CROP WILD RELATIVES IN THE FAMILIES OF DICOTYLEDON PLANTS IN ETHIOPIA

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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 (Biology: Botanical Science)

Addis Ababa University

Addis Ababa, Ethiopia

May 2015

ADDIS ABABA UNIVERSITY

GRADUATE PROGRAMMES

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ABSTRACT

CROP WILD RELATIVES IN THE FAMILIES OF DICOTYLEDON PLANTS IN ETHIOPIA

Debela Daba Gutta, MSc Thesis

Addis Ababa University, 2015

This study was undertaken in parts of Ethiopia where the crop wild relatives are available. Crop wild relatives of the dicotyledonous plant families in Ethiopia were studied to highlight their present status, as compared to the findings of earlier studies. This study has two parts: firstly data collection from Flora of Ethiopia and Eritrea, and the National Herbarium (ETH)), and secondly field data collection (ethnobotanical uses and voucher speciemens collection). Data were collected from the specimens accumulated in the National Herbarium (ETH) and the conservation status of all dicotyledonous crop wild relative species, 27 in total were assessed then proceeded to the interview-based field study. Semi-structured interviews were administered using purposive sampling in the selected floristic regions of Ethiopia namely: Shewa, Gojam, Welega, Kefa, Arsi, and Harerge. The Voucher specimens of 18 dicotyledonous crop wild relatives were collected and identified at both at field and at the National Herbarium, Addis Ababa University. Data had been collected and recorded using GPS, digital camera and analyzed mainly by using the Microsoft Excel and spread sheet .The status and ethnobotanical values of the collected crop wild relatives were identified. The highest number of species was found in Shewa Floristic Region especially around Addis Ababa area. Fabaceae contributed the highest number of dicotyledon crop wild relatives. Crop wild relatives in the families of dicotyledon had been compared by using bar graphs and tables. The major threats of dicotyledon crop wild relative are agricultural expansion, overgrazing and herbicide use in crop protection. The findings would initiate research ondiversity, conservation and possible use of crop wild relatives.

Key words/phrases: *Agriculture, crops, crop wild relatives, dicotyledons and vegetation*

Acknowledgements

I am very grateful to my supervisors Prof. Zemede Asfaw and Prof. Ensermu Kelbessa for their unreserved guidance and useful comments during the thesis work starting from proposal development. Their critical review of the manuscript is highly appreciated. They visited me several times while I was dealing with plant specimen identifications at the National Herbarium, (ETH).

I acknowledge the Department of Plant Biology and Biodiversity Management, AAU for facilitating my research work and financial support. Staff members of the National Herbarium (ETH), AAU are highly acknowledged for their technical and material support in plant specimen collection, identification and handling.

Above all, I would also like to thank my best friend Mr. Biniam Asfaw for his commitment on field work and starting from this proposal to the end of this paper, my mother Gelane Adugna and my best friends Dereje Gudeta, Basha Takele, Meseret Getnet, and Deressa Abetu for their financial and moral support and for hospitality. Also great thanks to Mr. Fitsum Dejene and Dereje Gudeta for their support in drawing map of the study area.

My heart-felt thanks go to all who participated directly or indirectly in the successful completion of my thesis work.

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Acronyms

AF – Afar Floristic Region, below and to the east of the 1000 m contour to the Eritrean border in the east and the Harerge border in the south

AR – Arsi Floristic Region

BA – Bale Floristic Region

CWR – Crop Wild Relatives

DA– Development Agents

DCWR– Dicotyledon Crop Wild Relatives

EBI – Ethiopian Biodiversity Institute

FAO – Food & Agriculture Organization

GD – Gonder Floristic Region

GDP – Growth and Development Program

GEF – Global Environment Facility

GG – Gamo Gofa Floristic Region

GJ – Gojam Floristic Region

HA – Harerge Floristic Region

IL – Ilubabor Floristic Region

IMF – International Monetry Fund

KF– Kefa Floristic Region

ma.s.l – meters above sea level

mm – millimeter

NGO – Non-Governmental Organization

PGRFA – plant Genetic Resources for Food and Agriculture

RF – Rain Fall

SD – Sidamo Floristic Region

SU – Shewa Floristic Region, above and to the west of the 1000 m contour

TU – Tigray Floristic Region, above and to the west of the 1000 m contour

UNEP – United Nations Environment Program

USDA – United State Department of Agriculture

WG – Welega Floristic Region

WU – Welo Floristic Region, above and to the west of the 1000 m contour

CHAPTER ONE

1 INTRODUCTION

1.1 Background of the Study

Ethiopia's agriculture is plagued by periodic drought, soil degradation caused by overgrazing, deforestation, high population density, high levels of taxation and poor infrastructure making it difficult and expensive to get goods to the market. Yet agriculture is the country's most promising resource. A potential exists for self-sufficiency in grains and for export development in livestock, grains, vegetables, and fruits. As many as 4.6 million people need food assistance annually (Matouš and Todo, 2013).

Crops are plants used by humankind and may include food, fodder and forage crops; medicinal plants, condiments, ornamental, and forestry species. There are many definitions of the word “crop”. When referring to plants, USDA considers crops to be those plants that are cultivated either for sale or for subsistence. There are many plants that are specialty crops when cultivated, but are also collected from wild populations. Wild plants are not considered specialty crops even though they may be used for the same purpose as cultivated plants. This is somewhat common among medicinal herbs and woodland plants (FCIC, 2009).

A crop wild relative (CWR) is 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 *et al*,. 2007). The wild relatives of crop plants constitute an increasingly important resource for improving agricultural production and for maintaining sustainable agro ecosystems (FAO, 1998:2008; Bioversity International, 2006). 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 (Maxted*et al*., 2008). In other words, CWRs are all those species found growing in the wild that to some degree are genetically related to food, fodder and forage crops, medicinal plants, condiments, ornamental and forestry species used by humankind. Most CWRs are found growing as weeds in disturbed habitats, such as roadsides, field margins, orchards and traditionally managed agricultural land.

Crop wild relatives (CWRs) include crop progenitors and their closely related species. Many ofthe latter species possess traits of interest for crop improvement, providing plant breeders withgenes coding for biotic and abiotic stress resistance (e.g. resistance against pests and diseases, temperature, drought or salinity stress) or higher values for nutritional traits compared to varieties of their crop relatives, to name but a few (Tanksley and McCouch, 1997). Besides their role in providing genes for crop breeding, local communities already exploit many CWRs as they directly contribute to food security through provision of fruits, leaves, tubers, and/or seeds.

According to United Nations Environment Programme (UNEP)/Global Environment Facility (GEF), a CWR is defined as 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. A similar approach has been proposed by Meilleur and Hodgkin (2004) who suggest that CWRs should include the wild congeners or closely related species of a domesticated crop or plant species, including relatives of species cultivated for medicinal, forestry, forage, or ornamental purposes.

Dicotyledons are not a monophyletic group, and therefore the names "dicotyledon" and "dicots" are paraphyletic terms. However, the vast majority of "dicots" do form a monophyletic group called the eudicots or tricolpates. These may be distinguished from all other flowering plants by the structure of their pollen. Other dicotyledons and monocotyledons have monosulcate pollen, or forms derived from it, whereas eudicots have tricolpate pollen, or derived forms, the pollen having three or more pores set in furrows called colpi (http://en.wikipedia.org. 15 may 2014).

Traditionally, the dicots have been called the dicotyledonous (or dicotyledoneae), at any rank. If treated as a class, as in the cronquest system, they may be called the Magnoliopsida after the type genus *Magnolia*. In some schemes, the eudicots are treated as a separate class, the Rosopsida (type genus *Rosa*), or as several separate classes. The remaining dicots (palaeodicots) may be kept in a single paraphyletic class, called Magnoliopsida, or further divided (http: //en.wikipedia.org. 15 may 2014).

This research saw the number of CWRs in the crops belonging to the dicotyledons. Is particularly focuses on finding out how many species that are included in the Flora volume, how many of them have voucher of specimen at the National Herbarium and how many were collected from the field. For the found in the field, their distribution in Ethiopia, for their ethnobotanical profiles and conservation status are described. The farmers of Ethiopia and the population lives in the rural areas used as food CWR during peak season between seed sowing to time of harvest, food scarcity and during drought. Since these CWR plants have major role to reduce the shortage of food in our country different study will important by different researchers. This study identified the status of CWR by comparing with the previous studies. Also, study the ethnobotanical knowledge of the farmers in the study area.

1.2 Research Questions and Objectives

1.2.1 Research Questions

This research work will answer the following main research questions:

i. What is the documentation status of dicot crop wild relative?
ii. Which floristic regions of the country are CWRs of dicotyledonous highly distributed?
iii. What are the ethnobotanical values of CWRs and their uses of in the study area?
iv. What is the current status of CWRs of dicot crops in Ethiopia?
v. What are the realized and potential values of the CWR to ensure food security and increase production in Ethiopia?
vi. What are the causes for the decline of CWR in the study area if there is a decline?
vii. Which plant families and crop categories have high crop wild relatives?

1.2.2 Objectives

General objective

The general objective of this study is to investigate the current status and the ethnobotanical uses of wild relatives of crops in the families of dicotyledonous plants.

Specific objectives

i. To produce a checklist of the wild relatives of dicot crops documented,those found in the study area and to know which cultivated dicot crops have got their wild relative in Ethiopia;
ii. To carry out interview-based field survey and collect voucher specimens of dicot crop wild relatives from the selected flora regions of Ethiopia;
iii. To document the indigenous knowledge of the farmers on the ethnobotany of dicot wild crop relatives;
iv. To compare the current distribution of CWRs with information from literature about their past distribution;
v. To find out the local nomenclature, uses and assess the awareness of local communities about the CWRs.

CHAPTER TWO

2 LITERATURE REVIEW

2.1 History of crop origin

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. Just when crop cultivation started in Ethiopia has not been determined, but its long history is also reflected in the high agricultural biodiversity, rich indigenous botanical, and agricultural knowledge including endemic crops, the best known of which is the cereal teff (*Eragrostis tef*). The high diversity in crop species and genetic diversity within crops is a reflection of the environmental and cultural diversity of Ethiopia (Engels & Hawkes, 1991).

Many crops that are known to have their centers of origin in the fertile crescent of south-west Asia, for example durum wheat (*Triticum durum*), now have their highest genetic diversity in Ethiopia. The treatment of *Triticum* for the Flora of Ethiopia and Eritrea recognizes a highly variable endemic species, *T. aethiopicum*, which is more usually considered a subspecies or variety of *T. durum* (Phillips, 1995). Other important crops with high genetic diversity in Ethiopia include the pulses faba bean (*Vicia faba*), field pea (*Pisum sativum* including the endemic var. *abyssinicum*), chickpea (*Cicer arietinum*) and grass pea (*Lathyrus sativus*); oil crops: linseed (*Linum sativum*), Niger seed (*Guizotia abyssinca*), safflower (*Carthamus tinctorius*) and sesame (*Sesamum orientale*); and root crops 'Oromo or Wollaita dinich' (*Plectranthus edulis*). Over 100 plant species used as crops in Ethiopia have been identified (Edwards, 1991).

In Ethiopia, different crops are cultivated due to different topography, soil type, rain fall and temperature different crops grown in different areas. Lowland crops like sorghum, teff, maize, sweet potato, etc., grown in lowland areas; and highland crops barley, broad bean, peas and wheat were grown in high land areas. In general, Ethiopia cultivated highly cereals like teff, wheat, maize, sorghum, and barley; pulses bean, peas, chickpea and cowpea; and oilseeds like sunflower and safflower (Bonger *et al*., 2004).

2.2 Vegetation of Ethiopia

Vegetation types in Ethiopia are highly diverse ranging from afro-alpine to desert vegetation. It has a large number of higher plants fairly estimated at about 6000 taxa with about 10% endemics. The vegetation of Ethiopia earlier had been classified into different types. Desert vegetation, Semi-desert and steppe vegetation, Savanna, Montane evergreen thicket and scrub, Montane savanna, Montane dry evergreen forest, Montane moist evergreen forest, high level bamboo forest, high mountain vegetation, Coastal formations, Swamp formations, Riparian formations (Gillett, 1941 and Mooney, 1961).

These vegetation types were again regrouped into nine major categories (Ensermu Kelbessa *et al*., 1992); and later into eight (Friis and Sebsebe Demissew, 2001). In recent times, the vegetation types of Ethiopia are divided into twelve major types(Friis *et al*., 2011) as: i) Desert and semi-desert scrub land, ii) *Acacia-Commiphora* woodland and bush land, iii) wooded grassland of the western Gambella, iv) *Combretum-Terminalia* woodland and wooded grassland, v) Dry evergreen Afromontane forest and grassland complex, vi) Moist evergreen Afromontane forest, vii) Transitional rain forest, viii) Ericaceous belt, ix) Afroalpine belt, x) Riverine vegetation xi) Fresh water lake, lake shores, marshes, swamps and Flood plains vegetation, and xii) Salt-water lakes, lake shores, salt marshes and pan vegetation, as well there are 12 subtypes which account for a total of 15 types together with the major vegetation types.

2.3 Agriculture and crops

Agriculture accounted for 46.3% of 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 Ethiopia's economy. Ethiopia has great agricultural potential because of its vast areas of fertile land, diverse climate, generally adequate rainfall, and large labor pool. Despite this potential, however, Ethiopian agriculture has remained underdeveloped. Because of drought, which has repeatedly affected the country since the early 1970s, a poor economic base (low productivity, weak infrastructure, and low level of technology), and overpopulation, the agricultural sector has performed poorly. For instance, according to the World Bank between 1980 and 1987 agricultural production dropped at an annual rate of 2.1 percent, while the population grew at an annual rate of 2.4 percent.

Consequently, the country faced a tragic famine that resulted in the death of nearly one million people from 1984 to 1986 (IMF, 2009).

The uses of crop diversity go beyond the production of food. In many cases, crop diversity is at the root of sustainable agriculture and provides environmental benefits. Humanity has historically used the wide variety of wild and cultivated crop plants to meet needs for cloth fibers, housing materials and livestock feed. Crops also underpin many cultural traditions, aesthetic aspirations, and medical needs. Even today 80% of the world's people rely on herbal cures rather than on pharmacies when they are sick. Generations of farmers have enhanced the world's crop diversity. Varieties that have arisen through selection by farmers sometimes called landraces suit their immediate environments and other preferences. In the last hundred years, scientific research institutions have contributed enormously to the breeding of new crop varieties for improved production and for adaptation to a broad range of farming environments (Padulosi, 1999).

Westphal (1975) studied the traditional agricultural systems of the Ethiopian highlands and identified four distinct systems on a technical basis: seed-farming, *ensete* (false banana) planting, shifting cultivation and pastoralism. Agriculture in Ethiopia is the basis for the entire socioeconomic structure of the country and has a major influence on all other economic sectors and development processes of the country. It provides for the country about 80% of the total employment and generates about 40% of the country's earnings from export. Of the total area, which is 122 million hectares, 84 million hectares (69%) 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 (Plant Genetic Resources Center, 1995).

2.4 Dicot and Monocot crop in Ethiopia

There are around one hundred seventy five cultivated crops in Ethiopia. Most of these crops are dicots and approximately 64% and monocots crops are approximately 36% (Figure 1).

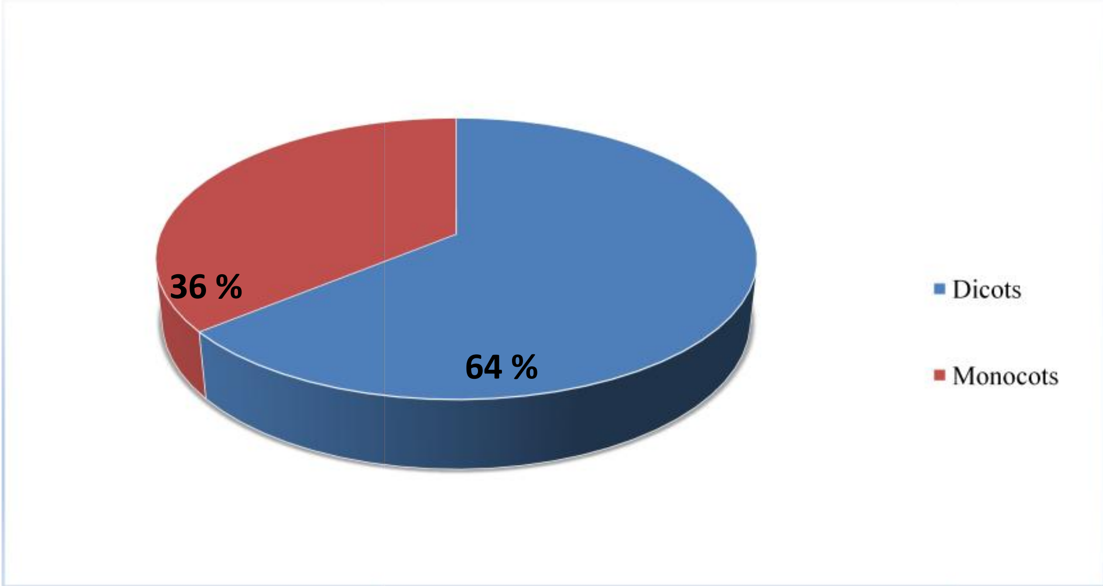

Figure 1 Proportion of dicotyledonous and monocotyledons crops in Ethiopia

Cereals dominate Ethiopia crop production. Cereals were grown on 73.4% of the total area cultivated, by 11.2 million farmers. Together, these holders produce a yearly average of 12 million ton of cereals, which is 68% of total agricultural production. The five major cereal crops are teff, wheat, maize, sorghum, and barley. Teff accounts 28% of total cereal areas, 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% 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 total annual production. Coffee is a major cash crop, accounting for 3.8% of GDP (and 19 and 35% of the quantity and value of exports respectively in that period), but occupying only 2.7% of total area cultivated (i.e. 306 thousand hectares). Two million farmers (Bonger et al., 2004) cultivate chat, and another stimulant crop.

2.5 Crop wild relatives

Kell *et al.* (2008) found that around 83% of the Euro-Mediterranean flora comprises of crop and CWR species. Faced with handling such large numbers of CWRs, a priority determining mechanism needs to be used to select which species will be the subject of particular conservation actions. CWRs are a very diverse group of plants and occur in a wide variety of habitats. They range from forest trees and shrubs to climbers, perennials, biennials and annuals. Some of them are widespread and may even occur as weeds while others have scattered or restricted distributions and some of them are rare and endangered.

Latest estimates report that there are between 50,000-60,000 crop wild relatives in the wild (Maxted & Kell, 2009). From the above estimated CWRs 10, 739 of these are important plant genetic resources for food and agriculture (PGRFA) and 700 of these, representing less than 0.26% of the world flora, are the most important in terms of global food security and the ones requiring urgent conservation measures.

The distribution of crop wild relatives is mostly correlated with the diversity of flora within a country. The countries that have larger diversity of plant species and the origin have got large number of its wild. Many developing countries, located within centers of plant and crop diversity, contain large numbers of important crop relatives.

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 (*Lycopersicon esculentum*), and grain legumes (Edwards *et al.*, 2007).

CWR have been used to improve yields and the nutritional quality of crops since the dawn of agriculture, with farmers often planting CWRs alongside domesticated crops to 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. The genetic transfer of beneficial traits from wild varieties has been so widespread, that most modern cultivars of crops contain some genes that are derived from a wild relative.

Both environmental degradation and modern agriculture 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).

2.6 Dicotyledonous crops and their wild relatives in Ethiopia

Dicotyledonous were the first angiosperms to appear, followed by monocotyledons. Both groups are thought by most experts to be monophyletic in nature, with the monocotyledons being derived from primitive dicotyledonous 135–75 million years ago. Both dicotyledonous and monocotyledons have undergone considerable genetic differentiation: there are currently 200,000 living species of dicotyledonous and 50,000 monocotyledons (Simmonds, 1979).

Thedicotyledonous, also known as dicots, consisted a grouping formerly used for the flowering plants whose seeds typically has two embryonic leaves or cotyledons. There are around 199,350 species within this group (Hamilton*et al*., 2006). Flowering plants that were not dicotyledonous were called monocotyledons, typically having one embryonic leaf.

CHAPTER THREE

3 MATERIALS AND METHODS

3.1 Description of the study area

3.1.1 Geographical Location

The study area includes the central part of Ethiopia where the CWRs are expected to be available especially namely in Shewa Upland (SU), Harerge (HA), Kefa (KF), Arsi (AR), Welega (WG) and Gojam (GJ). Ethiopia is located in the horn of Africa between 3º and 18º North latitude, 33º and 48º east longitude, and lies within the tropics and East Africa bordered by Eritrea, Djibouti, Somalia, Kenya, Sudan and South Sudan. With an estimated population of more than 80,000,000 Ethiopia is Africa's second most populous country but there are estimation around 90,000,000 due to increasing of population rapidly. It has diverse Physiogeographic features with high and rugged mountains, flat topped plateau, deep gorges, incised river valleys and rolling plains. The altitudinal variation ranges from 110 m below sea level in some areas of Kobat Sink, to 4,620 meters above sea level (m a.s.l) at Ras Dejen. The Great Rift Valley runs from northeast to southwest of the country and separates the northwestern and southeastern highlands. The highlands on each side of the rift valley give way to extensive semi-arid lowlands to the east, south, and west of the country (Plant Genetic Resources Center, 1995).

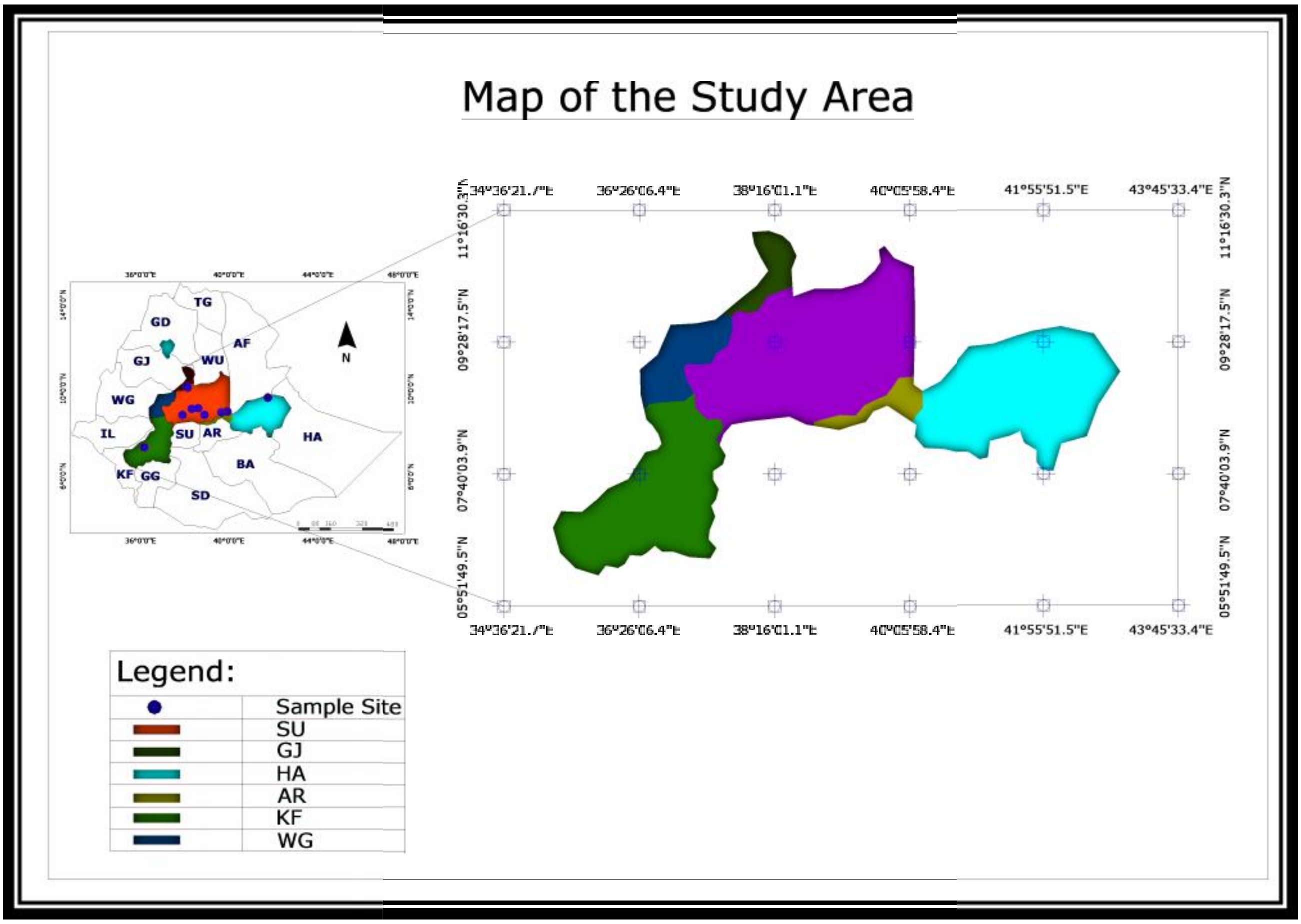

Figure 2 Map of Ethiopia showing thefloristic regions and data collection area

3.1.2 Geology and soil

From a geological perspective, the Great Rift Valley is a major feature. From the Kenyan border, it runs towards the north-northeast for more than 600 kilometers, causing a tectonic uplift, and bisecting the highlands as well as the country into a northwestern and a southeastern part. Towards the Red Sea coast, the rift's lateral escarpments are diverging (GSE, 1973).

The plateau and peaks in the highlands consist of igneous rocks as a result of volcanic activity. The steep-sided valleys, formed through fluvial erosion, easily reach a depth of 1,000 meters or more. The denudation process revealed underlying layers of metamorphic rocks, and sedimentary rocks like limestone and sandstone in the relatively lower areas. These rock formations remained mostly horizontal, as there were no persisting tectonic forces leading to crust faults or inclination. This explains the evolution of the typical Ethiopian lands with its steep-sided and flat top plateau and mountains (GSE 1973; Van de Wauw *et al*., 2008; Jarvis *et al*., 2011).

Considering precipitation, the eastern part of the country exhibits an arid to semiarid climate, and the western part is tropically humid. The mountainous centre of Ethiopia has a warm humid climate. Humidity is rising with increasing altitude, causing the highlands to be moist to wet, whereas the lowlands of Ethiopia are moist to dry. Within the highland complex, an asymmetry in the altitudinal moisture regimes can be observed. It is the result of the monsoon induced greater annual rainfall amount in the southwestern and western part of Ethiopia. Moreover, being a part of the Sahel zone, Ethiopia has high annual rainfall variability; it is especially high in the lowlands (Hurni, 1998; Kottek *et al*., 2006).

According to FAO (2001), a catena is a succession of soils developed from the same parent material and extending from a high position in the landscape to a low position. A typical catenary differentiation with reddish, well-drained soils on higher positions and black, poorly drained soils in depressions can be observed. The typical configuration features red soils (Luvisols) on crest and upper slope, shallow or moderately deep red soils (Leptosols and Cambisols) on steeper sections of the slope, and black Vertisols in lower positions.

According to Hurni (1998), agroclimatic zones of Ethiopia were classified into five: Bereha (< 500 m a.s.l & below 900 mm rainfall), Kolla (500-1500 m a.s.l & 900-1400 mm RF), Woina dega (1500-2300 m a.s.l & 900-1400 mm RF), Dega (2300-3200 m a.s.l &>1400 mm RF) and Wurch (>3200 m a.s.l and >1400 mm RF) and in sub division dry, moist and wet.

3.1.3 Climate and crops related with the livelihood of the community

The mean annual rainfall patterns range from 500 to 2,800 mm. The southwestern region receives the heaviest annual rainfall, which goes up to 2,800 mm in some areas. The central and northern central regions receive moderate rainfall that declines towards northeast and eastern Ethiopia, and the southeastern and northern regions receive an annual rainfall of about 700 mm and 500 mm respectively. The relative humidity regimes that closely follow the rainfall pattern, the rainfall pattern itself and the high variation in temperature (> 30^0C and < 10^0C) influence types and diversity of the vegetation and their distribution over the country (Plant Genetic Resource Center, 1995).

3.2 Materials

3.2.1 Voucher specimen collection and identification

The altitude, longitude, and latitude were recorded by using GPS and pictures taken by using digital camera.Voucher specimens of CWRs had been collected from the study area provided with collection numbers, pressed, dried, and identified at the National Herbarium (ETH), Addis Ababa University. The CWRswere identified in two ways: at collection time by local people in the study area and using Flora of Ethiopia and Eritrea and at the National Herbarium after fieldwork. During the field, some of the plants identified and checked while most were identified at the National Herbarium by comparing with already identified herbarium specimens and using taxonomic keys in the Flora of Ethiopia and Eritrea. Nomenclature follows Flora of Ethiopia and Eritrea. All specimens had vouchers and finally kept at the National Herbarium.

3.3 Methods

3.3.1 Sampling methods

The sampling methods have two parts: literature review (secondary data) and field data collection (primary data). Samplings were started from the previous studies by compiling the list of dicot crop wild relatives as the initial guide. Different species of dicotyledon CWRs that were found in different flora regions of Ethiopia were identified from the literature. After identification from different sources cross checking were made against the Flora of Ethiopia whether the species is found in Ethiopia or not and existence of wild relatives or not, the location of the species according to the floristic region, local name, types of crop, families of the species, growth altitude (Appendix1).

Information covering the locality (specific collected place), year of collection, altitude and others were collected from the voucher specimens found at the National Herbarium (ETH), Addis Ababa University. Finally, thepictures of the previous collected specimen were taken as supportive material for field and color printed to help in the identification of CWRs by local people in the study area (Appendix 2).

After completion of information from literature review, the required data were collected by using purposive sampling. Following preliminary field observation, a survey questionnaire administered to farmers living in the study area and the researcher together with the local field guides; collect the data using the semi-structured interviews (using the questionnaire in Appendix 4 as a guide).

Through a series of systematic fieldworks, the stakeholders were recorded via oral interview by their own languages, which were translated into English to assess the local knowledge on individual CWR along with the ecological knowledge of the community and the history of the vegetation. Ultimately, the major uses of CWRs, preference ranking, data matrix and their present status were been identified as highly increasing, increasing, intermediate, decreasing and highly decreasingaccording to the informant's responses. Taxa can be marked. If the highly decreasing ones are encountered the causes were studied in detail along with the change and the extent of the impact on CWR.

3.3.2 Ethnobotanical information

Ethnobotanical data were collected between November 15, to December 30, 2014 on field trips made to the site based on methods given by Martin (1995) and Cotton (1996), and Alexiades (1996). The ethnobotanical techniques employed to collect data on knowledge and management of DCWR used by the local people of the study area were group discussion, semi-structured interviews, preference ranking,direct matrix ranking, and specimen collection. Most of the interviews and discussions were held in Amharic and Afan Oromo directly by the investigator and information was gathered technically. By speaking to the villagers and accessible informants on an informal base to maximize the source of information of DCWR: whether they were used for the food, forage spices, construction or other function and by using field guide when the areas two language are not spoken.

3.3.3 Group discussion and semi structured interview

Different ethnobotanical data such as the major crops cultivated in the study area, the local names, uses and distribution of CWRs and their status were collected (Table 5). The field assessment interview guides (Appendix 4) were used to gather information from farmer households and both males and females who live in the study area were involved. By using purposive sampling, the people who have indigenous knowledge about DCWR were selected by gathering information from Wereda Agriculture Office and from Development Agency (DA's). Priorities are given for the older farmers who have lived in the study area for a long period, who were native to the study area and live the rural area rather than in the urban area.

Elder farmers who have indigenous knowledge about crops and crops relatives and the development agencies, Wereda's crop experts and the researchers in the study area, and 2-4 persons were used for each study area. During field tracking and random walks, encountered farmer households were asked to participate by considering their willingness to sit for an interview and group discussion. By taking into account the above concepts the data were gathered mainly through individual interviews, guided field walk and discussion with the selected individuals.

A brief group discussion was made at each site prior to important DCWR collection with all informants of the study siteand after collecting the specimens with few informants. During the discussions, an attempt was made to encourage a person who has cultural knowledge. In such a way that his/her cooperation was of great benefit to the country and at the same time the revelation of his/her knowledge of DCWR.About cultural medicine will not in any, way interfere with the continued practices of their art and the confidentiality of their CWR plants. Use knowledgewill be keptsecret by the researcher. A semi structured checklists consisting of questions or issues (Appendix 4) were prepared in advance. The interviews were based on and around these checklists and some issues arose promptly depending on responses of an informant. All of the interviews were held in the local language of the local people (Amharic and Afan Oromo) and by using field guidance in southern Ethiopia**.** The place and time for discussion were settled on the interest of the informants.

3.3.4 Informant's consensus/DCWR use reports

Each informant was visited 2-3 times in order to confirm the reliability of the ethnobotanical information. Consequently, the responses of an informant that were not in agreement with each other were rejected since such responses were considered unreliable. Thus only relevant ones were taken and used for calculating an informant consensus value of each documented DCWR based on the proportion of informants who independently claimed the DCWR use, regardless of its specific use (Alexiades, 1996). Plants that are popular in the study area have local name and well known by the selected local people of the area.

3.3.5 Direct matrix ranking

Direct matrix ranking was conducted following Martin (1995) and Cotton (1996). This was conducted considering several attributes of plants such as their use as food, medicine, firewood, building, charcoal, fodder, spices and making fence. These were uses of DCWR commonly reported by key informants. Based on information gathered from informants, DCWR were ranked directly. In the direct matrix ranking exercise, each key informant was asked to assign use values. Accordingly, each key informant gave use values for the DCWR multipurpose use and average values of use diversity for species was taken and the values of each species were summed up and ranked.

3.3.6 Preference ranking

Preference/priority ranking was conducted for evaluating the degree of preferences or levels of importance of certain selected plants or parts of 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. Values of 1 to 5 were used in this ranking. Accordingly, each key informant gave use values for all the DCWR located in their site and average values of use diversity for species was taken and the values of each species were summed up and ranked.

3.3.7 Data Analysis

The collected lists of the CWR and ethnobotanical uses were analyzed by using Microsoft Excel spreadsheet (Microsoft Corporation, 2007) compared by bar graph chart that were employed for organizing and analyzing data on traditional knowledge and experience of farmers within the study area, such as: the plant species frequently used by them, land holding and farm characteristics. The results were expressed in terms of maps, figures, tables, and graphs.

CHAPTER FOUR

4 RESULTS

4.1 DCWRs Retrieved from Flora of Ethiopia and Eritrea and from the Collections of the National Herbarium (ETH)

The dicot crop wild relatives found in Ethiopia were initially checked in the various volumes of the Flora of Ethiopia and Eritrea and for the presence of voucher specimens. This was further checked in the collections of the National Herbarium (ETH). A total of 27 species in 23 genera and 10 families were recovered from five Flora volumes. Of the total species 23 (85%) had voucher specimens at the ETH, and 20 (74%) were found in the field and fresh specimens of all these 20 species were collected during the field survey. From 20 vouchers of specimen two plant species one is not relative to crop (*Solanum marginatum* to *Solanum tuberosum*) and other species both are not cultivated (*Ziziphus mucronata* and *Ziziphus jijuba*). The detailed information is presented in Table 1.

Table 1 DCWRs present in Ethiopia as recorded from the Flora of Ethiopia and Eritrea, the ETH and field survey (√- presence, x - absence)

No.	DCWRs in Flora of Ethiopia and Eritrea				Voucher specimens of the National Herbarium (ETH)	Voucher specimens collected from field
	Scientific name	Family	Volume	Page		
1	*Apium nodiflorum*	Apiaceae	(4,1)	20	X	X
2	*Canavalia Africana*	Fabaceae	3	165	√	X
3	*Carthamus lanatus*	Asteraceae	(4,2)	37	√	√
4	*Cicer cuneatum*	Fabaceae	3	248	√	√
5	*Coffea arabica*	Rubiaceae	(4,1)	266	√	√
6	*Cucumis melo* subsp. *agrestis*	Cucurbitaceae	(2,2)	33	X	√
7	*Cyamopsis senegalensis*	Fabaceae	3	139	X	X
8	*Gossypium bricchettii*	Malvaceae	(2,2)	220	√	X
9	*Gossypium somalense*	Malvaceae	(2,2)	220	√	X
10	*Guizotia scabra*	Asteraceae	(4, 2)	310	√	√

No.	DCWRs in Flora of Ethiopia and Eritrea				Voucher specimens of the National Herbarium (ETH)	Voucher specimens collected from field
	Scientific name	**Family**	**Volume**	**Page**		
11	*Lablab purpureus* subsp. *Uncinatus*	Fabaceae	3	179	√	√
12	*Lagenaria abyssinica*	Cucurbitaceae	(2,2)	237	√	√
13	*Lathyrus pratensis*	Fabaceae	3	250	√	√
14	*Lathyrus sphaericus*	Fabaceae	3	250	√	√
15	*Lens ervoides*	Fabaceae	3	249	X	X
16	*Luffa echinata*	Cucurbitaceae	(2,2)	56	√	√
17	*Momordica balsamina*	Cucurbitaceae	(2,2)	42	√	√
18	*Ocimum forskolei*	Lamiaceae	5	571	√	√
19	*Plectranthus punctatus*	Lamiaceae	5	595	√	√
20	*Rhamnus staddo*	Rhamnaceae	3	390	√	√
21	*Ricinus communis* var. *africanus*	Euphorbiacea e	(2,2)	294	√	√
22	*Solanum marginatum*	Solanaceae	5	140	√	√
23	*Thymus schimperi*	Lamiaceae	5	552	√	√
24	*Vicia sativa* var. *angustifolia*	Fabaceae	3	249	√	√
25	*Vigna unguiculata* subsp. *Mensensis*	Fabaceae	3	174	√	√
26	*Vigna unguiculata* subsp *dekindtiana*	Fabaceae	3	174	√	X
27	*Ziziphus mucronata*	Rhamnaceae	3	393	√	√
Total					23	20

4.2 List of Dicotyledonous crop wild relatives in the study area and their distribution

The DCWRs collected from different parts of Ethiopia are presented in Table 2 with full information including scientific, family and local names, growth form, and geographical location. Local names were found for 14 (78%) of the species collected from the field and their distribution ranged from 1127-2883 m a.s.l. Having local names could indicate their popularity and their importance as well as their diversity in the study area, while the remaining four species (22%) do not have local names by the informants in the study area. Large number (13) of DCWR specimen collected from SU followed by HA (3). Highest numbers of DCWR were located in grassland.Some DCWRs were frequently encountered in the field while some others were rare.

Table 2 Dicotyledon crop wild relatives collected from the field in the various study areas (SU, KF, HA and GJ)

No	Scientific name		Family	Local name of CWR	Growth form	Flora region	Source	Geographic location		Altitude ma.s.l	Voucher number
	CWR	The crop plant						Longitude (N)	Latitude (E)		
1	*Carthamus lanatus*	*Carthamus tinctorius*	Asteraceae	Mech (amh), ada tufo (Oro)	Herb	SU	Grassland	090457	384331	2815	DD4
2	*Cicer cuneatum*	*Cicer arietinum*	Fabaceae	Yeayt misir	Herb	SU	Meadow, cropfield	100348	0381360	1640	DD3
3	*Coffea arabica*	*Coffea arabica*	Rubiaceae	Buna	Shrub	KF	Forest	071559.3	361556.7	1797	DD14
4	*Cucumis melo* subsp. *agrestis*	*Cucumis melo subsp. melo*	Cucurbitaceae	Hababi harre (Oro.)	Herb	HA	Sorghum field	093351	415244	1303	DD9
5	Guizotia scabra	*Guizotia abyssinica*	Asteraceae	Sokorruu (Oro.)	Herb	SU	Roadside	084620	0390041	1881	DD10
6	*Lagenaria abyssinica*	*Lagenaria siceraria*	Cucurbitaceae	Bukke setana (Oro.)	Herb	SU	Roadside	090308	382608.5	2397	DD11
7	*Lathyrus pratensis*	*Lathyrus sativus*	Fabaceae	_______	Herb	SU	Grassland				DD15
8	*Lathyrus*		Fabaceae	_______	Herb	SU	Grassland	085910	372721	2600	DD16

No	Scientific name		Family	Local name of CWR	Growth form	Flora region	Source	Geographic location		Altitude ma.s.l	Voucher number
	CWR	The crop plant						Longitude (N)	Latitude (E)		
	sphaericus										
9	*Lens ervoides*	*Lens culinaris*	Fabaceae	Yeayt shimbira(Amh	Herb	SU	Crop field	100348	381360	1640	DD1
10	*Luffa echinata*	*Luffa cylindrica*	Cucurbitaceae	Ye amora megib (Amh.)	Herb	SU	Forest, grassland	100348	381360	1640	DD2
11	*Momordica balsamina*	*Momordica charantia*[1]	Cucurbitaceae	Martaz (Oro.)	Herb	HA	Gorge	093348	415300	1308	DD12
12	*Ocimum forskolei*	*Ocimum basilicum* var. *basilicum*	Lamiaceae	Urgoftu (Oro.)	Herb	HA	Roadside	085259	394700	1127	DD13
13	*Plectranthus punctatus*	*Plectranthus edulis*	Lamiaceae	________	Herb	SU	Grassland, wet land	090247.7	382543.7	2348	DD8
14	*Rhamnus staddo*	*Rhamnus prinoides*	Rhamnaceae	Qadida (Oro.), Tseddo (Amh.)	Shrub	SU	Forest	090459	384327	2829	DD5
15	*Ricinus communis* var. *africanus*	*Ricinus communis* var. *communis*	Euphorbiaceae	Qobbo (Oro), Gulon (Amh.)	Tree	SU	Forest, road side	090449	384355	2755	DD6
16	*Thymus schimperi*	*Thymus vulgaris*	Lamiaceae	Tosign (Amh.), Tosignii (Oro)	Herb	SU	Grassland, forest	090501	384321	2883	DD7
17	*Vicia sativa* var. *angustifolia*	*Vicia sativa* var. *sativa*	Fabaceae	___________	Herb	SU	Grassland	090409	384330	2700	DD18
18	*Vigna unguiculata* subsp. *mensensis*	*Vigna unguiculata* subsp. *cylindrica*	Fabaceae	Motjo (Kef)	Herb	GJ	Riverside in wood land	110660	362290	1250	DD17

[1]According Friis *et al.*, (4084) *Momordica charantia* is found in IL/KF and often cultivated elsewhere as a vegetable. Also according to Edwards (1991), a crop has *Mimordica balsamina* as wild relative in Ethiopia. However, not more information wether it is cultivated or not.

4.3 Taxonomic diversity of dicotyledon crop wild relatives

According to the documentation in the Flora of Ethiopia and Eritrea, 27 dicotyledonous crop wild relatives were identified. These are classified under 10 families. Of the 10 families found at the ETH the Fabaceae is the largest family which is represented by ten species followed by Cucurbitaceae and Lamiaceae; Apiaceae, Euphorbiaceae, Rubiaceae and Solanaceae are the least families have only one each DCWR.The data collected from field shows that classified under seven families, sixteen genera, and eighteen species. The largest families in the Flora represents by large species in the field even if the number decrease. The specimen and data of three families which represented by only one species each; Apiaceae, Malvaceae and Solanaceae were not collected (Table 3).

Table 3 Number of genera and species in each family

No	**Family**	**Number of genera**		**No of species**		**Percentage of plant species (%)**	
		Data from Flora	Field data collection	Data from Flora	Field data collection Flora	Data from Flora	Field data collection
1	Fabaceae	8	5	10	6	37.0	33.3
2	Cucurbitaceae	4	4	4	4	14.8	22.2
3	Lamiaceae	3	3	3	3	11.1	16.6
4	Asteraceae	1	1	2	2	7.4	11.1
5	Malvaceae	1	0	2	0	7.4	0
6	Rhamnaceae	2	1	2	1	7.4	5.6
7	Apiaceae	1	0	1	0	3.7	0
8	Euphorbiaceae	1	1	1	1	3.7	5.6
9	Rubiaceae	1	1	1	1	3.7	5.6
10	Solanaceae	1	0	1	0	3.7	0
Total		23	16	27	18	100	100

4.4 Current status of DCWRs according to informants

As studied in different parts of Ethiopia, informants considered three of the DCWR species (*Cicer cuneatum, Momordica balsamina,* and *Ocimum forskolei*) highly decreasing in number and described them as endangered. Others (7species**)** were considered decreasing while there were no DCWRs that were considered highly increasing in the study areas (Table 4). Local names found for 14 (78%) of them and from thes 14 species five have local name in Afan Oromo, three in Amharic, one in keficho, and five in both Afan Oromo and Amharic.

Table 4 Status of DCWRs (√) (HD = highly decreasing, D=Decreasing, IN=Intermediate, I=Increasing).

No	Scientific name	Local Name	Language	Status				Remark
				HD	D	IN	I	
1	*Carthamus lanatus*	Mech Ada tufo	Amh. Oro.				√	
2	*Cicer cuneatum*	Yeayt misir	Amh.	√				
3	*Coffea arabica*	Bunna Buna	Amh. Oro.			√		
4	*Cucumis melo* subsp. *agrestis*	Hababi harre	Oro.			√		
5	*Guizotia scabra*	Sokorruu	Oro.				√	
6	*Lagenaria abyssinica*	Bukke setana	Oro.			√		
7	*Lathyrus pratensis*	________	________			√		
8	*Lathyrussphaericus*	________	________		√			
9	*Lens ervoides*	Yeayt shimbira	Amh.		√			
10	*Luffa echinata*	Ye amora megib	Amh.		√			
11	*Momordica balsamina*	Martaz	Oro.	√				
12	*Ocimum forskolei*	Urgoftu	Oro.	√				
13	*Plectranthus punctatus*	________	________				√	
14	*Rhamnus staddo*	Tseddo Qadida	Amh. Oro.		√			
15	*Ricinus communis* var. *africanus*	Gulo Qobbo	Amh. Oro.		√			
16	*Thymus schimperi*	Tosign Tosignii	Amh. Oro.		√			
17	*Vicia sativa* var. *angustifolia*	____________	________		√			
18	*Vigna unguiculata* subsp. *mensensis*	Motjo	Kef.			√		
Total				3	7	5	3	

4.5 Uses of dicotyledonous crop wild relatives

According to this study from the 18 DCWRs, higher numbers are used as fodder, which is followed by food and medicine directly, or in directly. *Momordica balsamina* and *Rhamnus staddo* are first in being multi-functional in use. The respondents gave full points (5) for five species with their uses: *Carthamus lanatus* (fodder), *Coffea arabica* (stimulant*)*, *Cucumis melo* subsp. *agrestis* (fodder), *Momordicabalsamina* (Medicinal), and *Thymus schimperi* (Spices) (Table 5).

Table 5 Uses and ranks according to importance in the study area based on direct matrix ranking. (5= excellent, 4=very good, 3 = good, 2 = less used, 1 = least used, 0 = not used done by DMR)

No	DCWR species lists	Uses						Total	Rank
		Fodder	Spices	Food	Construction	Medicinal	Stimulant		
1	*Carthamus lanatus*	5						5	9
2	*Cicer cuneatum*	2						2	17
3	*Coffea arabica*						5	5	9
4	*Cucumis melo* subsp. *agrestis*	5			3			8	5
5	Guizotia scabra				2			2	17
6	*Lagenaria abyssinica*				3	4		7	6
7	*Lathyrus pratensis*	3		2				5	9
8	*Lathyrus sphaericus*	2		4				4	14
9	*Lens ervoides*	3						3	16
10	*Luffa echinata*	3				1		4	14
11	*Momordica balsamina*	3		4		5		12	1
12	*Ocimum forskolei*	4	5					9	3
13	*Plectranthus punctatus*	4				3		7	6
14	*Rhamnus staddo*	3		4	2		3	12	1
15	*Ricinus communis* var. *africanus*			1				1	18
16	*Thymus schimperi*	4	5					9	3
17	*Vicia sativa* var. *angustifolia*	2		3				5	9
18	*Vigna unguiculata* subsp. *mensensis*	2		4				6	8
Total		45	10	22	10	13	8	106	

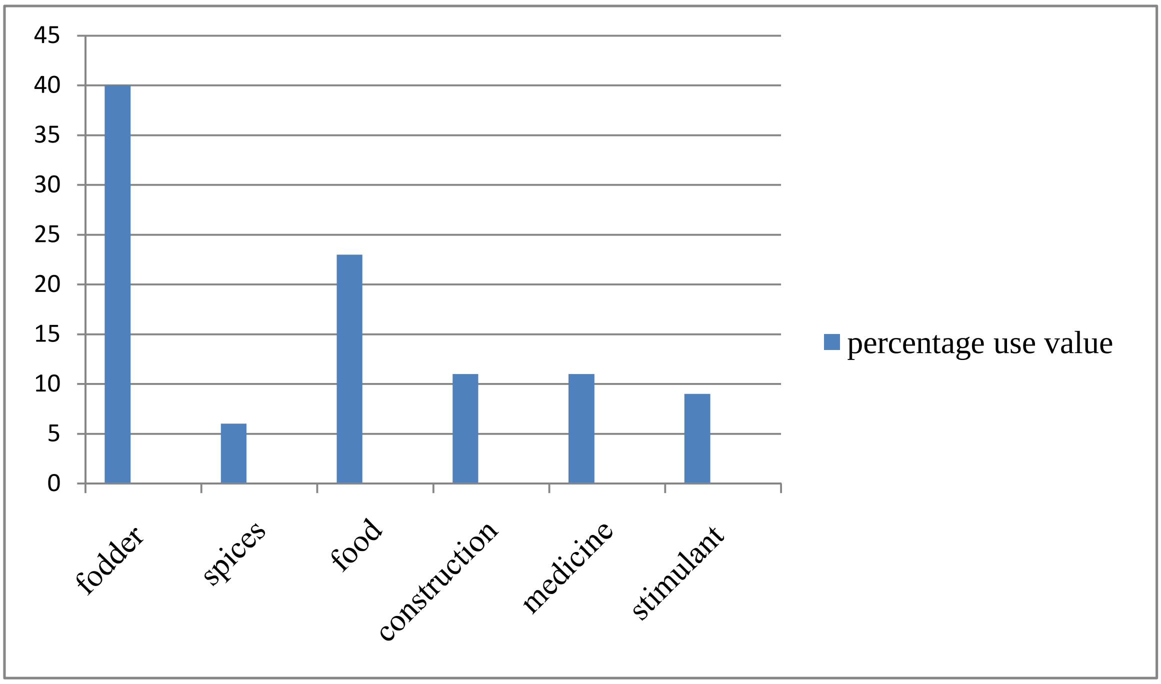

Figure 3 Percentage use value of DCWRs

4.6 Diversity of crop resources in the Study Area

The crops encountered in areas where the study was undertaken are listed in table 4. This table shows the scientific name, vernacular name, family, habit, category, and parts used. This shows that the majority of crops are herbs (Table 6). Comparison with the list of wild relatives (Table 2) shows about eight (44.5%) of the parent crops were also found in the studiedarea.

Table 6 List of crops (food plants) in recorded from the study area

No	Name of crop found in the study area	Vernacular name	Family	Habit	Category	Parts used
1	*Aframomum corrorima*	Cororima	Zingiberaceae	Herb	Spices	Tuber
2	*Allium ampeloprasum*	Leek	Alliaceae	Herb	Root and tuber	Root
3	*Allium cepa*	Onions	Liliaceae	Herb	Root and tuber	Tuber
4	*Allium sativum*	Garlic	liliaceae	Herb	Root	Tuber
5	*Ananas cosmos*	Ananus	Bromeliaceae	Shrub	Fruit	Fruit
6	*Arachis hypogaea*	Groundnut	Fabaceae	Herb	Pulse	Seed
7	*Avena sativa*	Oat	Poaceae	Herb	Cereal	Seed
8	*Beta vulgaris*	Beetroot	Amaranthaceae	Herb	Root & tuber	Tuber
9	*Brassica oleracea*	Cabbage	Cruciferae	Herb	Vegetable	Leaf
10	*Capsicum annuum*	Chili	Solanaceae	Herb	Vegetable	Fruit

No	Name of crop found in the study area	Vernacular name	Family	Habit	Category	Parts used
11	*Carthamus tinctorius*	Safflower	Asteraceae	Herb	Oilseed	Seed
12	*Catha edulis*	Chat	Celastraceae	Shrub	Stimulant	Leaf
13	*Cicer arietinum*	Chickpea	Fabaceae	Herb	Pulse	Seed
14	*Citrus aurantifolia*	Lime	Rutaceae	Tree	Fruit	Fruit
15	*Citrus sinensis*	Orange	Rutaceae	Tree	Fruit	Fruit
16	*Coffea arabica*	Coffee	Rubiaceae	Shrub/tree	Stimulant	Fruit
17	*Cucumis melo*	Water melon	Cucurbitaceae	Climber	Fruit	Fruit
18	*Cuminum cyminum*	White cumin	Ranunculaceae	Herb	Spice	Seed
19	*Daucus carota*	Carrot	Apiaceae	Herb	Root & tuber	Root
20	*Eleusine coracana*	Finger millet	Poaceae	Herb	Cereal	Seed
21	*Ensete ventricosum*	Enset	Musaceae	Herb	Root and root	Tuber
22	*Eragrostis tef*	Teff	Poaceae	Herb	Cereals	Seed
23	*Helianthus annuus*	Sunflower	Asteraceae	Herb	Oil seed	Seed
24	*Hordeum vulgare*	Barley	Poaceae	Herb	Cereals	Seed
25	*Ipomoea batatas*	Sweet potato	Convolvulaceae	Herb	Root and Tuber	Tuber
26	*Lactuca sativa*	Lettuce	Asteraceae	Herb	Vegetable	Leaf
27	*Lens culinaris*	Lentils	Fabaceae	Herb	Pulse	Seed
28	*Malus domestica*	Apple	Rosaceae	Shrub	Fruit	Fruit
29	*Mangifera indica*	Mango	Anacardiaceae	Tree	Fruit	Fruit
30	*Musa × paradisiaca*	Banana	Musaceae	Herb	Fruit	Fruit
31	*Nigella sativa*	Black cumin	Ranunculaceae	Herb	Spices	Seed
32	*Persia americana*	Avocado	Lauraceae	Tree	Fruit	Fruit
33	*Psidium guajava*	Guava	Myrtaceae	Tree	Fruit	Fruit
34	*Rhamnus prinoids*	Gesho	Rhamnaceae	Shrub/tree	Stimulant	Leaf
35	*Saccharum officinarum*	Sugarcane	Poaceae	Shrub		Stem
36	*Solanum lycopersicum*	Tomato	Solanaceae	Herb	Fruit	Fruit
37	*Solanum tuberosum*	Potato	Solanaceae	Herb	Root and tuber	Tuber
38	*Sorghum bicolor*	Sorghum	Poaceae	Shrub	Cereals	Seed
39	*Trigonella foenum-graecum*	Fenugreek	Fabaceae	Herb	Spices	Seed
40	*Triticum aestivum*	Wheat	Poaceae	Herb	Cereal	Seed
41	*Vicia faba*	Faba bean	Fabaceae	Herb	Pulses	Seed
42	*Vigna unguiculata*	Cowpea	Fabaceae	Herb	Pulse	Seed
43	*Zea mays*	Maize	Poaceae	Herb	Cereal	Seed
44	*Zingiber officinale*	Ginger	Zingiberaceae	Herb	Spices	Rhizome

4.7 Growth forms of DCWR

According to the study, the habits of DCWR high numbers of species were classified under the herb (83.4 %), followed by shrubs (11%) and the least was for tree (5.6) as shown in (Table 7)

Table 7 The habits of DCWR and shows number and percent of species

Growth forms of DCWR	Number of plant species	% of plant Species
Herbs	15	83.4
Shrubs	2	11.0
Tree	1	5.6
Total	**18**	**100**

4.8 Most Important DCWRs

The respondents in different study sites gave ranked the selected six DCWR listed (Table 8): All key informants gave priority ranking to *Coffea arabica* and only one respondent gave four for *Thymus shimperi* while other respondents give five (Table 8).

Table 8 Priority ranking of selected DCWR uses based on in daily activity of the informants perceptions (Values given 0 to 5; 0=not used, 1=least used, 2 less used, 3=good, 4=very good, and 5=excellent).

DCWR	**Respondents labeled A to E**						**Total**	**Rank**
	A	B	C	D	E	F		
Coffea arabica	5	5	5	5	5	5	30	1
Rhamnus staddo	3	0	5	4	5	4	21	4
Ricinus communis var. *africanus*	5	4	4	5	4	3	25	3
Thymus schimperi	5	4	5	5	5	5	29	2
Momordica balsamina	5	2	0	4	4	1	16	5
Ocimum forskolei	1	3	4	0	2	2	12	6

4.9 Threats to CWR in the Study Area

In the study area, the most threatening for DCWR are: Agricultural expansion due to increasing population, overgrazing, herbicide use in crops, used for construction especially climber shrub, lack of awarenessespecially on plant genetic and climatic change respectively (Table 9)

Table 9 Priority on perceived factors of threats to CWR used on their degree of destructive effects/value 1-5 were given 1= the least destructive threat and 5=the most destructive /threat/

Factors	Respondent labeled A to F						Total	% age
	A	B	C	D	E	F		
Overgrazing	3	4	5	4	3	4	23	25
Agricultural expansion	4	5	4	5	5	5	28	30
Herbicide use	3	5	4	3	2	3	20	21
Construction	1	1	2	3	3	2	12	13
Lack of awareness	2	1	1	2	1	1	8	8
Climatic change	0	1	0	2	0	0	3	3

4.10 A Summary of Information about the Informants in the Study Area

4.10.1 Comparisons of knowledge about CWR by age group

According to the study the medium age category which 33-47 age range have more knowledge about crop wild relatives than other followed by elder 48-62. As age increase the ability to know about crop and other plants become decreasing (Table 10).

Table 10 Comparisons of knowledge about CWR as compared age group

Age group	Age category	Informants		No of plant species cited by the informants
		no	%	
1st	18-32	12	21.4	10
2 nd	33-47	21	37.5	23
3rd	48-62	17	30.4	20
4th	>63	6	10.7	12

4.10.2 Marital status of informants in the study area

Of the total informants, 60.7 % were married, but 23.3 % and 16 % were single and divorced respectively. This shows that the number of married respondents hare higher than single and divorced. In addition, the married informants have more knowledge than others (Table 11).

Table 11 Marital statuses of informants in the study area

Marital Status	Sex		Total	Percentage
	Male	Female		
Married	31	3	34	60.7
Single	10	3	13	23.3
Divorced	5	4	9	16.0
Total	46	10	56	100

4.10.3 Educational status of informants and comparison according to age group

The result shows that 17 (30.5%) were illiterate followed by who can write and read 13 (23%) and the least is greater than 12 (12.5%) and others (Table 12). This shows that there is a negative relationship between the educational level of informants and their ethnobotanic knowledge. As educational level increases ethnobotanic knowledge decreases. However, it is difficult to get the full truth of the informationfrom illiterate who keep all things as secret.

Table 12 Education status of informants and comparison as education level

Education level	Grade	Percent of total
Illiterate	17	30.5
Read and write	13	23.0
1-8	10	18.0
9-12	9	16.0
>12	7	12.5
Total	56	100.0

CHAPTER FIVE

5 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

5.1.1 DCWR resources in the study area

Full information was initially compiled on CWRs especially on floristic regions, geographical location (altitude, longitude, and latitude), collector name, year of collection and collection number were collected from previous study used as guide and to facilitate this study. A total of 27 dicotyledonous crop wild relatives (DCWRs) were identified from the study by Edwards (1991) and the National Herbarium by using Flora of Ethiopia and Eretria. Out of the 27 species listed, the specimens of three species namely, (*Apium nodiflorum*, *Lens ervoides*, and *Cucumis melo* subsp. *agrestis)* were not found in the National Herbarium (ETH). These made it difficult to get more information from the field due to the lack of pictures of the plants and the specimens of the species

From previous study (Edwards, 1991) shows that two-plant species *Solanum marginatum* and *Ziziphus mucronata* are crops that have CWR; *Solanum tuberosum* and *Ziziphus jijuba* in respective order. However, according to present study (*Solanum marginatum* to *Solanum tuberosum*) are not related; and (*Ziziphus mucronata* and *Ziziphus jijuba*) both are wild not cultivated in the study area. Twenty of these were collected and identified including the above two. Of these, the majority of DCWR are collected from roadside, in grassland, forest and inside cultivated land as weeds.

According to this study, the growth habits of CWR highly distributed under herbs. In related to this the finding, the finding of Abiyot Birhanu (2002); Hussien Adal Mohammed (2004); Tizazu Gebre (2005); Tilahun Teklehaymanot and Mirtsue Giday (2007) showed that herbs are the most frequently used for medicinal plants. Fabaceae are the largest in contribution of DCWRs followed by Cucurbitaceae, and Lamiaceae. Also according to Hedberg and Edwards (1989), it is the first in number of species and subspecies (678) that found in Ethiopia. This could be the indication that the study area (especially the area selected purposively) consist of considerable diversity of plant species within these families. Nevertheless, Asteraceae and Lamiaceae are among the largest families in Flora of Ethiopia and Eretria. These two families are also having good contribution to CWRs found in Ethiopia even if not as such as Fabaceae and Cucurbitaceae and have high contribution to Ethiopia medicinal lore (Mesfin Tadesse *et al*., 2005; Endale Amenu, 2007).

The distribution of informants with respect to age class shows that, the majority of knowledgeable elders are in the age class of 33 to 47 followed by age group 48 to 62. This shows that the younger generation does not have much knowledge about DCWR and as their age become older their ability to remember decreases. According to Tesfaye Awas (2007) study on ethnobotany reported that the older people have accumulated knowledge during their past life time than the younger ones.

5.1.2 Floristic Regions of the country where CWRs of dicotyledonous plants are abundant

None of the DCWRs is endemic to Ethiopia and they have not been observed within the protected areas. This demonstrates the poor conservation for crop wild relatives in Ethiopia. Some of them occur in natural vegetation habitats, or as weeds in agricultural fields or on the roadsides, dispersed by human activities. In Shewa floristic region of the country, DCWRs are widely distributed more than in other Floristic Regions which contributing 18 (67%) species according to Flora of Ethiopia and Eritrea; and 13 (72%) species from field data collection.

5.1.3 Potential values of the CWRs to ensure food security and production in Ethiopia

This finding shows that highest DCWRs used for food next to fodder while others and least number were used for stimulants especially during food scarcity. This study improves the previous study that during food scarcity and famine, people rely heavily on non-cultivated (wild) food plants (Cotton, 1996; Zemede Asfaw, 1997; Tesfaye Awas, 1997; Tuxill, 1999). Wild food plants are not only used as a source of food energy but also are very important sources of vitamins, trace minerals and other nutrients. Non-cultivated food plants and wild relatives of cultivated plants play significant role in the improvement of crops. Non-cultivated food plants also serve as a source of subsistence income from local marketing (Zemede Asfaw, 1997). The DCWR have greater value for ensuring of food security and food shortage in this country directly or indirectly and cope up with climate change. Also according to FAO, (1998; 2008) and Biodiversity International, (2006) the wild relatives of crop plants constitute an increasingly important resource for improving agricultural production and for maintaining sustainable agroecosystems. Since Ethiopia is the place of origin for many crops, and there are many CWRs in its diverse floristic regions. Modern cultivars of most crops now contain some genes that are derived from wild relatives.

The wild portion of a crop's gene pool generally contains more variation than is found in the cultivated taxa, as domestication has tended to create a genetic bottleneck: the efforts of farmers and plant breeders involve the selection of certain favored types from the diversity available(Seaton, 2010). In addition, Seaton (2010) necessarily, selection leads to diversity being left behind and the centers of origin of crops, wild relatives occasionally cross naturally with farmer's varieties, infusing the crops with a stream of new genes. Away from the natural distribution of the wild relatives, though, this process needs a helping hand from breeders and, increasingly, molecular geneticists (Seaton, 2010).

The cultivator of crops does not cultivate CWR and attention given from government, researchers, and farmers is low as compared to cultivated crops. The main reasons for neglecting CWR in conservation have to do with practicality, priorities, and economics. Additional reason could be that CWRs do not give high production and many are not used directly as cultivated crop rather they are used in the breeding of cultivated crops. Therefore, in situ and ex situ conservation is very important. The reason is CWRs are resistant to diseases, drought, and pests.

According to Tanksley and Mc Couch (1997), crop wild relatives are stress resistant against pests and diseases, temperature, drought or salinity stress or they have higher values for nutritional traits compared to varieties of their crop relatives. If the conservation and the status of CWRs are high, the recovery of crops destroyed due to different reason will be high. The farmers of Ethiopia and the population living in the rural areas used CWRs as food during peak food shortage season between seed sowing and the time of harvest when food scarcity is at its highest and during drought. Since these CWR plants have major roles to reduce the shortage of food in our country, studies on them are important. The study of the ethnobotanical knowledge of the farmers in the study area had given important information. This, the study addressed the problem of CWRs and would be used as a guide for many stakeholders including farmers, researchers, governmental organizations, and others.

5.1.4 Description of the most important DCWRs

Brief notes about six DCWRs in the top priority ranking considering their uses and importance's in the study area and their ecological roles are described below.

Wild *Coffea Arabica* L. (Wild relative of cultivated ***Coffea arabica*****) Rubiaceae**

Arabica coffee (*Coffea arabica*) has its centre of origin in Southwestern and Southeastern Ethiopia, where it occurs naturally in the undergrowth of Afromontane rainforests between 1,000 and 2,000 m a.s.l. Wild coffee is defined as coffee that grows and regenerates spontaneously in its natural habitat and is genetically different from known cultivars (DFSC and IPGRI, 2001; Wiersum, 1997). The gene pool of these wild coffee populations is of national and international importance, because it has high potential for the breeding of new coffee varieties (Hein and Gatzweiler, 2005; Kassahun Tesfaye, 2006). In addition, the original forest habitat of wild coffee is internationally recognized for its high plant diversity and large number of endemic species (Gil *et al*., 2004). Indigenous communities have been utilizing wild coffee for centuries, and the art of preparing coffee is a central element of the Ethiopian culture. Furthermore, coffee is Ethiopia’s most important export crop contributing 41% of the country’s foreign currency income (FAO and WFP, 2006).

Modern type plantations only constitute 6% of the total coffee production area in Ethiopia, while the majority of the production area consists of montane rainforest with wild coffee (Demel Teketay, 1999). However, today’s wild coffee is decreasing and cultivated coffee increasing due to increasing of population. Local farmers simply pick wild coffee fruits inside these forests, or manage wild coffee stands by removing competing undergrowth vegetation and some canopy trees. Coffee is their main source of cash income. In the past three decades, however, large parts of the Ethiopian rainforests with wild coffee have been modified or destroyed by conversion to agricultural land, new settlements, and timber extraction (Reusing, 2000). They are recognized as part of the Eastern Afromontane Biodiversity Hotspot (Gil *et al*., 2004). In Bonga forest, one of the study areas the wild coffee is managed and harvested for its seed for drinking and income generation. The lives of the people in this area are highly depending on it.

Figure 4 Wild *Coffea Arabica* (photo credit: Debela Daba)

The wild *Coffea arabica* beans (the seeds), which are washed, dried, roasted and ground to make coffee for drinking in the study area. The residue from coffee processing is used as fertilizer and mulch. The leaves can also be used as fuel and animal fodder.

Rhamnus staddo A. *Rich.* **(**Wild relative of ***Rhamnus prinoides*****)** **Rhamnaceae**

Rhamnus staddo is a dense shrub or sometimes appears as small tree. It is spineless and evergreen. It is one of the two representative species of the family Rhamnaceae that are found in Africa (Phillips, 1994). It is sometimes used for preparation of traditional alcoholic beverages, "tella" (Ethiopian local beer), and "tej" in Ethiopia when there is scarcity of *Rhamnus prinoides*. It's leaf and stem are used as depressor. Also used for cleaning pot due to making butter from milk, both the milk material and butter.

Figure 5 *Rhamnus staddo* (photo credit: Debela Daba)

Ricinus communis L.**var.** ***africanus*** *muell. A*rg**. (**Wild relative of ***Ricinus communis*** **var.*communis***) Euphorbiaceae

A widespread plant of home gardens in both rural land urban areas. Material from eastern Africa mostly falls between var. *communis* and var. *africanus* (Wild).The oil from the seeds has many recorded medicinal and industrial uses and is produced commercially. The plant itself contains a very dangerous toxin, a few molecules of which are capable of killing any cell into which they are introduced (Edwards *et al*., 1995). The people in the study areas used for many purposes. They used the stem as fire wood due to easily grow in everywhere, the leaves used for butter holding while going to market and the fruit used for selling for smoothing and softness of leather, for smoothness of “enjera mitad” while enjera preparation.

Figure 6 Wild *Ricinus communis* var. *africanus* (photo credit: Debela Daba)

Thymus schimperi *Ronniger* **(**Wild relative of ***Thymus vulgaris)*** **Lamiaceae/ Labiatae**

It is the perennial herb, which is woody at the base and 5-40 cm tall and is a promising source of antimicrobial agents especially when extracted using chloroform. The broad antimicrobial activity of chloroform extract indicates the presence of highly active anti-microbial agents that can treat wide spectrum of human pathogens including the resistant ones. It might represent an inexpensive source of natural antibacterial substances for use in treating various diseases and drug design. Also to prevent the growth of bacteria and extend the shelf life of the processed food. The result indicated that the leaves and stems of *Thymus schimperi* used as spices while tea preparation, “shiro” preparation, pepper preparation, fodder, and cleaning of pot for making butter from milk and milk material.

Figure 7 *Thymus schimperi* (photo credit: Debela Daba)

Momordica balsamina *L.* **(**Wild relative of ***Momordica charantia*****) Cucurbitaceae**

It is a tendril bearing annual vine native to tropical regions of Africa, introduced and invasive in Asia, Australia, and Central America. It has pale yellow, deeply veined flowers and round, somewhat warty, bright orange fruits. The outer rind and the seeds of the fruit are poisonous. Used as medicinal to treat wounds (Nelson *et al.*, 2007). The people in the study area used the leaves of this plant for treating of wound and the fruits are edible.

Figure 8 *Momordica balsamina* (photo credit: Debela Daba)

Ocimum forskolei *Benth.* **(**Wild relative of ***Ocimum basilicum*****) Lamiaceae/Labiatae**

It is annual plant with a woody base or subshrub and erect. *Ocimum forskolei* is used as a mosquito repellent in the western lowlands of Eritrea where it grows widely in bush land at an altitude of 100-1000 m.

Ocimum forskolei was reported as being hung at the head and foot of the bed in house to reduce *Anopheles arabiensis* mosquito's bites by 53% (Waka *et al.,* 2004). Furthermore, laboratory wind tunnel studies found that when crushed *Ocimum forskolei* was added to human odor, it became less attractive than human or goat odor alone (Waka *et al.,* 2006). Improved knowledge of the volatile compounds released by *Ocimum forskolei* may improve the use of the plant in field situations. It may also lead to the identification of novel compounds with potential for development as synthetic repellents, as well as deciphering the olfactory mechanisms underlying repulsion. The leaves are used as spices specially while preparation of "shiro wot" as it gives tasty odor in the study area. The ladies in the study area mixed the dried and pounded leaves with butter as perfume for its attractive odor.

5.1.5 Description of less important DCWRs in the study area

G*uizotia scabra* (Vis.**)** *Chiov.* **(**Wild relative of **G*uizotia abyssinica*)** **Asteraceae /Compositae**

It is a native plant species to Africa, is a common weed in Ethiopia, and is locally known as "mech". In Ethiopia, it is used for treating gonorrhoea and hepatitis (Hiremath and Murthy, 1986). In ethnomedicine practice; its leaves are used in the treatment of hepatitis, malaria and to act against helminthes. Maceration made from mixing its leaves together with the leaves of other plant species such as *Vernonia amygdalina* and *Cinchona ledgeriana* is administered both orally and through the nasal pathway to treat adenitis, piroplasmosis, and theileriasis in livestock. Its aqueous leaf extracts exhibit hepatoprotective properties. A galactogenic mixture made from mixing its ground leaves together with the ground leaves of the plant species *Acrocephalus galeopsifolium*, *Hypericum revolutum* and *Clerodendrum rotundifolium* is administered to livestock with agalactia as a treatment (Hiremath and Murthy, 1986).But in the study area it is only used as fodder and seen invasive weed, which is difficult to control.

Figure 9 G*uizotia scabra* (photo credit: Debela Daba)

Plectranthus punctatus** (L.f.) L'Her.* **(**Wild relative of ***Plectranthus edulis**) Lamiaceae /Labiatae**

The growth habit is pubescent and branched herb, which is 15 to 75 cm tall. *Plectranthus punctatus* has leaves ovate to ovate-elliptic, obtuse, cuneate, upper leaves sessile, lower ones shortly petiolate, with a petiole up to question length of blade and shallowly. Located around roadside as weed, open ground by streams, marshes, in flood canal and forest edges; 1350-3200 m (Hedberg *et al*., 1995). The specimens of these plants were collected from riverbanks 2500 m a.s.l. According to informants in the study area, these plants seen as invasive weeds especially, that invades grassland. Nevertheless, according to Dereje *et al* (2009) shown that *Plectranthus punctatus* contain possible anthelmintic compounds that used to control haemonchus contortus.

Carthamus lanatus** L.* **(**Wild relatives of ***Carthamus tinctorius**) Asteraceae/Compositae**

It is widely naturalized in warm-temperate and subtropical semi-arid areas, often on low fertility soils in areas receiving 300 to 600 mm of annual rainfall. Most seeds are dispersed close to the parent plant, but some remain in the persistent seed heads. Rates of dormancy can vary among populations at different locations. Most seeds germinate after the first autumn rains 1-3 years following maturation, but some seed can remain dormant and viable for up to eight years under field conditions. Optimal emergence occurs at or just below the soil surface. Seeds are susceptible to predation by termites (Brusati, 2003).This plant has been used as fence for crops in the study area to prevent crop damage by animals and humans. The leaves and the flower are used as fodder for donkey. The people in study area consider it an invasive alien species.

Figure 10 *Carthamus lanatus* (photo credit: Debela Daba)

5.1.6 Factors threatening DCWRs

The cause of threats to CWR can be generally grouped into natural and human induced factors. However, as reported in this study most of the causes for the threats to CWR and associated knowledge are the anthropogenic factors such as deforestation due to exploitation of plants for different uses/ overgrazing, using of herbicide, for construction , agriculture expansion, lack of knowledge about CWR, cutting and burning of plants to create new agricultural land. According to Lulekal *et al*. (2011) agricultural expansion, overgrazing, fire, and other utilization-related factors such as fuel wood and charcoal, construction, and house and farm implements are the major threats in both agroecologies

The amount of food we produce now will probably not be sufficient to keep people all alive, let alone healthy. We also face a number of challenges for food production. The erosion and degradation of soils, the scarcity of water, arable land and other natural resources, the shortage and unreliability of energy, and the increasing impacts of climate change will all constrain our efforts to achieve real food security. Changing lifestyles and expectations in developing regions of the world, low stockpiles and high food prices, and decades of underinvestment in agricultural research will not make things any easier. The task is enormous. Luckily, agriculture has an ace up its sleeve.

The results of the present study showed that agricultural expansion and overgrazing were ranked as 1^{st} and 2^{nd} factors respectively followed by the use of herbicides, wood and climber for construction and lack of awarness that ranked as the 3^{rd} and 4^{th} and 5^{th} factors respectively for the threats to CWR and associated knowledge in the study area. In addition, impact of climatic change ranked as sixth factors.

5.1.7 Conservation of DCWRs and associated knowledge

The above causes and other similar reasons are the problems for the conservation of CWR and associated knowledge. Even though, there are many problems icluding high population growth, resulting in the over exploitation of DCWR for use of their habitat for different purposes and for getting the daily income, the significant numbers of the local people of the area know the importance of conserving the plants in both ex-situ and in-situ conservation methods. For instance, some people and/ or the government offices have started conserving the plants by in-situ method, fenced/protected pasture land different worship areas (churches, mosques, etc) in their (farms' field/farm margins) and so on. This improved by Alemayehu Wasie (2002) confirmed that in Ethiopia protecting natural forests and rehabilitating vegetation around churches, mosques and graveyards has been practiced as parts of human endeavor for millennia. And also conserving by ex-situ method like in and around their home gardens, as live fences of the gardens, plantation fields, and so on.

5.2 Conclusions

The data or more information of DCWR (27) was collected from different literature and from the volumes of Flora of Ethiopia and Eritrea. The presence of voucher specimens of the DCWR found in Ethiopia in the National Herbarium (ETH) was thoroughly done and gave less number of species (23). After compiling herbarium data, field data collection was done in two ways: specimen collection and ethnobotanical data collection and finally description of the DCWR found from field of study were made. From these sources of information 18 DCWRs were identified. People in the study area are knowledgeable about the plants, their distribution, and botany but they do not have awareness about the genetical uses of the DCWRs. The status of three DCWRs was found to be highly decreasing (*Cicer cuneatum, Momordica balsamina, and Ocimum forskolei*) and eight are decreasing and require more conservation than the other species. DCWRs in the study area were mostly seen as weeds rather than being used as crops. These resulted from low level of awareness among the local people about genetic resource value of the crop wild relatives. Some local people want these plants to be destroyed from their land rather than conservation because they see them as Invasive Allien Species (ISA).

The major uses of DCWR in the study area are fodder, food, medicine, construction material, stimulant, and spices in their respective order. From all Floristic Regions in the study area, Shewa Upland had the largest number of DCWRs. It might be due to the increasing number of population and the availability of good land for agriculture, large number of study were done in this floristic region due to accessibility of infrastructure (nearest to the capital city) and cost allocation. On the other hand, the population of these plants decreasing in this floristic region. Fabaceae had the largest number of CWR species from all families in the study area followed by Cucurbitaceae and Lamiaceae. The major threatening factors to DCWRs and the associated knowledge in this particular study area are agricultural expansions, herbicide use, over grazing, construction, and awareness of people especially on conservation and genetic resources. In order to overcome these problems providing training and raising awareness of the people in the study area are required.

5.3 Recommendations

Based on the findings of the study the following recommendations are forwarded:

- The local people need support through awareness raising provision of appropriate education on the sustainable utilization and management of plant resources.
- Resources, especially plant resources are integral to the life of all biota, as they are the primary food producers. Life of world biota is directly or indirectly dependent on plant resources. Thus, encourage the people to manage DCWRs in their home gardens and farmlands. Indigenous people of the study area should be involved in conservation and management plans of plant resources or their indigenous knowledge in their locality.
- Encourage and initiate farmer's morality by supporting with necessary infrastructures such as provision of micro finance services, experts follow up, training, rewarding for best performing ones, which are essential to bring radical change over home gardening and especially on the highly decreasing DCWRs development in the study area.
- Studies should be conducted in each Floristic Region to get the most prefered information in all floristic regions of the country about the status and distribution of the DCWR and to ensure food security and increase production in our country, inorder to reduce the food security problem.
- The plant breeders should initiate to consider crop wild relatives in their breeding programmes in order adapted and resistant plants to disease and pests.
- Encouraging Government offices and NGOs to participate in conservation of CWRs, by supporting the local people and provide incentives to farmers for conservation ex-situ in their home gardens and in-situ.
- The presence of different plant in the farming complex should improve the soil fertility status and agrobiodiversty. Therefore, the agricultural extension workers should consider this fact and reshape the farmers to practice and increase the kwowledge of CWR through training programs.

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APPENDIXES

Appendix 1 List of crop wild relatives in Ethiopia

No	CWR		Crops			Family	Distribution of Floristic area	Flora volume and no
	Scientific name	Local name	Scientific name	Common name	Category			
1	*Apium nodiflorum* L. Lag.		*Apium graveolens*	Celery		Apiaceae	TU GD BA HA	(4,1), 20
2	*Canavalia africana* Dunn	Ater-ancwa (Tya), Ater-gwasot (Tya)	*Canavalia ensiform*	Jack bean, sword bean	Pulse	Fabaceae	HA IL GG	3 , 165
3	*Carthamus lanatus* L.	Shofua (Agew), ye-ahiya-suf (Amh), dender-bayta, af-ansti (Tya)	*Carthamus tinctorius*	Safflower	Oilseed	Asteraceae	TU GD GJ SU AR HA	(4,2) , 37
4	*Cicer cuneatum* (Hochst.) Ex A. Rich	Yeayt-shmbra (Amh)	*Cicer arietinum*	Chickpea	Pulse	Fabaceae	TU SU	3, 248
5	*Coffea arabica* L.	Bunna	*Coffea arabica*	Coffee	Stimulant	Rubiaceae	IL KF BA SU HA GJ SD GG	(4'1), 267
6	*Cucumis melo subsp. agrestis* Naud.	Arkula (Sid.); Yeql 'mbway (Amh.)	*Cucumis melo* subsp. *melo*	Melon, musk melon	Vegetable	Cucurbitaceae	AF SU KF GG HA	(2,2),34
7	*Cyamopsis senegalensis* Guill. & Perro.		*Cyamopsis tetragonoloba*		Pulse	Fabaceae	AF TU GD GJ WG SU KF	3, 139
8	*Gossypium bricchettii* (Ulbr.) Vollesen.	Embwa'y (Amh); Hidi (Orom); Cag-waraabaale,Canduuro-shugux (Som)	*Gossypium herbaceum*	Cotton		Malvaceae	BA	(2,2),220

No	CWR		Crops			Family	Distribution of Floristic area	Flora volume and no
	Scientific name	Local name	Scientific name	Common name	Category			
9	*Gossypium somalense* (Gorke) Hutch.	Ado-qurqura (Amh), Eddi-shebel (Som), Fochi (Amh), Gaba (Amh &Tya)	*Gossypiumarboretum*	Cotton		Malvaceae	SU(Awash Valley) SD HA	(2,2),220
10	*Guizotia scabra (Vis.) Chiov.*		*Guizotia abyssinica*	Niger seed	Oil seed	Asteraceae	TU GD GJ SUWG IL KF SD BA HA	(4, 2),310
11	*Lablab purpureus* subsp. *uncinatus* A. Rich.		*Lablab purpureus*subsp. *purpureus*	Hyacinth bean,	Pulse	Fabaceae	TU GJ AR HA IL	3, 179
12	*Lagenaria abyssinica* Hutch. & Bruce	Bukkee sexana (Or), Ye setan kil (Amh)	*Lagenaria siceraria*	Bottle gourd, calabash	Vegetable	Cucurbitaceae	GD GJ SU AR KF GG SD	(2,2), 237
13	*Lathyrus pratensis* L.		*Lathyrus sativus*	Grass pea	Pulse	Fabaceae	SU BA	3, 250
14	Lathyrus *sphaericus* Rea.		*Lathyrus sativus*	Grass pea	Pulse	Fabaceae	TU GD GJ SU	3, 250
15	*Lens ervoides* (Brign.) Grande	Missira hantuta(Or)	*Lens culinaris*	Lentils	Pulse	Fabaceae	TU GD SU	3, 249
16	*Luffa echinata* Roxb.	Ye amora migib (Amh)	*Luffa cylindrical*	Lipa	Vegetable	Cucurbitaceae	AF GG	(2,2),
17	*Momordica balsamina* L.	Hababi hare(Or)	*Momordica charantia*		Vegetable	Cucurbitaceae	HA	(2,2),42
18	*Ocimum forskolei* Benth.	Balambal (Som.) Urgooftu(Or)	*Ocimum basilicum* var. *basilicum*	Sweet basil		Lamiaceae	TUWU SU SD BA HA	5, 571
19	*Plectranthus punctatus* (L.f.) L 'Her.		*Plectranthus edulis*	Ethiopian potato	Root and tuber	Lamiaceae	GD GJ WU SU AR IL WG KF GG SD HA	5, 595
20	*Rhamnus staddo* A. Rich.	Jajale (Som); Qadida (Gam & Or); Seddo (Amh &	*Rhamnus prinoides*			Rhamnaceae	TU GD SU AR KF GG SD BA HA	3, 390

No	CWR		Crops			Family	Distribution of Floristic area	Flora volume and no
	Scientific name	Local name	Scientific name	Common name	Category			
		Tya)						
21	*Ricinus communis* var. *africanus* Muell. Arg.	Kobbo (Or), Gulo(Amh)	*Ricinus communis* var. *communis*	Castor		Euphorbiaceae	TU GD WU SU WG KF GG SD BA HA	(2,2), 295
22	*Solanum marginatum* L.f.	Hiddi (O), Embay (Amh)	*Solanum tuberosum*	Potato	Root and tuber	Solanaceae	TU GD GJ SU AR GG SD BA HA	5, 140
23	*Thymus schimperi* Ronniger	Tosignii (Or), Tosign(Amh)	*Thymus vulgaris*	Thyme		Lamiaceae	TU GD WU SU AR SD BA HA	5, 552
24	*Vicia sativa* var. *angustifolia* L.		*Vicia sativa* var. *sativa*	Pea, field pea, garden pea,	Pulse	Fabaceae	TU GD GJ SU AR HA KF GG SD	3, 249
25	*Vigna unguiculata* subsp. *mensensis* (L.) Walp.	Dembo (Amh); Budunkh (Bench); Motjo (Kef)	*Vigna unguiculata* subsp. *cylindrica*	Common cowpea	Pulse	Fabaceae	KF GG	3, 174
26	*Vigna unguiculata* subsp *dekindtiana (Banns) Verde.*		*Vigna unguiculata* subsp. *unguiculata*	Cowpea	Pulse	Fabaceae	TU GD IL	3, 174
27	*Ziziphus mucronata Willd.*	Kobta (Kefa)	*Ziziphus jujuba*			Rhamnaceae	GD GJ WU SU AR IL KF GG SD BA HA	3, 393

Source: Flora of Ethiopia and Eritrea volume ((2,1) ,(2,2) ,3 ,(4,1), (4,2),5)

Appendix 2 Lists of CWR and location of collection according to information extracted from specimens at the National Herbarium (ETH), Addis Ababa University

No	Species name of CWR	Family	Floristic region	Locality	Altitude, latitude,& longitude	Date of collection	Collector & collection no.	Habitat	Notes
1	*Apium nodiflorum* L.Lag.	Apiaceae							No specimen in herbarium
2	*Canavalia africana* Dunn.	Fabaceae	WG	15 km N of Tongo towards Bambasi ,where the new road crosses the Changi & Jabush rivers	1250 m, 9°30'N, 34°27 E'	12 Nov. 2006	Ib Friis, Assefa Hailu & Ermias Getachew , 12700	Disturbed riverine scrub vegetation along permanent river	Herbaceous climber to 3m; flowers pinkish purple
3	*Carthamus lanatus* L.	Asteraceae	SU	30km W. of Addis Ababa along road to Ambo, near Menagesha barren waste fields	2200 m	7/IV/ 1965	Herbarium Vadense (WAG)	Barren waste field	Herbs, annuals up to 80cm high, prickly, green glavcous green involucral bracts, flowers pale yellow.
4	*Carthamus lanatus* L.	Asteraceae	SU	Ambo, 125 km W of A.A. around plain of river Debis on maize field	2100 m	Dec.15, 1979	Mesfin T.		
5	*Carthamus lanatus* L.	Asteraceae	SU	10km Nof Denneba on the road branching off from A.A.DebreBerhan main road towards Jihur	2550 m	Nov. 28, 2000	I.Friis, M. lock& Legesse Egigu	Rocky and stony soils	Erect annual herb to 100cm high florets yellow
6	*Carthamus lanatus* L.	Asteraceae	SU	Near A.A.	2440 m	15/11/ 59	H.F. Mooney	Road sides and fallow lands	Prickly herbs, 60-120cm high much branched in its upper

No	Species name of CWR	Family	Floristic region	Locality	Altitude, latitude,& longitude	Date of collection	Collector & collection no.	Habitat	Notes
									half, flowers lemon yellow
7	*Cicer cuneatum* (Hochst.) Ex A. Rich	Fabaceae	TU	Adwa Awraja tsoloda	1980-2230 m	Oct. 26, 1991	MesfinTadesse, 8674	Steep m slopes on stone soils	
8	*Cucumis melo subsp. agrestis* Naud.	Cucurbitaceae							No specimen of subsps. agrestis in herbarium
9	*Cyamopsis senegalensis* Guill. & Perro.	Fabaceae							No specimen in herbarium
10	*Gossypium bricchettii* (Ulbr.) Vollesen.	Malvaceae	BA	WeldyaDolo Bai Gypsum hill just E. of Town	300 m 4^{0}17’N4 2^{0}04’E	June 12, 1986	M.G. Gilbert Sebsebe D.&K. vollesen, 8173	*Acacia* woodland	Erect shrub 1.5 m high little branched flower pale yellow with small dark
11	*Gossypium somalense* (Gorke) Hutch.	Malvaceae	SD	16 km E. of Bokol Mayo on Dolo to Filtu road	450 m 4^{0}32’N4 1^{0}38’E	May 20, 1983	M.G. Gilbert Ensermu K.&K. vollesen, 7648	*Acacia Commiphora* woodland	Erect shrub to 1.7 m corolla quite large yellow with red center
12	*Gossypium somalensen* (Gorke) Hutch.	Malvaceae	SD	72km S. of Negelle along the road to MelkaGuba	1000 m	13/5/82	I.Friis, MesfinTadesse&K. Vollesen, 2840	*Acacia Commiphora* woodland	Shrub to 2 m tall, flower yellow with dark center, turning pink
13	*Gossypium somalense* (Gorke)	Malvaceae	SU	50 km W. of Nazret on road to Metehara and Awash station	1275 m 8^{0}42’N3 9^{0}32’E	May 8, 1983	M.G. Gilbert Sebsebe D. K. vollesen, 7414	*Acacia Senegal* bushland	Erect shrub

No	Species name of CWR	Family	Floristic region	Locality	Altitude, latitude,& longitude	Date of collection	Collector & collection no.	Habitat	Notes
	Hutch.								
14	*Gossypium somalense* (Gorke) Hutch.	Malvaceae	SD	90km E. of Filtu road to Dolo	900 m $4^0$40'N4 $1^0$13'E	June 10, 1986	M.G. Gilbert, Sebsebe D.&K. vollesen, 8125	Dense Commiphora woodland	Shrub 2.5m high fruit small
15	*Guizotia scabra* (Vis.) Chiov.	Asteraceae	SU	Jibat & mecha awraja 13 km W. Gedo on the way to Nekemt	1900 m	10/XI/ 1981	Mesfin T.&Kagnew G.Y. 2068	Common in grassland along road side	Erect herb up to 1.5mhigh liguless yellow, phyllsries green, Leaves yellowish green
16	*Guizotia scabra* (Vis.)Chio.	Asteraceae	GG	Gofa Awraja7km from Sawla on the road to Bulki	1950 m	27/12/ 83	Ensermu K. &Zerihun W. 663	In grassland with scattered riverine forest	Herb up to 2mhigh stems and leaves rough inflorescence yellow
17	*Guizotia scabra* (Vis.) Chiov.	Asteraceae	SU	Guder river valley, 15km W. of Ambo	1900 m $08^0$59'N $37^0$46'E	26/X/ 1982	ArenAnderberg, 1617	Grassland with scattered scrub land	Herb with 40cm radiate Yellowcapitula and scarbid leaves
18	*Guizotia scabra* (Vis.)Chiov .	Asteraceae	SU	Menagesha Awraja entoto hills, above RasSeyoumsefer	2800 m	19/VII / 1980	Mesfin T. O.Hedberg, Sue Edwards & Tewolde B.G.E. 1027	In *Juniperus,Bersama*& Erica dominant trees	Herb up to 1.5m
19	*Lablab purpurus* subsp. *uncinatus* A. Rich.	Fabaceae							Specimen collected from Kenya

No	Species name of CWR	Family	Floristic region	Locality	Altitude, latitude,& longitude	Date of collection	Collector & collection no.	Habitat	Notes
20	*Lagenaria abyssinica* Hutch. & Bruce	Cucurbitaceae	SU	Wollame sefer	2400 m	20/3/84	A.A. R.F, 469	Along the fence	Herb climber perennials ,flowers white cup shaped pollen source
21	*Lagenaria abyssinica* Hutch. & Bruce	Cucurbitaceae	SU	30 km west of Ambo or 180 km from Addis Ababa on Nekemte road	2200 m	18 July 1971	J.W. Ash , 1057	Riverine vegetation by stream side	Herbaceous climber, growing through willow.
22	*Lagenaria abyssinica* Hutch. & Bruce	Cucurbitaceae	KF	Mount Maigudo	2200-2300 m	27.11.1970	Ib Friis, 494	Scrab grass land climbing in vernonia	Vine
23	*Lathyrus sphacricus* L.	Fabaceae	SU	Eastern end of bole runway beside Gargi river, 1 km East of Bole Home Estate		August 23,1984	Masresha F. , Yohannes P.& sue Edwards , 9	Grass land	Pod green, leaves dark green, flowers pale red
24	*Lathyrus sphacricus* Rea.	Fabaceae	BA	34km from Dinsho to Adaba	9000 ft	Oct. 1, 1971	Tewoldeberhan G.E., 251		Herb; flowers scarlet red
25	*Lathyrus sphacricus* Rea.	Fabaceae	SD	24 km from Negele on road to MalkaGuba	1600 m $5^0$12'N3 $9^0$37'E	May 23, 1983	M.G. GilbertEnsermu K.&K. Vollesen, 7741	Open wooded land	Erect ephemeral;flowers light red
26	*Lathyrussph acricus* Rea.	Fabaceae	SU	Addis Ababa hill behind British embassy	8100 - 8500ft	26/9/54	H.F. Mooney, 5816		Erect leguminous herb, with bright red flowers
27	*Lathyrus sphacricus* Rea.	Fabaceae	SU	2km east of Ghedo	2600 m, $8^0$59'N3 $7^0$27'E	20/Ix/75	M.G. Gilbert &M. Thulin, 931	Grass land	Flower light red
28	*Lathyrus*	Fabaceae	SU	26km S.W. A.A from		Sept.	Mesfin T.	Rocky outcrop	Herb; flower very pale

No	Species name of CWR	Family	Floristic region	Locality	Altitude, latitude,& longitude	Date of collection	Collector & collection no.	Habitat	Notes
	sphacricus Rea.			Arat killo to Butajira road.		14, 1980	M.G.Gilbert&Sue Edwards, 1164	area	blue or lilac
29	*Lathyrus* spp. Rea.	Fabaceae	SU	Bole Airport beside Gargi river 1 km east of Bole Homes Estate		August 23, 1984	Sue Edwards, 14	Grass land	Herb; flower pink
30	*Lathyrus* spp. Rea	Fabaceae	SU	Debrezeit nursery compound	2000 m	19/II/ 1987	MesfinTadesse, 5840		Herb; flower blue
31	*Lathyrus* spp. Rea.	Fabaceae	BA	Between Dinsho and Sebsebewasha mountain slope of *Juniperus* & *Hagenia*	2990-3600 m	25/XII / 1989	MesfinTadesse, 7650	Grassland	Herb; flower purple
32	*Lens ervoids (Brign.)* Grande	Fabaceae							Not found in herbarium
33	*Luffa echinata* Roxb.	Cucurbitaceae	WU	Jandecho plantation irrigated farm	350 m, $11^0$44’N $41^0$05’E	27/11/ 75	JAR.E&Niemaann		Host plantation for various
34	*Luffa echinata* Roxb.	Cucurbitaceae	GG	Lower Omo valley 5 km from Omo Rati to Turmi	450m4^0 48’N $36^0$6’E	12/1/98	I. Friis S. Bidgood, Melaku W & Gashaw G/hiwot	Stagnant water terminalia black cotton soil	Prostate herbaceous climber dioecious white male flowers
35	*Momordica balsamina* L.	Cucurbitaceae	HA	Hurso	1000 m 09^o14’N 41^o37’E	26/11/ 69	S.A. Robertson, 1396	Edge of permanent stream	Trailing plant; flowers cream; fruit red inside.
36	*Momordica balsamina* L.	Cucurbitaceae	HA	Miles East of Dire Dawa	1162 m	Sep. 5, 1971	J.W. Ash , 1123	*Acacia* land cover& bed	Yellow green blotches
37	*Momordica balsamina* L.	Cucurbitaceae	HA	Hurso on the way to Harar from Dire Dawa	1100 m	April 26,1968	TadesseEbba, 733		Fruits edible; climbing; white petals

No	Species name of CWR	Family	Floristic region	Locality	Altitude, latitude,& longitude	Date of collection	Collector & collection no.	Habitat	Notes
38	*Ocimum forskolei* Benth.	Lamiaceae	AF	50 km from Mille towards to Bati	850 m 11°15’N 40°18’E	15 sep.2001	I.Friis, SallyBidgood, Melaku W. & Ermias G.	Open *Acacia mellifera* dominated bush land	Perennial herb; flowers white
39	*Ocimum forskolei* Benth.	Lamiaceae	SU	Yerer kereyou Awraja, 50-51 km from Nazreth Adama Ras hotel to Metehara	1200-1240 m	1.V.1986	Sebsebe D& Berhanu A.	Acacia Grewia common in the year	A herb 50-70 cm high
40	*Ocimum forskolei* Benth.	Lamiaceae	HA	East Harargie region Fafen 3½ km of Dhagaxile	1450 m 42°37’E 9°12½N	5-6 Nov.1992	Peter Kuchar& Mahdi Kidar	Dominated *Acacia senegal*	In herbaceous plant; roadside
41	*Ocimum forskolei* Benth.	Lamiaceae	HA	Idli valley, 45 km ESE of Harar on road to Jigjiga	1550 m 42°24’E 9°11N	21 July 1961	W. Burger	Stream valley tamarisk; *Acacia* and fig trees	In grass at edge of stream bed and upside down
42	*Plectranthus punctatus* (L.f.) L 'Her.	Lamiaceae	SU	Menegesha Awuraja. Wolmera woreda abt 55 km west of AA	2390 m	Tikimt 12, 1979	Sebsebe D.		A herb 30 cm high; flowers blue
43	*Plectranthus punctatus* (L.f.) L 'Her.	Lamiaceae	SU	Bolo, a town near Ambo;110 km w of AA	2490 m	Dec.16.1979	Mesfin T.		Below the bridge and in swampy area. Anherb ca 50 cm high.
44	*Plectranthus punctatus* (L.f.) L 'Her.	Lamiaceae	GG	Gughe highlands 2 km N of Ezzo (Azzo), 16 km from Chencha	2750 m 6°22’N 37°36’E	Oct.9, 1989	M.G.Gilbert, Sylvia Phillips & Damtew Tefera	Low rolling hills with land terracing from *Hordium* field	Flowers bright blue
45	*Plectranthus punctatus* (L.f.) L	Lamiaceae	GJ	40 km Injibara towards Debremerkos, b/n Bure and Feneto Selam	2050 m 37°07’E ,10°42.5	10 Sep.2004	I.Friis, sally Bidgood, Assefa Hailu &Berhanu Y.	In undated grass land	Annual herbs; stems with juicy, swollen nodes

No	Species name of CWR	Family	Floristic region	Locality	Altitude, latitude,& longitude	Date of collection	Collector & collection no.	Habitat	Notes
	'Her.				'N				
46	*Rhamnus staddo* A. Rich.	Rhamnaceae	KF	32 km along Jimma to Addis Road near to Serbo	1600 m $7^0$40'N3 $7^0$05'E	Feb. 21, 1988	Sue Edwards, Tewolde B.G.E. &LisaneworkNigatu, 4129	Disturbed bush land associate with *Dodone*a and *Carr*isa	Shrub to 3 m, flower yellow green, fruit hanging
47	*Rhamnus staddo* A. Rich.	Rhamnaceae	HA	Gursum 1.5km NW of Gursum	2000-2500 m $9^0$22'N4 $2^0$23 E	May 15, 1993	Peter Kuchar&Mahdi Kidar, 18945	Open shrubland dominated by *Dodonia* and *Euclea*	
48	*Rhamnus staddo* A. Rich.	Rhamnaceae	SU	10km W. of Guder, W. of Ambo	2400 m	18/IV/1965	Herbarium Vadense(WAG), 6378	Shrub vegetation	Shrub 2.5m high, leaves dark green above, immature fruit green
49	*Rhamnus staddo* A. Rich.	Rhamnaceae	SD	Arero Awraja trace Teltele Chew Bahir, 39km	1400 m $4^0$50'58' N$37^0$05' 12E	April 24, 1987	Sebsebe D. and Ensermu K., 870424	Mixed woodland	Shrub to 2 m, flower greenish
50	*Ricinus communis* Muell. Arg.	Euphorbiaceae	SU	Lake Ziway		5/9/78	G.Aweke, 1473	Widely in Grassland &*Acacia* tree	Small very dense tree 3-4 m high
51	*Ricinus communis* Muell. Arg.	Euphorbiaceae	SU	Wondo genet F. college campus		20/6/78	G.Aweke and S. Tegne, 1391		A shrub about 2 m high; flower whitish yellow
52	*Ricinus communis* Muell. Arg.	Euphorbiaceae	GG	Hola		31/08/72	G. Awake, 517	Semi-desert area	Shrub up to 4m high
53	*Ricinus communis* Muell. Arg.	Euphorbiaceae	SU	A.A. bole higher 17, kebele 23 near to Moenco	2350 m	June 12, 1995	Sebsebe D., 4665		Tree to 4 m high, flower yellowish
54	*Solanum*	Solanaceae	SU	On the slope of mount	2600 m	Jan.13	Tewolde B.G.E. and		Shrub 75cm lower

No	Species name of CWR	Family	Floristic region	Locality	Altitude, latitude,& longitude	Date of collection	Collector & collection no.	Habitat	Notes
	marginatum L.f.			Zqualla going down		, 1973	Gelargn A.		surface of leaves whiter fruit ripening to orange
55	*Solanum marginatum* L.f.	Solanaceae	SU	E. of Geddo town of	2550 m $8^0$59'N3 $7^0$28'E	16/11/97	I. Friis, Tesfaye Awas and Gashaw G.H.	Mountain evergreen scrub	Shrubby perennial herb, flowers white to very pale blue
56	*Solanum marginatum* L.f.	Solanaceae	SU	Near 7th day Adventist Church beside Cottage Restaurant		10/2/78	Ensermu K.		Herb of 1.5-2m very much branched growing in a waste fallow land
57	*Solanum marginatum* L.f.	Solanaceae	BA	Sebsebe Washa 43 km W of Dinsho at 357km on Addis to Goba road	2460 m	28/IX/1985	Mesfin T.	River side	Branched shrub by herb; 1.5 m high; leaves darker green
58	*Thymus schimperi* Ronniger	Lamiaceae	SU	Entoto hills, beyond St.Raguel church 5-8 km N A.A	3000 m	7.III.1982	Mesfin T., O. Hedberg ,S.Edwards, Tewolde B & Ensermu K.	Dry scrub *Erica arborea*	
59	*Thymus schimperi* Ronniger	Lamiaceae	SU	15 km of A.A to Dassie road	2500 m	11.IV.1987	Mesfin T.	Hill in *globulus* plantation	
60	*Thymus schimperi* Ronniger	Lamiaceae	SU	Debre Berhan	2850 m	Nov.1.1982	Zerhun W.	Intensely grazed grass land	A trailing herb with strong aromatic smell
61	*Vicia sativa* var. *angustifolia* L.	Fabaceae	AR	5km N of Asella near Kulumsa farm	2100 m	6/X/71	M. Thulin, 1382	Grass land	Herb
62	*Vicia sativa* var. *angustifolia* L.	Fabaceae	AR	Lemu South of Asella	2300 m	March 4, 1970	G. Aweke, 112	On cultivate land	Herb

No	Species name of CWR	Family	Floristic region	Locality	Altitude, latitude,& longitude	Date of collection	Collector & collection no.	Habitat	Notes
63	*Vicia sativa* var. *angustifolia* L.	Fabaceae	KF	38 km from Jimma at Sheik-Gorgeb river road	2600 m $7^0$25’N3 $6^0$55’E	8/xII/ 72	I. Friis, G. Awake, F.Rasmussen&K.Vollesen, 1633		Climber herb, flower red
64	*Vicia sativa* var. *angustifolia* L.	Fabaceae	SU	Menagesha Awraja 55 km W of Addis in Ambo road around Gilgel river	2390 m	Oct. 12, 1980	Ensermu K,	Plantation	Herb with tendrils, flower dark blue
65	*Vicia sativa* var. *angustifolia* L	Fabaceae	SU	Sibilu river near to Chancho 40kms north of A.A. to Gojam road	2650 m	22/III/ 81	Sue Edwards , 2137		Herb
66	*Vicia sativa* var. *angustifolia* L	Fabaceae	SU	A.A. behind British Embassy	8100 – 8500ft	26/IX/ 54	H.F. Mooney, 5817	*Eucalyptus* plantation	Herb with mauve flowers
67	*Vigna unguiculata* subsp. *dekindtiana* (Banns) Verde.	Fabaceae	IL	12 km N Of Abobo, along the road to Gambella	600 m $7^0$55’N3 $4^0$30’E		I. FriisS. Bidgood P. Host Desalegne D. Shigulte K, 7245	Tall grass land	Herb climber; flower reddish purple, keel white
68	*Vigna unguiculata* subsp. *mensensis* (L.) Walp.	Fabaceae	GJ	Chagni-Pawi road	1500 m$11^0$03 N$36^0$26’ E	13/10/ 96	I.Friis, S. Bidgood, Fantahun S, Michael Jensen&Menassie G. 7752	Bamboo woodland	Herb climber; Flower pale purple standard reds with yellow spot on
69	*Vigna unguiculata*	Fabaceae	GJ	10 km N.W. of Mandura road to Phawi	1250 m $11^0$06.6	Oct. 22,	I.Friis, S. Bidgood, AssefaHailu&Ermias	Wood land	Herb climber standard yellow, wing and keel

No	Species name of CWR	Family	Floristic region	Locality	Altitude, latitude,& longitude	Date of collection	Collector & collection no.	Habitat	Notes
	subsp. *mensensis* (L.) Walp.				N36^{0}22. 9E	2004	G., 11903		purple
70	*Ziziphus mucronata* Willd.	Rhamnaceae	GG	8-10 km from Key Afer towards Shala-Luka	1300-1350 m	Dec. 20, 1996	Sebsebe D. &Ensermu K.	*Acacia* - *Combretum* woodland	Shrub to 5m high fruit edible
71	*Ziziphus mucronata* Willd.	Rhamnaceae	SU	Blue Nile Gorge, downstream from bridge	1100 m10^{0}05 N38^{0}12 E	Oct. 11, 1981	C. Puff, D. Mantell and Ensermu K.	Dry rocky slope woodland	Rounded shrub to small tree to 4 m tall; fruit green (immature)

Source: National Herbarium (ETH), Addis Ababa University

Appendix 3 List of informants in the study area

No	Name	Sex	Age	Marital status	Education	Location	Occupation
1	Abdela Hussien *	M	41	Married	Write and read	"	Farmer
2	Abera Bekele	M	64	Divorced	Illiterate	Sansusi	security
3	Abera mekonnen	M	55	Married	Read and write	Burayu	Farmer
4	Adugna Gari	M	40	Married	Deegre	Guwatsihon	Woreda extension team leader
5	Adugna Hordofa	M	50	Married	Illiterate	DZ	Farmer
6	Amaw melesse	F	50	Divorced	Read and write	Holeta	Farmer
7	Amekalu Difabachew	M	70	Married	Illiterate	Guwatsihon	Farmer
8	Aregash Gidago *	F	26	Un married	3	Around W/fall	Jobless
9	Ashenafi Mekonnen	M	36	Married	6	Xuxuxxi	Group leader in kebele
10	Asnakech Lema	F	45	Married	Read and Write	"	House wife
11	Bekele Tolossa	M	37	"	Read and write	"	Farmer
12	Belachew Gifole *	M	61	Married	Illiterate	Around W/fall	Farmer
13	Berhanu kasaye	M	32	Married	MSc.	Haromaya	Student
14	Birtuken bayecha	F	22	Unmarried	8	Gojeb	Merchant
15	Biru Boru	M	32	Unmarried	Degree	D/Z	Private campaign workers
16	Daba Gerado	M	74	Divorced	Illiterate	Ejere	Farmer
17	Dita kemal *	M	35	Married	Degree	Fentalle	Woreda agr.(employee)
18	Eshetu Bulto	M	48	Divorced	Illiterate	Sululta	security
19	Fetiya kasim	F	41	"	Illiterate	"	"
20	Gebru Tesfa	M	58	Married	Illiterate	"	Farmer
21	Gezmu Belete*	M	71	Married	Illiterate	Ejere	EEPCo. security
22	Hana Wegane	F	24	Unmarried	11	"	Student
23	Hussien Hassan	M	51	married	Illiterate	"	Farmer
24	Jamaynesh Kebede	F	54	Married	Illiterate	AA	Daily workers
25	Jemal Ahmed	M	52	Married	Illiterate	"	Farmer
26	Jemal mohammed *	M	49	married	Illiterate	D/Dawa area	Farmer
27	Jemila Suleman	F	71	Divorce	Illiterate	"	Farmer
28	Jewar Beyene *	M	57	Married	Illiterate	Guwatsihon	Farmer
29	Ketema Bekele	M	63	Married	10	filiklik	Farmer
30	Mesfin Abebe	M	45	Married	Read and write	Keffa	Farmer
31	Metadel Kefyalew	M	56	Married	8	Filiklik	Kebele v/chairman
32	Mohammed Hassan	M	47	Married	Read and Write	"	Farmer
33	Molla muche	M	36	Unmarried	Illiterate	Menegesha	Merchant
34	Mulugeta Taklu *	M	25	"	Illiterate	"	"
35	Nesru Amhed	M	21	Unmarried	8	"	Student
36	Netsenat Ketema	F	37	Unmarried	11	"	Student
37	Neway Ayalew	M	37	Un married	Diploma	"	DA
38	Obsa Boru	M	29	Married	3	"	Farmer

39	Radiet Dararo	M	27	"	10+3(diploma)	"	Employee
40	Regasse Senbeta *	M	41	Married	9	Sululta	"
41	Roba Bokku	M	49	Divorced	Read & write	"	Merchant
42	Rufael Aman	M	24	Unmarried	9	Bonga	Student
43	Samuel Berhanu	M	26	"	10+1	Kejja hoddanno	Student
44	Tadesse Bedade	M	35	Married	Diploma	Filiklik	Kebela DA
45	Tagenu Daba	M	51	Divorced	8	Wesarbi	"
46	Tamirat Anbasse	M	36	Married	Read & write	"	Merchant
47	Tesfaye Gedafa	M	50	Married	7	"	security “ketene” coordinator
48	Tesfaye Mekonnen	M	39	Married	7	Entoto	"
49	Teshome Borboda	M	38	Unmarried	10	Chanco	Farmer
50	Tidanek Yilma	F	46	Divorced	Read & Write	AA	daily labor
51	Tsigereda Tarekegn	M	46	Married	8	"	Farmer
52	Woldeyesus Melkamu	M	30	"	10+2	"	Student
53	Yirgaw Alemayehu	M	60	Married	Read & Write	Sansusi	Security
54	Zakir Mohammed	M	59	Married	Read & Write	"	Farmer
55	Zeleke Mekata	M	33	Unmarried	10	Weserbi	Merchant
56	Zenebech Worku	F	45	Married	Read and write	"	Farmer

*Shows the key informants

Appendix 4 Data Collection Format with questions as interview guide

1. General Information

Informant's Name_______________ Age_____ Sex _____

Location: Region__________Zone __________Wereda_____________Kebele____

Local name of the CWR ______________ Soil type________

Altitude _____Latitude _________________ Longitude _______________

Cropping season (Meher, Belg, Kiremtor others) ______________________

2. Ethnobotanical Information

1. What are the major crops commonly cultivated in your area?

No	Crop cultivated local name	Language	CWR local name	Language	Meaning	Habitat	Uses of CWR	Part used

____

2. Is there any wild plant related to the cultivated crop? What is it called________________

   ____

3. What are the functions of those species identified as wild relative of crop in your community? / For what purpose do you use them? List for each species

   A. Fodder D. Spices

   B. Food F. Construction

   C. Medicinal

   List if any____

4. List traditional way of classifying vegetation, soil types, and landscapes in your area

   A. Vegetation____

   B. Soil types ____

C. Landscapes____

5. Where do most crop wild relatives grow?

   A. Inside the forest

   B. Inside/ at margin of the cultivated crops

   C. Road sides

   D. Inside forest

   E. Ingrassland

   F. others

6. Has the diversity of WR Increased or decreased through time?

   ____

7. Reason out for question No 6____
8. What is so special about this plant? ____
9. Is there 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: **Debela Daba** Signature: _______________ Date: _____________

This work has been done under our supervision.

Name: **Prof. Zemede Asfaw** Signature: __________________Date: ___________

Name: **Prof. Ensermu Kelbessa** Signature: __________________Date: ___________