenance of natural soil fertility; making better use of increasingly scarce natural resources such as energy, mineral phosphorus and water (Gilbert, 2009) and maintaining a highly skilled farming population. However, an additional critical factor underpinning food security is conserving and making available genetic diversity for use in the breeding of new crop varieties. This includes not just the genetic resource of the crops

themselves, but also the genetic resource of CWRs, the wild plants from which our crop plants are descended, or to which they are related (Tester and Langridge, 2010).

2.5.2 Importance of crop wild relatives

Domestication inevitably means that only a subset of the genes available in the wild-species progenitor gene pool is represented among crop varieties and livestock breeds. Unexploited genetic material from landraces, rare breeds, and wild relatives will be important in allowing breeders to respond to new challenges. Most crop geneticists agree that enrichment of the cultivated gene pool will be necessary to meet the challenges that lie ahead (Tester and Langridge, 2010).

2.5.3 Crop wild relatives in Ethiopia

All wild plants are bases for the development of our modern crops. Crop wild relatives are the wild species which are closely related to crops of today. The domestication of a plant passes through stages from intensified usage of the wild plant to the development of a domesticate so dependent on Man that it cannot survive in the wild. All stages are seen in the crop complement of Ethiopia (Edwards, 1991). Crops and their CWRs may be more or less related. They may be many of them within a family or they may be very few it is a bit like human being family.

Ethiopia has fully domesticated crops, crops related to domesticates, semi-domesticated plants, also has fully domesticated endemic crops, the best known being teff (*Eragrostis tef*) and enset (*Ensete ventricosum*). For fully domesticated plants the wild species from which the crop developed has in some cases been identified, in others it seems to have disappeared after the plant was domesticated (Edwards, 1991).

Modern agriculture and environmental degradation are putting traditional crops and their wild relatives at risk. The now inadequate traditional agriculture must change if Ethiopia is to feed itself and this is one of the major tasks being faced by the Government. However, it is hoped that

the following account gives some idea of the size of the task facing conservationists who are working to preserve the traditional varieties and their wild relatives for use in developing modern and appropriate cropping systems. There is no part of the country where some crop or other and/or its wild relatives do not occur: for example, Thymus spp. in the Afro-alpine regions; *Ensete ventricosum* in the medium to higher altitudes and *Gossypium* spp. in the lowlands (Edwards, 1991).

Ethiopia is a country with varied a topography and a wide spectrum of habitats presenting a large number of endemic plants and animals. The country has about 6000 higher plant species of which about 10% are endemic (Hedberg *et al.*, 2009). Ethiopia is recognized as a Vavilov centre of origin and diversification for many food plants and their wild relatives (Edwards, 1991). Understanding the origins of crop plants is important because it can provide valuable information for plant breeders who are interested in introgressing agronomically desirable traits from wild relatives of the cultivated species (Ingram and Doyle, 2003).

2.6 Monocotyledons

The angiosperms provide most of our food crops. Monocotyledons are angiosperms which are derived from primitive dicotyledons 135-75 Mya. Monocotyledon, byname monocot, one of the two great groups of flowering plants, or angiosperms, the other being the dicotyledons (dicots). There are currently 50,000 monocot plants in the world (Simmonds, 1979), including the most economically important of all plant families, Poaceae (true grasses), and the largest of all plant families, Orchidaceae (orchids). Other prominent monocot families include Liliaceae (lilies), Arecaceae (palms), and Iridaceae (irises).

Monocotyledons (monocots) are one of the major radiations of angiosperms. One of the primary differences between the monocots and other angiosperms is their possession of a single cotyledon (vs. usually two in other angiosperms). Many systems of classification have emphasized this trait and erected two subclasses based on this difference in seed leaf number. There are other, perhaps more significant differences in their vegetative architecture (Tomlinson, 1995). Most monocots have parallel leaf venation (except in Dioscoreales and several other unrelated genera and families, which have net-veined leaves), floral parts in threes (rather than fours and fives as in most eudicots, but several members of the magnoliids, such as Annonaceae

and Aristolochiaceae, also have trimerous flowers, so this is clearly not a trait unique to the monocots), sieve-tube plastids with several cuneate protein crystals, scattered vascular bundles in their stems and probably as a direct result of the last, no vascular-cambium-producing secondary phloem and secondary xylem. In spite of their lack of a vascular cambium, some monocots (e.g., *Yucca*, *Aloe*, *Dracaena*, and *Cordyline*), nevertheless can become trees through increases in stem diameter via a novel process, usually termed ‘‘anomalous’’ secondary growth. In this case, plants are able to add new vascular bundles and parenchyma to the primary body (Zimmerman and Tomlinson, 1970), thus increasing their girth. Other monocot trees, such as the palms (Arecaceae), screwpines (Pandaceae), and bananas (Musaceae), are incapable of adding new bundles. Thus, these ‘‘trees’’ are merely overgrown herbs. The root systems of monocots are also distinctive in that the radical aborts at an early stage and the root system of the adult plants develop adventitiously.

In Ethiopia and elsewhere in the world monocots are very important because they contain the major crops categorized as cereals (wheat, rice, maize, sorghum, barley, teff, and many others) and other crop categories. A study of the wild relatives of such plants will have practical contributions to the future improvement of the crops concerned.

CHAPTER THREE

3 MATERIALS AND METHODS

3.1 Description of the study area

3.1.1 Location

The study was conducted in the central, southern, southwestern and eastern parts of the country and covered six floristic regions of Ethiopia having high distribution of wild relatives of monocotyledonous crops: Gamo Gofa (GG), Gojam (GJ), Harerge (HA), Kefa (KF), Shewa (SU) and Sidamo (SD) floristic regions of Ethiopia (Figure 2).

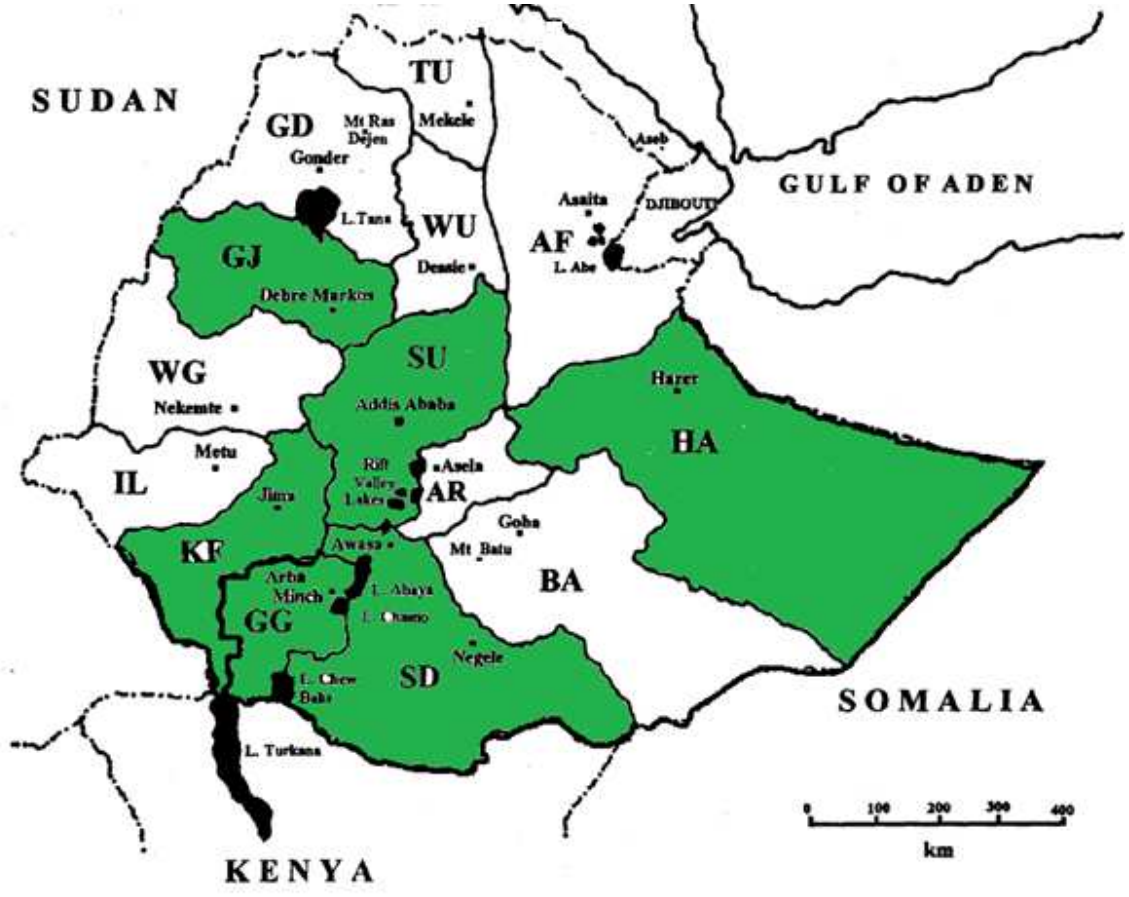

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Figure 2: Map of the Ethiopian part of the floristic regions used for the Flora of Ethiopia and Eritrea showing the floristic regions covered in the present study (Source of map: Flora of Ethiopia and Eritrea)

AF - Afar region, below and to the east of the 1000m contour to the Eritrean border in the east and the Harerge border in the south

TU - Tigray region, above and to the west of the1000 m contour

GD - Gonder region

GJ - Gojam region

WU- Welo region, above and to the west of the 1000m contour

SU - Shewa region, above and to the west of the 1000 m-contour

AR - Arsi region

WG- Welega region

IL - Ilubabor region

KF - Kefa region

GG- Garno Gofa region

SD - Sidamo region

BA - Bale region

HA- Harerge region

3.1.2 Climate

The study area has diverse climatic conditions. A twenty years climate data were taken from Ethiopian (EMA) from the nearest weather station to the study site (Figure 3). The data were collected from 1995- 2014 by National Meteorological Service Agency (NMSA, 2014).

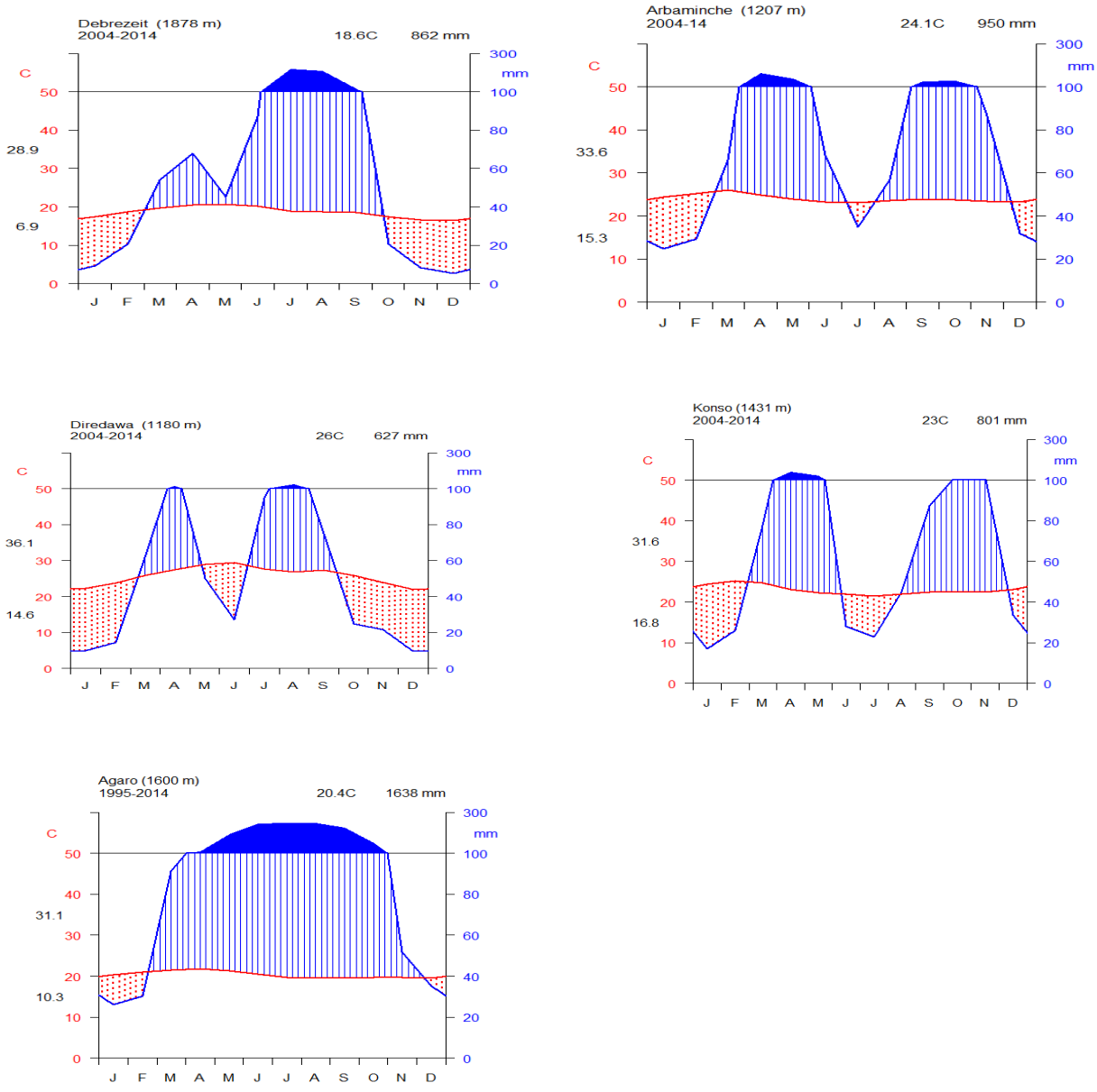

Figure 3: Climadiagram showing mean monthly rainfall and temperature from 1995-2014

3.2 Methods

3.2.1 Sampling methods

The data were gathered from literature and herbarium specimens and the field studies were undertaken to collect voucher specimens and ethnobotanical data on the monocotyledonous crop wild relatives. The field data were collected by using purposive sampling technique. Following the field observation, ethnobotanical data were collected and interview-based survey were administered to farmers/communities living in the study area. The researcher together with local field guides collected data and information from farmer households which involved both males and females who have indigenous knowledge about crops and crop wild relatives and the development agents, wereda crop experts and others.

3.2.2 Data collection from literature sources and the National Herbarium (ETH)

Wild relatives of monocotyledonous crop species which are found in Ethiopia were gathered and listed from different literature sources. This were particularly checked and confirmed by using the relevant volumes of the Flora of Ethiopia and Eritrea (Edwards *et al*., 1997 and Phillips, 1995) and full information (Local names of the monocotyledonous crop wild relatives, Crop category, family, distribution in floristic regions and others) were taken about each MCWRs which were a necessary information for the next field activity (Appendix 1). Herbarium data collections were also done and recorded sources of information like the local names, family of each species, locality, date of collection, distribution, altitude, latitude, longitude, habitat and other notes recorded on specimen labels regarding the CWRs. Herbarium specimen photos were also taken which were relevant for exact comparison with the field MCWRs and to avoid/reduce confusion/misidentification (Appendix 2).

3.2.3 Field data collection

3.2.3.1 Voucher specimen collection and identification

According to the preliminary assessment made based on the review made on the volumes of the Flora of Ethiopia and Eritrea and the plant collections of the Ethiopian National Herbarium, CWR plant species were collected from the wild in the study area by using purposive sampling technique. Basically at the time of collection, all the necessary information about the specimens

were recorded provided with ethnobotanical information. Then after, the voucher specimens were pressed and taken to the National Herbarium (ETH), AAU. At the National Herbarium the specimens were dried and identified using taxonomic keys in the volumes of the Flora of Ethiopia and Eritrea (Edwards *et al.,* 1997 and Phillips, 1995), by comparison with the already identified specimens that are housed at ETH, Finally, the difficult ones were re-checked with the assistance of senior taxonomic experts.

3.2.3.2 Ethnobotanical data collection

The methods used for ethnobotanical data collection were semi structured interviews described by (Martin, 1995; Cotton, 1996), field observation, preference ranking and direct-matrix ranking were employed following (Martin, 1995; Alexiades, 1996; Cotton, 1996). The respondents' background, local name of MCWRs, uses, plant part used, growing area, status, degree of scarcity and conservation practices of respondents were carefully recorded. Observations were made on the morphological features and habitats of each MCWR species in the field.

3.2.3.3 Group discussion and semi-structured interview

The major crops cultivated in the study area, the local names, uses and distribution of CWRs and their status from the earlier time were assessed during ethnobotanical data collection. Farmers who had indigenous knowledge about crops and crop wild relatives, gave priority for the older farmers who live in the study area for a long period of time, the development agencies, wereda crop experts and researchers in the study area, and 2-4 individuals were used for each sample site. Most of the interviews and discussions were held in Amharic directly by the researcher and Afan Oromo, Kefficho, Wolaita and Gamo languages indirectly using translators gathered technically by speaking to the villagers and accessible informants. During field tracking and random walks, encountered farmer households were asked to participate by considering their willingness to sit for an interview. By taking into account the above concepts the data were gathered mainly through individual interviews, guided field walk and discussion with the selected individuals.

Before the specimens were collected purposively from selected study site, a brief group discussion was made at each site prior to important MCWRs collection with all informants of the

study site. A semi-structured checklists consisting of questions or issues were prepared in advance. The interviews were based on and around these checklists and some issues that arose promptly depending on responses of an informant were also dealt with.

A

B

Figure 4: The researcher interviewing an informants in Kefa (A) and in the Abay George (Showa) (B)

3.3 Data analysis

The gathered data were computed by preference ranking and direct matrix ranking according to (Martin, 1995; Alexiades, 1996; Cotton, 1996). Informant consensus and ranking were computed.

3.3.1 Descriptive statistics

Data on Ethiopian MCWRs with their scientific and local names, parts used, diversity and distribution were gathered and compiled after assessing available ethnobotanical documents. Data were then entered into Microsoft Excel spreadsheet (Microsoft Corporation, 2007) and descriptive statistical methods including percentage were employed to analyze and summarize the data.

3.3.2 Direct matrix ranking

Direct matrix ranking exercise was done following Martin (1995) in order to compare multipurpose use of given species and to relate this to the extent of its utilization versus its dominance. In the direct matrix ranking exercise, each key informant was asked to assign use values / 5= excellent, 4= very good, 3 = good, 2 = less used, 1 = least used, 0 = not used, for each

species. Accordingly, each key informant gave use values for the nine CWR plants and average values of use diversity for species was taken and the values of each species were summed up and ranked.

3.3.3 Informant consensus

In order to evaluate the reliability of information during the interview, informants were contacted at least 2-3 times for the same ideas and the validity of the information was proved and recorded. If the responses that were given at different time contradicted each other, they were considered to be unreliable and were rejected or reliability of the information confirmed by similarities of information given by different informants on the same issue. Only the relevant ones were analyzed. This method was adopted from Alexiades (1996).

3.3.4 Preference ranking

Preference/priority ranking was conducted for evaluating the degree of preferences or degree of scarcity based on levels of importance of certain selected plants following Martin (1995) by using each CWR located in the study site key informants who were invited to rank the selected or located species that are used for their daily activity. Each key informant gave use values for all MCWRs located in their site and average values in terms of their degree of scarcity (the most scarce is highly preferred/priority first or most important) for species was taken and the values of each species were summed up and ranked.

CHAPTER FOUR

4 RESULTS

4.1 Preliminary assessment of MCWRs from Flora of Ethiopia and Eritrea and collections at the National Herbarium (ETH)

During the preliminary assessment first, the monocotyledonous crops grown in Ethiopia were listed. Then, crop wild relatives plants found in Ethiopia were gathered from volumes 6 and 7 of the Flora of Ethiopia and Eritrea and other available literature sources. From this bibliographic survey, 16 monocot crop wild relative species and one variety making a total of 17 taxa were recovered. These CWRs represented 11 genera and six families. Five of the families are included in volume 6 of the Flora and volume 7 has only the family Poaceae, which contains the majority (47.1%) of the MCWRs recorded.

The monocotyledonous crop wild relatives collected from the various literature sources (mainly from Flora of Ethiopia and Eritrea) were the targets used to guide the search made for plant specimens in the National Herbarium (ETH) that gave 16 MCWRs with voucher specimens (Table 1). While searching for the voucher specimens, there were some challenges including misplaced ones by another species in the case of *Allium subhirsutum* subsp. *spathaceum* for example. Upon finding the specimen, all the necessary information was recorded including the floristic region of collection and other features were compiled.

Table 1: MCWRs present in Ethiopia as recorded from the Flora of Ethiopia and Eritrea, ETH and field survey (√- Yes, × - No)

No.	Ethiopian MCWRs in Flora of Ethiopia and Eritrea				Voucher specimens of the National Herbarium (ETH)	Voucher specimens collected from field
	Scientific name	Family	Volume	Page		
1	*Aframomum corrorima*	Zingiberaceae	6	325	√	√
2	*Allium a1ibile*	Alliaceae	6	154	√	×
3	*Allium subhirsutum* L. subsp. *spathaceum*	Alliaceae	6	151	×	×
4	*Amorphophallus abyssinicus*	Araceae	6	42	√	×
5	*Colocasia esculenta*	Araceae	6	38	√	√
6	*Cymbopogon caesius*	Poaceae	7	328	√	×
7	*Cymbopogon commutatus*	Poaceae	7	330	√	×
8	*Cymbopogon schoenanthus*	Poaceae	7	329	√	×
9	*Dioscorea bulbifera* var. *bulbifera*	Dioscoreaceae	6	59	√	√
10	*Dioscorea abyssinica*	Dioscoreaceae	6	61	√	×
11	*Dioscorea praehensilis*	Dioscoreaceae	6	62	√	√
12	*Eleusine africana*	Poaceae	7	139	√	×
13	*Ensete ventricosum*	Musaceae	6	317	√	√
14	*Eragrostis pilosa*	Poaceae	7	125	√	√
15	*Oryza barthii*	Poaceae	7	10	√	×
16	*Oryza longistaminata*	Poaceae	7	10	√	×
17	*Sorghum arundinaceum*	Poaceae	7	299	√	√
	17	6	2	various	16	7

Voucher specimens were recorded with full information taken from specimen labels (Appendix 2). Locality of the specimens, distribution (altitudinal range, latitude, longitude) and date of collection collected from the specimen labels were the basic guiding information used for field data search and fresh specimen collection. Sample photos of the voucher specimens were also taken side by side and used for more clarity and to avoid confusion at the time of asking the respondents about how they can distinguish the CWR from the cultivated species or the cultivated strain in the cases when the cultivated form and the wild relative share the same scientific name as in the cases of *Aframomum corrorima, Dioscorea bulbifera* and *Ensete ventricosum.*

4.2 MCWRs found and collected in the field

The field study were done by using the necessary information after the preliminary assessment that gave clear direction for collection and record of different information about MCWRs distributed in varies floristic regions of Ethiopia. Accordingly, the field survey comes up with seven (41.2%) voucher specimens (Table 2). The field study showed that in cases where the cultivated form and its wild relatives share the same scientific names, the vernacular (local) nomenclature regularly used by the local communities had distinct names, as they perceive the two differently.

The indigenous people of the study areas distinguished wild relatives from the respective cultivated crops by their own different criteria that are based on morphological characteristics, in spiritual considerations, their use values and other features. Using these criteria they have since long time ago gave local names to the plants that present generation is applying in regular communications. This is illustrated in Table 2.

Table 2: Local nomenclature of crop wild relatives and their crops

No.	MCWRs					Crops		
	Scientific name	**Local Name**	**Language**	**Way of given the local name**	**Parts used by people**	**Scientific name**	**Local Name**	**Language**
1	*Aframomum corrorima*	OPHIO /SHET OPHIO, YEZINJERO KORERIMA	Kefficho, Amharic	Monkey's cardamom (mostly eaten by monkeys)	Seeds and leaves	*Aframomum corrorima*	KORERIMA, KOROORIMA, OFIO	Amharic & Guragae; Afan Oromo; Kefficho
2	*Colocasia esculenta*	KUBI KIDO	Kefficho	Wild Taro (food for wild animals)	Tubers and leaves	*Colocasia esculenta*	GODERIE, KIDO	Amharic; Kefficho
3	*Dioscorea bulbifera*	WOKKO, BUNDI BUCH/BOLA BOYE, AMA	Kefficho, Gamo, Sheko	Wild Yam	Aerial tubers eaten as cooked vegetable	*Dioscorea bulbifera*	KOOTEHARREE, SADA, BOLA BOYE,	Afan Oromo; Tya., Gamo
4	*Dioscorea praehensilis*	WODALA, KECHI/ KAKEB	Gamo, Sheko	Wild Yam	Underground tubers can be eaten.	*Dioscorea cayenensis-Dioscorea rotundata complex*	HATIYA	Gamo
5	*Ensete ventricosum*	YESETAN KOCHO, EPPO	Amharic, Kefficho	It is believed that a crop of devil.	Pseudocorm for food types and leaves for other types	*Ensete ventricosum*	KOICHO/ KOBA, WAARQEE, ESET	Amharic; Afan Oromo; Guragae
6	*Eragrostis pilosa*	_____	_____	_____	Shoot for forage and grains for food usually during famine	*Eragrostis tef*	TEFF, TAFFI, BAZRA TAF	Amharic; Afan Oromo; Tya.
7	*Sorghum arundinaceum*	FINCOO/ DAAPHOO, ABARO, TSLALAHE, MACADBI	Afan Oromo; Anywaa; Omotic; Somali	_____	Grain mixed with *Sorghum bicolor* and shoots for fodder & construction.	Sorghum bicolor	MASHILA, SHANGO, BOBEE	Amharic; Kefficho; Afan Oromo

4.3 Species of MCWRs and the floristic regions in which they occur according to the Flora of Ethiopia and Eritrea

According to Flora of Ethiopia and Eritrea 16 species and one variety of monocotyledonous crop wild relatives are distributed all over the country. Interestingly, the analysis showed that each floristic region had at least one MCWR. On the other hand, most of the MCWRs growing in Ethiopia were found to grow in TU, GD and IL while the least number occurred in AF, BA and WU which have single species each (Table 3). *Amorphophallus abyssinicus, Cymbopogon commutatus, Cymbopogon schoenanthus, Dioscorea praehensilis* and *Oryza barthii* are the only species, which are found in single floristic regions. In contrary to these, *Cymbopogon caesius* is a CWR distributed in ten floristic regions followed by *Sorghum arundinaceum* in eight floristic regions of Ethiopia (Appendix 5).

Table 3: Floristic regions and number of species

No.	Floristic region	Expanded name of the Floristic region	No. of MCWR species as indicated in the Flora volumes 6 and 7
1	AF	Afar	1
2	AR	Arsi	2
3	BA	Bale	1
4	GD	Gonder	8
5	GG	Gamo Gofa	5
6	GJ	Gojam	7
7	HA	Harergie	3
8	IL	Illubabor	8
9	KF	Keffa	6
10	SD	Sidama	5
11	SU	Shewa	5
12	TU	Tigray	9
13	WG	Welega	3
14	WU	Welo	1

4.4 Distribution of MCWRs among the plant families

In total, 17 MCWRs belonging to 11 genera in 6 families were found distributed in Ethiopia. The family Poaceae with eight species in five genera was found to be represented by the highest number of crop wild relatives in the monocotyledonous category. The Zingiberaceae and Musaceae had single genera and species of MCWRs in the Ethiopian flora (Figure 5).

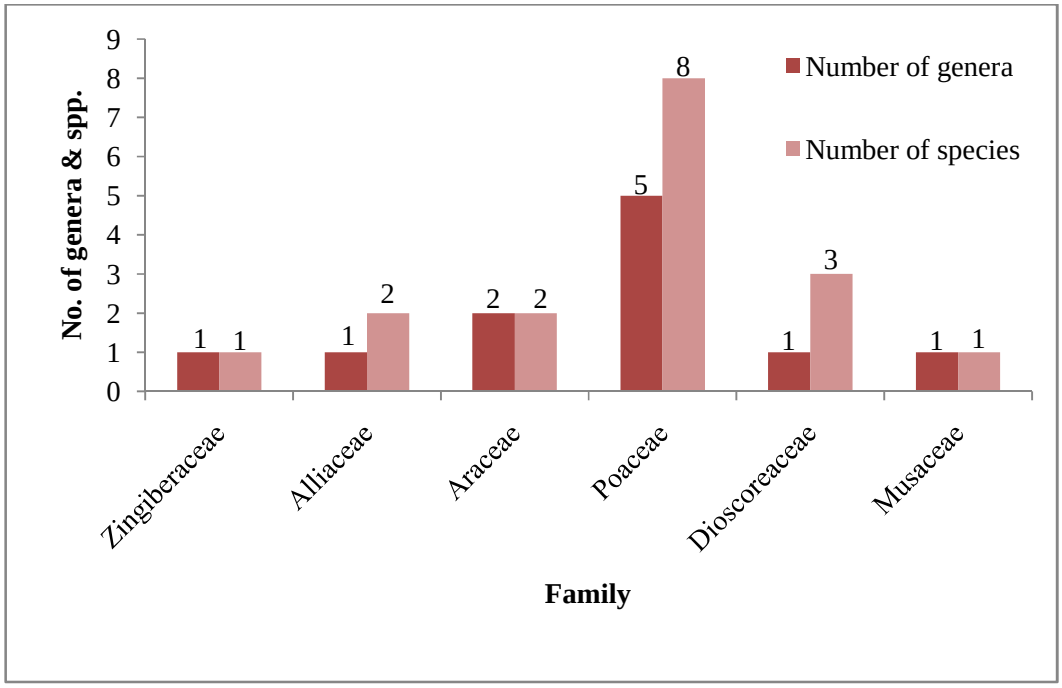

Figure 5: Graph showing the number of MCWR species and genera in each family

4.5 Monocotyledonous crop wild relatives in their natural habitat

Field investigation came up with seven MCWRs that belong to six genera and five families. According to the researchers view the species recorded from the field have different degrees of abundance based on the presence/absence of the species on targeted areas standing from the preliminary assesment information. The availability of crop wild relatives in the monocotyledonous families was studied mainly by asking people living around where the species were distributed. Accordingly, some of the MCWRs are Highly Decreasing (HD), others

Decreasing (D), Intermediate (IN), Increasing (I) and still others Highly Increasing (HI) as show in Table 4.

Table 4: Status of wild relatives of Ethiopian monocotyledonous crops

No.	Scientific name	Local name (Language)	Status				
			HD	**D**	**IN**	**I**	**HI**
1	*Aframomum corrorima*	OPHIO /SHET OPHIO (Kefficho)			√		
2	*Colocasia esculenta*	KUBI KIDO (Kefficho)					√
3	*Dioscorea bulbifera*	WOKKO (Kefficho), BUNDI BUCH/BOLA BOYE (Gamo)	√				
4	*Dioscorea praehensilis*	WODALA (Gamo)	√				
5	*Ensete ventricosum*	YESETAN KOCHO (Amharic), APPO (Kefficho)		√			
6	*Eragrostis pilosa*	_____		√			
7	*Sorghum arundinaceum*	FINCOO/ DAAPHOO (Afan Oromo)				√	

4.6 Current distribution of MCWRs

The current distribution of MCWRs was studied in six floristic regions (GG, GJ, HA, KF, SU and SD) of Ethiopia according to the flora classification of the country for the purpose of writing the Flora and they do not bear any relation to the present administrative structures. These six floristic regions cover the present three administrative regions (Amhara, Oromiya and SNNPRS) of Ethiopia where the fieldwork was done. Specific study areas (Zones and reference Ethiopian Towns) where the voucher specimens were collected are indicated in Figure 6.

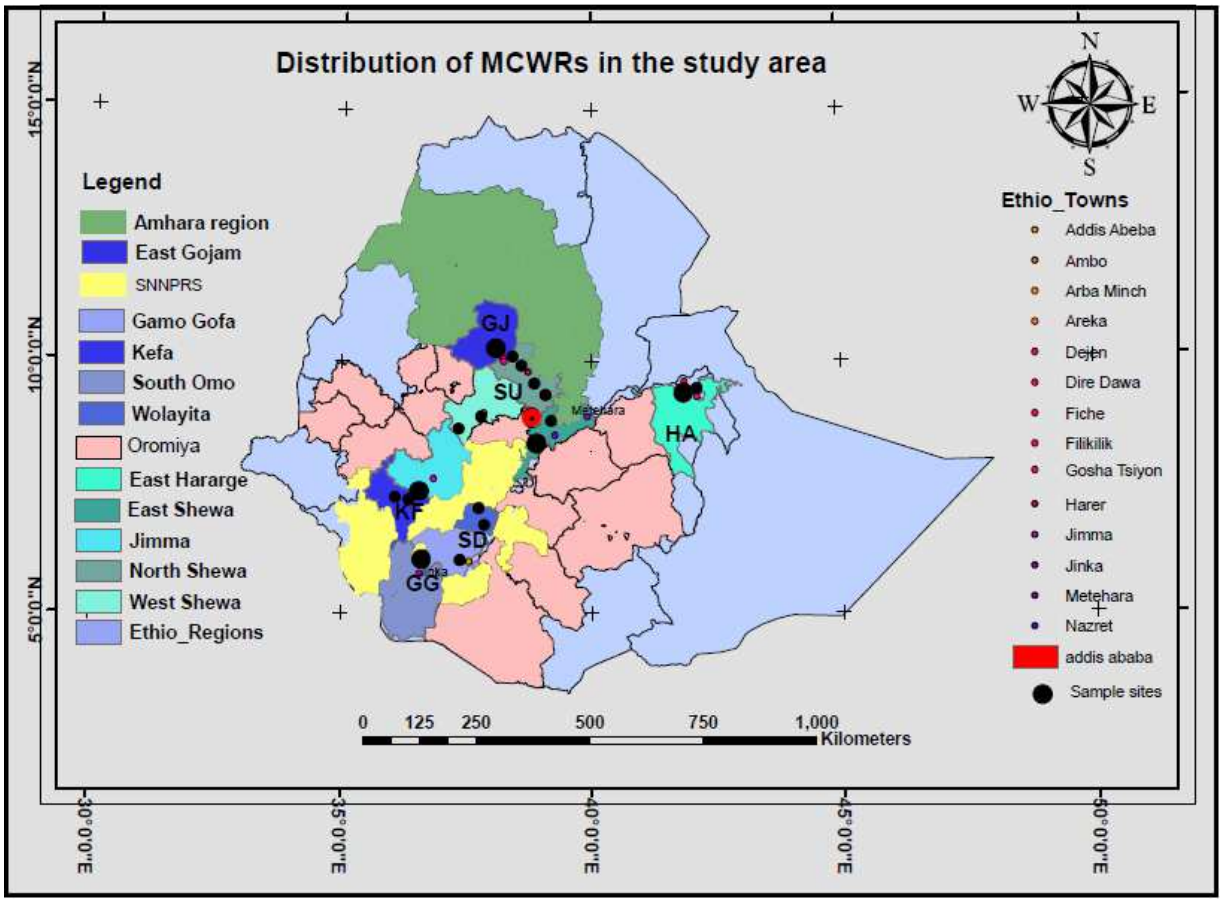

Figure 6: Map of Ethiopia showing MCWRs distribution from where the voucher specimens collected

4.7 Cultivated monocot crops found in the study area and the CWRs

Many crops are grown in the study area that include cereals, vegetables, root/tuber crops, fruits, fibers, stimulants and sugarcane. Almost all crop categories are cultivated or grown near/around the areas surveyed for MCWRs in which 18 crop species or varieties were recorded (Table 5).

Table 5: List of crops around the study sites (√- Have wild relative in the field, × - Have no wild relative)

No.	Scientific name	Family	Category	Common English name	CWR found in Ethiopia	CWR collected from the field
1	*Aframomum corrorima* (Braun) Jansen	Zingiberaceae	Spice	Ethiopian cardamom	√	√
2	*Allium cepa* L. var. *aggregatum* G. Don.	Alliaceae	Vegetable	Shallot	√	×
3	*Allium cepa* L. var. cepa	Alliaceae	Vegetable	Onion, common onion, bulb onion	√	√
4	*Allium porrum* L.	Alliaceae	Vegetable	Leek	×	×
5	*Allium sativum* L.	Alliaceae	Spice	Garlic	×	×
6	*Colocasia esculenta* (L.) Schoott.	Araceae	Root/tuber	Taro, Cocoyam, Dasheen, Elephant's ear	√	√
7	*Dioscorea alata* L.	Dioscoreaceae	Root/tuber	Yam	√	√
8	*Dioscorea bulbifera* L.	Dioscoreaceae	Root/tuber	Potato yam, Aerial yam	√	√
9	*Eleusine coracana* (L.) Gaertn.	Poaceae	Cereal	African finger millet	√	×
10	*Ensete ventricosum* (Welw.) Cheesman	Musaceae	Root/tuber	Enset, false banana	√	√
11	*Eragrostis tef* (Zucc.) Trotter	Poaceae	Cereal	Tef	√	√
12	*Hordeum vulgare* L.	Poaceae	Cereal	Barley	×	×
13	*Musa x paradisiaca* L.	Musaceae	Fruit	Banana	×	×
14	*Saccharum officinarum* L.	Poaceae	Sugar	Sugar cane	×	×
15	*Sorghum bicolor* (L.) Moench	Poaceae	Cereal	Sorghum	√	√
16	*Triticum aestivum* L.	Poaceae	Cereal	Common wheat, bread wheat	×	×
17	*Zea mays* L.	Poaceae	Cereal	Maize	×	×
18	*Zingiber officinale* Rosc.	Zingiberaceae	Spice	Ginger	×	×

4.8 Habitats of MCWRs

The crop wild relatives were found from different habitat types as indicated in Table 6. More (4) species were found in the cultivated landscape particularly on farmlands and on margins of farmlands while fewer (2) numbers were found in grassland areas.

Table 6: Habitats of the collected monocot crop wild relatives

Habitat	MCWRs Collected				Total
Inside the forest	*Aframomum corrorima*	*Dioscorea praehensilis*	*Ensete ventricosum*		3
Inside/at margins of farms	*Dioscorea bulbifera*	*Sorghum arundinaceum*	*Dioscorea praehensilis*	*Eragrostis pilosa*	4
Road side	*Sorghum arundinaceum*	*Colocasia esculenta*	*Eragrostis pilosa*		3
River side	*Aframomum corrorima*	*Colocasia esculenta*	*Ensete ventricosum*		3
In grazing land	*Eragrostis pilosa*	*Sorghum arundinaceum*			2

4.9 Importance of monocot crop wild relatives

The importance and relative importance of the MCWRs was studied through assessment of informant consensus, scoring and ranking exercises.

4.9.1 Informant Consensus

Application of informant consensus analysis showed that some MCWRs were more popular than others. The results may be partly related to importance to the community or to the fact that some species occurred in more areas than others that were restricted in their distribution. Accordingly, *Sorghum arundinaceum* was cited by 22 (48.89%) followed by *Dioscorea bulbifera* and *Dioscorea praehensilis* which were cited by 20 (44.44%) and 18 (40.00%) informants respectively (Table 7).

Table 7: Informant consensus of MCWRs in the study area

Scientific name	No of informants who cited the plant	% of total citations	Rank
Aframomum corrorima	12	26.67	6th
Colocasia esculenta	14	31.11	5th
Dioscorea bulbifera	20	44.44	2nd
Dioscorea praehensilis	18	40.00	3rd
Ensete ventricosum	16	35.56	4th
Eragrostis pilosa	10	22.22	7th
Sorghum arundinaceum	22	48.89	1st

4.9.2 Uses of monocotyledonous crop wild relatives by the local community

In the study area, the people reported their use of many MCWRs for different purposes. These informants were requested to give value based on their personal perceptions: 5 to the most used plant for that particular purpose and 1 to the least. Some crop wild relatives were rated as important and used frequently by many, appearing in many formulations. Preferences for seven MCWRs were checked and seen that fodder was said to be the most common use value of these CWR species. *Eragrostis pilosa* received the best value compared to others. *Sorghum arundinaceum* was found to be the most multi-purpose species scoring 10, followed by *Ensete ventricosum, which* scored nine (Table 8).

Table 8: Direct matrix ranking based on use criteria (5 = best; 4 = very good; 3 = good; 2 = less used; 1 = least used and 0 = no value)

Usefulness to the community	**Plant species**						
	Aframomum corrorima	*Colocasia esculenta*	*Ensete ventricosum*	*Dioscorea bulbifera*	*Dioscorea praehensilis*	*Eragrostis pilosa*	*Sorghum arundinaceum*
Fodder	3	2	3	3	2	5	4
Food	0	3	2	5	5	1	3
Medicinal	2	0	1	0	0	0	0
Spice	2	0	0	0	0	0	0
Others	0	0	3	0	0	0	3
Total	7	5	9	8	7	6	10
Rank	4	7	2	3	4	6	1

4.9.3 Degree of scarcity MCWRs

The informants ranked the species of MCWRs based on their degree of scarcity in the local environment (7 for most scarce (preferred/priority 1), 1–least preferred/last priority). Accordingly, *Dioscorea praehensilis* took the first rank followed by *Dioscorea bulbifera* (Table 9).

Table 9: Priority ranking of seven MCWRs by six informants

MCWR	Respondents						Total	Rank
	A	B	C	D	E	F		
Aframomum corrorima	3	2	2	1	3	2	13	6th
Colocasia esculenta	1	2	3	2	2	2	12	7th
Dioscorea bulbifera	6	4	5	5	6	5	31	2nd
Dioscorea praehensilis	7	7	6	5	6	5	36	1st
Ensete ventricosum	4	3	2	4	4	3	20	3rd
Eragrostis pilosa	3	4	3	3	2	2	17	4th
Sorghum arundinaceum	2	3	2	4	3	2	16	5th

4.9.4 Threats to MCWRs

In the study area various factors that were considered the main threats to MCWRs were ranked by informants. Most of the causes for the threats to wild relatives of the crops included in this study were the anthropogenic factors. These factors, which include agricultural expansion, overgrazing/overstocking, use for construction and also lack of awareness were indicated as the major threatening factors. To rank these factors according to the degree of damage they cause, six informants were selected to give 5 to the most threatening factor and 1 to the one which is least threatening (Table 10).

Table 10: Factor threatening monocotyledonous crop wild relatives by six informants

Factors	Respondents						Total	Rank
	A	B	C	D	E	F		
Agricultural expansion	4	5	4	5	3	3	24	1st
Use for construction	3	2	3	4	2	3	17	4th
Lack of awareness	5	2	1	4	5	2	19	3rd
Over grazing	4	3	4	4	3	4	22	2nd
Using of herbicides	2	1	2	3	1	1	10	5th

CHAPTER FIVE

5 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Species of MCWRs and the flora regions in which they occur

According to the analysis from the Flora showed that each floristic region had at least one MCWR. However, most of the MCWRs growing in Ethiopia were recorded from TU, GD and IL while the least number occurred in AF, BA and WU that have single species each. This may alternatively indicate differences in collection or exploration intensity since collectors may frequently visit some areas more than others. In fact, some plant collectors come and collect as tourists and to run away from the cold weather of the temperate winter season and hence visit areas where they can enjoy life rather than planned field visits based on identification of floristic regions. Other areas may have not enjoyed frequent visitations perhaps because of being unsafe for security reasons, no roads or the harsh conditions. Tewolde Berhan Gebre Egziabher (1991) said, on hasty recording has often meant that a species goes by different names, causing double counting. The situation is made more confusing because the plant specimens collected from Ethiopia are scattered in various herbaria, mostly in Europe.

In this study, it was found that the existing information on distribution of MCWRs of Ethiopia is very limited and fragmentary. Although the research was started to cover all representative floristic regions of the country based on data collected from the Flora and ETH, there were so many factors that limited the research work including financial, seasonal (the season that MCWRs grow) and the security problems that reduced the area coverage to six floristic regions only. *Aframomum corrorima and Ensete ventricosum* were collected from one floristic region. Kefa Floristic Region takes the lion's share in that most of the MCWRs were distributed in it. The reason behind could be that Kefa Floristic Region is known to possess dense moist afromontane forest and the probability of getting monocotyledonous crop wild relatives was relatively high. However, the probability of finding MCWRs on targeted areas were less because those areas were disturbed due to different anthropological and natural factors. The conservation efforts made regarding the designated National Forest Priority Areas so far are not encouraging.

The adjacent communities appear to have unrestricted access to the forest. As a result, the forest is subjected to agricultural expansion and selective cutting (Feyera Senbeta, 2006).

5.1.2 MCWRs found and collected in the field

According to the preliminary assessment, from 17 MCWRs the field survey come up with seven (41.2%) voucher specimens. The finding clearly shows the need for more field survey and collection targeting MCWRs. Cases in which the cultivated form and its wild relatives share the same scientific names regularly used by the local communities. *Colocasia esculenta* found in wild lands is most likely an escape from cultivation that occurs outside cultivation rather than being a purely wild relative of the crop. *Dioscorea bulbifera* is known is both in the wild and cultivated forms and their distinguishing is made by their varieties. However the varieties are difficult to distinguish in practice. One voucher specimen called *Dioscorea bulbifera* var. *bulbifera* is theoretically possible to distinguish from other varieties but in practice no attempt is made. Therefore, voucher specimens of wild *Dioscorea bulbifera* were collected from the field and it is impossible to distinguish them at variety level, due to these the researcher used the same as the wild species, which is *Dioscorea bulbifera.* Similar situation on naming of wild relatives for other three species (*Aframomum corrorima, Colocasia esculenta* and *Ensete ventricosum*) and the same scientific names have been used with the cultivated crops.

5.1.3 Habitats and families of MCWRs

The crop wild relatives were found from different habitat types (forest, crop/agricultural land, road or riverside and grazing land). Most of them were growing in or near margin of cultivated crop lands especially to their close relative in the form of weed. Heywood and Dulloo (2005) also reported that CWRs growing alongside domesticated crops promote natural crossing of beneficial traits. Genes from wild plants have also provided cultivars with resistance against pests and diseases and improved tolerance to abiotic stresses. While other MCWRs near ditches, river or road sides. The reason for these could be erosion. When agricultural and grazing lands eroded, the seeds of crop wild relatives are also washed away and the probability of growing in such habitats became high. An investigation by Genet Birmeta *et al*. (2004) on wild enset shares that its habitat ranging from dense forests to open shrub land, or along riverbanks.

From all six families of MCWRs which are found in Ethiopia, the most popular family was Poaceae which contributed eight (47.1%) species which takes the lion's share, followed by Dioscoreaceae with three (17.7%) species. Phillips (1995) described that the grass family (Poaceae) including the MCWRs has about 650 genera and 10,000 species, which are widely distributed throughout the world and covers a greater land area than any other family of flowering plants.

5.1.4 Status of crop wild relatives

The availability of crop wild relatives in the monocotyledonous families was studied mainly by asking people living around where the species were distributed. Also by comparing their status (distribution increasing or declining) from the earliest time. Accordingly, the availability of targeted species on targeted areas was found to be on the decrease due to different anthropological and natural factors. Considering the observation during the collecting trips, the population size of the wild relative species are highly reduced as a result of rapid natural habitat change for human settlement, agriculture, construction, etc. Despite the problems associated with the distribution of MCWRs, seven MCWRs were collected. *Colocasia esculenta* was found to be on increase while *Dioscorea praehensilis* and *Dioscorea bulbifera* were declining through time and consequently finding these species in the wild (natural habitat) was difficult. Matthews *et al.* (2012) stated that wild taro grows on stream banks, road sides and among rocks next to small waterfalls. This variation in the habitat of *Colocasia esculenta* and its capacity to reproduce vegetatively might have helped to be commonly found in the study area.

5.1.5 Uses of monocotyledonous crop wild relatives

In the study area, the majority of the inhabitants rely on wild relative plants directly or indirectly for various purposes such as fodder, food, spices, etc. It was found that seven species of MCWRs have values for different purposes being used as food and/or they have other value for the community.

Sorghum bicolor is known to make 'injera', either alone or mixed with 'teff ', used in brewing and other types of food. Likewise *Sorghum arundinaceum* is used mainly for animal forage, construction (charcoal, merchants uses it highly to construct the roof and wall of the mini house

near road sides) and some repondents informed that informally it is also supplied to market by mixing with cultivated Sorghum (*Sorghum bicolor*) and which is difficult to identify the mixing and used for food by different techniques. Even though it is used for such purposes, it is also seen as weed growing in farmland.

Wild enset is growing mainly in southwestern parts of the country. By many of the respondents, there is a spiritual belief about wild *Ensete ventricosum* in addition to being used as food, fodder, medicinal and having other value. They believed that it protects the cultivated enset from devil although some respondents belief the reverse. Studies on cultivated enset shares that, besides its use as a source of large quantities of carbohydrate-rich food, enset is also utilized for animal forage, fiber production, construction materials, as an ornamental, and for its medicinal values, with a demonstrated antimicrobial activity against viral, bacterial, fungal and nematodal diseases of humans (Holscher and Schneider, 1998).

All of the ranked species have use value from least to best use criteria for fodder. The implication of this is that the local community has the habit of using MCWRs for their domestic animals as feed. Because almost all peasant farmers in Ethiopia graze their domestic animals in wild, the MCWRs are used grazing. The over exploitation of those crop wild relatives comes from the above reasons.

5.1.6 Prioritization of CWRs based on the degree of scarcity

Dioscorea praehensilis and *Dioscorea bulbifera* are highly consumed by the local community. Tubers of these two *Dioscorea* species are edible and *Dioscorea praehensilis* is a favorite food type for the locality compared with other wild yam species. The reason is that the local people extremely consume the tubers of *Dioscorea praehensilis* from the forest and use it in different preparations. Especially, it is used for the preparation of special traditional food called "Fichata" by combining with *Dioscorea cayenensis* during holidays typically in "Meskel" time. According to Muluneh Tamiru *et al*. (2008), some landraces such as Hatiye (*Dioscorea cayenensis*) are popular due to their sweet taste and white tuber flesh color, and are preferred for preparing fichata, a popular dish made of boiled and mashed yam mixed with fermented milk and butter. The white tuber flesh goes well with the milk during mixing.

The local people had also a habit of taking these two wild relatives from their natural environment and domesticated and cultivated them in agricultural lands. The trend of cultivation could be that the local people had indegenous knowladge that wild species/wild relatives have the ability to adapt to climatic or any other environmental changes. Therefore, the local people want to select these species to become domesticate. Whilst Hopkins and Maxted (2010) said, protection is undergone for crop plants from pests and diseases with pesticides and from drought by irrigation, wild populations must have the genetic composition to naturally withstand all such stresses. Other studies on wild yams have also stated that the starches extracted from wild yam tubers were thermo resistant, with relatively opaque and less viscous gels (Sahoré *et al*., 2007).

The wild *Colocasia esculenta* had last (7^{th}) rank that was least scarce compared to other MCWRs. The reason behind is that the cultivated Taros are highly cultivated near home gardens and/or agricultural land. The local people do not use the wild relative species (Wild Taro) unless they are exposed to shortage of food in their locality. There were also beliefs that the plants that are found in the wild is for wild animals. Matthews *et al*. (2012) describes, the leaves of roadside Taros, whether wild or cultivated, are generally regarded as edible, and can be cooked for pigs.

5.1.7 Description of some selected MCWRs

Wild Enset (*Ensete ventricosum* (Welw.) Cheesman) wild relative of the domestic *Ensete ventricosum* (Musaceae)

In Ethiopia, wild *Ensete ventricosum* occurs in the highlands (1100-3100 m a. s. l.) in the southwestern part. The wild populations grow mainly around the city of Bonga (Kefa administrative region) in habitats ranging from dense forests to open shrub land, or along riverbanks. Although areas where wild enset grows are often not suitable for human settlements, human interference still prevails through the raising of domestic animals and cutting of trees and shrubs. By contrast, cultivated enset grows in a wider area comprising the central, south and southwestern parts of Ethiopia, but mainly at higher altitudes ranging from 1500 to 3100 m (Genet Birmeta *et al*., 2004).

Wild enset provides fiber used for rope as a byproduct of decorticating the leaf-sheaths. Fresh leaves are used as bread food wrappers. Corm is processed to form a starchy food. Analysis by

Genet Birmeta *et al*. (2004) suggested that the present-day cultivated enset clones have been introduced to domestication from a limited number of wild progenitors. In addition, subsequent gene flow between wild and cultivated enset may have been prohibited by differences between modes of propagation and harvesting time; cultivated enset is propagated vegetatively through sucker production and the plant is generally harvested before maturity or flower set, thereby hindering pollination by wild enset or vice versa. A significant correlation was not found between genetic and geographical distances.

Photo credit- Biniyam Asfaw

Figure 7: Wild Enset (*Ensete ventricosum*)

***Sorghum arundinaceum* (Desv.) Stapf (Wild relative of *Sorghum bicolor)* (Poaceae)**

This wild sorghum species has been described as one of the progenitors of cultivated sorghum, which is probably the result of selection by man of plants with big undeciduous seeds. *Sorghum arundinaceum* comprises an extremely variable complex of intergrading forms of wild sorghum. According to (De wet *et al.*, 1970 and Doggett, 1991) all the races of *Sorghum bicolor* ssp. *verticiliflorum* including *Sorghum arundinaceum* differ from each other mainly in inflorescence morphology and distribution. They are fully inter-fertile with the cultivated sorghum.

Gene flow from crops to wild relatives has received considerable attention since the advent of genetically modified crops. Numerous researchers have found wild – crop hybrids to be nearly as fit as their wild parents, which suggests that crop genes may persist in wild populations. Sorghum is one of the crop plants that has extensive genetic exchange with its wild and weedy relatives. Wild and weedy relatives of crop plants have been known to be sources of useful genes, such as genes for resistance to diseases and pests as well as genes for tolerance to different stress conditions. Genetically, Amsalu Ayana *et al.* (2000) analyzed RAPD variation in 93 wild sorghum individuals representing 11 populations from five geographical regions of Ethiopia to determine the extent and distribution of genetic variation. The number of polymorphic bands generated per primer in the study was high than cultivated sorghum. The low genetic variation in wild sorghum may be due to the reduced population size of the wild sorghum in Ethiopia.

Photo credit- Biniyam Asfaw

Figure 8: Photos of Specimens of *Sorghum arundinaceum* (wild relative) collected from field

***Dioscorea* species (Dioscoreaceae)**

Dioscorea species are commonly known as yams. Yam is a multi species crop that belongs to the genus *Dioscorea* and family Dioscoreaceae. *Dioscorea bulbifera, Dioscorea praehensilis and Dioscorea abyssinica* are the wild relatives of cultivated *Dioscorea bulbifera, Dioscorea*

cayenensis - *Dioscorea rotundata* complex and *Dioscorea cayenensis* - *Dioscorea rotundata* complex respectively that are cultivated in south and southwestern parts of the country. *Dioscorea bulbifera* has numerous varieties, both wild and cultivated. The wild variety var. *bulbifera* being characterised by the presence of aerial tubers and bulbils, which are rounded.

Several species of yams are widely cultivated. The major species used as food are: *Dioscorea alata* L., *Dioscorea cayenensis* Lam. - *Dioscorea rotundata* Poir. complex. At least 20 others are used as food in times of famine, and a similar number have medicinal and other uses. The typical example is *Dioscorea praehensilis.* The tuber is eaten during famine. It is one of the parents for many varieties in the *D. cayenensis* - *D. rotundata* complex **(**Edwards *et al*., 1997).

A

B

C

Figure 9: Wild *Dioscorea bulbifera (A & B), Dioscorea praehensilis* Benth. (Wild relative of *Dioscorea cayenensis - Dioscorea rotundata* complex) (Photo credit- Biniyam Asfaw)

5.1.8 The importance of CWRs to food security

Two major challenges to continued global food security are the ever increasing demand for food products, and the unprecedented abiotic stresses that crops face due to climate change. The important benefits of biodiversity is the usefulness of wild plants in the future security of our food supply. However all crops were originally wild plants. In cultivation, they were changed into the crops we now grow. Many CWRs were used as emergency, supplementary or seasonal food sources to avert food insecurity in households of Ethiopian cultural groups because of their ability to adapt/resist unfavorable conditions in contrary to cultivated crops. Genet Birmeta *et al.* **(**2004**)** also reported maintenance of the existing germplasm in the wild populations, as well as introduction of genes from wild or related species into the cultivated clones to improve e.g. disease resistance and adaptation could have a major impact on future food security of Ethiopia**.**

Wild yam for southern parts of Ethiopia (Wolaita and Gamo-Gofa) farmers are familiar with the diversity available in yams and attributes of each landrace, which they utilize accordingly to meet their needs. Wild relatives of yam are adapted to dry-season and exist in dormant throughout a year that attribute widely manipulated by local farmers to ensure household food security. That is why the CWRs such as *Dioscorea praehensilis* and *Dioscorea bulbifera* var. *bulbifera* are widely consumed/harvested from the wild. Unlike other crops cultivated yams like *Dioscorea cayenensis* planted in October, the first harvest of early-maturing landraces is expected around May or June. This is a period of relative food shortage in the area, as most of the other crops are still in the field. Thus, yam fills a seasonal gap in food supply. Muluneh Tamiru *et al*. (2008) show, the role that CWRs of Ethiopia play at least at local levels, to combat food insecurity and their potential to address food insecurity at national level if properly managed.

Enset is grown both in the wild and in cultivated forms. The cultivated enset is extensively produced and consumed locally. It is particularly known for its value as an insurance crop in dry seasons, when annual crops fail. It is known principally as the staple of a number of the peoples

of southwestern Ethiopia. In contrary to these the wild enset is for that community is used highly for fiber, animal forages and wrapping bread during cooking. The respondents told that when they use wild enset for food, they are misgiving that it could be toxic. Because during process when they scrape the corm, the watery fluid gushes from the crop and if it touched their body, burns their skin. So the majority of the community conclude that wild enset is non-edible in their sense. Even though the perception of the local people that it is not edible, they said that it was consumed when there was poverty and famine in the earliest time. For example in 1977 E.C. in Ethiopian history it is the known famine of the country. Currently also the people called "Menja" (people which do not have permanent settlement/moving people) in southwest Ethiopia use wild enset as usual. Enset is capable of withstanding drought and has helped many Ethiopians survive famine in years of bad weather. Brandt *et al*. (1997) also described, enset is presently the main crop of a sustainable indigenous African system, which ensures food security in a country that is severely food deficient. A group of researchers from the American Academy for the Advancement of Science went so far as to call it the “Tree against Hunger.” However, in spite of their potential for food security and export, very little research has so far been done to improve the productivity of this important crop category.

5.1.8.1 CWRs and climate change

Adapting agriculture to climate change is one of the most urgent challenges of our time, necessary to ensure that the crops that feed humanity are able to thrive in new climates with changing pest and disease pressures. New crop varieties that are productive under such changes are needed, and to breed these varieties, crop genetic diversity must be conserved and available to plant breeders. An enormously diverse and largely untapped source of this raw material for crop improvement is the wild relatives of our crops. Redden (2015) described that wild relatives of domesticated crops serve as a reservoir of genetic material, with the potential to be used to develop new, improved varieties of crops. CWRs and Climate Change integrates crop evolution, breeding technologies and biotechnologies, improved practices and sustainable approaches while exploring the role wild relatives could play in increasing agricultural output.

5.1.9 Threats and conservation of MCWRs

Our plant diversity is threatened globally due to industrial, agriculture and forestry practices, urbanization, over-collection, pollution, land use changes, the spread of invasive alien species and climate change. CWRs are also subject to these threats. Agricultural expansion is the most threatening factor for MCWRs which scored 24, followed by over grazing 22. The results of the analysis showed that the source of threats to crop wild relatives especially the human made factors pose a great impact on them. Amsalu Ayana *et al.* (2000) stated that human population is rapidly increasing with concomitant disappearance of wild sorghum. Construction works, settlement projects and large farms are rapidly expanding in Gambella and Ghibe, where relatively good stand of wild sorghum is observed at the moment. This calls for strong need to collect and conserve this invaluable genetic resource before it's lost forever. Other research on threats to Ethnoveterinary medicinal plants at Bale Mountains National Park, Ethiopia indicates similar investigation that agricultural expansion is the most threat human made factor (Haile Yineger *et al*., 2007). It indicates that there is an urgent need to collect CWR special focus should be given for conservation of these plants since they are being widely exploited.

Many CWRs are threatened in the wild by habitat modification, the modernization of agricultural areas and climate change among other factors, and is likely to increase their vulnerability. The main options for conservation of MCWRs are ex-situ conservation in gene banks and in-situ conservation in the natural or farmed environment. They are particularly suited to in-situ conservation as they are able to maintain themselves in the wild under conservation management. Conservation of selected crop wild relative genetic diversity in gene banks is also desirable as insurance against loss and to make material available to breeders. Hopkins and Maxted (2010) stated that, ex-situ conservation of genetic diversity in “gene banks”, where practices for storage of genetic material. Forging a better relationship between specialists working on the conservation and utilization of crop genetic resources and those working on biodiversity conservation is needed to optimize crop wild relative conservation.

In-situ conservation of crop wild relatives involves ensuring their survival in natural ecosystems in which they occur or, in the case of landraces and weedy crop wild relatives, on farms. Genetic reservation approach is suited for conservation of non-weedy crop wild relatives and likely to be

a particularly efficient option where protected areas have been established to conserve other aspects of biodiversity. Although both ex-situ and in-situ methods are possible and complementary to each other, conservation of MCWRs germplasm in their natural habitat seems challenging as the natural habitat is rapidly changing under various human activities. Therefore, urgent rescue collection and in situ conservation are possible. One of the related station in Ethiopia is Areka Research Station, located in the Wolaita Zone in southern Ethiopia, which has been active in collection and maintenance of enset germplasm in field banks since 1987 (Genet Birmeta *et al*., 2004). Abobo Agricultural Research Centre, which is situated in Gambella, also plays a significant role for species like wild sorghum and wild rice by allocating area for the establishment and maintenance of the botanical garden.

5.2 Conclusion

Many of the world's major crops are grown extensively outside the centers of origin. Crop wild relatives are the wild ancestors of crop plants and other species closely related to crops. Throughout the history of agriculture, crop plants have become more and more genetically uniform through selective breeding for traits like high yield. According to Flora of Ethiopia and Eritrea 16 species and one variety of monocotyledonous crop wild relatives are distributed all over the country. Most of the MCWRs growing in Ethiopia were found to grow in TU, GD and IL while the least number occurred in AF, BA and WU, which have single species each. The field survey came up with seven (41.2%) species only, clearly showing the need for more field survey and collection and they have values for different purposes such as food, fodder, construction, etc.and have values for different purposes such as food, fodder, construction etc. The best use value of MCWRs for food was reported for *Dioscorea bulbifera* and *Dioscorea praehensilis.* Similarly, *Eragrostis pilosa* was highly used for fodder.

Aframomum corrorima and Ensete ventricosum were collected from the same floristic region. Kefa Floristic Region is a floristic region in which the majority (Four) of monocotyledonous crop wild relatives are distributed. However, the probability of finding MCWRs on targeted areas was limited because those areas were disturbed due to different anthropological and natural factors.

The study showed that the common habitats for MCWRs are forest, agricultural land, road or river side and grazing land. Most of them are growing in or near margin of cultivated crop lands especially to their close relative in the form of weed. Many MCWR species are under threat in their natural habitats. The main cause for the disappearance of most wild relative crops was agricultural expansion. Storing the seeds of CWRs in seed banks is a form of ex-situ conservation, allowing them to be reintroduced into the wild as well as being available for scientific research.

5.3 Recommendations

Based on the results of the study, the following recommendations are forwarded:

- The members of the community should be encouraged to conserve MCWRs in their natural habitat as well as collaborate in urgent rescue collection is needed for those which are threatened. In this regard, the Ethiopian Biodiversity Institute, which is mandated for germplasm collection and conservation, should be heightened for the collection and ex-situ conservation.
- Relevant scientific research should be conducted on crop wild relatives in terms of genetic aspect because they are untapped sources of crop genetic diversity and important for crop improvement as well as documentation of CWRs including unstudied areas which are not covered in these study.
- The removal of crop wild relatives from their environment as a weed should be conserved by giving awareness to people in any public meeting.
- The concerned body should focus on CWRs that are supplementary or seasonal food sources to avert food insecurity in households of Ethiopian cultural groups.

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APPENDICES

Appendix 1: List of MCWRs treated in Flora of Ethiopia and Eritrea

No	CWR		Crops			Family	Distribution of flora region	Flora volume and no
	Scientific name	Local name/ Language	Scientific name	common English name	Category			
1	*Aframomum corrorima* (Braun) Jansen	korerima (Amh., Gur. & Tya.); koroorimaa (Or.); ofio (Kef.); oghioo (Or.); orsha (Gim.); otiyo (Kef.)	*Aframomum corrorima*	Ethiopian cardamon	Spice	Zingiberaceae	KF IL WG	(6) 325
2	*Allium a1ibile* Steud. exA. Rich.	Ye'gziabhier shnkurt (Amh.)	*Allium cepa*		Vegetable	Alliaceae	TU SU	(6) 154
3	*Allium subhirsutum* L. subsp. *spathaceum* (Steud. ex Rich.)	_____	*Allium cepa*	Bulb onion; Shallot; sweet onion	Vegetable	Alliaceae	GD HA	(6) 151
4	*Amorphophallus abyssinicus* (A. Rich.) N.E. Sr.	Bagana (Kon.); chido (Kef.); hambaguyta (Tya.); ziizee (Or.)	*Amorphophallus gallaensis & A. gomboczianus*		Root/tuber	Araceae	SD	(6) 42
5	*Colocasia esculenta* (L.) Schott	Boneya godare kido.(Kef); garaboo, godaaree kall chomaa (Or.); goderie (Amh.); upela (Anu.).	*Colocasia esculenta*	Taro, Cocoyam, Dasheen, Elephant's ear.	Tuber	Araceae	IL GG SD and undoubtedly throughout west and southwest Ethiopia	(6) 38
6	*Cymbopogon caesius* (Hook. &Arn.) Stapf	Cheguar SA'RI (Tya.)	*Cymbopogon citratus*	Lemon grass	Fragrance	Poaceae	TU GO GJ SUAR KF GG SD BA HA	(7)328
7	*Cymbopogon commutatus* (Steud.) Stapf	Sembeliet (Amh.)	*Cymbopogon citratus*	Lemon grass	Fragrance	Poaceae	TU	(7)330
8	*Cymbopogon schoenanthus* (L.)	SA'RI GAGYA (Tya.) TRIHITO	*Cymbopogon citratus*	Lemon grass	Fragrance	Poaceae	TU	`(7)329

No	CWR		Crops			Family	Distribution of flora region	Flora volume and no
	Scientific name	Local name/ Language	Scientific name	common English name	Category			
	Spreng.							
9	*Dioscorea bulbifera var. bulbifera* L.	Sa'da (Tya.) kooteharree (Or.)	*Dioscorea bulbifera*	Potato yam, Aerial yam	Root/tuber	Dioscoreaceae	TU GD GJ KF IL SD GG	(6) 59
10	*Dioscorea abyssinica* Hochst. ex Kunth	Yecakaboyna (Amh.) kach bhoi (Sh.) maze (WeI.) sa'da (Tya.)	*Dioscorea cayenensis - Dioscorea rotundata complex*	Guinea yam	Root/tuber	Dioscoreaceae	TU GD GJ WG KF GG SD	(6) 61
11	*Dioscorea praehensilis* Benth.	Yecakaboyna (Amh.) kach bhoi (Sh.) maze (WeI.) sa'da (Tya.)	*Dioscorea cayenensis - Dioscorea rotundata complex*	Guinea yam	Root/tuber	Dioscoreaceae	IL	(6) 62
12	*Eleusine africana* Kenn.-O 'Byrne	_____	*Eleusine coracana*	African finger millet	Cereal	Poaceae	TU GJ IL KF	(7) 139
13	*Ensete ventricosum* (Welw.) Cheesman	Enset (Amh.); eset worqiet (Gur.); guna guna, koba, qoco (Amh., Tigre & Tya.); koicho (Kef.); muz (Som.); waarqee(Or.)	*Ensete ventricosum*	Ethiopian banana, false banana, wild banana	Root/tuber	Musaceae	TU GD GJ SU WG IL KF	(6) 317
14	*Eragrostis pilosa* (L.) P. Beauv.	_____	*Eragrostis tef*	Tef	Cereal	Poaceae	TU GD SU	(7)125
15	*Oryza barthii* A. Chev.	Alumo(Anywaa)	*Oryza sativa*	Rice	Cereal	Poaceae	IL	(7) 10
16	*Oryza longistaminata* A. Chev. & Roehr	SUMIHI (Amh.)	*Oryza sativa*	Rice	Cereal	Poaceae	GD GJ IL	(7) 10
17	*Sorghum arundinaceum* (Desv.) Stapf	DAAPHOO(Orom.); MACADEI (Som.)	*Sorghum bicolor*	Sorghum	Cereal	Poaceae	AF GD WU GJ SU AR GG SD HA	(7) 299

Appendix 2: Herbarium specimens of crop wild relatives in the monocotyledonous families

No	Species name of CWR	Family	Local name	Floristic region	Locality	Altitude, latitude & longitude	Date of collection	Collector/s and Collection No	Habitat	Notes	Remark
1	*Aframomum corrorima* (Braun) Jansen	Zingiberaceae	korerima (Amh., Gur. & Tya.); koroorimaa/ Oghioo (Or.); ofio (Kef.)	KF	About 3km from Beha on the way to Chiri.	1880 m a.s.l $7^0$09'N $036^0$13.19' E	Jan-23-2000	Melaku Wondafrash & Tesfaye Awas No. 515	Forest nearby Kappi river Decha wereda agricultural spice trial site (IBCR field gene bank)	Flowers Pink	
2	*Aframomum corrorima* (Braun) Jansen	Zingiberaceae	korerima (Amh., Gur. & Tya.); koroorimaa/ Oghioo (Or.); ofio (Kef.)	KF	Kaya kella Village, in meeadow close to cultivated land land & distributed forest	1760 m a.s.l $7^0$18'N $30^0$14'E	18 Dec.1999	Sebsebe Demissew & Melaku Wondafrash No. 5651	Disturbed forest	Fruit basal growing from the rhizome red	
3	*Aframomum corrorima* (Braun) Jansen	Zingiberaceae	korerima (Amh., Gur. & Tya.); koroorimaa/ Oghioo (Or.); ofio (Kef.)	IL	South of River Qoncho-about 3km	1920 m a.s.l	Aug. 27 1973	Tewolde & Mesfin No. 2092	Rain forest	Rhizomatous plant formingclumps in shades	
4	*Allium a1ibile* Steud. exA. Rich.	Alliaceae	ye'gziabhier shnkurt (Amh.)	SU	Blue Nile Gorge S side	1650 m a.s.l $10^0$04'N $38^0$15'E	23.IX.1975	M.G. Gilbrt & M. Thulin No. 998	Grassy slops On gypsum	Flowers white flushed pale purple with dark mid vein	
5	*Allium a1ibile* Steud. exA. Rich.	Alliaceae	ye'gziabhier shnkurt (Amh.)	SU	Blue Nile Gorge arround Filiklik	1600 m a.s.l	Oct, 9,1994	Sue Edwards and Tewolde Berhan G/E No. 5346	Area protecting from graizing with much Hyperhenia	Herb with underground bulb/ corm	
6	*Allium subhirsutum* L. subsp.	Alliaceae	____	____	____	____	____	____	____	____	No specim

No	Species name of CWR	Family	Local name	Floristic region	Locality	Altitude, latitude & longitude	Date of collection	Collector/s and Collection No	Habitat	Notes	Remark
	spathaceum (Steud. ex Rich.)										en collected
7	*Amorphophallus abyssinicus* (A. Rich.) N.E. Sr.	Araceae	Bagana (Kon.); chido (Kef.); hambaguyta (Tya.); ziizee (Or.)	WG	Anbesa Chaka, c. km from assosiation towards Nekemt under *Oxythenanthera abyssinica* forest	1540 m a.s.l $9^0$54'N $34^0$40'E	12 May 2001	Sebsebe Demissew, Christoff Hermann & Tesfaye Awas No. 5921	*Oxythenanthera abyssinica* forest	Perennial herb Hysteranthous, Spadix shorter than spathea young leaves also seen	
8	*Amorphophallus abyssinicus* (A. Rich.) N.E. Sr.	Araceae	Bagana (Kon.); chido (Kef.); hambaguyta (Tya.); ziizee (Or.)	GJ	70km from mankush towards Chagni.	940 m a.s.l $11^0$11.54'N $35^0$50'E	25 July 2001	Sebsebe Demissew, Melaku Wondafrash, Tesfaye Awas & Kagnew H. No. 6122	Anogeissus Lannae dominated woodland	Erect herb to 1 m high, Leaves dissected, Spathe not covering the whole spadix with fruit, fruit green turning red at maturity	
9	*Amorphophallus abyssinicus* (A. Rich.) N.E. Sr.	Araceae	Bagana (Kon.); chido (Kef.); hambaguyta (Tya.); ziizee (Or.)	GJ	94km on the now, partial, completed, road to Guba starting 5 km S of Injibara	1200 m a.s.l	29.5. 1980	M. Thulin and A. Hunde No. 4015	Oxytenanthera thiket with some combretum etc	Acaulescent when flowering but stem up to 0.4m in fruit	
10	*Amorphophallus abyssinicus* (A. Rich.) N.E. Sr.	Araceae	Bagana (Kon.); chido (Kef.); hambaguyta (Tya.); ziizee (Or.)	Bensh angul - GumuzN. R.S.	Soge (Belo Jegonfoy wereda)	1320 m a.s.l $09^0$21'33"N $36^0$11'01"E	18.5.00	Christof Herrmann No. 94	Meadow around School compound	Flowers & fruits	

No	Species name of CWR	Family	Local name	Floristic region	Locality	Altitude, latitude & longitude	Date of collection	Collector/s and Collection No	Habitat	Notes	Remark
11	*Amorphophallus abyssinicus* (A. Rich.) N.E. Sr.	Araceae	Bagana (Kon.); chido (Kef.); hambaguyta (Tya.); ziizee (Or.)	Benishangul-GumuzN. R.S.	Koncho/ sirba Abay wereda	820 m a.s.l $10^0$03'59"N $35^0$16'25"E	15.5.00	Christof Herrmann No. 77	Wood lands around school compound	Spathes/ flowers appearing just above the ground, peduncle below ground, abundant	
12	*Colocasia esculenta* (L.) Schott	Araceae	Boneya godare kido.(Kef);	GJ	50km SSE of Bahir Dar	1800 m a.s.l	25. Dec. 1971	J.W. Ash No. 1409	Growing amongst roots of a tree on a small Island, in streams	Vegetative condition only and collected above falls, where naturalized	
13	*Colocasia esculenta* (L.) Schott	Araceae	Kefi kido (Keficho)	KF	Kaya Kela , 5km N of Bonga	1760 m a.s.l $7^0$18 'N $30^0$14'E	18 Dec 1999	Sebsebe Demissew & Melaku Wondafrash No. 5626	Around home	~75cm tall leaf base sagitate almost peltate	
14	*Colocasia esculenta* (L.) Schott	Araceae	Upela(Ak) Goderae(Ama)	IL	Abobo-Gambella	543 m a.s.l	Feb, 6, 1990	Getachew Aweke No. 2882	On marshy area	Roots edible, herb 1 1/2 m high	
15	*Colocasia esculenta* (L.) Schott	Araceae	Garaboo, godaaree kall chomaa (Or.);	SD	Yirgalem Hospital Compound	2000 m a.s.l	June 22, 1979	Mesfin T. No. 570	_____	Soil reddish brown: asso. plants Solanum sp. Maesa lanceolata & ferns	
16	*Colocasia esculenta* (L.) Schott	Araceae	Goderie (Amh.); upela (Anu.).	TU	27.4km on Enda-Selassie-Adi Dahro Sheraro road: Endagabir Gudllo	1820 m a.s.l	28 oct. 1991	Mesfin Tadesse No. 8736-8755 & 8772-8773	Spring Bordered by an ever green wood land	_____	

No	Species name of CWR	Family	Local name	Floristic region	Locality	Altitude, latitude & longitude	Date of collection	Collector/s and Collection No	Habitat	Notes	Remark
17	*Cymbopogon caesius* (Hook. &Arn.) Stapf	Poaceae	Cheguar SA'RI (Tya.)	KF	67km Jimma Bonga Beside the river Gojeb	1350 m a.s.l $7^0$20.4'N $36^0$26'E	Aug 10 1972	Tewelde Berhan G.E No. 442	Open savannal with the occasional Piliostigma Thoningii	Grass growth thick, grass bunched, inflorescence red on green background, stem red	
18	*Cymbopogon caesius* (Hook. &Arn.) Stapf	Poaceae	Cheguar SA'RI (Tya.)	BA	25 miles NW of GHINIR	1980 m a.s.l $7^0$10'N $34^0$45'E	11/12/1958	R.H.D. SANDFORD No. S.22	In open grassland plain on black cotton soil	_____	
19	*Cymbopogon commutatus* (Steud.) Stapf	Poaceae	Sembeliet (Amh.)	SU	12.5km on Zwai- butajira road	1860 m a.s.l	9.IV.1989	Mesfin Tadesse No. 7421-7455 & 7465-7466	Olea-Rhus woodland	Tefted perennial, common	
20	*Cymbopogon commutatus* (Steud.) Stapf	Poaceae	Sembelet(Amh.)	SU	Mulu 40 mils N of Addis Ababa	8100Ft	9/1956	R. Sanaford M No. ____.	_____	_____	
21	*Cymbopogon commutatus* (Steud.) Stapf	Poaceae	Sembelet(Amh.)	SU	Abay(Blue nile) Gorge by 205km mark on Addis Ababa Debre markos road	1350 m a.s.l	8.9.1973	M.G. Gilbert& Getachew A. No. 3094	Growing in silt in shallow gulley	_____	
22	*Cymbopogon commutatus* (Steud.) Stapf	Poaceae	Sembelet(Amh.)	SD	19km S of wachile on road to moyale	1180 m a.s.l $4^0$27'N $39^0$04'E	6 June 1988	M.G. Gilbert & Sebsebe D. No. 8709	Bushland with scattered trees	Small tussocks in open, inflorescence grey-green	
23	*Cymbopogon commutatus* (Steud.) Stapf	Poaceae	Sembelet(Amh.)	SU	Awash NP	$8^0$55'N $39^0$55'E	14.4.69	M.G.& S.B. Gilbert No. 1222	_____	Tussock grass	
24	*Cymbopogon schoenanthus* (L.) Spreng.	Poaceae	SA'RI GAGYA (Tya.)	AR	20km of Neghelle, a long road to Melka Guba	1500 m a.s.l	31/8/89	Sue Edwards No. 7432	*Acacia drepanolobium* grassland on black clay	_____	

No	Species name of CWR	Family	Local name	Floristic region	Locality	Altitude, latitude & longitude	Date of collection	Collector/s and Collection No	Habitat	Notes	Remark
									perennial		
25	*Cymbopogon schoenanthus* (L.) Spreng.	Poaceae	SA'RI GAGYA (Tya.)	SD	Nechsar NP, SE part, Northern slope of Gatyra Mt.	1320 m a.s.l $5^0$56'N $37^0$45'E	Dec. 9 1991	D.A. Petelin No. 527	Open wooded grass land	Tall (more than 1m high) tufted grass	
26	*Dioscorea bulbifera var. bulbifera* L.	Dioscoreaceae	Sa'da (Tya.) kooteharree (Or.)	GD	Tekeze vally near bridge on Gonder - Asmera road	900-950 m a.s.l $13^0$43'N $39^0$11'E	30-8-1973	M.G. Gilbrt & Getachew A. No. 2965	Boswellia papyrifera wood land	Steep slopes with broad leafed deciduous	
27	*Dioscorea abyssinica* Hochst. ex Kunth	Dioscoreaceae	Yechakaboyna (Amh.) kach bhoi (Sh.) sa'da (Tya.)	KF	Bebeka coffee plantation, S of Mizan Teferi along the track to Gurafada about 24km W of the coffee plantation	1050 m a.s.l $6^0$50'N $35^0$15'E	1.12.1984	I. Friis, M.G. Gilbrt & K. Vollesen No. 3923	Growing in secondary growth, in forest	Herbacious climber to 5m high	
28	*Dioscorea abyssinica* Hochst. ex Kunth	Dioscoreaceae	Yechakaboyna (Amh.)	WG	35 km E of Gimbi, on The way to Nekemte Welega	1400 m a.s.l	21/11/80	Sebsebe D. & Erich No. 651	South facing slop in the crystalline highland. Ever green mountane forest.	Twining shrub Fruits green	
29	*Dioscorea abyssinica* Hochst. ex Kunth	Dioscoreaceae	Yechaka Boyena(Amh.) maze (WeI.)	SD	4 km W of Dilla grown in densy(forest) shrub	_____	Aug 24 1967	Tadesse Ebba No. 610	Grown in densy forest	Climbing, root edible	
30	*Dioscorea abyssinica* Hochst. ex Kunth	Dioscoreaceae	Yechakaboyna (Amh.) kach bhoi (Sh.)	WG	Gimbi 65 km SW of Gimbi on the Gimbi nekemt road	1180 m a.s.l	16.XI.1981	Mesfin Tadesse & Kagnew G.Y. No. 2301-2321	On upper plains &banks of Dedessa river	_____	
31	*Dioscorea abyssinica* Hochst. ex Kunth	Dioscoreaceae	Yechakaboyna (Amh.) kach bhoi (Sh.)	WG	56km of Asosa along road to kurmuk	1500 m a.s.l. $10^0$25'N $34^0$33'E	20 Nov 1998	I. Friis, Sally Bidgood, Melaku Wondefrash , Amsalu Ayana & Fantahun Simon No. 9139	Glaucus tinge Terminaliya woodland	Herbaceous climber	

No	Species name of CWR	Family	Local name	Floristic region	Locality	Altitude, latitude & longitude	Date of collection	Collector/s and Collection No	Habitat	Notes	Remark
32	*Dioscorea abyssinica* Hochst. ex Kunth	Dioscoreaceae	Yechakaboyna (Amh.)	GD	Metema c. 3 km N of the town towards the Atbara river	850 m a.s.l. $13^0$00'N $35^0$17.14'E	28.10.1995	I. Friis, Sally Bidgood, P. Host, Melaku Wondefrash & Shigulte Kebede No. 6968	Mixed wood land, on stony hills	Herbaceous climber	
33	*Dioscorea abyssinica* Hochst. ex Kunth	Dioscoreaceae	Yechaka Boyena(Amh.) maze (WeI.)	SD	Sidama Awraja Awassa Junior Agri college compound	1700 m a.s.l.	8.X.I985	Mesfin Tadesse No. 3212-3216	_____	_____	
34	*Dioscorea praehensilis* Benth.	Dioscoreaceae	Yechakaboyna (Amh.) kach bhoi (Sh.) sa'da (Tya.)	GJ	24km from janction on mankush-chagni road towards Abbay	880m a.s.l. $11^0$07.605' N $35^0$17.141' E	24 July 2001	Sebsebe Demisew, Melaku Wondefrash, Tesfaye Awas & Kagnew H. No. 6118	Pterocarpus Senna dominated wood land	Climbing shrub to 3 m high	
35	*Dioscorea praehensilis* Benth.	Dioscoreaceae	Kawon (Majanger)	IL	Gambela region, 23kmfrom Metitown southern side of Bishan waqa lake Dushi area	1300 m a.s.l.	25-05-1996	Tesfaye Awas No. 348	Cordia celtis Aningeria dominated forest	Herbaceous Climbing to 3 m high Underground tuber edible after cooking	
36	*Dioscorea praehensilis* Benth.	Dioscoreaceae	Yecakaboyna (Amh.), Modo (Anywaa)	IL	Benshangul Gumuz-NR state	1550 m a.s.l 10.04.04N 34.33.40E	28.07.01	Christof Herrmann No. 248	Bushed meadow	Flowering	
37	*Dioscorea praehensilis* Benth.	Dioscoreaceae	Modo (Anywaa)	IL	17km along the road from Gambela to Abobo, Air port	750 m a.s.l.	23-11-1995	Tesfaye A. & Okeach O. No. 126A	Anogeissus - Lonchocarpus-Grewia-Tamandus-Terminalia-Combretum dominated closedwoodland.	Herbaceous Climber 3m to 8 m long, fruit 3-winged seeds winged	
38	*Eleusine*	Poaceae		GG	Omo NP	500 m a.s.l.	May 10,	Jacobs &	Riverine		

No	Species name of CWR	Family	Local name	Floristic region	Locality	Altitude, latitude & longitude	Date of collection	Collector/s and Collection No	Habitat	Notes	Remark
	africana Kenn.-O 'Byrne						93	Schloeder No. 824		_____	
39	*Eleusine africana* Kenn.-O 'Byrne	Poaceae	_____	IL	23-33km on Gambella-Abobo road	580 m a.s.l.	23.xI.1987	Mesfin Tadesse No. 6670-6702	Dry deciduous forest	Soil sandy, light grey	
40	*Eleusine africana* Kenn.-O 'Byrne	Poaceae	_____	IL	Gambela IAR/EID site Ag research site	450m a.s.l.	22.9.76	F.F. Piato & S.H. saunders No. 1059	Ag. Research site	Volunteer grass(weed) in & around experimental plots of highland soil area	
41	*Eleusine africana* Kenn.-O 'Byrne	Poaceae	_____	GD	Mai-teklit near adi-arkaie	1520 m a.s.l. $13^0$31'N $38^0$06'E	2nd Sep 1973	G. Aweke & M.G. Gilbert No. 952	_____	Asso. Sp. *Erythrina abyssinica*, Rhus sp. Angeissus sp. & Sterreospermum sp.	
42	*Ensete ventricosum* (Welw.) Cheesman	Musaceae	Enset(Amh)	KF	Bonga along path to water fall near Catholic misson	1850 m a.s.l. $7^0$15'N $36^0$15'E	16.11.1970	Ib Friis No. 326	On rocky slop in forest , rather common on open places in the forest	Herb 4m, 0.8-0.9m in diameter. No fruits	
43	*Eragrostis pilosa* (L.) P. Beauv.	Poaceae	Teff(Amh), Teffi(Oro)	AR	Adamitulu Arusi	5400ft	-/9/1956	R. sand ford No. A7, 61	_____	_____	
44	*Eragrostis pilosa* (L.) P. Beauv.	Poaceae	_____	GD	Adi Arkai by the street	1525m a.s.l.	3/9/1972	Tewolde B.G.E. No. 796	Growing besides road on shallow soil	_____	

No	Species name of CWR	Family	Local name	Floristic region	Locality	Altitude, latitude & longitude	Date of collection	Collector/s and Collection No	Habitat	Notes	Remark
45	*Eragrostis pilosa* (L.) P. Beauv.	Poaceae	_____	SD	43 kmS of wachile on the road to Moyale	1300-1400m a.s.l. $4^0$11'N $39^0$05'E	6. June,1988	M.G. Gilbert & Sebsebe No. 8731	Base with dense Acacia bush land	Ephemeral growing in and around dry cattle trough	
46	*Eragrostis pilosa* (L.) P. Beauv.	Poaceae	_____	GD	Beyond Debre Bahr in wolfit pass. Gonder to Asmera	_____	6/9/1972	Tewolde B.G.E. No. 733	Growing on shallow soil	Annual, young panicles, compact linear, spikelet dark, green with red margin	
47	*Eragrostis pilosa* (L.) P. Beauv.	Poaceae	_____	IL	30 km to W from V. abobo left side Alvero near V. vrija on wet places	420 m a.s.l.	26.08.88	V. N. Pavlov No. 188	On wet places in savanna	4 to 1m high	
48	*Oryza barthii* A. Chev.	Poaceae	Alumo(Anywaa)	IL	1km N of Itang	600m a.s.l. $8^0$10'N $34^0$15'E	18.11.1995	I. Friis, Sally Bidgood, P. Host, Dessalegn Desissa & Shigulte Kebed No. 7192	Grass swamp along small stream, on black cotton	Swared forming annual grass, dominant species in swamp	
49	*Oryza barthii* A. Chev.	Poaceae	Alumo(Anywaa)	IL	Gambela	_____	7-8-74	F. Pinto No. 1020	Field Besides river which get flooded	Grass fruits eaten by Annak & Muer	
50	*Oryza barthii* A. Chev.	Poaceae	Alumo(Anywaa)	IL	Itang Town along Baro river temporally flooded	570 m a.s.l.	03.10.1996	_____	Flooded area	Seeds edible under famine Condition	
51	*Oryza barthii* A. Chev.	Poaceae	Alumo(Anywaa)	GJ	Bahirdar awraja , 6 km SE of Bahirdar on the way to Tis Isat Falls	1800 m a.s.l.	1.XI.1981	Mesfin Tadesse & Kagnew G.Y	Marshy area with pools of water & dry shruby wood land	_____	
52	*Oryza longistaminata* A. Chev. &	Poaceae	Aluma(Anywaa)	IL	At bridge across small stream 27km W of	600m a.s.l. $8^0$10'N$34^0$26'E	1.11.1996	I. Friis, Sally Bidgood, P. Host, Fanthhun semon,	Swampy ground along river seems to remain	Dominant grass in the flooded area	

No	Species name of CWR	Family	Local name	Floristic region	Locality	Altitude, latitude & longitude	Date of collection	Collector/s and Collection No	Habitat	Notes	Remark
	Roehr				Gambela road to Itang			Micheal Jensen & Menassie Gashaw No. 7995	flooded for long time		
53	*Sorghum arundinaceum* (Desv.) Stapf	Poaceae	DAAPHOO (Orom.)	AR	Oromia Region , Mekdela village,15 km SE of Meki Toown , NW side of Lake Ziway	1710 m a.s.l.	16/02/99	Mirutse Gidey No. MG-13-91	Grows on margins of agricultural plots	A grass about 11/2m high	
54	*Sorghum arundinaceum* (Desv.) Stapf	Poaceae	Fincoo(Orom.)	SD	Borena Zone Dambala Abba Canna in Dida Hara, 30km from yabello	1601m a.s.l. 044857.5N 038/8/0.5E	2/07/2001	Gemedo Dalle No. 200	In the valley where there is more moisture available	Long grass of about 3-5km in height. It looks like Sorghum	
55	*Sorghum arundinaceum* (Desv.) Stapf	Poaceae	DAAPHOO (Orom.)	SU	IAR Melkassa Research station, near Nazret	1600 m a.s.l.	8.1.87	C. Parker No. 4391	_____	Frequent tufted (Perennial) 0.5-2 m high grass	
56	*Sorghum arundinaceum* (Desv.) Stapf	Poaceae	DAAPHOO (Orom.); MACADEI (Som.)	HA	Diredawa, Territry of Airport , near the N end of runaway	1175 m a.s.l. $9^0$35'N $41^0$53'E	18.11.1990	D.A. Petelin No. 241	Dry grassland	_____	
57	*Sorghum arundinaceum* (Desv.) Stapf	Poaceae	DAAPHOO(Orom.)	IL	Abobo, c.40kms S of Gambella	600m a.s.l.	14.7.87	C. Parker No. 4570	_____	Abundant, often dominant weed of road sides & Crops, up to3m, tufted	
58	*Sorghum arundinaceum* (Desv.) Stapf	Poaceae	DAAPHOO (Orom.); MACADEI (Som.)	GD	30km S of Humera, along the track of Noggera running parallel with the Sudan Border	700m a.s.l. $14^0$02'N36^0 32'E	23.10.1995	I. Friis, Sally Bidgood, P. Host, Melaku Wondefrash & Shigulte Kebed No. 6863	Balanites aegyptiaca wood land	Loosely tufted annual grass common weed in Sorghum fields	

Appendix 3: General information of respondents

No.	Name of respondents	Sex	Age	Marital status	Educational background	Occupation	Location		
							Region	Zone	Locality
1	Abdela Hussien	M	41	Married	Read and write	Farmer	Oromia	East Hararge	Ganda Gabballa
2	Adanech	F	37	Married	8	Merchant	SNNPRS	Keffa	Gojeb
3	Adugna Gari	M	40	Married	Degree	Wereda extension team leader	Oromia	North Showa	Gohuatsion
4	Alemayehu	M	36	Married	Degree	Park expert	Oromia	East Showa	ANP
5	Amanueal	M	35	Divorced	6		Oromia	East Showa	
6	Ayelech	F	35	Married	6	Student	SNNPRS	Keffa	Berta Waterfall
7	Belachew Gifole	M	61	Married	Illiterate	Farmer	SNNPRS	Keffa	Berta Waterfall
8	Birtukan bayecha	F	22	Unmarried	8	Merchant	Oromia	Jimma	Gojeb
9	Biru Boru	M	32	Unmarried	Degree	Private worker	Oromia	East Showa	Debrezeit
10	Chala Adugna	M	56	Married	Diploma	Teacher	Oromia	West Showa	Gedo
11	Dagnachew	M	32	Married	Degree	Private worker	Afar	East Showa	ANP
12	Dagne	M	29	Unmarried	10	Charcoal producer	Oromia	North Showa	Abay gorge
13	Emawayish Deneke	F	45	Married	Read and write	Farmer	Oromia	North Showa	Filiklik
14	Fantu Tessema	F	45	Married	6	Farmer	Oromia	West Showa	Gedo
15	Fasika	M	52	Married	8	Farmer	SNNPRS	Wolaita	Kokati
16	Fitsumwork Tessema	F	43	Married	9	Farmer	Oromia	North Showa	Mulo
17	Genet Zewdu	F	42	Married	Illiterate	House wife	Amhara	East Gojam	Dejen
18	Getnet Ayalew	M	40	Married	Illiterate	Farmer	SNNPRS	Gamo Gofa	Kucha/Selamber
19	Gezu kebede	M	29	Unmarried	10	Student	Oromia	North Showa	Mulo
20	Hana	F	24	Unmarried	11	Student	Oromia	North Showa	Gohuatsion
21	Kebede Ejersa	M	53	Married	6	Farmer	Oromia	North Showa	Mulo
22	Ketema Bekele	M	63	Married	10	Farmer	Oromia	North Showa	Filiklik
23	Konjit	F	35	Married	6	Merchant	SNNPRS	Keffa	Gojeb

No.	Name of respondents	Sex	Age	Marital status	Educational background	Occupation	Location		
							Region	Zone	Locality
24	Mekonnen yayeh	M	80	Married	Illiterate	Farmer	Oromia	North Showa	Kunde T/Haymanot
25	Melese Aragaw	M	32	Unmarried	Read and write	Charcoal producer	Oromia	North Showa	Abay gorge
26	Metadel Kefyalew	M	56	Married	8	Kebele vice chairman	Oromia	North Showa	Filiklik
27	Mime	F	28	Married	4	Student	SNNPRS	Keffa	Berta Waterfall
28	Mitiku Mekuriya	M	44	Married	Illiterate	Farmer	SNNPRS	Keffa	Gojeb
29	Mohammed Hassan	M	47	Married	Read and Write	Farmer	Oromia	East Hararge	Ganda Gabballa
30	Mulugeta	M	25	Unmarried	10+1	Student	SNNPRS	Keffa	Kejja hoddanno
31	Nesru Amhed	M	21	Unmarried	8	Student	Oromia	East Hararge	Ganda Gabballa
32	Netsenat	F	37	Unmarried	11	Student	Oromia	North Showa	Gohuatsion
33	Radiet	M	27	Unmarried	10+3(diploma)	Student	SNNPRS	Keffa	Kejja hoddanno
34	Rufael	M	24	Unmarried	9	Student	SNNPRS	Keffa	Berta Waterfall
35	Samuel Berhanu	M	26	Unmarried	10+1	Student	SNNPRS	Keffa	Kejja hoddanno
36	Jafar Abdela	M	40	Married	6	Park guard	Oromia	East showa	ANP
37	Tadesse Bedade	M	35	Married	Diploma	Kebela DA	Oromia	North Showa	Filiklik
38	Tamirat Abinso	M	67	Married	Illiterate	Farmer	SNNPRS	South Omo	Alega
39	Tigist Zewdu	F	39	Divorced	8	Farmer	Amhara	East Gojam	Dejen
40	Tsigereda Tarekegn	M	46	Married	8	Farmer	Oromia	North Showa	Filiklik
41	W/Eyesus Melkamu	M	30	Unmarried	10+2	Student	SNNPRS	Keffa	Kejja hoddanno
42	Wordofa	M	40	Married	8	Park guard	Oromia	East Showa	ANP
43	Yalfal G/yohannes	M	32	Unmarried	10	Farmer	Oromia	East Showa	Fentalle
44	Zemenay Abebe	F	35	Married	8	Farmer	Oromia	East Showa	Fentalle
45	Zerihun Tadesse	M	50	Married	Degree	Teacher	Oromia	West Showa	Dirki

Appendix 4: List of plant specimens collected in the study area.

No	Species name	Family	Floristic region	Collection No.
1	*Aframomum corrorima*[*]	Zingiberaceae	KF	BA -19
2	*Amorphophallus gallaensis*	Araceae	SU	BA-13
3	*Colocasia esculenta*[*]	Araceae	KF, GG & SD	BA-18
4	*Dioscorea alata*	Dioscoreaceae	GG	BA-15
5	*Dioscorea bulbifera*[*]	Dioscoreaceae	KF,GG & SD	BA-14
6	*Dioscorea cayenensis*	Dioscoreaceae	GG	BA-16
7	*Dioscorea praehensilis*[*]	Dioscoreaceae	GG	BA-17
8	*Dioscorea schimperiana*	Dioscoreaceae	SU	BA-12
9	*Drimia altissima*	Hyacinthaceae	SU,GJ	BA-2
10	*Eleusine floccifolia*	Poaceae	SU & HA	BA-3
11	*Ensete ventricosum*[*]	Musaceae	KF	BA-20
12	*Eragrostis gangetica*	Poaceae	SU	BA-5
13	*Eragrostis pilosa*[*]	Poaceae	SU,HA	BA-9
14	*Eustachys paspaloides*	Poaceae	HA	BA-10
15	*Hyparrhenia anthistirioides*	Poaceae	SU	BA-4
16	*Hyparrhenia dregeana*	Poaceae	KF	BA-22
17	*Hyparrhenia hirta*	Poaceae	HA	BA-7
18	*Ledebouria urceolata*	Hyacinthaceae	HA	BA-8
19	*Monocymbium ceresiiforme*	Poaceae	KF	BA-25
20	*Sauromatum venosum*	Araceae	KF	BA-21
21	*Sorghum arundinaceum*[*]	Poaceae	SU	BA-11
22	*Sorghum* x *drummondii* =*Sorghum bicolor* subsp. *drummondii*	Poaceae	SU & GJ	BA-6
23	*Sporobolus africanus*	Poaceae	SU	BA-1
24	*Thunbergia alata*	Acanthaceae	KF	BA-23
25	*Cynodon dactylon*	Poaceae	SU	BA-24

Remark:[*]MCWRs

Appendix 5: Distribution of monocotyledonous crop wild relative species in Ethiopia

Species name	Region according to Flora of Ethiopia and Eritrea													
	AF	AR	BA	GD	GG	GJ	HA	IL	KF	SD	SU	TU	WG	WU
Aframomum corrorima (Braun) Jansen								√	√				√	
Allium a1ibile Steud. exA. Rich.											√	√		
Allium subhirsutum L. subsp. *spathaceum* (Steud. ex Rich.)				√			√							
Amorphophallus abyssinicus (A. Rich.) N.E. Sr.										√				
Colocasia esculenta (L.) Schott					√			√		√				
Cymbopogon caesius (Hook. &Arn.) Stapf		√	√	√	√	√	√		√	√	√	√		
Cymbopogon commutatus (Steud.) Stapf												√		
Cymbopogon schoenanthus (L.) Spreng.												√		
Dioscorea bulbifera var. *bulbifera* L.				√	√	√		√	√	√		√		
Dioscorea abyssinica Hochst. ex Kunth				√	√	√			√	√		√	√	
Dioscorea praehensilis Benth.								√						
Eleusine africana Kenn.-O 'Byrne						√		√	√			√		
Ensete ventricosum (Welw.) Cheesman				√		√		√	√		√	√	√	
Eragrostis pilosa (L.) P. Beauv.				√							√	√		
Oryza barthii A. Chev.								√						
Oryza longistaminata A. Chev. & Roehr				√		√		√						
Sorghum arundinaceum (Desv.) Stapf	√	√		√	√	√	√				√			√

Note: √ implies floristic regions, which MCWRs present.

Appendix 6: Data collection format with questions as Interview guide (questionnaire)

1. General Information

Name: _____ Age_____ Sex _____

Location: Region_____ Zone _____ Wereda _____ Kebele ____

Village: _____

Marriage Status: ▷Married ▷Unmarried ▷Divorced

Educational Status: _____

Altitude _____Latitude _____ Longitude _____

Cropping season (Meher, Belg, Kiremt or others)

2. Ethnobotanical Information

1. What are the major crops commonly cultivated in your area? Please list out the names of all crops and CWRs on the space provided by filling the table and put only mark (√/×) for the last column.

No	Crop cultivated (Local name)	Language	Crop Wild Relatives			Habitat	Use CWR(√) /Not used(×)
			Local name	Language	Meaning of local name		
1							
2							

2. If the CWR is used, in which use category is it classified? Put (×) for your selection more than one use category is possible.

Name of CWR species	Use categories							
	Medicine	Fire wood	Char coal	Construction and furniture	Food	Fodder	Other (Specify)	Part used
1								
2								

3. Where does this most crop wild relative grow? Put (√) inside the triangle from the choice?

   ▷ Inside the forest

   ▷ Inside/ at margin of the cultivated crops?

   ▷ Road side

   ▷ River side

   ▷ Other (Specify it)

4. Has the diversity of this CWR increased or decreased through time or compared from earliest time?

   _____

5. Reason out for question No 4?

   _____

6. What is so special about this plant?

_____

7. Can you give me any additional information about this plant?

_____

Declaration

I, the undersigned declare that this Thesis is my original work and it has not been presented in other universities, colleges or institutes for a degree or other purpose. All sources of the materials used have been duly acknowledged.

Name: Biniyam Asfaw Signature: _____ Date: _____

This work has been done under my supervision.

Name: _____ Signature: _____ Date: _____

_____ Signature: _____ Date: _____