

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES



AN ETHNOBOTANICAL STUDY OF USEFUL PLANTS OF THE FARMING SITE IN
GOZAMEN WEREDA, EAST GOJJAM ZONE OF AMHARA REGION, ETHIOPIA



BY
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**An Ethnobotanical Study of Useful Plants of the Farming Site in
Gozamen Wereda, East Gojjam Zone of Amhara Region, Ethiopia**

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List of Acronyms

CSA= Central Statistical Agency

EARO= Ethiopian Agricultural Research Organization

FAO=Food and Agricultural Organization

IBCR=Institute of Biodiversity Conservation and Research.

IPGRI= International Plant Genetic Research Institute

WHO= World Health Organization

EMA=Ethiopian Mapping Authority

MoARD= Ministry of Agriculture and Rural Development

EIAR= Ethiopian Institute of Agricultural Research

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Abstract

*An ethnobotanical study of useful plants in Gozamen Wereda with special emphasis on cultivated plants was conducted from November 20/2009- January 1/2010. The study was aimed at documenting indigenous knowledge of people on plants in their farming complex and maintenance of local crop genetic resource. Six kebeles were selected based on altitude range between 1500 and 3500 m a s l., at which many crops can grow. Sixty farmers (10 females &50 males) were systematically selected from 120 farmers that have well established homegarden and farm fields. Ten key informants from 60 ordinary informants were selected systematically. The data were collected using semi-structured interviews, direct field observation, group discussion and market survey. The collected data was analyzed by using preference ranking, direct matrix ranking, paired comparison, and use value analysis. A total of 136 plant species (29 trees, 30 shrubs, 73 herbs, and 4 climbers) in 48 families were collected and identified from two farming sites. The plants can be grouped in to 10 major use categories i.e., 39 multipurpose plants, 38 food plants, 19 medicinal plants, 10 spice plants, 8 nutraceutical plants, 7 both spice and medicinal plants, 4 both fragrant and medicinal plant, 3 stimulants, 1 fragrant plant and 7 others. Food plants are further classified in to major classes as cereals, pulses, oil crops, fruits and vegetables. Preference ranking on major cereal crops for making ‘injera’ and use value of 8 farmer’s variety of *Hordeum vulgare* was made. Traditional practices like selecting the soil type, improving the fertility of soil, determining time of sowing, obtaining planting materials through different methods, seed storage techniques, weed and pest management, mixed cropping, perception about exotic seed and their effect shows the farmers diversified knowledge in their farming system. The market utility value of desired fragrant plants, vegetables and threats that hinder production of major fruit and vegetable crops were further analyzed by paired comparison. In general, the local people are experts on plants that are grown in their homestead and farm fields. Before deciding to clear or cut or weed the plant, farmers evaluate the plant based on different criteria acquired through their life long experience than ordinary agriculturalists decide to reach conclusion about the plant. A greater evaluation criteria in kind and dimension have been giving a chance to the plant either tolerated, managed and/or cultivated by farmers so as to conserve agrobiodiversity of the study area.*

1. INTRODUCTION

1.1. Background

Plant use and plant-human interaction are shaped by history, by physical and social environment. The role played by plants reflects the biological and physical properties of the plants, the biological and perceived needs of humans, the natural and anthropogenic environments of which the plants are apart, and the genetically limited responses of plants to human disturbance. Ethnobotany is the study of this plant-human interrelationship embedded in dynamic ecosystem of natural and social components (Alcorn, 1997; cited in Lukasser and Vogl, 2002). In the beginning, plant use was restricted to food, medicine and shelter but with time man explored the potential of plants for a number of other purposes hence their dependency on plants increased both directly and indirectly (Ali and Qaiser, 2009).

Ethiopia is one of the world's eight major centers of crop diversity (Vavilov, 1997), and like many developing countries depends up on its rich biodiversity for its socioeconomic development (Yigardu Mulatu, 2005). Ethiopia is the home of amazing system of indigenous knowledge that helped the people survive under adverse environmental conditions, famine and poverty (Amanuel Assefa and Tesfahun Fanta, 2006). Farmers in Ethiopia manage their cropping system with considerable indigenous skill. For millennia, they have been the generators and curators of the rich assemblage of crop biodiversity under their custodian ship (Shewaye Deribe *et al.*, 2002).

As Tesfahun Fanta (2000a) explains, in Ethiopia, traditional farming represents centuries of accumulated experience and skills of peasants who often sustained yields under adverse farming conditions using locally available resources. The foundation of Ethiopian farming is composed of the traditional crops and farmer's varieties which farmers have adapted over centuries of selection and use to meet dynamic and changing needs. Ethiopian farmers are instrumental in conserving germplasm as they control over the bulk of the country's genetic resources

Human beings depend mainly on plants and to a lesser extent on animals for the basic requirements of their existence (Teskaye Awas *et al.*, 1997). This indispensable dependence of

humans on plants for their livelihoods primarily started with domestication and dates back to 10,000 years (Martin, 1995). The collection of useful plants and animals around homes must have gradually lead to small scale plant and animal husbandry, whose continued intensification resulted in the emergence of full- scale agriculture in gardens and fields (Zemedede Asfaw and Ayele Nigatu, 1995).

Studying the relationship between people and plants and the significance of plant use knowledge towards the well being of the community is extremely important (Martin, 1995; Cotton, 1996). Through ethnobotanical study it is possible to find out how people have traditionally used plants, for what purpose and how they are still doing so (Ford, 1978).

1.2 Justification

According to reports made by ethnobiologists (Martin, 1995; Posey, 1999) modernization is dominating the life styles of traditional society resulting in cultural and environmental changes. Consequently, the indigenous knowledge vital to sustainability to agrobiodiversity is being lost at an incredible rate. A decline in the transfer of indigenous botanical knowledge cause not only loss of the knowledge and skill of planting, but also the plant themselves will be irreversibly lost.

Ethnobotany is a key science for working with local people on the botanical aspects of conservation and development. Ethnobotany remains the leading tool in finding how people have traditionally used plants (Martin, 1995; Balick and Cox, 1996). An ethnobotanical research is very crucial for a country like Ethiopia, where local people depend on local plant resource for their livelihood.

Traditional knowledge is the information that people in a given community have developed, based on experience and adaptation to a local culture and environment (Stephen and Justin, 2003). Such knowledge is a potential for reducing hazards and maintaining cultural and biological diversity. Therefore the results of this ethnobotanical study are also expected to give a clue on the current states of traditional knowledge and utilization of cultivated plants in and around homegarden.

In this study useful plants in the farming site were studied by using appropriate ethnobotanical methods, but emphasis was given to cultivated plants. Homegardens are realized as an important self sustaining agroecosystem with the dual function of production and on farm conservation of the agro-biodiversity (Zemedede Asfaw and Zerihun Woldu, 1997).

1.3 Statement of the Problem

- The value of traditional homegardening in the conservation and management of use full plant species by indigenous people of the Wereda were not well recognized. Moreover, most of the natural vegetation and forest of the study area are almost totally lost by human impact and hence monoculture practice is becoming a common phenomenon.
- Loss of biodiversity, disruption of indigenous knowledge, practice and cultures is becoming evident due to limited integration of traditional practices and modern science in the study area.
- Much of the information to be generated through ethnobotanical studies remained outside the sight of scientific community.

1.4 Null Hypotheses

- There are no significant number and diversity of useful plants in the farming site in the study area.
- Traditional practices and cultures have no contribution to the management and conservation of useful plant diversity in the farming site in the study area.
- There is no imperative problem associated with useful plants especially cultivated ones in the study area.
- There are no gender differences in plant knowledge and traditional management of home gardens and field crops.

1.5 Objectives of the Study

1.5.1 General Objective

➤The general objective of the study is to assess and document traditional knowledge of the use and management of useful plants in the farming site and to generate and make available information on the role of homegardening and field cropping practices so as to cultivate plants in promoting food security in the study area.

1.5.2. Specific Objective

➤To gather, record and document the indigenous knowledge of the Gozamen Wereda people on the use and management of useful plants in the farming site.

➤To identify the conservation status of local crop species /varieties and factors that influence their availability and on farm diversity

➤To list out farmers activities to manage cultivated plants in the farming site and propose the prospects for its enhancement in the area

➤To find out threats and the local methods used by indigenous people to conserve cultivated plant.

➤To contribute to the building up of ethnobotanical information's on useful plants and to provide baseline data for future studies to enhance agricultural sustainability.

➤To give the scientific explanation for the traditional agronomic practices of the people related to maintaining planting material, farming and harvesting.

2. LITERATURE REVIEW

2.1 Ethnobotany

Martin (1995) defined ethnobotany as the study of local people's interaction with the natural environment: how they classify, manage and use plants that are available around them and Balick and Cox (1996) defined it as the relationship between plant and people. Ethnobotany studies the complex relationship between plants and cultures on how plants have been or are used, managed and perceived in different societies (Tesfaye Hailemariam *et al.*, 2009). Therefore, the role played by plants reflect the biological and physical properties of the plants, the biological and perceived needs of humans, the natural and anthropogenic environments of which the plants are apart, and the genetically limited responses of plants to human disturbance.

Generally ethnobotany serves as a tool to document knowledge of people on plant uses by merging different methodologies and disciplines. Documentation of the indigenous knowledge, which is part of the ethnobotanical studies, includes cultural use of plants as medicine, food preparation (food, spices and condiments) and their preservation and management. For example, the study on plants showed that they have been used for thatch for huts, timber for boats, fibers for textiles and dyes to color them, and other uses at early stages in human prehistory (Balick and Cox, 1996).

2.2 Indigenous Knowledge (IK)

According to the convention on biological diversity (CBD), traditional knowledge refers to the knowledge, innovations and practices of indigenous and local communities around the world. Article 8 (i) of the convention on biological diversity states that: each contracting party shall, as far as possible and as appropriate, subject to national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional life styles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge innovations and practices.

As the convention on biological diversity points out, traditional knowledge is of great importance not only to those who depend on it in their daily lives, but to the western society as well. Many plant based medicines and cosmetics are derived from traditional knowledge can also help to achieve sustainable development. Most indigenous and local communities are situated in areas where the vast majority of the world's plant genetic resource is found and many species have been cultivated and used in a sustainable way for thousands of years. The skill and techniques of these indigenous and local communities and can be use full model for biodiversity polices.

As Cunningham (1996) pointed out both saving plant species and documenting and preserving indigenous knowledge are fundamental urgent issues to be accomplished. An ethnobotanical research can play an important role by helping to preserve and disseminate traditional knowledge. Development practitioners and researchers are not much interested in building on the success full and worthwhile indigenous knowledge as the local people are confronted with new conditions and challenges (Amanuel Assefa and Tesfahun Fenta, 2006). Indigenous knowledge is a result of many generations', long years' experiences, careful observations and trial and error experiments (Martin, 1995). Thus over centuries, indigenous people of different localities have developed their own specific knowledge on plant resource use, management and conservation (Cotton, 1996).

2.3 Useful Plants

The usage of plants usually relate to peoples conceptualization of the importance of plants including their use for food, medicine, cosmetics, dyeing, textiles, for building tools, clothing and ritual ([http://www. Ethnobotany-wikipedia](http://www.Ethnobotany-wikipedia), the free encyclopedia html). Therefore, plants which are familiar and recognized by the local people as having a beneficial use can be domesticated and cultivated on a large scale. Management and conservation of plants began with prehistoric human's endeavor of domesticating wild plants. It is along and complex process and many plants are found in various stages of domestication as a result of human selection (FAO, 1999).

Crop cultivation started early in Ethiopian civilization, with the domestication of new and unique crops from the field and forest (Harlan, 1969). Some of these are grown nowhere else; this includes tef (*Eragrostis tef*), niger seed (*Guizotia abyssinica*), ensete (*Ensete ventricosm*) and cabbage (*Brassica carinata*). Cultivated or domesticated plants or plant species that have arisen through human action, such as selection or breeding and that depend on management for their continued existence (FAO, 1999) also included in this domain.

Farmlands and gardens are source of cultivated plants. The collection of useful plants and animals around homes must have gradually led to small scale plant and animal husbandry, whose continued intensification resulted in the emergence of full-scale agriculture in gardens and fields (Zemedede Asfaw and Ayele Nigatu, 1995).

2.3.1 Major use categories of useful plants

2.3.1.1. Food

Depending on their tradition, the people of the world feed up on various types of food. However 90% of the food is derived from plant materials and most of this are of high nutritional value (Tigist Wondimu *et al.*, 2006).

In Ethiopia, there are lots of food materials that are obtained from either cultivated or non cultivated plants. For example, Zemedede Asfaw and Mesfin Tadesse (2001) estimated that 8% of the higher plant species in the country are edible, and 25% of these are cultivated. Ethiopia has many indigenous food crops (Harlan, 1969; Zemedede Asfaw, 1997). *Eragrostis tef*, *Ensete ventricosum*, *Brassica carinata*, *Plectractus puncatus* subsp. *edulis*, *Guizotia abyssinica* and *Coccinia abyssinica* are the well known examples of indigenous crops (Harlan, 1969; Zemedede Asfaw, 1997; Zemedede Asfaw and Mesfin Tadesse, 2001).

As Tigist Woundimu *et al.* (2006) presented about thirty species of cultivated plants were documented from Arsi. Among these, 8 species are oil crops and 2 species are cash crops. The largest number for the cultivated plants goes to herbs (63%) and the seeds are the most usable parts (19.72%). These cultivated plants are mainly from Fabaceae, Asteraceae, and Rutaceae,

which is cultivated in the farmland and the people considers as the main source of staple food. Barley (*Hordeum vulgare*), Wheat (*Triticum Spp*), Maize (*Zea mays*), and Tef (*Eragrostis tef*) are mainly produced for consumption. Others like pea (*Pisum sativum*), chickpea (*Cicer arietinum*), haricot bean (*Phaseolus vulgaris*), lentil (*Lens culinaris*), and linseed (*Linum usitatissimum*) are produced mainly for market.

2.3.1.2. Traditional medicine

In Ethiopia, more than 95% of traditional medical preparations are of plant origin (Dawit Abebe, 1986), and more than 80% of the people are dependent on plants for their health services (Dawit Abebe, 2001). The wide spread use of traditional medicine among both urban and rural population in Ethiopia could be attributed to cultural acceptability, efficacy against certain types of diseases, physical accessibility and economic affordability as compared to modern medicine (Tilahun Teklehaymanot and Miruttse Giday, 2007). Medicinal plants may be defined as those that are commonly used in treating and preventing specific ailments and diseases and that are generally considered to have a beneficial role in health care (FAO, 1999).

Medicinal plants are plants that are used to treat some diseases of human and or other animals. Traditional healers practice on these plants because of their availability and hence, they are called as traditional medicine. Primitive peoples in all ages have had some knowledge of medicinal plants, derived as the result of trial and error (Hill, 1989). Medicinal plants were traditionally used for health care and serve as the bases for the emergence of modern medicine. About 6,000 medicinal plants are believed to be used in traditional medicine globally (Dawit Abebe *et al.*, 2003). Most of the medicinal plants are directly used from the wild and rarely from home gardens. However, home gardens played important role in cultivating and retaining medicinal plants beyond other useful plants (Belachew Wasihun *et al.*, 2003).

Traditional medicine is cheaper and more accessible to most of the rural population and could become the potential source of the new drugs. It was reported that 60-85% of the population in every country of the developing world has to rely on traditional or indigenous forms of medicine (Sofowora, 1982). Many of the most important drugs of recent times were first isolated from plants (Dawit Abebe *et al.*, 2003).

The efficacy of a given plant may vary from others on the basis of the site of action, dosage of the constituent and the different constituents it may embody (Dawit Abebe *et al.*, 2003). Many problems can be identified in relation to the use of medicinal plants in Ethiopia, such as over dosage and lack of adequate knowledge (Kokwaro, 1979), beliefs (Kebu Balemie *et al.*, 2004), over harvesting, destruction and keeping the knowledge secrete and confidential (Afewerk Kassu, 2004, Kebu Balemie *et al.*, 2004).

2.3.1.3. Multipurpose Use

Despite the increasing influence of synthetic alternatives and rapid acculturation, plants remain vital to many aspects of traditional life such as tools, shelters and clothing as well as more decorative arts and crafts, component of contraction work such as load bearing house posts and roof supports, as well as for side wall, roof shingles, thatching, lashing materials (cordage), doors, windows and flooring Cotton (1996). Among the many functions of plants that can be recognized by the people, using it as a source of energy supply is the major one. As Yigardu Mulatu (2005) outlined, woody biomass is the largest source of energy supply accounting for 77-78% and dung and crop residues providing 16%. Currently, fuel wood is scarce in 75% of the country (Azene Bekele, 2007). Such shortage of fuel wood leads to an increase use of crop residues and cow dung to compensate for the increasing scarcity and cost of firewood. The use of crop residues and cow dung as fuel instead of applied in to the farmland will lead to diminishing of soil fertility, which will, then results in lower agricultural products.

In principle all types of wood can be used, as a source of fuel but if wood is abundant then only particular categories of wood are selectively used. In times of scarcity, however, the order of preference decreases successively and form lack of option as a result the less preferred categories might be used (Lumasia, 1995). Various parts of woody plant species including their leaves, twigs, barks, fibers along with non- woody plants belonging to the grasses, sedges, climbers are incorporated into the construction of traditional dwellings (Abbiw, 1990).

2.4 Traditional Farming System

The most familiar methods adopted to overcome the adverse effect of water logging in Ethiopia are improving surface drainage or reduce water logging through the application of flat bed planting, drainage furrows, ridges and furrows, handmade beds and furrows, post rain planting and soil burning (EARO, 2001). In high rainfall areas and lower slope highlands of Ethiopia; ridges and furrows having a width of 40 to 60cm and height of 10 to 15cm are maintained using traditionally made 'Maresha' and oxen-drawn plough on which durum wheat cultivation is common on top of the ridges (EARO, 2001). The traditional farming system, which contribute to the conservation of cultivated and non-cultivated plants in Ethiopia include: Traditional field crop practice, Traditional home-gardens, Traditional seed exchange, traditional soil and water conservation practices

2.4.1. Traditional field crop practices

The spatial and temporal distribution of crops (farmer's varieties) demonstrates farmer's active role in maintenance of indigenous crops and agricultural innovations, which survived for generations as distinct species, land races, practices and skills (Shewaye Derby *et al.*, 2002). Farmers who have an array of crop selection criteria tend to maintain greater agrobiodiversity by planting different crops and varieties or land races to fulfill their diversified demands (eg, yield, early maturity, drought resistance, market value, weed resistance, insect pest resistance, straw quality, threshability, and beverage quality (kirose Melese, 2008).

Small scale farmers in various region of Ethiopia quite frequently practice intercropping (growing of two or more crops on the same land during the same season) or even grow their crops in mixture, to stabilize their crop production especially under adverse growing conditions (Melaku Werede *et al.*, 2000). Crop rotation is also a very customary farming practice in various regions of Ethiopia with great emphasis in the study area due to the growth of cereals and pulse field crops (EARO, 2001).

Diversity of crops both in time and space is a traditional strategy to ensure harvest security or stability of production to promote diversity of diet and income sources, to minimize crop failure risk, to reduce insect and diseases incidence and to ensure efficient use of labor (Yemane Tsehay *et al.*, 2006). The foundation of Ethiopian farming is comprised of the traditional crops and land races which farmers have adopted over centuries of selection and use to meet dynamic and changing needs (Melaku Werede *et al.*, 2000).

2.4.2 Traditional homegardens

The homegarden system differs from all agricultural production system by its major role for domestic use, location, diversity and its size. It is a fenced or protected area around homestead where crops, vegetables, fruits, medicinal plants, spices, fodder and other plant species are intensively integrated (Shrestha *et al.*, 2004). In Ethiopia also the home-gardens are described as highly managed, mixed gardens of trees, shrubs and herbaceous species close to home (Zemedede Asfaw and Ayele Nigatu, 1995). The evolution of homegardens possibly started from shifting cultivation practices that were used to overcome problems of resources and to a certain rights to land resources. Hence, homegardens have been described as living 'gene banks' in which a variety of germ plasm, in the form of indigenous varieties, land races and rare species thrive side by side and has been preserved through generations (Tesfaye Hailemariam *et al.*, 2009).

Two types of home gardens are recognized on the bases of their contribution to the welfare of households (Tesfaye Abebe, 2005). The first one is small-scale supplementary food production system around houses in areas where livelihood of the owners is based on other land use or other activities. It is common in much of the tropics. The second category of home gardens is extended farm field around houses that form the principal means of livelihood for farming households.

2.4.3 Traditional Seed Exchange

Farmers' portion of quality seed sources are dependent on the real situation of farmers' localized environments such as; local source of own-saved seeds, social networks of relatives,

neighborhoods, cultural practices, traditional relationships including shopkeepers and open-air grain market traders that play coinciding roles (FAO, 2002). Conversely, it is difficult in some areas to come seeds in the next cropping season by most households since they consume it in the dry season of March and April due to lack of any other source of grain for food (FAO, 2002).

Local seed supply system or informal seed supply system or farmer seed system is defined as in which selection, production and exchange are integrated in to crop production and socioeconomic process of forming communities (Almekinders and Louwaars, 1999). It deals specifically with the processes, which farmers use to produce, obtain, maintain, develop and distribute seed resources both from one growing season to the next in the long run.

2.4.4. Traditional soil and water conservation practices

Ethiopia has a long history of indigenous soil and water conservation technologies such as stone bunding (Alemayehu Mengistu *et al.*, 2006) and other physical conservation structures traditionally built by farmers such as cheek dams and cut-off drains (Esser, *et al.*, 2002). Farmers also practiced contour plowing, grass strips, tree planting, terracing, fallowing, mulching, and crop rotation to improve soil fertility and there by agricultural productivity.

Farmers practice crop rotation as a means to conserve soil fertility by planting legumes one year and non-legumes the following cropping seasons. Farmers incorporate legumes in their crop rotations approximately every four years (Esser, *et al.*, 2002). In addition, farmers restore soil fertility and reduce nutrient lose by incorporating crop residues and dung in to the soil or using them as mulch (Tilahun Amede *et al.*, 2001). Leaving cropland fallows is a common practice in many parts of Ethiopia. This is intended to allow the soil to rest and regain some of its fertility from the growing vegetation. However, due to scarcity of land resulting from population pressure in many areas, fallow periods have became very short and rare, if extent at all (Esser, *et al.*, 2002).

2.5. On-farm Conservation

It is a kind of in-situ conservation, which allows the maintenance of organisms in their natural habitat. For cultivated crops, on farm conservation of genetic resources refer to the continued cultivation and management by farmers of crop population in the open, genetically dynamic system where the crop has evolved (Bretting and Duvick, 1997). The genetic diversity of

traditional varieties of crops is the most economically valuable part of global biodiversity and is of paramount importance for future world crop production (Tesfahun Fanta, 2000b).

On farm conservation involves farmers continued cultivation and management of diverse set of crop populations and accompanied taxa in the agro ecosystem where the crop evolved, or in secondary centers of diversity (Almekinders & Louwaars, 1999). In situ conservation of genetic resources can also specifically target the conservation of local varieties or land races (Alvarez *et al.*, 2005). In this case the farm agro ecosystem is considered to be habitat where the genetic diversity developed or originated. Conservation at farm level allows continual farmers' selection, interaction with environment and gene exchange with wild species so that evolution of land races may continue. On farm conservation practices by farmers influence the evolutionary force acting up on crop plant population.

Ethiopia is one of the world's richest regions of crop diversity and its genetic resources are of considerable value both within and outside Africa. Among the numerous examples is yellow Dwarf virus resistance Ethiopian barley by which California's 160 million dollars income is dependent on; as well as, the high lysine gene found in sorghum. Much of this diversity is still in the hands of the traditional farmers despite depletion of some (Harlan, 1969). The recognition of this situation has served as a basis for inception of on farm farmers' varieties maintenance and enhancement strategy, in the year 1989 through the project entitled a dynamic farmer based approach to the conservation of Ethiopia plant genetic resource founded by the global environmental facility (IBCR, 2001).

2.6 Ex-situ Conservation

The limited supply of good-quality seed for local varieties can be an obstacle to farmers' continued maintenance of genetic diversity. One potential means for overcoming this limitation is the establishment of community bio-diversity registers or community gene banks. Community gene banks may provide a way for farmers to store valuable land race germ plasm in a community based ex-situ setting. This approach may further enhance benefits when integrated with a seed exchange network, helping to improve farmers' control over their genetic material (Fassil Kebebew, 1999; IBCR, 2001).

Ex- situ conservation, however, has several problems related to the flow of diversity. Classical seed banks collect biodiversity from farmers' fields, but have not been made available to farmers i.e. the diversity flows from the source to gene banks and from there to the breeders, but not back to farmers, who are therefore deprived from playing the role of conservator, innovator and consumer genetic diversity. Thus, stocks would be eroded from the source and obviously leads to the impossibility of sustainable agriculture (Nablus, 2006).

2.7. Agrobiodiversity

Biological diversities are the basis of life for all human beings in the world. Agriculture and agrobiodiversity are the two basic components that sustain the lives of the world nations. Farmers have traditionally maintained them as a means of insuring stability because farmer's varieties often have a unique food use, provide good animal feed, meet additional household needs or have religious, ceremonial and cultural significance (Frankel *et al.*, 1995)

Genetic diversity of plant species is the unique and irreplaceable source for further genetic improvement of crops and for higher diversity of crops and cultivars in agriculture. The genetic diversity of agricultural crop is represented by bred cultivars, land races and other genetic stock (breeder lines, experimental lines) as well as by wild relatives of cultivated plants. All these materials form a gene pool of agricultural crops which is used to improve important traits, to broaden the genetic bases of cultivars and also as a source of new diversity for agriculture (alternative use of crops, utilization of neglected crops, broadening the spectra of crops grown) (Dotlacil *et al.*, 2002).

At present genetic diversity in agriculture as well as in nature is often seriously endangered. In nature biodiversity has been reduced due to the industrial development, climatic changes and agricultural practices. The biodiversity of crops in agricultural systems also decreased during the last century and especially during the last 50 years the diversity of local and well adapted farmer's varieties has been replaced by a much narrower spectrum of breed cultivars that are often genetically similar. Some valuable original resources were lost in many crops in most countries (FAO, 1998)

3. STUDY AREA AND METHODS

3. 1. Description of the Study Area

a. Geographical Location

Gozaamen Wereda is one of the 18 Wereda in East Gojjam Zone and 151 Weredas in Amahara National Regional State (GWAO, 2008). The relative location of the Wereda is 300 km away from the capital city of the country, Addis Ababa and 260 km from Bahirdar, the zonal capital city. This Wereda is found almost mid way from Addis Ababa to Bahirdar. The geographical location of the Wereda is $10^{\circ} 36' 18''$ N and $37^{\circ} 55' 02''$ E. The Wereda is bounded by Senan Wereda in the North, Basoleben Wereda and Oromiya National Regional State in the South, Aneded and Debay Tiltagen Wereda to the East and Machakle and Deberea Elias Wereda in the West. The study area showing the study site is presented in Fig. 1.

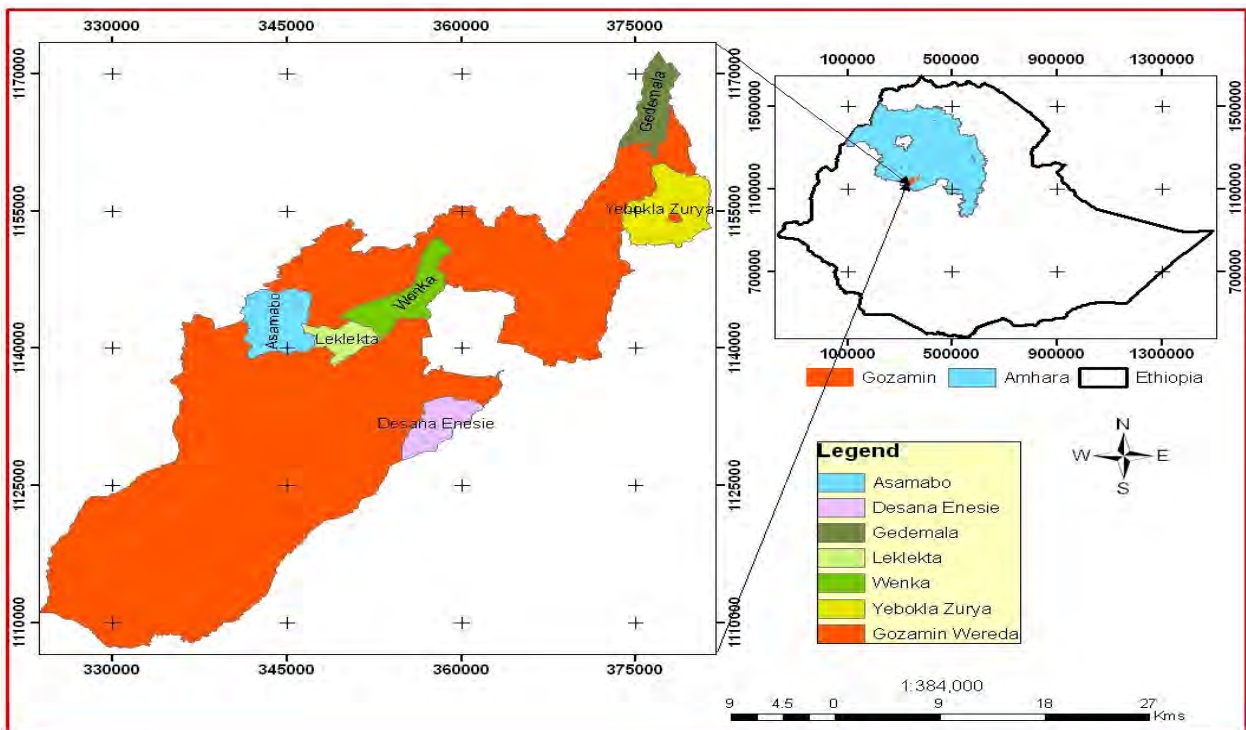


Figure 1. Map of the Study area showing the sampling sites.

b. Population density

The Wereda has a population size of 133,656 of which 66,875 males and 66,981 female: 2,583 (1.93%) of the population are urban dwellers which is less than the Zonal average of 9.88 % (CSA, 2007), more over with an estimated area of 1,218.07 square kilometer, it has an estimated population density of 109 people per square kilometer which is also less than the Zonal average of 179.96. The ethnicity of the Wereda population is Amhara and Amharic is every body's language.

c. Climatic condition

Climatic elements such as precipitation, temperature, humidity, sunshine and wind are affected by geographic location and altitude. Ethiopia, being near the equator and with an extensive altitude range, has a wide range of climatic features suitable for different agricultural production systems. The study area precipitation & temperature were presented in Fig 2.

d. Geomorphology and Vegetation Type

The topography of the Wereda is characterized by three major agroclimatic zones with in altitude range of 1000-3500 meter above sea level: Dega (35.55%), Weina Dega (41.41%), and Kola (15.72%). The Wereda relief in percentage is given as: Plateau 45%, Mountain 48% and Valley 7%. With respect to soil type, the majority of the Wereda soil belongs to vertisole and lithosole (GWAO, 2008).

According to Zerihun Woldu (1999), the vegetation of the study area is of two types. One, Afro-alpin and Sub-Afroalpin vegetation. This vegetation type is found at Gedemala Kebelle that borders Chokie Mountain. The common plant species is *Erica arboria*, *Hagenia abyssinica* and others. The people in this area cultivate mostly *Hordeum vulgare* L., *Solannum tuberosum* L. and *Vicia faba* L. since productivity of crops is low because of the low growth rate. Second vegetation type is Dry Ever Green Mountain Forest. This vegetation type according to Zerihun Woldu (1999) roughly occurring above 1500m and below 3200m altitude.

In this vegetation zone sedentary rain feed agriculture is practiced and the economy of the people primarily based on mixed cereal agriculture with the farmers growing tef, finger millet, sorghum, maize, barley, wheat, as well as pulses, oil crops, vegetables and fruits. Due to high anthropogenic effect in the study area forests have been lost but remainenat plants around holy places, inaccessible areas, and left for shade trees and on grazing lands are observed. Some of the vegetations are *Juneperus procera*, *Hagenia abyssinica*, *Podocarpus falcatus*, *Acacia abysinica*, *Cordia africana*, *Ficus sur*, *Erythrina brucei*, *Eucalyptus camaldulensis*, *Calpurnia aurea*, *Prunes africana*, *Carissa spinarum*, *Rosa abyssinica*, *Dombeya torrida*, *Maytenus arbutifolia*.

e. Land use Pattern

According to the Wereda Agricultural Office annual report (GWAO, 2008), 34,690 hectare of the Wereda land used for plough, 10,000 hectares for grazing, 661.5 hectares are covered by shrubs and the 73,055.5 hectares belongs to other land use categories.

Cultivated land is a type of land cover where intensive mixed agricultural practices that depend on rain feed production of grains as well as sedentary livestock is being undertaken (EMA, 1988). The pronounced proportion of land owned by peasants is concentrated in the central high lands of Ethiopia; Country lowest values were possessed by the low lands and postural areas (CSA, 2006). In the study area farm fragmentation describes a situation where a farmer's land holding is broken up in to a number of small separate plots often distant from each other. This fragmentation can be caused by first, the land inheritance customs where inherited land is shared equally among matured sons and the second cause of fragmentation is that farmers considered agro ecologically diversified cultivation fields as a means of insurance for crop production when seasonal fluctuation in cropping system is encountered (CSA, 2006).

f. Socioeconomy

Crop production and livestock husbandry are the main economic activity of the study area. Farmers in the Wereda follow mixed farming system to make their living. teff, wheat, barley, maize, peas, bean and nug are the major crops produced in the area where as cattle (48.76%), sheep (40.39%), goat (2.59%), hourse (2.25%), donkey (5.92%) and mule(0.09%) constitute the life stock population (GWAO, 2008). Home gardening is also a common practice throughout the Wereda and agricultural products such as fruits and vegetables are important sources of both home consumption and commercial products in addition to crop fields. Major crop category cultivated in the Wereda during 'MEHER' season along with its area of plough and amount produced is presented in Table 1.

Table 1. Major crop production in two years

No	Crop category	In 2008		In 2009	
		Area in hectare	Amount produced	Area in hectare	Amount produced in (quintal)
1	Cereals	19242	746658	26004	906242
2	Pulses	2716	50890	1905	24584

3	Legumes	100	7861	2941	26786
4	Spices	100	1500	25	150
5	Vegetable	956	115342	28	3081
6	Fruit	2909	335732	588	90120
Total		26923	1287953	31491	1080584

Source, (GWAO, 2009) Annual report

3.2 Data Collection Methods

3.2.1 Selection of the study site

The study was conducted in six kebeles in Gozamen Wereda, East Gojam Zone Amahara National Regional State, from November 20, 2009 to January 1, 2010. The Wereda contain 26 different kebele with the range of 1000-3500 m a s l. The study sites were selected due to altitude, that represent the main cropping agroecological zone of the Wereda (1500- 3500m a s l). Dessana Enessie, Leklekita, Assamaboo and Wenka kebele that represents the Weyna Dega agroecology (1500-2500 m a s l) and Yeboklazuria and Gedemalla kebele that represent the Dega agroecology (2500-3500m a s l), were selected systematically. Kebeles found in the same altitude was selected by lottery type. Agroclimatic zone classification was taken from the Wereda Agricultural Office (GWAO, 2009)

3.2.2 Selection of informants

From one kebele 20 farmers were selected systematically by the direct participation of the kebele administrative and agricultural extension workers. Selection was based in accepting ideas forwarded by agricultural extension workers to do all agronomic activities and through direct observation that do have well organized gardening and field crop management. From these, 10 informants were selected randomly from each kebele. Therefore, a total of 60 ordinary informants were selected. From 60 ordinary informants, 10 key informants or local experts' i.e. local people who posses and share a profound indigenous knowledge of a particular aspect of local culture recommended by kebele admenstratives and agricultural agents were systematically selected.

3.2. 3. Ethnobotanical data collection and analysis

Ethnobotanical techniques were employed to collect data on knowledge and management of useful plants used by people in Gozamen Woreda as described in Martin (1995), Alexiades (1996) and Cotton (1996). The techniques were group discussion, semi-structured interviews, field observations, preference ranking and direct matrix ranking.

Semi-structured interviews

Semi-structured interviews are those in which some questions are pre-prepared and others arise during the time of conversation (Martin, 1995). These interviewing methods will let the researcher to inquire culturally appropriate questions in the course of conversation.

Free listing

A list of local terms that refers to the topic that we will study is one of the initial steps in collecting linguistic data for ethnobotanical studies. In this regard, useful plants in the farming site are listed categorically that will help characterize diversity of useful plants in the farming complex.

Preference ranking

One of the simplest analytical tools involves inquiring respondents their favorite use full plants in the farming site or allows them to preferentially rank a few items in the category. Preference ranking is based on one dimension. In this study the respondents were asked to rank cereal crops for making 'injera'.

Direct matrix ranking

Direct matrix ranking is a more complex version of preference ranking, unlike preference ranking it requires informants to order them by taking it to account several attributes at a time

i.e., it considers multiple dimensions. In this study, the interviewees were requested to rank top ten multipurpose plant items using a numerical scale in which the highest number will be equal to the “best” item and the lowest number to the “worst” by taking notice of 10 use attributes at a time. Eventually, the results of several individual responses were summed up to create a matrix that is representative of the community.

Paired comparison

The sequence of the pairs and the order within each pair were randomized beginning from the alphabetical list. The sequence are determined by numbering the pairs when they are in alphabetical order and then reordering them by reference to a random numbers table or by drawing numbered slips out of a hat. This enables as to determine whether the data gathered reflect perfect transitivity or inconsistent result. After doing that the treats and market utility of the top seven perishable food crops and market utility of the six desirable fragrant plants were analyzed.

Jaccard’s coefficient of similarity

This is used to determine the similarity in species composition of the study area with other study areas done by other researchers. The formula $S_j = [c / (a+b+c)]$, where S_j is Jaccard’s similarity coefficient, a is the number of species present in habitat A and absent in habitat B. b is the number of species present in habitat B and absent in habitat A. c is the number of common species to both habitats A and B (Coker and Kent, 1992). This was done to compare cultivated plants in homegarden with data given for Sabata (Habtamu Hailu, 2008) Welayta and Gurage (Zemedede Asfaw and Zerihun Wouldu, 1997) and in Arbaminch (Belachew Wasihun *et al.*, 2003).

Use value

Species importance was estimated by using use value analysis of Philips (1996).in the use value analysis; uses were categorized in to three classes, no use, minor use, and major use. The use value scores assigned to these classes were, 0, 0.5, and 1 respectively (Philips, 1996).the plant

use value was determined to evaluate the importance of each plant species to the ethnic people and was calculated as the average of the use value of the species. This methodology was used to analyze eight (8) *Hordeum vulgare* varieties collected in the study area:

$$U_v = \sum U_{is} / n_{is}$$

Where,

U_v is= the use value (U_v) attributed to a particular species (s) by one informant

(i)

$\sum U_{is}$ = summation of all the uses mentioned in each event by the informant

n_{is} = total number of events in which that informants gave information on the species

Market Survey

Market survey was conducted at four major markets in the Wereda. The market sites are found in three kebelles i.e. Chertekel, Yeboqla, and Gedemala. The Wereda people also use a large market at Debrmarkos town. These four markets were also used by people that came from nebourhiring Wereda. From the above mentioned markets, grains of crops were collected by assuring the source at which the grain is cultivated and came from the study sites. In general market survey gives a clear image or mind map about the Wereda food crops and other products of plants that have market utility.

3.2.4. Plant specimen collections and identifications

Useful plant species encountered in the farming site during the study were recorded and voucher specimens of the species when available including reproductive structures were collected, pressed, dried, identified and deposited at the National Herbarium (ETH), Addis Ababa University. The specimens were determined with the help of keys, descriptions and illustrations provided in the Flora of Ethiopia and Eritrea. In addition specimens that were not easily identified with the help of the flora were compared to well authenticated specimens housed at ETH. The local names, habits and other necessary information's were recorded for each of the species [appendix 3]. Additional references (Azene Bekele, 2007 and Dawit Abebe *et al.*, 2003) were used for facilitating the identification process.

4. RESULT

4.1 Emic Categorization Systems and Practices in the Study Area

The local people of the study area have local categorization techniques that focus on various environmental components including soil, land, vegetation and season.

✓ Local categories of soil

The local categories of soil have their own peculiar cropping times. The local soil types and their cropping time along with descriptions are presented in Table 2.

Table 2. List of soil type, its cropping time and description.

No	Soil type	Harvesting time	Description
1	Walka	September	Highly fragile in texture and high water logging ability during rainy season so that people plough this soil after the rainy season.
2	Borenk	-	Non harvestable soil (poor soil)
3	Debay	August	The soil fragile in texture and also it is water logging
4	Borebore	June to July 30	Light soil, easily eroded by wind, rain
5	Ashalma	July	Heavy soil, well drained and aerated soil relatively fertile
6	Dalcha	June	Very shallow less fertile soil

✓ Categories of arable land

a. Guaro- refers to home garden (farm land near the home and its surroundings). It is the land where more manure is applied and more fertile. It is usually fenced, protected and more intensively cultivated.

b. Massa- refers to the main crop field. The remote open fields distant from the home stead and because of their location, sometimes full day's work have to be set aside to work on this farm. Generally these farms are less fertile, less or no manure applied and usually planted with single with diversified variety or more than one crop species but it is the bigger plot than Guaro.

✓ Local categories of plants

a. Qut quato (refers to shrubs)

b. Zaf (refers to trees)

c. Hareg (refers to creepers and climbers)

d. Aremamo (refers to herbs)

✓ Local categories of season

There are four seasons that can be recognized by the local people for doing agronomic activities. The seasons and durations are presented in Table 3.

Table 3. Farmer's categorization of seasons

Season	Duration	Remark
'Kiremt'	It lasts from June to September(The main rainy season)	The highest labor peak season(Sawing and weeding) Farmers confront food shortage in this season
'Mehere'	It lasts from October to December	The second highest labor peak period Collecting matured food crops and threshing of cereal crops by animals are practiced.
'Bega'	It lasts from mid December to mid March (Driest season)	Labor reached on its lowest peak It is season of weeding and festivity
'Belg'	It lasts from mid March to May (small rainy season)	Season of land preparation (third highest labor peak) crops like <i>solannum tuberosum</i> L. some <i>Hordeum vulgare</i> varieties can be start to saw

4. 2. The spatial and temporal arrangement of useful plants in the farming site

The spatial arrangements of plants in the two farming site ('Guaro' & 'Massa') centering living houses vary in composition and diversity based on ecological, socioeconomic, personal preference and availability of market. In average, most of the inspected plants in the farming site have a typical zonation. Look at (Fig.3).

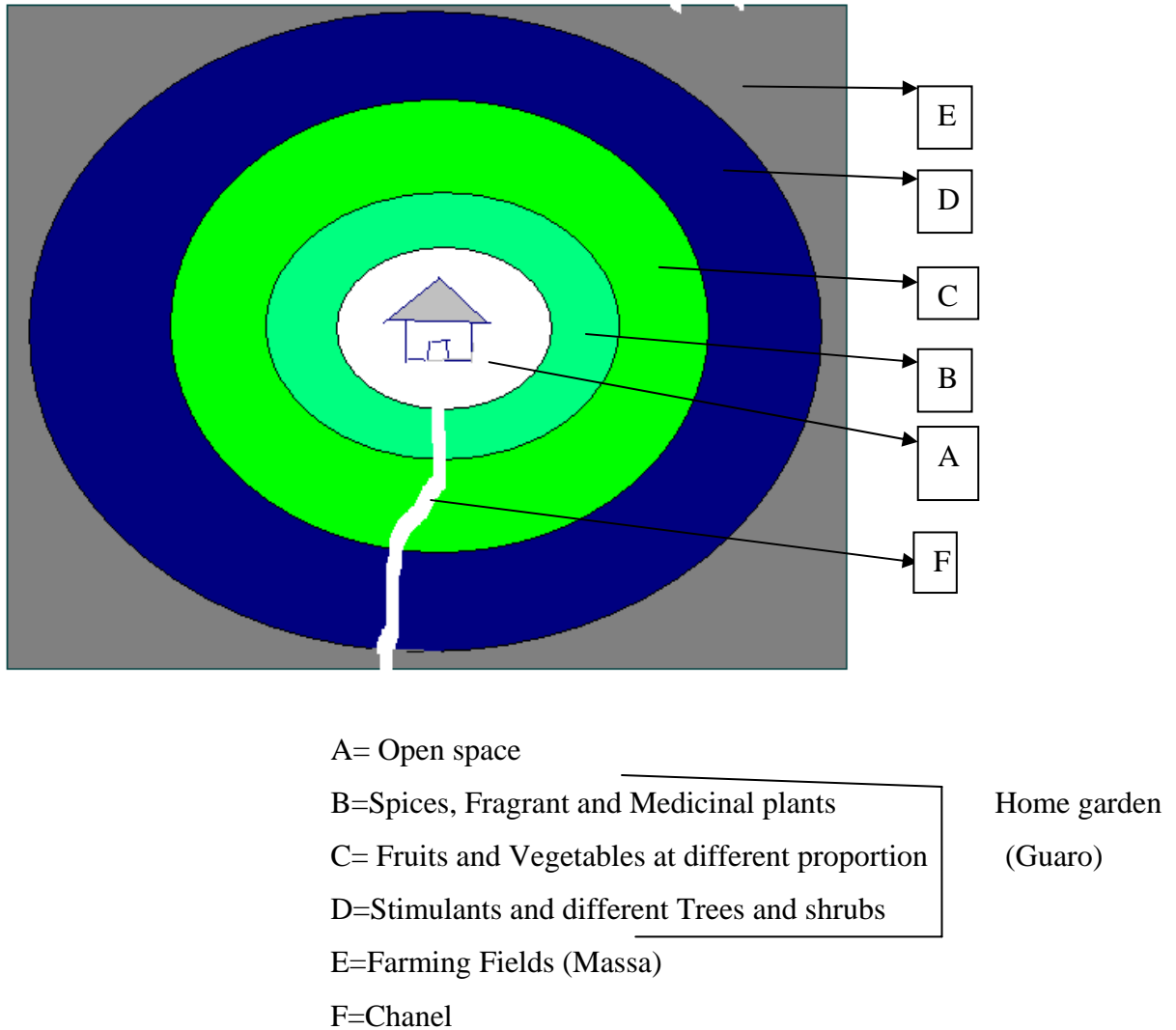


Figure 3. Model showing crop zonation in the farming site of the study area.

The spatial arrangement of plants follows certain pattern. The patterns with reference to the living house became as follows. Cattles are penned on the dawn hillside of the house and a channel is cut in the ground to take the urine and droppings out and dumped to the nearest side

yard. Zone B, C and D in the sampled study sites are considered as Guaro (home garden). The last zonation is considered as Massa (farming fields) and mainly cereals, pulses oil crops and trees that constitute the agroforestry system are present. The farming fields (Massa) and home gardens (Guaro) are separated by live fences at which multipurpose plants are mainly cultivated. Number of species of useful plants in these two farming site from different status of cultivation on major use category is presented in Table 4.

Table 4. Major use classification, number of species with their status and place of cultivation of collected plants in the study area.

No	Major use Classification	Total species	Status of management			Place of farming site in the study area		
			High	Medium	low	Hg	Fie	Both
1	Multipurpose plants	39	-	34	5	16	4	19
2	Spice plants	10	8	1	1	8	1	1
3	Fragrant plants	1			1	1		
4	Medicinal plants	19		1	18	8	8	3
5	Fragrant and Medicinal plants	4		4		4		
6	Spice and Medicinal plants	7	3	4		6	1	
7	Food plants	38	38			13	15	10
8	Neutraceutical plants	8	8			5	3	
9	Stimulants	3	2	4		3		
10	Others	7	1	3	3	7		
	Total	136	60	48	28	71	32	33

Where, Hg= Homegarden, Fie= Farm field

4.3. Useful Plant Complexity in the Farming Site ('Guaro' & 'Massa')

Local people in the study area give due attention for those plants that are deliberately cultivated or planted in their farming site and those plants that can be grown spontaneously in the farming site. The plant that can be grown spontaneously in the farming site should be evaluated by farmers based on their use and these outlooks contribute for plant diversity in the study area. One hundred thirty six (136) useful plants are documented in the study area due to the extended management activities done by the farmers. The detailed descriptions of these plants are presented in Appendix 3.

4. 3. 1 Plants that need low level of management

The criteria of the farmer grouping the plants in this level of management are; the plants have no well defined procedure to cultivate, they have limited use, they also considered as weeds by some farmers. In general, due to their use farmers tolerate these plants not to clear or weed from their homestead and farm field. A total of 29 plant species that can be distributed to 22 different families were tolerated by farmers at their homestead and farm fields. The people tolerate these groups of plants mostly for their medicinal application. 62.07% of the listed plants in this level of management can be exclusively serving for traditional medicinal application and other uses are presented in Appendix 6.

4.3.2 Plants that need medium level management

The ordinary informants in the study area grouped the plants in this level of management was due to their multi or diversified uses and their market utilities. In addition, these groups of plants were grown in nurseries, they can be protected by farmers, and farmers participating as seed dispersal agent, farmers bring seedlings from the natural habitat and plant them in their farming complex. If farmers get the seedling in their farming site they give special protection. Fragrant plants, trees and shrubs that make agroforestry in the study area can be grouped in this level of management (Appendix 3).

a. Fragrant plants

People use this group of plants for changing the smell of the surrounding or object /material that can be used as house hold utensil or they can be used in place of commercially made perfumes. The method of utilization and list of this group of plants are presented in Appendix 7.

Pair wise comparison was conducted by using 10 key informants to determine the highest market utility among the six (6) plant species collected in the study area that serves for fragrant. Analysis of responses indicated that *Olea europaea* subsp. *cuspidata* and *Otostogea integrifolia* takes the highest market utility. People in the study area believed that fumigation of the house by leaves and stems from the above two plants remove bad sprit from the house and they frequently fumigate their house. In addition, frequently used house hold utensils for example pots that store water and milk can be fumigated by leafs and dried small pieced stems of *Olea europaea* subsp. *Cuspidate*. Because of these reason it has the highest market utility. Others, like *Cymbopogon citratus*, *Artemisia absinthium* and *Myrtus communis* are served in relation with spiritual and cultural ceremonies unless and otherwise their market utility is reduced. Their statuses of market utility are presented in Table 5.

Table 5. Paired comparison by 10 informants of six fragrant plants based on market utility.

Name of the species	Respondents (R1- R10)										Total score	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
<i>Artemisia absinthium</i>	2	2	2	2	2	2	2	2	2	2	20	4
<i>Cymbopogon citratus</i>	3	2	2	2	3	3	3	3	3	3	27	3
<i>Myrtus communis</i>	0	2	2	2	1	0	1	2	2	2	14	5
<i>Ocimum lamiifolium</i>	0	2	0	1	1	2	2	1	1	1	13	6
<i>Olea europaea</i> subsp. <i>Cuspidate</i>	5	3	4	4	4	4	4	4	4	4	40	1
<i>Otostogia integrifolia</i>	5	4	5	4	4	4	4	3	3	3	39	2

Note that, *Olea europaea* subsp. *Cuspidate* is grouped in multipurpose plants in 10 major use classification.

b. Multipurpose plants

Thirty nine multipurpose plants are collected from farm site and hence 34 of them are listed under medium level management where as the rest 5 plants are under low level management. The plants are distributed to 24 families and 66.66% are trees, 25.54% are shrubs and 7.7 % are herbs. All of the species have more than 2 uses and out of the 39, 14 plants also serve the people as source of traditional medicine. The use diversity of this group of plants are; some of them used for making farm implements (raw material for oxen plough and materials that dig the soil, weed removing etc.), for food (children’s mainly engaged themselves to collect fruits from *Morus alba*, *Cordia africana*, *Ficus sur* and *Opuntia ficus-indica*), for live fence, for fuel (firewood and charcoal), for forage, for house construction, for furniture (making box, bed, chair, table, tool handle, utensil), for medicine, for shade and mislaneous uses. This group of plants also constitutes the agroforestry system of the farming complex in the area. The plants and their use can be presented in (Appendix 3).

Ten top plants based on their use I. e., greater than six uses, are selected for direct matrix ranking. 10 key informants are participated in the direct matrix raking. The result showed that *Eucalyptus globulus*, *Eucalyptus camaldulensis* and *Cordia africana* are top of the list, the rest are presented in Table 6. In the direct matrix ranking, the informants were told to give score of 10 for the use which they considered the best, 1 for the least and 0 for the uses not known for a specific use criteria.

Table 6. Direct matrix ranking of 10 multipurpose plant species by 10 key informants.

No	Scientific name	Use diversity										T	R
		Ch	Hc	Fr u	Fo	Fi	Fr	M	S	Lf	Fw		
1	<i>Acacia abyssinica</i>	59	67	0	48	60	42	0	72	62	30	440	7
2	<i>Albizia gummifera</i>	57	78	0	37	84	30	0	84	69	64	503	4
3	<i>Arundinaria alpina</i>	0	94	0	70	55	95	0	50	69	48	481	6
4	<i>Cordia africana</i>	48	88	47	84	55	100	0	42	26	36	526	3

5	<i>Croton macrostachyus</i>	67	36	0	0	20	63	81	73	69	90	499	5
6	<i>Cupressus lusitanica</i>	60	69	0	49	61	72	0	62	21	19	413	9
7	<i>Eucalyptus camaldulensis</i>	92	99	0	14	88	86	0	47	56	81	563	2
8	<i>Eucalyptus globulus</i>	100	10 0	0	14	98	89	61	37	55	96	650	1
9	<i>Juniperus procera</i>	58	65	0	40	59	60	0	73	30	24	409	8
10	<i>Senna singueana</i>	32	59	0	0	62	24	70	57	60	24	388	1 0

Where, Fi= Farm implement, Fru =Fruit, Lf=Live fence, Fw= Fire wood, Ch=Charcoal, Fo= Forage/ Foder, Hc= House construction, Fr= furniture, M =Medicine, Shade=S, T= Total, R=Rank

c. Traditional agroforestry

Agroforestry was found to be practiced in the study area. A large number of trees and shrubs were observed in the homestead and farm fields that have unreserved function for regulating the different ecological services. The detail feature of the plants and shrubs are presented in Appendix 3, but the number that they show in their farm sites and status of management are presented in Table 7.

Table 7. Total number of trees and shrubs that contribute to traditional agroforestry with their place and status of cultivation

Habit	No. of the plant	Farm site			Management Status		
		Hg	Fie	Hg & Fie	low	Medium	High
Tree	30	13	2	15		23	7
Shrub	28	20	4	4	9	6	13
Herb	1	1				1	1
Total	59	34	6	19	9	30	20

Note that, Hg = Homegarden (Guaro), Fie = Farm Field (Massa)

4.3.3 Plants that need High level of management

Food crops and majority of spices need high level of management i. e., farmers have well known agronomic procedures about these crops (Appendix 3). Food crops in the study area can be classified by informants as cereals ('Ye-bir' and 'Ye -ageda ihl'), pulses ('Ye-abeba ihl'), oil crops ('yekbat ihl'), sugar ('yeskuar tekle'), Vegetables (ktelaktel), roots and tubers (srasr) and fruits (frafre). The primary uses of highly managed plants with the exception of spices are for food. Spices are not considered as food; they give flavor to food and increase the appetite. In general spices have less nutritional value.

4.3.3.1. *Cereals, pulses and oil crops*

These group of crops are grown due to wide range of agroecology of the study area i.e., in between 1500- 3500 m. a. s. l. The whole list of these crops is presented in Appendix 8. All of them fall under 4 different families and 21 different species. Their place of cultivation is mainly in farm fields (Massa). The major ones which are presented at Fig. 4 and the local common farmers varieties presented in Table 8 are able to fulfill cultural, religious, consumption, agronomic and economical requirements of the local communities.

The ethnobotany of these group of crops that have diversified uses were selected by the key informants at that culture is presented in Appendix 5. Among them, the species that have largest number of farmer's varieties are further analyzed by use value analysis and which results in 'Mesno gebs', 'Dinbulo gebs' and 'Weyno gebs' subsequently has the highest use value in the study area (Table 9). Especially mesno gebs can grow in a wide agroecology and has the highest use value. The use values of other *Hordeum vulgare* farmer's varieties are presented in Table 8. In addition, preference ranking of the major cereal crops for making 'injera' was done by ten key informants (Table 10) were indicated that, 'injera' from *Eragrostis tef* is preferred from the rest and ordinary respondents told that adding the flour of tef to other cereal crops improves the quality of 'injera'. Generally the major cereal and pulse crops selected by many respondents were presented in the following figure below (Figure 4).

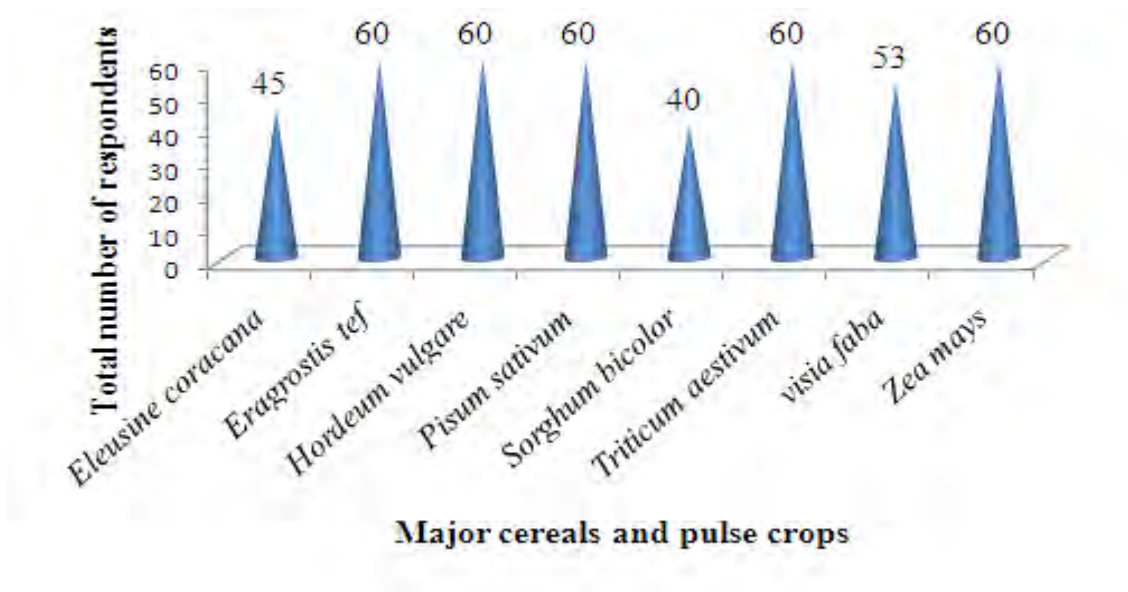


Figure 4. Major cereals and pulse crops with its total number of respondents

Table 8. List of farmers varieties in the study area

No	Name of the species	Farmers' varieties
1		Mesno gebs
		Weyno gebs
		Tkur gebs
		Temej gebs
		Late gebs
		Dnbulo gebs
		Tkur senef kollo gebs
		Nech gebs
2	<i>Triticum durum</i>	elyas snde
	<i>Triticum aethiopicum</i>	Tkur snde
	<i>Triticum aestivum</i>	Mrte snde
	<i>Triticum aestivum</i>	Wasma snde
	<i>Triticum aestivum</i>	Sida snde

	<i>Triticum aestivum</i>	Bulga snde
	<i>Triticum turgidum</i>	Zenbolel snde
3	<i>Eragrostis tef</i>	Key tef
		Bursa tef
		Nech tef
4	<i>Zea mays</i>	Nech bokolo
		Key bokolo
		Weyno bokollo

Table 9. Use value ranking for 8 *Hordeum vulgare* farmers' varieties

No	Name of farmers varieties	Use of farmers varieties								Total score	Rank
		DER EKO T	ABSHL O	Malt	INJE RA	BES O	Roasted grain	Porridge	Bread		
1	Mesno gebs	0.5	0.35	0.9	0.7	1	0.8	1	0.8	6.05	1
2	Weyno gebs	0.9	0.8	0.65	0.8	0.65	0.4	0.65	0.8	5.65	4
3	Tkur gebs	1	1	0.8	0	0	0.3	0	0	3.1	6
4	Temej gebs	0.4	0.9	1	0.9	0	0	0	0	3.2	5
5	Late or Nechtie gebs	0.3	0.55	0.4	0.55	0.65	0.25	0.55	0.65	3.0	7
6	Dnbulo gebs	0.65	0.65	0.55	0.9	0.8	0.55	0.8	0.9	5.8	2
7	Nech gebs	0.55	0.4	0.3	1	0.9	0.65	0.9	1	5.7	3
8	Tkur senef kollo gebs	0	0	0	4	4	10	4	0	2.2	8

Table 10: Preference ranking of the top major crops grouped under cereals for making ‘injera’

Name of the crop	Respondents										Total	Rank
	R1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R9	R 10		
Wheat	2	2	1	2	1	4	2	3	3	2	21	5
Barley	5	4	6	5	4	5	4	4	6	5	48	2
Sorghum	3	3	4	4	3	3	3	5	2	4	34	4
Tef	6	6	6	6	6	6	6	6	5	6	59	1
Finger millet	4	5	3	3	5	2	5	3	4	3	41	3
Maize	1	1	2	1	2	1	1	1	1	1	12	6

4.3.3.1.1. The major cereal and pulse crop species and the locally preferred soil types for their cultivations

Soil preference of individual crop varieties is a natural reality; meaning, the type of soil in one area is amongst the key factors playing a progressive role in determining the productivity and survival of land races. The same principle applies in specific soil requirements of crops in Gozamen Wereda. *Hordeum vulgare* grows successfully in ASHALMA AFER (100%), *Triticum aestivum*. In BOREBORE AFER (96.66%), *Eragrostis tef* in DEBAY AFER (95%) and WALKA AFER(100%) , *Zea mays* in BOREBORE AFER (100%), *Pisum sativum* in ASHALMA AFER (95 %), *Vicia faba* in ASHALMA AFER (91.66%), *Cicer arietinum* in WALKA AFER (100%) and DEBAY AFER (95%). The extent of other soils preference by individual crops is listed in Table 11.

Table 11. The major field crops and their soil preference

No	Major crops	Soil type	Total respondent
1	<i>Hordeum vulgare</i>	BOREBORE	19
		DEBAY	51
		ASHALMA	60
		DALCHA	0
		WALKA	0
2	<i>Triticum aestivum</i>	BOREBORE	58
		DEBAY	29
		ASHALMA	50
		DALCHA	3
		WALKA	0
3	<i>Eragrostis tef</i>	BOREBORE	45
		DEBAY	57
		ASHALMA	53
		DALCHA	47
		WALKA	60
4	<i>Zea mays</i>	BOREBORE	60
		DEBAY	19
		ASHALMA	20
		DALCHA	39
		WALKA	0
5	<i>Pisum sativum</i>	BOREBORE	31
		DEBAY	51
		ASHALMA	57
		DALCHA	11
		WALKA	0
6	<i>Vicia faba</i>	BOREBORE	20

		DEBAY	51
		ASHALMA	55
		DALCHA	11
		WALKA	0
7	<i>Cicer arietinum</i>	BOREBORE	29
		DEBAY	57
		ASHALMA	54
		DALCHA	15
		WALKA	60
8	<i>Sorghum bicolor</i>	BOREBORE	32
		DEBAY	8
		ASHALMA	48
		DALCHA	50
		WALKA	0

The preferred soil types are also integrated with traditional soil fertility maintenance. All methods are vitally important for keeping land race diversities on their farm site so that one farmer uses more than one method. The methods of soil fertility maintenance are manuring (100%), crop rotation (96.66%), composting (83.33%), repeated deep tillage (65%) and others are presented in Table 12. Traditional soil maintenance methods take the precedence as one of the grassroots practice to run the wheel of plant conservation in the farming system of the study area. Even though, composting and addition of chemical fertilizers are modern practices advertised by agricultural agents to increase agricultural product per plot.

Table 12. List of Traditional soil maintenance methods with their total number of respondents in the study area.

No	Method of soil fertility maintenance	Total number of respondents
1	Composting	50
2	Manuring	60
3	Crop rotation	58
4	Chemical fertilizer	20
5	Fallowing	2
6	Cheek dam	10
7	Terracing	35
8	Furrowing	20
9	Burning	14
10	Repeated deep tillage	39

4.3.3.1. 2. Frequency of tillage and sowing time of the major cereal and pulse crop species

Generally cereal crops require higher frequencies of tillage than pulses where as early sowing for cereals with exception of *Hordeum vulgare* especially MESENO gebs and relatively late sowing for pulses is practiced in the study area. The specific times or months of tilling and sowing the farm lands are amply influencing the yields of crops and the existence of farmers varieties on their farm site. Table 13 below shows the frequency and time of sowing for major crops grouped under cereals and pulses.

Table 13. Frequency of tillage and sowing time of the major crop species of the study area

No	Crop species	Freq. of tillage	No. of respo.	%	Time of sowing	No. of resp.
1	<i>Hordeum vulgare</i>	4	56	93.33	May	58

		3	4	6.66	June	12
					September	55
2	<i>Triticum aestivum.</i>	3	55	91.66	June	54
		4	5	8.34	July	33
3	<i>Eragrostis tef</i>	4	48	80	July	49
		3	12	20	August	50
4	<i>Zea mays</i>	4	60	100	April	20
					May	50
5	<i>Pisum sativum</i>	2	60	100	July	48
					August	20
6	<i>Cicer arietinum</i>	2	60	100	September	57
					October	10
7	<i>Vicia faba</i>	2	54	90	July	45
		1	6	10	August	21
8	<i>Sorghum bicolor</i>	2	7	11.67	May	30
		3	53	88.33	June	54

4.3.3.1.3. Seed source of cereals, pulses and oil crops

Obtaining local quality seed during each sowing period is mandatory to individual farmers in order to harvest a reasonable amount of production from a plot of land. Irrespective of other environmental, socio economical, political and natural factors: local quality seed by itself determines the quantity and quality of production that is expected to be produced after the end of every cropping season.

Areas of farmer's possible quality seed sources are exchanging with like grain/ seed 75% and the others are exchanging with unlike grains/seed (60%) and purchasing from market (43.33%) the rest are presented in Fig. 5. From the traditional farmer quality seed sources, seed purchasing

from market and sowing would face frost risk in the high land farmer's farm land that can easily feasible in *vicia faba* purchased from local market at one of the study site called Gedemala kebele.

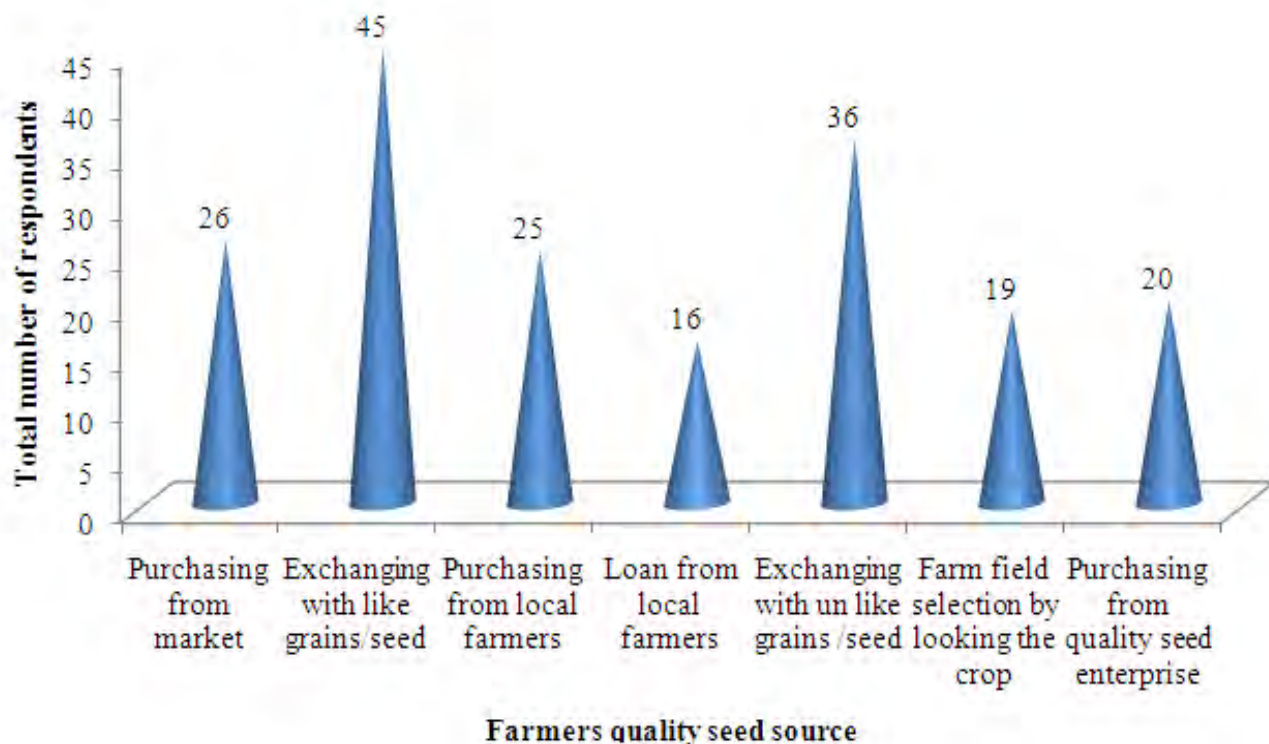


Figure 5. Number of respondents and traditional seed source of cereals pulses and oil crops in the study area.

4.3.3.1.4. Traditional agronomic practices of cereals pulses and oil crops after collecting planting material

Farmers once obtain quality seed and plough the land, they sow following mixed (taking one dominant crop, road side cultivation, using fast and slow growing crops simultaneously) or sole cropping techniques and cultivate properly by proper weeding. The major weeds and traditional management techniques are presented in Table 14. Other technical managements for example using frightening devices like scare crew (model of a person that is put in a field in order to frighten away birds during sowing time and maturing time of barely, wheat, tef, finger millet, maize, sorghum), slingshots (a Y-shaped stick with a piece of elastic material that can stretch, tied to each side that is used by children for shooting stone to control the effect of monkeys and

birds on crops). Farmers also use botanicals like leaf juice of *Clematis simensis* mixed with cattle urine. The mixture stays about 21 days and farmers spraying the mixture on pests that affect the above mentioned crops. The effect of pests is presented in Fig. 7.

After the seed mature, farmers collect the crops by cutting the part of the plant that contains the seed and collect it in places where it can be virgin land, far away from other crops or some times in the free space around their home in order to thresh the crop by using animals (Fig.6. Threshing differentiates the seed from non seed and finally the straw and the seed separated by using wind. This is a unique practice of farmers in the study area and has been transferred from the experiences of past ancestors and it is another side of traditional farmer agrobiodiversity quality maintenance techniques in Gozamen Wereda.



Figure 6. Farmers thresh cereal crops by using animals (Photo: Author, November, 2009)

4.3.3.1.5. Crop pests and weeds

Organic pollutants of *plantago lanceolata* in *Eragrostis tef*, *Lolium temulentum* (Enkirdad) In *Hordeum vulgare* and in *Triticum spp.* and *Guizotia shimperi*, in *Zea mays* have been reported by respondents as the major cause of yield loss in the study area with the exception of seasonal insect pests (Fig. 7). Therefore, farmers have devised cultural seed maintenance methods for the seeds affected by the mentioned weeds. Some of the risks averting technical mechanisms are (the majority are not direct methods), purchasing / exchanging pure seed especially *Eragrostis tef* free

from *lolium temulentum* seed can be the major management activity practiced by more than 75% of respondents. But the best method of weed management techniques is applying all methods that can be listed in Table14. The respondents also use more than one management methods integrally for increasing the chance of eradicating the weeds from the farmland.

Table 14. The major weeds and management techniques in the study area

No	Weeds	Traditional management t technique	Number of respondents
1	<i>Plantago lanceolata</i>	Purchasing or exchanging clean seed	46
		Burning the field after collecting the crop	32
		Ploughing the field many times by giving a chance for the weed to grow	39
		Hand picking the weed from the field during harvesting	33
		Sieving	25
2	<i>Lolium temulentum</i>	Obtaining pure seed from any source	45
		Wind separation before sowing	27
		Hand picking from the field	37
		Sowing the seeds before the soil become muddy	31
		Sieving	16
3	<i>Guizotia schimperi</i>	Obtaining clean seed from any source	47
		Hand picking the weed from the field	34
		Sowing the seed before the soil become muddy	38



Larvae of *Lepidoptera* on *Lupinus albus* L.

Figure 7. Effect of insects on Cereals and pulse crops (Photo: Author, November, 2009)

4.3.3.1.6. Traditional seed storage techniques of cereals, pulses and oil crops

Indigenous knowledge related to seed storage in Gozamen Wereda is another appealing practice. Farmers are alert enough about how to store seed/grains in safe environment in order to protect its deterioration. This valuable traditional skill of seed storage and preservation technique parallel to other pre-harvest operations made them to be called as ‘custodians’ of genetic diversity. In selecting quality seeds for the next harvesting season and maintaining it for long period is mainly by women’s in the survived study sites so that, women are instrumental for seed conservation and take the precedence in strategies of local crop environmental maintenance in the study area.

The best and the most well practiced seed storage methods and are amongst the momentous cultural techniques pivoting the wheel of circumvention not to lose the agroecologically and the locally environmental situation adapted for indigenous crop species are mud pin (GOATA),

Joniya (MADABERIA OR KESHA), and woven basket are frequently practiced by the communities of Gozamin Wereda at recent time to protect the seed mainly from insect (termite and weevil) and moisture problems. The other methods are presented in Figure 9 and Fig 8

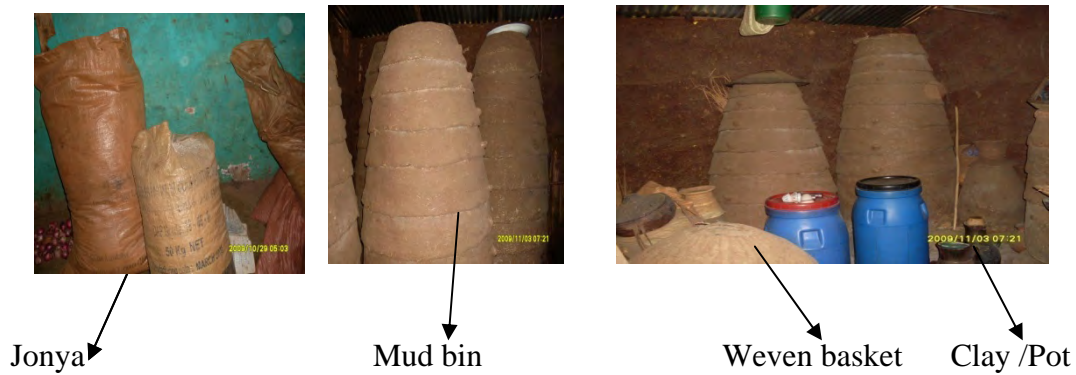


Figure 8. Figurative representation of Traditional seed storage techniques in the study area

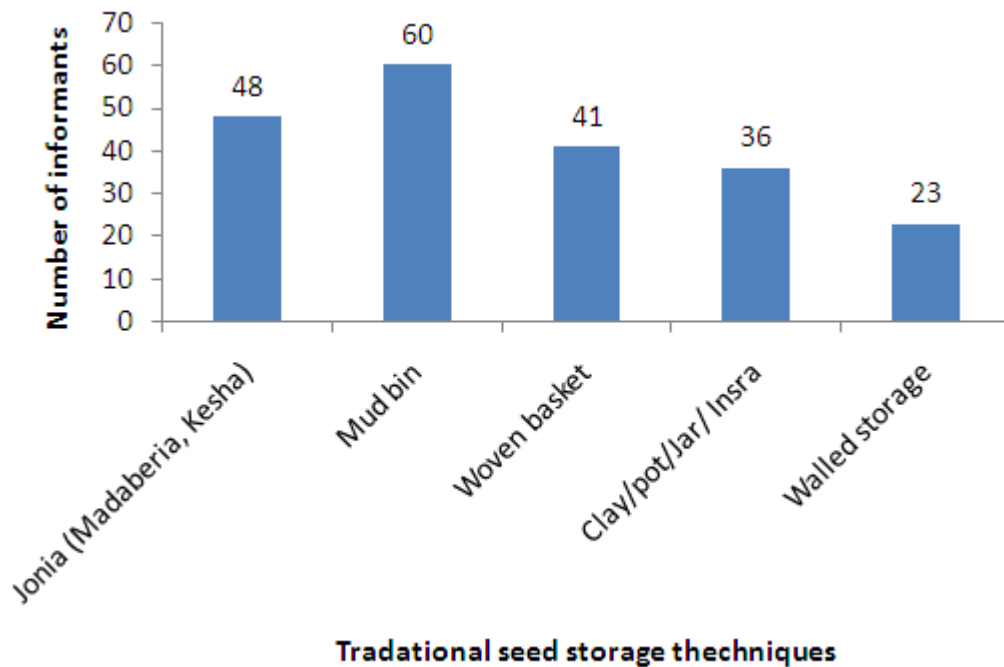


Figure 9. Total number of respondents and traditional seed storage techniques in the study area.

4.3.3.2 Fruit and vegetable production in the study area

Fruits and vegetables are cultivated in small-scale farmers in the study area at different agroecology. The taxon diversity of fruits and vegetables fall under 15 different families that contain a total of 24 different species of plants. 48.84% of the total plant can be considered as fruits and the remaining 54.16% are vegetables (it also includes roots and tubers) (Appendix 9). When we see the mode of consumption of these plants, all fruits can be consumed as raw and vegetables with the exception *Lactuca sativa* and *Capsicum annuum* can be eaten by cooking its parts. The parts to be eaten are diversified like root, bulb, leaf, and fruit. Growth form of fruits is perennials that can produce fruits ones per year where as vegetables are annuals, they can be cultivated in the absence of rain or rainy season.

Use diversification of Fruits and vegetables in the study area mainly put under three categories i.e. 100% for food, 83.33% for means of income (cash crop), and 33.33% as traditional medicine (Table 15). Fruits and vegetables play a valuable role in food systems by diversifying diets and fostering increasing dietary consumption of micronutrients and other plant products known to benefit human health. Fruits in the study area consumed in the form of raw where as vegetables have diversified parts and eaten by the people mainly by cooking. The parts of vegetables eaten by the people are, 30.6% root, 30.6 % leaf, 23.07 % fruits and 15.38% bulb [Table 16].

Table 15. Use diversification of perishable food crops in the study area.

No	Use	Number of respondents
1	Food	60
2	Sold in the local market (means of income)	50
3	Medicines	20

Late alone farmers in the study area use fruits and vegetables as a source of food, they can be sold in the near market and get income out of it. Especially people leave in the high land of the study area produce *Solanum tuberosum* and *Allium sativum* and from low lands they mainly

cultivate *Musa x-paradisiaca*, *Mangifera indica*, *Citrus sinensis* and *Lycopersicon esculentum*. Farmers sold these crops in the local market and purchase other cereal crops, because this area could not provide sufficient amount and kinds of cereal crops. The ten most major Fruits and vegetables crops that many respondents list in the entire study area are: *Allium cepa* (96.66%), *Brassica carinata* (93.33%), *Brassica oleraceae* (90%), *Lycopersicon esculentum* (83.33%), *Daucus carrota* (81.66%), *Lactuca sativa* (75%), *Citrus sinensis* (66.66%), *Citrus aurantifolia* (65%), *Prunus persica* (58.33%), *Musa x paradisiaca* (53.33%), *Solanum tuberosum* (100%). The market utilities of the top seven out of the above list were further analyzed by using pair wise comparison of ten key informants. The result indicated that *Solanum tuberosum*, *Allium cepa* and *Brassica oleraceae* are the highest market utilities respectively (Table 17).

Table 16. Parts consumed by the people from fruit and vegetable

No	Kinds of crop	Parts consumed
1	Fruit	Raw fruit
2	Vegetable	Root
		Bulb
		Leaf
		Fruit

Other use of fruits and vegetables in the study area is for traditional medicinal application. For example, fruits from *Carica papaya* used for gastritis and the fleshy part can be creamed over face to improve skin colour, *Daucus carrota* to adjust menstrual cycle, leaf juice from *Lycopersicon esculentum* is used for withdrawing leach from caw through nostril, fruit juice from *Persea americana* can be used for hair fungal treatment for human, fruit from *Psidium guajava* can reduce serious effects of gastritis. *Citrus aurantifolia* used to treat fungal disease.

Table 17. Paired comparison by 10 informants of seven vegetable crops based on market utility.

Name of the species	Respondens (R1-R10)										Total score	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
<i>Lycopersicon esculantum</i>	4	4	2	1	3	2	2	1	3	3	26	5
<i>Allium cepa</i>	5	4	3	5	2	3	5	5	5	6	42	2
<i>Solanum tuberosum</i>	6	5	5	5	6	6	5	5	5	6	54	1
<i>Bressica oleracea</i>	3	4	2	4	5	4	3	4	2	4	35	3
<i>Brassica carinata</i>	2	3	4	4	3	4	3	3	5	1	32	4
<i>Lactuca sativa</i>	0	1	3	2	1	1	1	1	0	0	10	6
<i>Daucus carota</i>	1	0	2	0	1	1	2	2	1	1	11	7

4.3.3.2.1 Factors that hinder cultivation of fruit and vegetable food crops

The majority of fruits and vegetables food crops listed in Appendix 9 are grown in home gardens with the exception *Allium cepa*, *Solanum tuberosum*, *Brassica oleracea*, *Lycopersicon esculentum* and *Daucus carota* that can be grown in home garden and field by market oriented farmers even though, market oriented agriculture reduce the agrobiodiversity. Scaling up of home gardening in comparable with suitability of the agroecology and untapped potential of the area is regrettably having its lowest position. Reasons proposed by the respondents to externalize the situation are of different in title and respondents face more than one of the constraints.

The major constraints of fruit and vegetable production in the study area are low level of information supply (100%) (About production, marketing, food preparation) low level of agricultural support system (93.33%) (High emphasis is given for cereals and pulses), small garden size (86.66%), water availability (81.66%), absence of planting material (75%), biological determinants i.e. insect pests (73.33%), absence of improved varieties that swit to the Wereda agroecology (66.66%), relatively long gestation period to develop most fruit and payback period (70%) and poor pre and post harvesting management techniques (45%). To

prioritize the treats, pair wise comparison was done on the six most threats at which higher proportion of the informants list. The result also shows that lack of awareness takes the highest position (Table 18).

Table 18. Paired comparison by 10 key informants of six threats of fruit and vegetable production

Factors	Respondents (R1-R10)										Total score	rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
Lack of awareness	5	4	4	4	4	4	4	4	4	4	41	1
Low level of agricultural support	3	4	3	3	4	5	4	4	3	4	37	2
Biological determinants	2	1	2	1	1	0	1	1	2	2	13	6
Absence of planting material	2	1	3	1	2	2	1	2	1	1	16	5
Garden size	1	3	1	4	3	2	3	3	3	2	25	3
Water availability	2	2	2	2	1	2	2	1	2	2	18	4

4.3.3.2.2 Water harvesting types to cultivate home garden crops

One of the limiting factors for year round cultivation is availability of water. In the study area almost all farmers harvest food crops during the rainy season as a result they stay home and kept idle during off seasons. But few farmers in the surveyed study sites use different water harvesting methods to cultivate vegetables and fruits in off seasons. The techniques are presented in Fig.10. These water harvesting techniques are an option to increase production so as to improve lively hood at family level and increases the fertility of soil for farmers that have a small plot of farm land. Of course, many farmers have a total of less than 3 hectares' in the area and there are also farmers with no farm land. Farmers with no farm land get arable land through rent system. These farmers give 1/3or2/3 of the products what they cultivate to the land owner.



Geo membrane



Pond



Manual water pump

Figure 10. Water harvesting techniques to harvest fruit and vegetables food crops. (Photo: Author, November, 2009)

4.3.3.3 Spices

A total of 17 different species that can be distributed to 9 different families are cultivated in the entire study area. Out of the total families, Zingiberaceae and Apiaceae together constitute 35.52% of the spice with 17.65% each and Lamiaceae individually contribute 23.52% the rest presented in Appendix 9. The different plant parts are served as a spice for example seed 41.18% fruit 23.52% rhizome 11.76%, leaves 23.52%.

Plants serve as medicinal value in addition to spices are, *Brassica nigra* for malaria, *Foeniculum vulgare* for abdominal pain, *Lepidium sativum* for Anthrax, *Rhamnus prinoides* for Leach, *Mentha spicata* for constipation, hemorrhoids and difficulty in urination *Nigella sativa* and

Ruta chalempensis for common cold (Appendix 5). Utilization of this group of plants for traditional medicine is another dimension that gives emphasis to the plant over look by farmers and increases their chance of cultivation.

4.4 Introduction of Exotic Varieties and Loss in Diversity of Farmers Varieties

Seed of indigenous crop varieties have the service potential for unlimited number of years unless anthropogenic and natural environmental constraints oblige them to lose this quality. All respondents said that, there is yield reduction in local varieties due to different factors. The yield reduction of local varieties are due to diversion practices, low level of fertilizer application, use of already polluted seed varieties, mismanagement of terracing, absence of crop rotation, impracticality of contour Ploughing and incapability of fallowing, are the factors listed by respondents affecting the yield. These problem forced the farmers to look for hydride seeds, even though the local people recognizes indigenous varieties are magnificently useful as seed for unlimited years consecutively.

4.4.1 Types of introduced (exotic) seed varieties

Specialization mode of agricultural extension system (modern commercialized monocropping system of cultivation) insists the local farmers to cultivate a few crops specially crops provided by seed quality enterprise. Farmers in the study area can obtain the seed by loan from the enterprise and sowing in their farmland by giving sufficient amount of inorganic fertilizer with proper weed management techniques. The desire of farmers to secure food at family level accepts this extension system and tries to show a strong affinity towards exotic crops. The high yield of exotic crop influence to divert the attitude of many traditional farmers especially the young farmers towards cultivation of company hydride seed varieties.

Currently 60 (100%) of respondents said that, the supply and demand of exotic crops in the area can't go side by side. For instance *Zea mays* (NECH BOKOLO), *Eragrostis tef* (NECH TEF) and *Triticum durum* (YEDABO SINDIE OR AELIAS SINDIE) seed supplied by quality seed enterprise is not sufficiently distributed to all farmers and the supply and the need to wards such seed especially by young farmers were not balanced. Due to such imbalance and other associated attitudes on exotic seeds, farmers in the study area equipped with diversified

cultivation system to defend the war of poverty, food insecurity, problem of malnutrition and dependency by developing a system of local food sustenance via selection of crops adapted to the agroecology of their environment.

4.4.2 Perception of local farmers towards exotic seed varieties in the study area

Farmers in the study area have diversified out looks towards exotic seed varieties. The perception would arise from adaptation, nutritional quality, tolerant to climatic fluctuation, longevity of the seed for storage and considering as a planting material, multipurpose functionality and quantity of yield per plot of cultivated land. From a list of reasons, I like exotic seed varieties, but I take care about local varieties, yield dependent selection, using exotic seed without giving care for local varieties. The others can be listed in Table 19.

Table 19. Perception of local farmers towards exotic species

No	Perception towards exotic seed varieties	Number of respondent
1	I do not like totally exotic seed varieties	13
2	I like exotic seed varieties and do not care about local varieties	17
3	I like exotic seed varieties but take care about local varieties	41
4	The local and exotic seed varieties served the same function if they are equally provided fertilizers.	15
5	I accept exotic seed as a seed source if and only if its product is greater than the local variety (Yield dependence)	25

4.4.3. The impact of introduced seed varieties on indigenous farming practices and welfare of the community

When farmers try to saw exotic seeds instead of local varieties, producing, multiplying, managing, consuming and conserving practices are changed. This change brings about a change in culture of farming practices and traditionally experienced food-processing techniques. In the study area farmers recognize changes like high degree of fertilizer application, poor pest

resistance, have no good test during eating and other impact of exotic varieties on indigenous farming system can also be presented in Table 20.

Table 20. Impacts of introduced seeds proposed by respondents in the study area

No	Peoples attitude towards exotic crops	Number of respondents
1	Their longevity is very short	45
2	It needs extreme weeding	40
3	Needs fertilize and select soil type	49
4	The seed can't resist effect of pest during storing	27
5	Lose of land race	39
6	Have no good test during eating	15
7	Can't tolerate climatic fluctuations	12

4.5 Threatened local Farmers Varieties

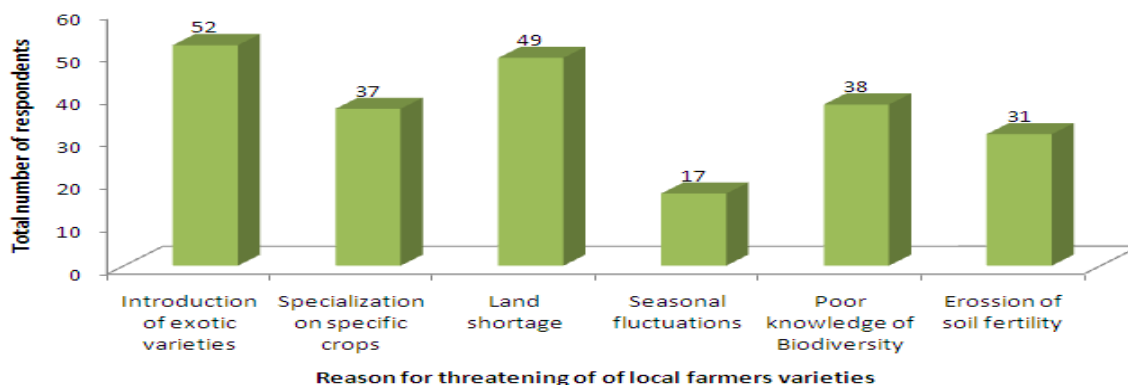
Agrobiodiversity loss is one of the most critical issues for environmental problems and food insecurity. It is strongly linked with livelihood of farmers in the study area. Therefore it needs due consideration in order to device proper alleviation mechanisms. In the study area loses of farmers varieties are highly manifested on some crops. Fifty three respondents indicate that TIKUR SNDE became highly threatened in the area. The rest of the crops that are included in the categories are listed in Table 21.

Table 21. List of Threatened crop varieties and their number of respondents in the study area.

Threatened local varieties	Total No. of respo.
Wasma Sende	37
Zenbolel Sende	43
Tkur Sende	53
Tkur Gebes	18
Temj Gebes	17
Key Bokolo	22
Weyno Bokolo	50

4.6 Reason of Threatening of Local Farmers Varieties

Many factors are involved largely in threatening the cultivation of several farmer varieties as it was explicitly discussed by the respondents. The factors listed by the respondents are posed a meaning full and an over whelming impacts on the survival and multiplication of the local genetic resource of the study area. According to the respondent’s feedback people’s preference to exotic varieties and land shortage are the main threatening although other factors presented in Fig. 11 that contribute a significant impact.



Note that, one ordinary respondent give more than one reason

Figure 11. Reasons for threatening of local varieties with its total number of respondents

4.7. Medicinal Plants in the Entire Study Area

Among 53 medicinal plants that were reported by local people. Forty medicinal plants were reported as medicine for human ailments, 10 for live stock ailments and the remaining 2 and 1 plant are used for both human and live stock and anti –infestation respectively (Table 22)

Table 22. Number of medicinal plants used for human, Livestock, both human and Livestock and anti infestation

User	No. of Species	Percentage
Human	40	75.47
Livestock	10	18.87
Both Human and Livestock	2	3.77
Anti- infestation	1	1.89
Total	53	100

a. Life form of medicinal plant

Herbs are the dominant life forms among the reported medicinal plant that constitute 27 species (50.94%) followed by shrubs with 13 species (24.53%), tree with 10 species (18.89%) and climbers with 3 species (5.65%) (Table 23).

Table 23. Habit of medicinal plant in the study area

Habit	No. of species	Percentage
Tree	10	18.89
Shrub	13	24.53
Herb	27	50.94
Climber	3	5.65
Total	53	100

b. Diversity of medicinal plant and their status of cultivation

Among the cited medicinal plant species of the study area, the majority (56.61%) were collected from home garden ‘Guaro’, (22.64%) from ‘masa’ and (22.64%) plants from ‘Massa’ and ‘Guaro. Their number and status of cultivation is presented in (Table 24).

Table 24. Number and percentage of medicinal plants obtained from home garden, field and homegarden and field with their status of cultivation.

Place of collection	Number	percentage	Status of cultivation and their number		
			High	Medium	Low
Home garden(guaro)	30	56.61	5	14	10
Field (massa)	12	22.64	3	1	8
Homegarden and field	11	20.75	2	5	4

c. Parts of medicinal plants used to treat human and live stock diseases

Widely used plant part by local people in the study area to treat human and live stock diseases include Leaves (56.61%), root (18.89%) seed (7.55%), fruit (7.55%), and others (15.09%). The method of preparation and rout of administration along with aliments cured are presented in Appendix 5.

5. DISCUSSION

5.1 Local Categories used by Indigenous People

Studying local people's categorization of natural resources in the study area was at the fore front of the research endeavor. Martine (1995) stressed that a good way to start an ethnobotanical study is to understand how local people classify rivers, hills, valleys and other geographical features that dominate the land escape. There are local system of classification and categorization of resources including land forms, soil type, season and vegetation. This system, which is a component part of overall traditional environmental knowledge of the local people, passed down over generations with its root firmly attached to the remote ancestors.

5.2 Structure and Diversity of Use ful Plants in the Farming Site

The distribution of crops in the farmers farming site shows variation with distance from the dwelling in the study site. The same situation is reported by Ramaswamy and Sanders (1992), in Africa the distribution of crops in the farmer's village shows variation with distance and Okigbo (1994), the species diversity of crop plants decreases with increasing distance from the homestead. The study area home gardens similar to other traditional home gardens in the country mentioned by Zemedede Asfaw (1997) and Tigist Wondimu *et al.*, (2006) houses diverse species of plants. This diversity is clearly visible in the model showing crop zonation in the farming site of the study area

a. Zone B

This zone contains spices, medicinal plants and fragrant plants that provide good fragrance to the house surroundings. The majority of spices originated in the Asiatic tropics and was among the 1st objects of commerce between the East and the West. Their aromatic qualities were useful in overcoming the odors of bad food and unwashed humanity. They were used in beverages, in medicine and even in lieu of money. Spices cannot be classified as food for they contain little of nutrition value. They do, however, give an agreeable and aroma to food, and add greatly to the pleasure of eating. They stimulate the appetite and increase the flow of the gastric juice, for this

reason they are often referred to as food accessories or adjuncts. Whatever value they have is due to the presence of the essential oils, and occasionally to other aromatic principles. (MoARD, 2007). Another use of spices in the study area is for medicinal application. From seventeen (17) plants of spices, seven (7) plants could serve as medicine for traditional healers.

Six (6) fragrant plants are collected in the study area. The pair wise comparison result of these plants based on market utility indicated that, cultivating them and selling the products to the local market is culturally well accepted and frequently done by the people for different purposes. The plant also serves as source of traditional medicine for the local people. Because of these, in all servayed markets their plant parts are under sell and serve as subsistence for the poor farmers in the study area.

b. Zone C

This zone contains vegetables and fruits. The taxon diversity of fruit and vegetable can be fall down on 15 different families that contain a total of 24 different species of plants. 48.84% of the total plant can be considered as fruits and the remaining 54.16% are vegetables (it also includes roots and tubers). These groups of plants improve the health and nutritional status of the people. For example, Non-communicable diseases (NCDs), especially cardio vascular diseases (CVDs), cancer, obesity and type 2 diabetes mellitus, currently kill more people every year than any other cause of death can be controlled or reduced by eating fruits and vegetables (FAO/WHO, 2004).

Even though 100% of the respondents told that cultivation of fruits and vegetables is of for the purpose of food, the feeding culture in relation to its use for health is not well understood. This indicates that utilization of fruits and vegetables for food is much less than the required in take per day. In the same way farmers in the study area also have no well-established culture of eating fruits and vegetables as a result the scale of production is very low when we compare the land used for other food crops.

Reports from Gozamen Wereda agricultural office in the year 2008 indicates that from the total arable land i.e. 34,690 hectare, 5,380.8 hectare were used for vegetable cultivation and 208.2

hectares were used for fruit cultivation. Totally 5,589 hectares (16.11%) is served for cultivation of perishable food crop production (GWAO, 2008).

Fruits and vegetables are able to fill a variety of food gaps, for example if the previous crop harvest was not able to provide enough food to last through the next harvest, leafy vegetables cabbage and tuber type food plants will be consumed to fill the gap because leafy vegetables and tubers grow fast after the first rain showers, where as fruits usually mature only once a year, mostly coinciding with the growth cycle of cereal food crops, but where a dry spell exacerbates serious crop losses or even complete harvest failure, fruits would fill the immediate food gaps after a field harvest in the study area.

c. Zone D

This zone contains stimulants and other multipurpose trees that serve as shade partly. Farmers found especially in the low land area, for example, in Desana Enese kebele cultivate *Catha edulis* and *Coffea arabica* extensively. These plants significantly improve the subsistence of the poor farmers at large and also act as a driving force to bring many multipurpose plants as shade and live fence to protect these crops and the home garden area. In some surveyed houses there is also another stimulant plant i.e. *Nicotiana tabacum* it can serve as a smoke during cultural ceremonies and also used as traditional medicine to expel leaches from cow through nostril.

The high diversity of plants in home garden is due to the fact that household wastes are hipped near to the house on the lower side and hind of the houses and sometimes on the upper side of the house if possible. Therefore, plants those need manure for their growth tend to appear their and increase the species diversity besides the culture of the people to grow diversified plants in and around their home.

The general pattern within the mature home gardens of the study area shows that diversity is highest near homes and plant size increases with distance from the house. Thus species number generally decreases away from the house while number of individual of a single species increases i.e. the farming complex changed from poly-culture to monoculture system. Similar

pattern is reported in keffa (Zemedede Asfaw, 2004). The main role of home gardens is for production of diversified food crops and by so doing they include high species diversity when compared with monoculture production around home gardens i.e. farm field. Therefore, home garden in the study site provide a number of services to the local people in nutritional aspect(for food variability or to get balanced diet), Medicinal aspect (to treat day to day illness), economic aspect (income generation for domestic market and for their subsistence life), ecological aspect (to prevent soil fertility, to protect wind and others). A similar observation was reported by Belachew Wasihun *et al* (2003) and Zemedede Asfaw (2001).

d. Zone E

This zone is the last farming zone in the study area and people mainly cultivate cereals pulses and oil crops for food to their families and sold the extra products to the nearby market to conduct other cultural, spiritual and social affairs in their locality. Similar explanations were made by Tigist Wondimu *et al.*, (2006) in the study of ethnobotanical study of food plants around 'DHEERAA' town, Arsi. Other plants that coexist in this zone by their major use classification are 15 food plants, 8 medicinal plants, 4 multipurpose plants, 3 nutraceutical plants, 1 spice plants, and 1 spice and medicinal plant, totally 32 plants found in 'masa' and 19 multipurpose plants, 10 food plants, 3 medicinal plants and 1 spice plants, totally 33 plants that exist in both 'guaro' and 'masa' could add up and make the farming complex of 'masa'.

Plant biodiversity in and around home garden is managed by arranging both in horizontal and vertical structure. In the hierarchical arrangements of species in height from home to out wards till to farming fields, the lower layer is rich in species diversity than the middle and the upper layers. Similarly the lower sides of home garden in horizontal arrangements are rich in species diversity than the last zone (farm field that mainly mono culture farming system takes place). The high diversity of plants in home garden is due to the fact that household wastes are hipped and spreaded near to the house on the lower side and hind of the houses and sometimes on the upper side of the house if possible. Therefore, plants those need manure for their growth tend to appear their and increase the species diversity besides the culture of the people to grow diversified plants in and around their home.

Another biodiversity concept visualized in this last zone (masa) is intra specific diversity, particularly eight *Hordium vulgare* varieties (mesno gebs, weyno gebs, tikur gebs, temeje gebs, Latie gebs, Dinbulo Gebs, Netch Gebs and Tkur senef kollo). Three *Zea mays* varieties (Nech Bokolo, Key Bokolo and Weyno bokolo). Six *Triticum* spp. (Elyas Snde, Tkur Snde, Wasma Snde, Mrte Snde, and Zenbolel Snde) was recorded in the survey. The indication of this is that, intraspecific diversity of crops increases with increasing distance from the dwelling. In general, in the study area species diversity decreases and intraspecific diversity increases with increasing distance from the home stead.

5.3 Farming System

The farming system has intensified by adopting the strategy of mixing compatible crops, the application of organic manuring, and intensified labour input, all organized in space and time (Zemedet asfaw, 2001). In the study area also the traditional farming system which starts knowing or understanding the nature of soil, farming seasons, frequency of tillage, planting material collection, different seed storage techniques, weeding, crop rotation, mixed cropping and protection of indigenous and exotic plant species due to their multidimensional use are the domain at which the local people practices throughout his/ her life in the farming system.

5.3.1. Mixed and inter cropping or crop association in the study area

According to Olasanta (1999) mixed intercropping is biologically a more efficient method than sole cropping because the intercropped plants can use the resources found above and below the ground in greater amount through spatial and temporal complementary. Moreover, in fields where crops of different life span are intercropped, the niche will be exploited sequentially. That is, once the early maturing varieties are harvested, the medium and late maturing ones can take over the niche before they are harvested. Intercropping (multiple cropping system), which is the first form of organized agriculture in the history of man (Francis, 1986), is most prevalent in east Africa. The dominant crop association clearly visible in the study area and all respondents practiced are the following.

a. Taking one dominant crop

Taking *Zea mays* as a dominant crop and mixed with one or more than one other crops like *Catha edulis*, *Brassica carinata*, *Solanum tuberosum*, *Helianthus annuus*, *Cucurbita pepo* or and *Phaseolus coccineus* (bolekie) and mixing two species in one like *Guizotia abyssinica* with *Lupinus albus*, and *Pisum sativum* with *Vicia faba* are supervised during plant collection. In some houses especially that have relatively large home garden can grow many vegetables in a single plot of land by growing one crop in one row and another crop in the next row. The crops that can grow one over the other are *Beta vulgaris*, *Daucus carota*, *Brassica oleracea*, *Brassica rapa* and *Lactuca sativa*.

b. Road side cultivation

Another cultural crop association is growing crops in fields that has road along its hedge. For instance, *Lepidium sativum*, *Linum usitatissimum* and *Lupinus albus* can be cultivated at the road side of *Hordeum vulgare*, *Triticum* spp. and *Eragrostis tef* farm fields. Farmers told that those crops grown/ cultivated along road side control the effect of animals on other cultivated crops.

c. Using fast and slow growing crops simultaneously

The local farmers have indigenous knowledge and age-old experience in the right mix of crops to get better yield and it is culturally believed that crops give better yield when they compete with each other. Intercropping between fast maturing and slow maturing crop varieties allows efficient use of resources for longer period. Furthermore, it reduces work burden by extending harvesting time (i.e. a farmer will get time to harvest crops that mature at different time interval. Example, in *Zea mays* field *Solanum tuberosum*, *Cucurbita pepo* and *Phaseolus coccineus* can be cultivated and the product is collected at different time.

d. Using tree canopy

The other importance of intercropping in the study area is to cultivate crops under tree canopy. The plant species found in the upper layer are used as shade and reduces transpiration of plant species found in the lower layer. Because of this local people cultivate plant species like *Albizia gummifera*, *Cordia africana*, *Croton macrostachyus*, *Sesbania sesban* with *Coffea arabica* and *Catha edulis*. Most of the time the canopy of large trees of *Ficus sur*, *Albizia gummifera*, *Croton macrostachyus* and the like that may shade a large area and affect the growth status of major crops like *Eragrostis tef*, *Hordeum vulgare* and *Zea mays* so that farmers cultivate *Triticum dicoccon* in the shaded area.

The above mentioned farmer's cultural crop association practices can be affected by One, agricultural specialization approaches that focus only one crop in relation to suitable agroecology for yield maximization by using appropriate fertilizing methods and weed management techniques as a result *Triticum aestivum* (Wasma sende), *Triticum turgidum* (Zenbolel sende), *Triticum aethiopicum* (tkur sende), *Hordeum vulgare* (Tkur gebes), *Hordeum vulgare* (Temej gebes), *Zea mays* (Key bokolo) and *Zea mays* (Weyno bokoo) are becoming endangered food crops in the study area. Second, shortage of land Because of this, farmers are forced to divert more of their attention to sow single variety in a single parcel of cropping lands that are the main stay for the survival of their family such as *Hordeum vulgare* . *Zea mays*, *Eragrostis tef* and *Triticum* spp.

5.3.2 Soil management

In the study area farmers aware of the effects of soil erosion and traditionally they have created and applied different methods of controlling it. Burning of crop residues, manuring, composting, crop rotation, terracing, furrowing, repeated deep tillage, cheek dam, fallowing, and chemical fertilizers are the listed soil management parameters in the study area. The above methods are also reported in the study conducted by (Hoben, 1997; Altieri and Merrick, 1987 and Ghadim *et al.*, 1991). In the study area the proportion of farmers using chemical fertilizers is decreasing and utilization of organic fertilizers especially compost is becoming the well practiced soil fertility maintenance method. The same idea is reported by Abenet Belete *et al.*, (1992), the proportion of farmers using chemical fertilizers is decreasing in the high land of Ethiopia.

Farmers applications of chemical fertilizers became reduced due to its expensive nature and its yield increment obtained from using chemical fertilizer cannot cover the credit that can be initially acquired by lone from the Wereda agricultural office. Due to this reason farmers shift to look other soil fertility management practices. The well practiced and the most applicable soil fertility maintenance in the study area are composting, manuring, crop rotation and repeated deep tillage.

a. Composting

Compost refers to biologically processed decomposed organic matter usually through speeded up natural biological process by piling, aerating and moistening. It contains balanced plant nutrients including trace minerals and is rich in beneficial microbes that further improve the soil ability to nourish plants. In low rain fall areas where chemical fertilizers cannot be effectively used, compost is preferably used by farmers regardless of their financial capacity. Besides, it improves water holding capacity and drainage of soils (EIAR, 2009).

Compost improves organic matter content of the soil. Hence, compost can be used as fertilizer and soil conditioner. It contains good balance of essential plant nutrients in a stable form that will not easily leach away by rain and can be applied without danger of burning plants. It also increases the availability of existing soil nutrients besides supplying additional amounts already contained in the compost. Hence by using compost, one can not only improve the physical properties of the soil but also reduce up to half of the recommended chemical fertilizers (EIAR, 2009).

b. Manuring

Before 2 and 3 years, the farmers in the study area collect cow dung from grazing land and animal houses for the purpose of fuel either they use themselves or sale it to the local market and make income out of it. Know a day ordinary informants told that the above practices are totally changed to using all domestic animal wastes to improve their soil fertility by direct application

on their farmland before sowing any crop than using as a fuel. This attitudinal change acquired due to the expensive nature of chemical fertilizers.

In general the present day farmers attitudinal change for using organic fertilizers also open their eyes to look at the surrounding plants to use them as a raw material for making organic fertilizers if and only if, their green leaves are decomposed and these idea increases the conservation dimension of different plants in the farming complex.

c. Crop rotation

Crop rotation is the easiest and applicable methods used to maintain the soil fertility in the study area. Farmers practices crop rotation in such a way that they can sow legumes at one year and cereals in the next harvesting season mostly legumes have nitrogen fixing capacity and increases the nitrate content of the soil. Cereals that can be harvested from legume farm fields give high yield. Pulses that farmers mostly use for farm land fertility maintenance for crop rotation purpose is *Lupinus albus* L., *Pisum sativum* L., *Vicia faba* L. and *Cicer arietinum* L..

d. Repeated deep tillage

In the study area, ideas gathered by ordinary informant about frequency of tillage for major staple food crops indicate that, the higher the frequency of tillage, the higher the yield. Repeated deep tillage and early Ploughing are also essential methods of maintaining soil fertility and improving crop yield. Farmers in the study area plough their lands deeply step by step by increasing the length of the plough (blade). They realized that Ploughing deeply improves the water retaining capacity of the soil and there by causes increased crop yield

5.3.3 Medicinal plants in the farming complex

From the total plant species recorded in this study area about 53 species that are distributed in 29 different families serve the community as a source of traditional medicine. Eight (15.38 %) of these medicinal plants: *Daucus carota*, *Lycopersicon esculentum*, *Lupinus albus*, *Carica papaya*

Citrus aurantifolia, *Persea americana*, *Psidium guajava* and *Linium usitatissimum* have nutraceutical values. Nutraceutical plants are food plants which also have medicinal uses. Species of the family Asteraceae (4), Euphorbiaceae (4), Fabaceae (4), Lamiaceae (3), Myrtaceae (3), Solanaceae (3) and Cucurbitaceae (3) together constitute 45.28%. The rest 22 species account for 54.72%. Of these, 75.47% are used to treat human diseases, 18.87% are for livestock diseases, 3.77% are used to treat both human and livestock diseases and the remaining 1.89% is used to kill insects. Out of the collected medicinal plants 50.4% are herbs. The study conducted by Tilahun Teklehaymanot and Mirutse Giday (2007) also indicates that, in Ethiopia there is a general trend that the proportion of herbs for traditional medicinal application is high.

The study area people have low knowledge about medicinal plants used to treat live stock diseases. From 53 medicinal plants [Appendix 5], 40 plants were used for human and 10 plants were used for livestock and 2 plants for both human and livestock. The result of the study is similar to the study of Tadesse Beyene (2008). From 92 medicinal plants, 70 plants were used for human and 8 plants were used for live stock and 14 for both human and live stock.

5.3.4 Agroforestry system in the study area

The best and probably official definition of agroforestry is the one that is commonly used by the world agroforestry center: “Agroforestry is a collective name for land use systems and technologies where woody perennials (trees, shrubs, palms, bamboos etc.) are deliberately used on the same land management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence”. In agroforestry system there are both ecological and economical interactions between the different components (Lundgren and Raintree, 1982 cited in Badege Bishaw and Abdu Abdelkadir, 2003). Its service functions include soil fertility maintenance through erosion control and biological nitrogen fixation, water shade protection, maintain ecological stability, conservation of biodiversity and carbon sequestration & productivity functions such as high value fruits for income and nutrition security, supply high quality fodder for livestock, forage for honey bee, wood for house hold energy, timber/ poles for construction and income generation (Bashir Jamma *et al.*, 2006).

The local people are an expert for plants that can be grown in his or her homestead and farm fields. Farmers before decide to clear or cut or weed the plant, they can evaluate the plant based on different criteria acquired through their life long experience than ordinary agriculturalists decide to reach conclusion about the plant. A greater evaluation criteria in kind and dimension have been giving a chance to the plant either tolerated, managed or and cultivated by farmers. Therefore about 59 plants were collected in the study area and their status of manmanagement in the farming complex are: 9 low, 30 medium, 20 high and 33 plants found in homegarden, 6 in farm field and 19 in both home garden and field.

From the plants that serve for multipurpose use, the top 10 multipurpose plants are further obstructed by using direct matrix ranking. The result showed that *Eucalyptus globules* and *Eucalyptus camaldulensis* have the highest use diversity and highly preferred from other plants. This preference would be due to looking the direct use of plants only i.e. it is widely used plant in the study area as well as in many parts of the country for construction purpose since it has relatively shorter growing period and for its erect trunk. But it is believed to exert some ecological impacts (on the under growth plant species and soil water availability, especially in the dry season).

The natural continuum of vegetation is replaced by manmade continuum. Annual crops cover the general area. Natural climax vegetation is totally destroyed in the study area. After annual crops are harvested, the remaining ground is venerable to different external factors even though plants that serve agroforestry system are found in the farm field far apart each other that do not cised soil degradation. The only green areas visible after harvest are the water ways and the home gardens at which local people cultivate the most important ones i.e., fruit that they think with varied uses.

Exotic plant species like *Eucalyptus globules* and *Eucalyptus camaldulensis* can be cultivated in the home garden live fence and in farm plots that doesn't cultivate food crops due to soil erosion. These formed small artificial forest together with fruit trees around the dwelling. The dynamics had been such that the place of forests has changed from wild to domestic environment in the study area. The rapid invasion of *Eucalyptus globules* and *Eucalyptus camaldulensis* which is

getting wider acceptance in the area could eliminate indigenous tree species and this is a menace for indigenous genetic resource trees.

5.4 Home garden in the Study Area

In all home gardens of the study area a total of 104 plant species can be collected. Look at Appendix 3. The study area home gardens similar to other traditional home gardens in the country mentioned by Zemedie Asfaw (1997) and Tigist Wondimu *et al.*, (2006) houses diverse species of plants but the space and diversity is tend to reduce due to urbanization and population growth Zemedie Asfaw (1997). In the same way, in the study area those people that aware the situation are decide to resettle for seek of larger area for home gardening away from densely populated area and they have to develop home gardens having a desired farm size. Farmers establish new home gardens and they plant mainly vegetables and fruits that have market value. Even though market driven agricultural activities resulted in bulk production of few crops & reduced agrobiodiversty.

Traditional insect/pest control trials in the study area are: spraying wood ashes or cow dung mixed with caw urine, socking chopped leaves of *Clematis simensis* With animal urine in ajar and stay at least a minimum of 21 days and then the liquid after filtration is sprayed over insects that the farmer suspects the presence of any insect in his or her home garden and field crops as well. They conduct regular furrow irrigation to control worms found in the soil. Spraying mixture of locally available botanicals (chills, tobacco, soup solution and animal urine) to aphids, digging of the queen of termites (*Macroterm spp.*) is highly practiced one of the study kebele i.e. Desana Enese. This insect has a devastating effect on homestead and farm field crops as well. Hand picking and killing of cut worms locally named as 'Jemo' is mainly practiced in the study area. These worm cuts roots of annual homegarden crops mainly *Lycopersicon esculentum* and *Solanum tuberosum* during night

5.4.1. Comparison of study area home garden with other study area home garden

The comparison was made with data given for Sabata (Habtamu Hailu, 2008) Welayta and Gurage (Zemedede Asfaw and Zerihun Woldu, 1997) and Arbaminch (Belachew Wasihun *et al.*, 2003). Result of Jaccard's coefficient similarity revealed that the study area has almost an average 41% similarity with study conducted, Sabata, and Arbaminch (Table 25). This is due to availability of planting material of fruits and vegetables in local market and increased desire to cultivate many crops in home garden. Even though, the productivity of crops are different due to agroecology and cultural difference.

Table 25. The Jaccard's coefficient of similarity of home garden plants of Gozamen, Welayta and Gurage, Sabata, and Arbaminch.

Place	No. of species found a or b	Common species	Jaccard's coefficient (Sj)	% of similarity.
Gozamen	104	-	-	
Welayta and Gurage	60	43	0.36	36
Sabata	135	69	0.41	41
Arbaminch	133	69	0.41	41

5.4.2. The role of home garden crops in improving family livelihood: Food security, Nutrition and Income

In the present study 136 species of plants at different status of management are documented. From these, 71 (53.38%) are grown in home gardens and 33(24.48%) are grown in home garden and field. Moreover, home garden of the study area embrace a genuine portion of agrobiodiversity which represent a supplementary source of food and privileged basis for nutritional quality that are helpful to cope with food shortage periods and failure of staple crops these result shows the same trend to that of the survey work of Ethiopian home gardens (Zemedede Asfaw & Ayele Nigatu 1995; Zemedede Asfaw 1997). The area mainly experiences food shortages at which the produced staple foods can last to the next season and the gap can be filled by leafy vegetables and root crops that can be harvested in short periods that starts from after the first rain showers.

Besides their nutritional benefit (diet diversification or improving micronutrient intake), the home gardens of the study area do have considerable contribution in generating income for the family and enabling them to afford other staple crops (food items that are not cultivated in their garden). Moreover, there is promising improvement on the status of food or economic security in those families with good garden practices. According to FAO/WHO (2003), home gardens have an established tradition and offer great potential for improving house hold food security, in alleviating micronutrient deficiencies and they enhance food security in several ways, most importantly though direct access to diversify nutritionally rich foods, increased purchasing power from savings on food bills and income from sales of garden products and fall-back food provisions during seasonal lean periods.

6. CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Traditional farmer of Gozamen Wereda are equipped with the knowledge and mastery of plants in the farming complex along with their conservation which are bench marks for the survival of human beings. This time tested and time long experience about traditional farming practices is an important food security assurance technique for the local communities in the study area.

Farmers plan different activities in their farm in order to widen the confidence interval of conserving different plants in their home garden and fields. The main grassroots' traditional farmers farming activities are farm site and soil classification, availing proper time for tillage and sowing of individual crops, different soil maintaining activities, weeding and cultural pest control techniques by using Botanicals, harvesting water for year round harvesting, mixed cropping, acquiring planting material especially seed through different methods, maintaining the quality of their seed and cultivation of their own varieties are the main activities done by the Wereda people even though there is a growth desire to wards exotic seeds.

In situ conservation efforts of crop genetic resources can be fruitful if it includes the active participation of farmers. Farmers in their close association to their varieties have identified physical and biological factors that support the existence of their varieties for example inter and mixed cropping, seed selection and traditional farming practices in general contribute for the lifelong existence of some farmer varieties recorded in the study area.

6.2 Recommendation

Based on the result of the study, the following recommendations are given

- Before cultural transformation destroys the traditional agricultural system, greater efforts should be devoted to survey, document and conserve plants in the farming system. Such activities should be done in different Weredas with similar agroecology in order to have a better understanding in the wealth of the information available.
- Effort of the study area farmers for making organic fertilizer (compost) is supported by scientific researches as to which identifying the plants that should use as a raw material and contain higher proportion of nitrogen and phosphorus in its part.
- The indigenous knowledge of controlling pests by using botanicals should also evaluate scientifically to address the problem.
- Awareness creation of the local people and training on the sustainable utilization and management of plant resource is crucial.
- Shifting of farmer's attitude to monoculture agricultural system must be stopped by efforts made by the Wereda agricultural office experts by pushing them for year round harvesting through the utilization of different water harvesting techniques.
- Encourage home gardening for plant biodiversity conservation and management.
- The presence of different plant in the farming complex should improve the soil fertility status and agrobiodiversity. Therefore, the agricultural extension workers should consider this fact and reshaped the farmers to practice and increase the plant knowledge through arranging training programs.
- Encourage and initiating farmer's morality by supporting with necessary infra structures such as provision of micro finance services, quality local seed varieties supply, experts follow up, training, rewarding for best performing ones is essential to bring radical change over home garden and field crop development in the study area.

- Young farmers in the study area mainly focus on commercial oriented company hybrid seeds rather than local varieties. Strategic reformation via arranging training programs has to be devised so as to attract the attention of the youth in to the previous intuitive wisdom of farmer's varieties' cultivation through conducting researches about these varieties and outline their use.

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8. APPENDICES

Appendix 1. Checklist of semi-structured interview items for collecting ethnobotanical data.

General information

1. Date _____ Residence area (village) _____ Kebele code _____
2. Name of respondent _____ Sex _____ Age _____
Marital status _____ Occupation (main job) _____
Religion _____
3. For how long have you lived in the area?
 - a. Since birth
 - b. for the last 20 years
 - c. for the last 10 years
 - d. for less than 10 years

4. Educational background (what is the last grade you attend)?

Ethnobotanical Data

5. List the traditional way of classifying forests (vegetations) and land escapes in your area
Vegetation _____, _____, _____, _____
Land escapes _____, _____, _____, _____
6. List the soil types of your locality.
7. What are the major uses of cultivated plants?
8. List use ful plant species grown in the farming site including their vernacular name.
9. Is there any medicinal plant grown in the garden? If there is, describe the method of administration and the ailments cured?
10. From where do you bring the planting material for all crops cultivated in your farm site?
11. What are the major cultivated plants used as a source of food in the area?
12. The plants cultivated in your garden for food,
 - a. utilized in their home
 - b. used as means of income by selling it
13. Do you incorporate vegetable in your daily diet? Yes/ no.
14. If your answer is no, what do you think the reason?
15. What management practices you have been doing in your farm site in order to maintain soil fertility and sustain production?
16. Is there task division based on gender? Yes / no
17. If your answer for question no-15 is yes, who is involved in the management practice to cultivate plants in home garden in a prolonged time?
18. Are there any challenges or threats in the home garden cultivation as well as diversity of plants in your farm site? List them.
19. What do you think the possible solutions for the above threat to scale up productions in home garden?
20. Do you notice any change (reduction or increase) in the diversity and production of plants in your garden? Why?
21. What do you think the major causes for the above challenges?

22. Which cultivated plant do you think is more resistant to drought among the plants grown in your garden?
23. Are there any cultivated plants you can sell? If there are, what are the products you took to the market?
24. List down usefull plants used as a fence, boundary mark and others.
25. What do you use as fodder? Do you think the homegarden has a contribution for live stock production?
26. Which cultivated plant does have appositive influence in homegarden agroecosystem?
27. List the major cultivated plants in your garden in order of availability.
28. Please fore ward any suggestions that you have concerning the plant resource and the local community.

Appendix 2. List of ordinary respondents, Educational background, age and sex

No	Name	Sex	Age	Educational Background	Marital status	Kebele
1	Yitayeh Gashu	M	46	Grade 5	Married	Wonka
2	Belsty Gashue	M	48	Grade 12	Married	Wonka
3	Tenaw Zeleke	M	55	Read and write	Married	Wonka
4	Sewnetie Ayalew	F	38	Grade 9	Divorced	Wonka
5	Animaw wagaw	M	43	Read and write	Married	Wonka
6	Getie Jamberu	M	60	Read and write	Married	Wonka
7	Miheret Abate	F	45	Grade 12	Divorced	Wonka
8	Alebachew Fenta	M	42	Grade 4	Married	Wonka
9	Deresse Ferede	M	41	Grade 6	Married	Wonka
10	Endenat Abate	F	60	Read and write	Divorced	Wonka
11	Enawgaw kassie	M	38	Grade 6	Married	Assambo
12	Nega melaku	M	49	Read and write		Assambo
13	Masresha wallie	M	24	Grade 8	Un married	Assambo
14	Abebe Mihiretie	M	50	Illiterate	Married	Assambo
15	Bekele Worku	M	41	Illiterate	Married	Assambo
16	Negash Animaw	M	36	Illiterate	Married	Assambo
17	Linger Kumie	M	52	Grade 5	Married	Assambo
18	Tefera Manaye	M	50	Illiterate	Married	Assambo
19	Tringo Egigu	F	38	Read and write	Married	Assambo
20	Alamirew Bezie	M	42	Grade 7	Married	Assambo
21	Essubalew Abie	M	38	Illiterate	Married	Dessanaenessie
22	Anteneh Tadeg	M	41	Illiterate	Married	Dessanaenessie
23	Eneyew Aniley	M	44	Illiterate	Married	Dessanaenessie
24	Tagel Bellay	M	54	Illiterate	Married	Dessanaenessie
25	Kibretie Mekuria	M	25	Read and write	Unmarried	Dessanaenessie
26	Yizengaw walle	M	35	Illiterate	Married	Dessanaenessie
27	Yigzaw Workneh	F	40	Illiterate	Unmarried	Dessanaenessie
28	Nigussie Yallew	M	52	Illiterate	Married	Dessanaenessie

29	Muluken mengist	F	45	Illiterate	Divorced	Dessanaenessie
30	Shekim Sinishaw	F	35	Grade 5	Married	Dessanaenessie
31	Linger Biazen	M	44	Grade 5	Married	Yeboklla zuria
32	Giza Abitie	M	46	Illiterate	Married	Yeboklla zuria
33	Hawltie Fetene	M	39	Grade 5	Married	Yeboklla zuria
34	Damtie Meharie	M	47	Grade 5	Married	Yeboklla zuria
35	Gizachew Hunegnaw	M	45	Grade 4	Married	Yeboklla zuria
36	Aytenew Bizualem	M	45	Illiterate	Married	Yeboklla zuria
37	Yismaw Sheferaw	M	40	Grade 4	Married	Yeboklla zuria
38	Tariku Yehuala	M	38	Grade 7	Married	Yeboklla zuria
39	Temie Assabie	M	50	Illiterate	Married	Yeboklla zuria
40	Abiwot Bizuayehu	M	25	Grade10	Unmarried	Yeboklla zuria
41	Ayal Fekele	M	53	Illiterate	Married	Gedemala
42	Bayche kassaneh	M	50	Grade 6	Married	Gedemala
43	Shita Biadlegn	M	35	Grade 3	Married	Gedemala
44	Aniley Wagaye	M	45	Illiterate	Married	Gedemala
45	Berega Tadesse	M	43	Grade 4	Married	Gedemala
46	Lamesgen Bimer	M	36	Grade6	Married	Gedemala
47	Zemenu Yimer	M	35	Grade 6	Married	Gedemala
48	Asmarie Walle	F	45	Illiterate	Divorced	Gedemala
49	Munuye Tirffe	M	42	Illiterate	Married	Gedemala
50	Abateneh Atinafu	M	50	Illiterate	Married	Gedemala
51	Abateneh Atinafu	M	48	Grade 3	Married	Lekelekita
52	Baye Mengistie	M	40	Read and write	Married	Lekelekita
53	Aschale Melak	M	39	Read and write	Married	Lekelekita
54	Lamesgen Chanie	M	38	Read and write	Married	Lekelekita
55	Alelgn Ambaw	M	42	Read and write	Married	Lekelekita
56	Kassie Mekonen	F	38	Read and write	Divorced	Lekelekita
57	Yalemzerf Derseh	F	30	Grade 8	Divorsed	Lekelekita
58	Kes Alehegn Mihiret	M	30	Read and write	Married	Lekelekita
59	Tesera Kassie	M	50	Read and write	Married	Lekelekita
60	Getachew Mussie	M	60	Read and write	Married	Lekelekita

Appendix 3. Complete list of use full plants collected in the farming site in the study area.

Where, Fi=Farm implement, F=Food, Lf= Live fence, Fw=Fire wood, Ch=Charcoal, Fo = Forage/ Fodder, Hc= House contraction
Fr= Furniture, M = Medicine, S= Shade, Hg= homegarden, Fie= Field. , Mp= Multipurpose use, Sp= Spice, Fra=Fragrant, Fra+M=
Both Fragrant and Medicinal, Sp+M= Both Spice and Medicinal, O= Others, N= Nutraceutical

No	Scientific name	Family name	Vernacular name	Crop type	Habit	Parts used	Use	Coll. No.	Altitude	Location	State of management & farm site	Major use classification
1	<i>Acacia abyssinica</i> Hochst. ex Benth.	Fabaceae	Grar		T	Stem /Leaf	Fi, Lf, Fw,Ch,Fo, Hc,Fr,S	HR-002	2330	10021.260'N, 037041.150'E	Medium & Fie.	Mp
2	<i>Acacia decurrens</i> Willd.	Fabaceae	Yeferenj grar		T	Stem /flower	Lf, Fw,Fo,Hc, S	HR-046	2307	10021.111'N, 037041.028'E	Medium & Hg, Fie	Mp
3	<i>Acacia melanoxylon</i> R. Br.	Fabaceae	Omedla		T	Stem	Lf, Fw,Ch,Hc, Fr, S	HR-140	2307	10021.111'N, 037041.028'E	Medium & Hg	Mp
4	<i>Aframomum corrorima</i> (Braun) Jansen.	Zingiberaceae	Korerima	Spice	H	Seed		HR-032	1845	10013.908'N, 037041.858'E	High & Hg	Sp
5	<i>Albizia gummifera</i> (J. F. Gmel.) C. A. Sm	Fabaceae	Sesa		T	Stem	Fi,Lf,Fw, Ch,Fo,S, Hc	HR-058	2196	10020.580'N, 037041.362'E	Medium & Hg, Fie	Mp
6	<i>Allium cepa</i> L.	Alliaceae	Key shinkurt	Vegetable	H	Bulb	Food	HR-041	2330	10021.260'N, 037041.150'E	High & Hg, Fie	F
7	<i>Allium sativum</i> L.	Alliaceae	Neshinkurt	Vegetable	H	Bulb	Food	HR-076	2330	10021.260'N, 037041.150'E	High & Hg	F
8	<i>Artemisia absinthium</i> L.	Asteraceae	Seret	Fragrant	S	Leaf /Stem		HR-098	2307	10020.974'N, 037040.972'E	Medium & Hg	M+ Fr

9	<i>Artemisia afra</i> Jacq. ex Willd.	Asteraceae	Chkugn		H	Leaves	M	HR-077	2196	10020.580'N, 037034.382'E	Medium & Hg	M
10	<i>Arudinaria alpina</i> K. Schum.	Poaceae	Krkaha		H	Stem/Leaf	Lf, Fw, Fo, Hc, Fr, S	HR-047	3291	10032.717'N, 037052.580'E	Medium & Hg	Mp
11	<i>Arundo donax</i> L.	Poaceae	Smiza		H	Stem/Leaf	Lf, Fw, Fo, Hc, Fr,	HR-075	2367	10020.954'N, 037040.972'E	Medium & Hg	Mp
12	<i>Avena sativum</i> L.	Poaceae		Cereals	H	Seed	Food				High & Fie	F
13	<i>Beta vulgaris</i> L.	Chenopodiaceae	Keysr	Vegetable	H	Root	Food	HR-061	2330	10021.260'N, 037041.150'E	High & Hg	F
14	<i>Brassica carinata</i> A. Br.	Brassicaceae	Gomen /Gomenzer	Vegetable / Oil	H	Leaves / seed	Food	HR-059	2330	10021.260'N, 037041.150'E	High & Hg. Fie	F
15	<i>Brassica nigra</i> (L.) Koch.	Brassicaceae	Senafch	Spice	H	Seed		HR-054	2307	10020.974'N, 037040.972'E	High & Hg	Sp+ M
16	<i>Brassica oleracea</i> L.	Brassicaceae	Tklgomen	Vegetable	H	Leaves	Food	HR-070	2330	10021.260'N, 037041.150'E	High & Hg, Fie	F
17	<i>Brassica rapa</i> L.	Brassicaceae	kosta	Vegetable	H	Leaves	Food	HR-144	2330	10021.260'N, 037041.150'E	High & Fie	F
18	<i>Brucea antidysenterica</i> J. F. Mill.	Simaroubaeae	Abalo		S	Fruit	M	HR-018	2307	10021.111'N, 037041.028'E	Low & Fie	M
19	<i>Buddleja polystachya</i> Fresen.	Loganiaceae	Anfar		S	Stem	Lf, Hc Fw	HR-099	2200	10020.116'N, 037055.381'E	Medium & Hg	Mp
20	<i>Calpurnia aurea</i> (Ait.) Benth.	Fabaceae	Dgta		S	Stem	Fi, Lf. Fw, Ch, M, S	HR-095	1856	10014.818'N, 037042.693'E	Medium & Fie.	Mp
21	<i>Capparis tomentosa</i> Lam.	Capparidaceae	Gumero		S	Spine /Root	Lf, M	HR-116	1856	10014.818'N, 037042.693'E	Low & Hg	Mp
22	<i>Capsicum annuum</i> L.	Solanaceae	karia	Vegetable /Spice	H	Fruit	Food	HR-074	2190	10020.804'N, 037033.472'E	High & Hg	F

23	<i>Carica papaya</i> L.	Caricaceae	Papaya	Fruit	T	Fruit raw	Food	HR-019	1845	10013.908'N, 037041.858'E	High &Hg	N
24	<i>Carissa spinarum</i> L.	Apocynaceae	Agam		S	Spine/Root	Lf,	HR-138	1856	10014.818'N, 037042.693'E	Low &Hg	O
25	<i>Carthamus lanatus</i> L.	Asteraceae	Yeset aff		H	Root	M	HR-115	2081	10015.246'N, 037042.698'E	Low & Fie	M
26	<i>Catha edulis</i> (Vahl.) Forssk. ex Endl.	Celastereae	Chat	Stimulant	S	Leaves		HR-065	2200	10020.116'N, 037035.381'E	High &Hg	St
27	<i>Cicer arietinum</i> L.	Fabaceae	Shimbra	Pulses	H	Seed	Food	HR-066	1856	10014.818'N, 037042.693'E	High & Fie	F
28	<i>Citrus aurantifolia</i> (Christm.) Swingle	Rutaceae	Lomi	Fruit	S	Fruit raw	Food	HR-067	1845	10013.908'N, 037041.858'E	High & Hg	N
29	<i>Citrus aurantium</i> L.	Rutaceae	Komtate	Fruit	T	Fruit raw	Food	HR-068	2307	10020.974'N, 037040.972'E	High & Hg	F
30	<i>Citrus medica</i> L.	Rutaceae	Trngo	Fruit	T	Fruit raw	Food	HR-045	2307	10020.974'N, 037040.972'E	High & Hg	F
31	<i>Citrus sinensis</i> (L.) Osb.	Rutaceae	Brtukan	Fruit	T	Fruit raw	Food	HR-044	2307	10020.974'N, 037040.972'E	High & Hg	F
32	<i>Clausena anisata</i> (Willd.) Benth.	Rutaceae	Lmch		S		For tooth brush	HR-003	2330	10021.260'N, 037041.150'E	Low &Hg	O
33	<i>Clematis simensis</i> Fresen.	Ranunculaceae	Yeazohar eg		H	Leaf	M	HR-112	2081	10015.246'N, 037042.698'E	Low & Hg	M
34	<i>Coffea arabica</i> L.	Rubiaceae	Buna	Stimulant	S	Seed/Fruit		HR-034	2307	10020.974'N, 037040.972'E	High & Hg	St
35	<i>Cordia africana</i> Lam.	Boraginaceae	Wanza		T	Leaf/stem/flower	Fi,Lf,Fw, Ch,S,Fr,Fo, Hc.	HR-064	1856	10014.818'N, 037042.693'E	Medium &Hg, Fie	Mp+ fra
36	<i>Coriandrum sativum</i> L.	Apiaceae	Dnblal	Spice	H	Seed		HR-026	2215	10019.780'N, 037037.320'E	High & Hg	Sp
37	<i>Croton macrostachyus</i> Del.	Euphorbiaceae	Bsana		T	Stem	Fi, Lf, Fw,Ch,M,S	HR-022	2219	10020.804'N, 037033.472'E	Medium Hg, Fie	Mp

							,Hc,Fr					
38	<i>Cucumis ficifolius</i> A. Rich.	Cucurbitaceae	Yemdr emboy		C	Fruit	M	HR-091	2200	10020.116'N, 037035.381'E	Low &Hg	M
39	<i>Cucurbita pepo</i> L.	Cucurbitaceae	Duba	Vegetable	H	Fruit	Food	HR-080	2081	10015.246'N, 037042.698'E	High &Hg	F
40	<i>Cuminum cyminum</i> L.	Apiaceae	Kemun	Spice	H	Seed		HR-102	2190	10013.908'N, 037041.858'E	High &Hg	Sp
41	<i>Cupressus lusitanica</i> Mill.	Cupressaceae	Yeferenjt sd		T	Stem/Leaf	Lf, Fw, Ch, Fo, Hc, Fr, S	HR-142	2330	10021.260'N, 037041.150'E	Medium &Hg, Fie	Mp
42	<i>Curcuma domestica</i> Valetton	Zingiberaceae	Erd	Spice	H	Root		HR-023	1845	10013.908'N, 037041.858'E	High &Hg	Sp
43	<i>Cymbopogon citratus</i> (DC.) Stapf.	Poaceae	Tejesar	Fragrant	H	Leafd		HR-108	2216	10019.391'N, 037037.309'E	Medium &Hg	Fra + M
44	<i>Daucus carota</i> L.	Apiaceae	Carot	Vegetable	H	Root	Food	HR-069	2330	10021.260'N, 037041.150'E	High &Hg, Fe	N
45	<i>Datura stramonium</i> L.	Solanaceae	Astenagr		H	Fruit/Leaf	M	HR-037	2311	10020.986'N, 037041.029'E	Low &Hg	M
46	<i>Dracaena steudneri</i> Engl.	Dracaenaceae	Marko		T	Leaf	M, S, Lf	HR-096	2311	10020.986'N, 037041.029'E	Medium &Hg	Mp
47	<i>Dombeya torrida</i> (J. F. Gmel.) P. Bamps	Sterculiaceae	Wlkfa		T	Flower/ Stem	Lf, Fw, Fo, Fr, S	HR-094	2599	10026.985'N, 037052.861'E	Medium &Hg Fie	Mp
48	<i>Elusine coracana</i> (L.) Gaertn.	Poaceae	Dagusa	Cereal	H	Seed	Food	HR-157	2188	110020.073'N, 037035.516'E	High &Hg Fie	F
49	<i>Ensete ventricosum</i> (Welw.) Cheesman	Musaceae	Enset /Koba		H	Leaves	Lf,	HR-078	2311	10020.986'N, 037041.029'E	Medium &Hg	O
50	<i>Eragrostis tef</i> (Zucc.) Trotter	Poaceae	Bursa tef	Cereal	H	Seed	Food	-	2200	10020.116'N, 037035.381'E	High &Hg Fie	F
		Poaceae	Key tef	Cereal	H	Seed	Food	-	2200	10020.116'N, 037035.381'E	High &Hg Fie	F

		Poaceae	Nech tef	Cereal	H	Seed	Food	-	1845	10013.908'N, 037041.858'E	High & Fie	F
51	<i>Erica arborea</i> L.	Ericaceae	Asta		T	Stem	Fw, Ch, Hc	HR-084	3296	10032.717'N, 037052.592'E	Low &fie	Mp
52	<i>Erythrina brucei</i> Schweinf.	Fabaceae	Korch		T	Leaf/ Stem	Lf, M,	HR-039	2200	10020.986'N, 037041.029'E	Medium & Hg. Fie	Mp
53	<i>Eucalyptus camaldulensis</i> Dehnh.	Myrtaceae	Key bahrzaf		T	Stem/ flowe r	Fi,Lf,Fw, Ch,S,Fr,Fo, Hc.	HR-050	2190	10020.804'N, 037033.472'E	Medium & Hg, Fie	Mp
54	<i>Eucalyptus globulus</i> Labill	Myrtaceae	Nech bahrzaf		T	Leaf /Stem /flow er	Fi,Lf,Fw, Ch,S,M,Fr, Fo, Hc.	HR-028	2190	10020.804'N, 037033.472'E	Medium & Hg, Fie	Mp
55	<i>Euclea divinorum</i> Hiern	Ebenaceae	dedeho		T	Stem	Fw, Ch,Hc, S	HR-104	1856	10014.818'N, 037042.693'E	Medium & Hg, Fie	Mp
56	<i>Euphorbia abyssinica</i> Gmel.	Euphorbiac eae	kulqual		S	Stea m exoda te	Lf. M	HR-006	2215	10019.780'N, 037037.310'E	Medium & Hg	Mp
57	<i>Euphorbia petitiana</i> A. Rich.	Euphorbiac eae	Yegede wotet		S	Leaf exoda te	M	HR-093	3296	10032.721'N, 037052.592'E	Low &Fie	M
58	<i>Ficu sur</i> Forssk	Moraceae	Shola		T	Stem	Fi, F, S	HR-008	2196	10020.580'N, 037034.362'E	Medium & Hg, Fie	Mp
59	<i>Foeniculum vulgare</i> Miller	Apiaceae	Inslal	Spice	H	Leaf		HR-114	2196	10020.580'N, 037034.362'E	Medium & Hg	Sp+M
60	<i>Guizotia abyssinica</i> (L. f.) Cass.	Asteraceae	Nug	Oil	H	Fruit	Food		2196	10020.580'N, 037034.362'E	High & Fie	F
61	<i>Hagenia abyssinica</i>	Rosaceae	Koso		T		Lf, M, S	HR-137	2605	10026.627'N,	Medium	Mp

	(Brace) J. F. Gmel.									037053.495'E	& Hg	
62	<i>Helianthus annuus</i> L.	Asteraceae	Yeferenge suf	Oil	H	Fruit	Food		2188	10020.073'N, 037035.516'E	High & Fie	F
63	<i>Hordeum vulgare</i> L.	Poaceae	Dinbulo gebs	Cereals	H	Seed	Food	HR-124	3281	10032.418'N, 037052.435'E	High & Fie	F
			Late gebs	Cereals	H	Seed	Food	HR-123	3291	10032.717'N, 037052.580'E	High & Fie	F
			Nech gebs	Cereals	H	Seed	Food	HR-126	3291	10032.717'N, 037052.580'E	High & Fie	F
			Nech mesno gebs	Cereals	H	Seed	Food	HR-120	3079	10030.782'N, 037052.367'E	High & Fie	F
			Temej gebs	Cereals	H	Seed	Food	HR-122	3281	10032.418'N, 037052.435'E	High & Fie	F
			Temej netela gebs	Cereals	H	Seed	Food	HR-125	3291	10032.717'N, 037052.580'E	High & Fie	F
			Tkur gebs	Cereals	H	Seed	Food	HR-121	3281	10032.418'N, 037052.435'E	High & Fie	F
			Tkur senef kollo	Cereals	H	Seed	Food	HR-127	3079	10030.782'N, 037052.367'E	High & Fie	F
			Weyno gebs	Cereals	H	Seed	Food	HR-118	3291	10032.717'N, 037052.580'E	High & Fie	F
64	<i>Hygrophila schulli</i> (Hamih.) M. R. & S. M. Almeida	Acantaceae	Yemesk shoh		H	Leaf	M	HR-004	2188	10020.073'N, 037035.516'E	Low & Fie	M
65	<i>Ipomoea batatas</i> (L.) Lam.	Convolvulaceae	Skuar dneh	Vegetable	H	Root	Food	HR-	2330	10021.260'N, 037041.150'E	High & Hg	F
66	<i>Jasminum grandiflorum</i> L.	Oleaceae	Tenbelel		S	Steam	M	HR-086	2081	10015.246'N, 037042.698'E	Low & Hg	M
67	<i>Juniperus procera</i>	Cupressaceae	Yeabesha		T	Stem	Lf, Fw,	HR-143			Medium	Mp

	Hochst. Ex Endl.	ae	tsde				Hc,Ch,Fr, S				&Hg, Fie	
68	<i>Justicia schimperiana</i> (Hochst ex Nees.) T. Anders.	Acanthaceae	Smiza		S	Stem / flower	Lf, Few, M, Of	HR-055	2307	10021.111'N, 037041.028'E	Medium & Hg	Mp
69	<i>Lactuca sativa</i> L.	Asteraceae	Selata	Vegetable	H	Leaves	Food	HR-031	2307	10020.974'N, 037040.972'E	High & Hg	F
70	<i>Lagenaria siceraria</i> (Molina) Stand.	Cucurbitaceae	qill		C	Fruit		HR-111	1845	10013.908'N, 037041.858'E	High & Hg	O
71	<i>Lathyrus sativus</i> L.	Fabaceae	Guaya	Pulses	H	Seed	Food		2780	10026.755'N, 037053.689'E	High & Fie	F
72	<i>Leonotis ocymifolia</i> (Burm. f.) Iwarsson	Lamiaceae	Yeferes zeng		H	Leaf	M	HR-089	2219	10019.454'N, 037037.323'E	Low & Hg	M
73	<i>Lepidium sativum</i> L.	Brassicaceae	Feto	Spice	H	Seed		HR-071	2330	10021.260'N, 037041.150'E	High & Fie	Sp +M
74	<i>Linum usitatissimum</i> L.	Linaceae	Telba	Oil	H	Seed	Food	HR-029	2330	10021.260'N, 037041.150'E	High & Fie	N
75	<i>Lippia adoensis</i> Hochst. ex Walp.	Verbanaceae	Kese		S	Leaf / Stem	M, Lf, Few	HR-009	2307	10020.974'N, 037040.972'E	Medium & Hg	Mp
76	<i>Lolium temulentum</i> L.	Poaceae	Ankerdad			Leaf	Weed	HR-141			Low Fie	O
77	<i>Lupinus albus</i> L.	Fabaceae	Gbto	Pulses	H	Seed	Food	HR-136	2188	10020.073'N, 037035.516'E	High & Fie	N
78	<i>Lycopersicon esculentum</i> Mill.	Solanaceae	Timatim	Vegetable	H	Fruit	Food	HR-073	2081	10015.240'N, 037042.698'E	High & Hg, Fie	N
79	<i>Maesa lanceolata</i> Forssk.	Myrsinaceae	Klambo		S	Leaf / Steam	Few, S, for covering ;injera'	HR-113	3296	10032.721'N, 037052.592'E	Medium & Fie	Mp
80	<i>Malus sylvestris</i> Miller	Rosaceae.	Pom	Fruit	S	Fruit raw	Food	HR-016	3296	10032.721'N, 037052.592'E	High & Hg	F
81	<i>Malva verticillata</i> L.	Malvaceae	Lut		H	Root	M	HR-092	3280	10032.658'N, 037052.595'E	Low & Fie	M

82	<i>Mangifera indica</i> L.	Anacardaceae	Mango	Fruit	T	Fruit raw	Food	HR-062	2307	10020.974'N, 037040.972'E	High & Hg	F
83	<i>Maytenus arbutifolia</i> (A. Rich.) Wilczek	Celastereae	Atat		S	Stem	Lf,Fw,S	HR-012	2311	10020.986'N, 037041.029'E	Medium & Hg, Fie	Mp
84	<i>Mentha spicata</i> L.	Lamiaceae	Nana	Spice	H	Leaf		HR-115	2311	10020.986'N, 037041.029'E	Medium & Hg	Sp+ M
85	<i>Momordca foetida</i> Schumach.	Cucurbitaceae	Yekura hareg		C	Root	M	HR-097	2215	10019.780'N, 037037.310'E	Low & Hg	M
86	<i>Morus alba</i> L.	Moraceae	Yeferenj enjori		T	Fruit	F,Lf,S	HR-038	2307	10020.954'N, 037040.972'E	Medium & Hg	Mp
87	<i>Musa x paradisiaca</i> L.	Musaceae	Muz	Fruit	H	Fruit raw	Food	HR-035	1845	10013.908'N, 037041.858'E	High & Hg	F
88	<i>Myrtus communis</i> L.	Myrtaceae	Ades	Fragrant	S	Leaf		HR-105	2599	10026.985'N, 037052.861'E	Medium & Hg	Fra+M
89	<i>Nicotiana tabacum</i> L.	Solanaceae	Tmbaho	Stimulant	S	Leaf		HR-081	2416	10020.141'N, 037044.214'E	Medium & Hg	St
90	<i>Nigella sativa</i> L.	Ranunculaceae	Tkurazmud	Spice	H	Seed			2190	10020.804'N, 037033.472'E	High & Hg	Sp+M
91	<i>Ocimum bacilicum</i> L.	Lamiaceae	Besobla	Spice	H	Seed		HR-013	2200	10020.116'N, 037035.381'E	High & Hg	Sp
92	<i>Ocimum lamiifolium</i> Hochst. ex Benth.	Lamiaceae	Dama Kese	Fragrant	H	Stem /Leaf	M, Few, Lf	HR-011	2215	10019.780'N, 037037.320'E	Low & Hg, Fie	Fra
93	<i>Ocimum americanum</i> L.	Lamiaceae	Tosgn	Spice	H	Seed		HR-005	2216	10019.391'N, 037037.309'E	High & Hg	Sp
94	<i>Olea europea</i> L. subsp. <i>cuspidata</i> (Wall. ex G. Don) Cif.	Oleaceae	Weyra	Fragrant	T	Leaf /stem	Lf,S	HR-053	3296	10032.721'N, 037052.592'E	Medium & Hg	Mp
95	<i>Opuntia ficus-indica</i> (L.) Miller	Cactaceae	Beles		S	Fruit	F, Lf,	HR-079	2602	10027.006'N, 037052.874'E	Medium & Hg	Mp
96	<i>Otostegia integrifolia</i>	Lamiaceae	Tnjt	Fragra	S	Stem		HR-090	2188	10020.037'N,	Medium	Fr+M

	Benth.			nt		/ Leaf				037035.516'E	&Hg	
97	<i>Pennisetum purpureum</i> Schumach.	Poaceae	Zhone Sar		H	Leaf	Fo	HR-033	2215	10019.780'N, 037037.310'E	Medium & Hg	O
98	<i>Persea americana</i> Mill.	Lauraceae	Avocado	Fruit	T	Fruit raw	Food	HR-017	2307	10020.974'N, 037040.972'E	High & Hg	N
99	<i>Phaseolus coccineus</i> L.	Fabaceae	Key boleke	Pulses	H	Seed	Food		1856	10013.908'N, 037041.858'E	High & Hg, Fie	F
			Nech boleke	Pulses	H	Seed	Food		1856	10013.908'N, 037041.858'E	High & Hg	F
100	<i>Phaseolus lanatus</i> L.	Fabaceae	Adenguar e	Pulses	H	Seed	Food	HR-007	2220	10020.116'N, 037035.381'E	High & Hg	F
101	<i>Phytolaca dodecandra</i> L'Herit.	Phytolacac eae	Endod		S	Leaf/ Fruit	M ,Lf, Laundry	HR-049	2188	10020.073'N, 037035.516'E	Low & Hg, Fie	Mp
102	<i>Pisum sativum</i> L.	Fabaceae	Ater	Pulses	H	Seed	Food		2602	10027.006'N, 037052.874'E	High & Fie	F
103	<i>Plantago lanceolata</i> L.	Plantaginac eae	Gorteb		H		M ,	HR-036	2190	10020.804'N, 037033.472'E	Low & Hg, Fie	M
104	<i>Podocarpus falcatus</i> (Thunb.) R. B.ex Mirb.	Podocarpac eae	Zgba		T	Stem	Fi ,Few, Ch, Hc, Fr, S	HR-139	2330	10021.260'N, 037041.150'E	Medium & Hg, Fie	Mp
105	<i>Prunus africana</i> (Hook. f.) Kalkm.	Rosaceae	Homa		T	Stem	Fi,Lf, Few, Ch,Hc, S	HR-010	2307	10020.954'N, 037040.972'E	Medium & Hg, Fie	Mp
106	<i>Prunus persica</i> (L.) Batsch	Rosaceae	Kok	Fruit	T	Fruit raw	Food	HR-020	2330	10021.260'N, 037041.150'E	High & Hg	F
107	<i>Psidium guajava</i> L.	Myrtaceae	Zeytun	Fruit	S	Fruit raw	Food	HR-063	2307	10020.974'N, 037040.972'E	High & Hg	N
108	<i>Rhamnus prinoides</i> L' Herit	Rhamnacea e	Gesho	Spice	S	Seed		HR-056	2216	10019.391'N, 037037.309'E	Medium & Hg	Sp+M
109	<i>Ricinus communis</i> L.	Euphorbiac ae	Gulo	Oil (non-	H	Fruit		HR-072	2188	10020.073'N, 037035.516'E	Medium & Hg	O

				food)								
110	<i>Rosmarinus officinalis</i> L.	Lamiaceae	Rosmarina	Spice	H	Leaf		HR-106	2307	10020.974'N, 037040.972'E	Medium & Hg	Sp
111	<i>Rubus steudneri</i> Schweinf.	Rosaceae	Enjori		S	Fruit	Lf, F,	HR-117	2605	10026.627'N, 037053.495'E	Low & Hg, Fie	Mp
112	<i>Rumex abyssinicus</i> Jacq.	Polygonaceae	Mekmeko	Spice	H			HR-051	2188	10020.073'N, 037035.516'E	Low & Hg, Fie	Sp
113	<i>Rumex nepalensis</i> Spreng.	Polygonaceae	Yeberiemlass		H	Root	M	HR-087	3296	10032.721'N, 037052.592'E	Low & Hg, Fie	M
114	<i>Ruta chalepensis</i> L.	Rutaceae	Tenadam	Spice	S	Seed. Leaf		HR-107	2200	10020.116'N, 037035.381'E	Medium & Hg	Sp+M
115	<i>Saccharum officinarum</i> L.	Poaceae	Shenkoragea	Suger	H	Stem	Food	HR-048	2307	10020.974'N, 037040.972'E	High & Hg	F
116	<i>Senna singueana</i> (Del.) Lock	Fabaceae	Gufa		T	Stem, Stem bark	Fi, Lf. Few, Ch, S, M	HR-100	1856	10014.818'N, 037042.693'E	Medium & Hg, Fie	Mp
117	<i>Senra incana</i> Cav.	Malvaceae	Chfreg		S	Leaf	M	HR-083	2188	10020.073'N, 037035.516'E	Low & Hg, Fie	M
118	<i>Sesbania sesban</i> (L.) Merr.	Fabaceae	Sasbania		S	Leaf/ stem	Fi,Lf,Fw, Ch,Fo,S	HR-027	2330	10021.260'N, 037041.150'E	Medium & Hg, Fie.	Mp
119	<i>Solanecio gigas</i> (Vatke) C. Jeffery	Asteraceae	Boz		S	Stem, Leaf	Lf, Few, compost	HR-144	2852	10028.070'N, 037052.112'E	Low & Hg	Mp
120	<i>Solanum tuberosum</i> L	Solanaceae	Dnch	Vegetable	H	Root		HR-014	2564	10026.718'N, 037053.726'E	High % Hg, Fie	F
121	<i>Sorghum bicolor</i> (L.) Moench	Poaceae	Mashela	Cereal	H	Seed	Food	HR-001	1845	10013.908'N, 037041.858'E	High & Hg, Fie	F
122	<i>Stephania abyssinica</i> (Dillo & A. Rich.) Walp.	Menispermaceae	Yaytareg		C	Root	M	HR-042	2307	10021.111'N, 037041.028'E	Low & Hg, Fie	M
123	<i>Tragia doryodes</i> M. Gilbert	Euphorbiaceae	Ablalit		H	Root	M	HR-103	2081	10015.246'N, 037042.698'E	Low & Hg, Fie	M

124	<i>Trigonella foenum-graecum</i> L.	Fabaceae	Absh	Spice	H	Seed		HR-101	2307	10020.974'N, 037040.972'E	High & Fie	Sp
125	<i>Triticum dicocoon</i> Schrank.	Poaceae	Aja	Cereal	H	Seed	Food		2605	10026.627'N, 037053.381'E	High & Fie	F
126	<i>Triticum durum</i> Desf.	poaceae	Alyas snde	Cereals	H	Seed	Food	HR-128	2200	10020.116'N, 037035.381'E	High & Fie	F
127	<i>Triticum aestivum</i> L	Poaceae	Bulga snde	Cereals	H	Seed	Food	HR-133	2852	10028.078'N, 037053.112'E	High & Fie	F
			Mrte snde	Cereals	H	Seed	Food	HR-130	2589	10026.981'N, 037052.756'E	High & Fie	F
			Sida snde	Cereals	H	Seed	Food	HR-132	2953	10028.599'N, 037052.981'E	High & Fie	F
			Wasma snde	Cereals	H	Seed	Food	HR-131	2953	10028.599'N, 037052.981'E	High & Fie	F
128	<i>Triticum aethiopicum</i> Jakubz.	Poaceae	Tkur snde	Cereals	H	Seed	Food	HR-129	2953	10028.599'N, 037052.981'E	High & Fie	F
129	<i>Triticum turgidum</i> L.	Poaceae	Zenbolel snde	Cereals	H	Seed	Food	HR-135	2589	10026.981'N, 037052.756'E	High & Fie	F
130	<i>Urtica simensis</i> Stedel	Urticaceae	Sama		H	Leaf	F ,Lf,M	HR-030	2307	10021.111'N, 037041.028'E	Low & Hg	Mp
131	<i>Verbascum sinaiticum</i> Benth.	Verbanaceae	Ketetna		H	Root	M	HR-085	2219	10019.454'N, 037037.323'E	Low & Hg, Fie	M
132	<i>Vernonia amygdalina</i> Del.	Asteraceae	Grawa		T	Leaf/ Stem	Fi, Lf, Fw,Ch,M,S	HR-021	2311	10020.986'N, 037041.029'E	Medium & Hg	Mp
133	<i>Vicia faba</i> L.	Fabaceae	Bakela	Pulses	H	Seed	Food		2692	10027.006'N, 037052.874'E	High & Hg ,Fie	F
134	<i>Zea mays</i> L.	Poaceae	Key bokolo	Cereals	H	Seed	Food		2200	10020.116'N, 037035.381'E	High & Hg, Fie	F
			Nech bokolo	Cereals	H	Seed	Food	HR-040	2200	10020116'N, 037035.381'E	High & Hg, Fie	F

			Weyno bokolo	Cereals	H	Seed	Food		2200	10020116'N, 037035.381'E	High & Hg, Fie	F
135	<i>Zehneria scabra</i> (Linn. f.) Sond.	Cucurbitaceae	Haregresa		C	Leaf	M	HR-109	2216	10019.454'N, 037037.323'E	Low & Hg	M
136	<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Zngble	Spice	H	Root		HR-024	2215	10019.780'N, 037037.320'E	High & Hg	Sp

Appendix 4. List of Food Crops and their method of preparation in the study area

Crops	Local name of food	Plant part and form	Method of preparation
Tef	'Injera'	Whole grain flour	Water being added gradually while stirring. The dough is allowed to stand for 2-4 days to ferment. Some proportion of boiled water must be added to the fermented dough with stirring and allowed to stand 30 minutes –one hour to rise. Liquefied dough is fine dropped to smear evenly on a hot clay plate or 'mtad' in concentric circle. A tight lid is placed on top of the plate. The lid is removed after 1-2 minutes depending up on the fire supply. 'Injera' is made by mixing flour of tef and other cereals (finger millet, barley, maize, wheat etc.). 'It is eaten with 'wot' or butter with spiced hot pepper or finely ground grain of <i>Guizotia abyssinica</i> (nug) mixed with salt and water was smeared over 'Injera' and served during spiritual ceremony in Ethiopian orthodox church next day of final fasting day of gospel.
	'Kita'	Whole grain flour	Adding water to the flour until the dough becomes soft enough to be baked. After adding proper amount of salt, the dough backed immediately on metal or clay plate by hand smearing and covers it by lid. Remove the lid after 5 minutes. It is eaten with butter and spiced hot pepper or eaten with finely ground grain of <i>Guizotia abyssinica</i> (nug) mixed with salt and water smeared over 'kita'.
	'Genfo'	Whole grain flour	The flour well cooked in water by simultaneous stirring. Add salt and remove from the fire. It is eaten with butter and spiced hot pepper.

Barly	'Injera'	Whole/dehulled grain flour	3-4 kg flour of 'Mesno gebs' or 'Nech gebs' or 'weyno' gebs and 4-5 litter water with 1-2litter-starter batter (yeast) mixed. The water being added by stirring the flour. The dough is covered and stayed 5 days to ferment. Boiled water was added to the dough if and only if the dough not so much liquefied. Let them for a hour to rise. Adding some fresh water if needed and the liquefied dough is dropped to smear evenly on a hot clay plate and placed tight lid over it. The lid removed after one minute and then 'injera' taken out.
	'Beso'	Whole/ dehulled grain flour	Flour of roasted grain moistened with boiled or fresh water by the addition of salt and sugar (in slightly solidified bolus form or liquefied form as eat and drink respectively).
	Shameta (non alcoholic beverage)	Whole/dehulled grain	The flour of barley mixed with small proportion of wheat malt flour with the addition of water, which stays not more than 4 hours.
	Tela (alcoholic beverage)	Malted, roasted and ground grain preparation of 'DEREKOT', 'ABSHLO', 'ENKURO'	The barley grain soaked with water until the germination initiates. Remove the water and put inside bamboo basket by being cover in ricinus comunis and enset ventricosum leaves. After the germination completed the barley become malted and removed from the basket and dried by using sunlight. The finely ground malt, ground stems and leaves of a flavoring plant (<i>Rhamnus prinoides</i>) and water mixed with 'ABSHILLO' or 'ENKURO' and 'DEREKOT' in ajar. Cover the jar and stay many days' minimum two days and used it as 'TELLA'. 'ABSHLO' is made when the grain of barley or finger millet or maize or wheat roasted, finely ground and mixed with water that stays 3 days and baked on hot metal or clay plate like 'KITA' but leaves or branches of <i>Vernonia amygdalina</i> is placed beneath and above the dough. After backed the KITA further cute in to smaller pieces and mixed to the ingredient of 'TELA'. 'ENKURO' is made when the grain of barley or maize or wheat roasted, finely ground mixed with small amount of water and stay 1-2 days in container. The product is placed on hot clay or metal plate with subsequent mixing of the product by using wooden material. This can be used as ingredient of TELA. DEREKOT is made from maize sometimes BLACK BARLEY. Maize was soaked in water that stays 5-7 days in a pot. Placed the maize on basket made from <i>Arundinaria alpina</i> (Bamboo) or <i>Arundo donax</i> (Shembeko) to drain the water. If the water is drained, it can be roasted by using hot metal or clay plate until the co lour become black. The roasted grain can be ground coarsely and serve as ingredients for TELA preparation.
	'Genfo'(Porridge)	Completely dehulled grain flour	Completely dehulled White barley finely ground. Boil the water and add the flour with simultaneously stirring. It is eaten by adding spiced butter and hot pepper

	Eshet (green roast)	Unripe grain	Spikes of barley at the right stage of ripening are picked and rubbed between the palms or thumped with the hands to remove the rachis, glumes and awns.
	Enkuto (partial roasted)	Un ripe partial roasted grain	The fragments like rachis, glumes and awns are removed during roasting by holding a hand full of spikes over the flame and then the roasted grain can be eaten.
	Kolo (roasted grain)	Roasted and dehulled grain	Grain from 'Senef kolo gebs' can be roasted by using hot clay or metal plate and served alone or in mixture with roasted chick pea, pea, or un roasted saf flower
	Atmit(Soup)	Dehuled grain flour	The white barley completely dehuled by partial roasting and ground in to fine flour. It can be served alone or mixed with flour of <i>Avena sativa</i> . Prepared in the same way as wheat flour or tef flour. Dissolved in water or milk, boiled, add sugar and salt with simultaneous stirring. Drink with or without spiced butter.
Maize	Kolo(roasted grain)	Whole grain roasted	Fresh grain roasted by using hot metal or clay plate.
	Tela (Local beverage)	Whole grain	Roasted or malted grain (Especially Key Bokolo) prepared in admixture with barley, gesho (<i>Rhamnus prinoides</i>) and water. The same method of preparation as Tela for barley.
	Nfro (Boiled grain)	Whole grain	Fresh grain is boiled alone or with chickpea, pea, fava bean, cowpea and wheat.
	Dabo (Bread)	Whole grain flour (Netch Bokollo)	Dough is made by adding water to the flour. It can be used alone or mixed with barley flour. The dough is allowed to stand four hours until to rise. Mostly yeasts added in to the dough to facilitate the rising. The dough baked on metal or clay plate by hand placing. The plate is covered by another metal plate or tight lid made of bamboo plastered with mud.
Wheat	Kolo(roasted grain)	The whole grain	The grain roasted by using hot clay or metal plate and served alone or in mixture with roasted chickpea, pea, barley or un roasted safe flower.
	Dabo (Bread)	The whole grain flour	Same method of preparation as bread from maize
	Tela (local beverage)	Grain, Malt, 'DEREKOT', 'ABSHLO', 'ENKURO'	The malt, 'ENKURO', 'ABSHLO' and DEREKOT are prepared in the same way as barley. Ingredients for local beverage preparation by different females are differently. One group use ingredients like Malt, 'DEREKOT', 'ABSHLO, finely ground 'gesho' (<i>Rhamnus prinoides</i>) leaf or steam and water with good proportion, and others use ingredients like 'ENKURO' DEREKOT' Malt, and finely ground 'gesho' leaf or steam and water.
Sorghum	Injera (pan cake like bread)	Whole/ dehulled grain flour.	Same method as for INJERA of tef or barley flour. It can be made from varying proportion of sorghum flour and other cereals.

	Dabo (Bread)	Dehulled grain flour	Same method of preparation as for 'KITA' of tef, but the dough is allowed to stand for hours to rise.
	Genfo (porridge)	Dehulled grain flour	Same method of preparation as porridge from barley flour.
Finger millet	Ingera (pan cake like bread)	Whole grain	Same method as for 'injera' of tef or barley flour. It can be made from varying proportion of Finger millet flour and other cereals.
	'Kita'	Whole grain flour	Same method as for 'Kita' of tef or wheat flour.
	Tela (alcoholic beverage)	Seed	It is used as malt 'ABSHILO' and 'ENKURO'. The preparation is the same as wheat.
Niger seed	'Zeyt'	Fruit	Oil extracted from seed in factory and used in food (for 'Wot' preparation).
	Fagulo (animal fodder)	Fruit	After the oil extracted, the by-product can be ground and mixed with salt and other fodder and gave to animal.
	'Nug'	Roasted fruit	Fruit roasted, crushed and made in to small balls. It can be eaten by mixing with 'Kolo' of barley or wheat during coffee ceremony.
	'Kba-nug'	Roasted fruit	Fruits roasted and crushed until the oil produced
Ethiopian kale	'Zeyt'	Seed	Oil extracted from seed in factory and used in food (for 'Wot' preparation).. The quality is less than Nug
	'Gomen'	Young leaves	It can be cooked, oiled, salted and eaten with 'injera'
Saf flower	'Kolo'	Fruit	Unroasted fruit mixed with roasted wheat or barley
	'Zeyt'	Fruit	Oil extracted from seed in factory and used in food (for 'Wot' preparation).
Bean	Boiled grain (Nfro)	Seed	The seed are boiled alone or with chick pea, pea, cow pea, maize or wheat and served as food
	'Bokelt'	Seed left to germinate	The seed immersed in a jar containing water and stay until the seed increase in its size and start to germinate that stays not more than 3 days. Remove the water and add powdered salt. Eventually it can be serve as food called 'Bokelt'
	'Shero'	Seed (removed the cotyledons)	The seed first roasted and crashed in to two pieces. Remove the cotyledons from the seed; finally ground the seed by adding spices. It can be served alone or together with chick pea or pea or cow pea in appropriate proportion.
	'Gulban' especial fasting food	Seed	The seed roasted to remove easily the cotyledon. Eventually boiled by adding salt and serve as food at Thursday of the last fasting week of Easter.
	Green grain	Unripe seed	At the right stage of ripping the pods are picked from the plant and by splitting the pod people

	('Eshet')		collect the seed and eat as green grain
	'Kik wot' or 'Alcha wot'	Seed	The crushed seed after removing the cotyledon was boiled. After boiling it can be further cooked by adding salt and other spices but not hot pepper. Its color become yellowish
Pea	Boiled grain (Nfro)	Seed	Same method of preparations as 'Nfro' from bean
	'Bokelt'	Seed	Same method of preparations as 'Bokelt' from bean
	'Shero'	Seed	Same method of preparations as 'Shero' from bean
	Green grain ('Eshet')	Unripe seed	Same method of preparations as green grain from bean
	'Kik wot' or 'Alcha wot'	Seed	Same method of preparations as 'Kik wot' or 'Alcha wot' from bean
Chick pea	Boiled grain (Nfro)	Seed	Same method of preparations as 'Nfro' from bean
	'Bokelt'	Seed	Same method of preparations as 'Bokelt' from bean
	'Shero'	Seed	Same method of preparations as 'Shero' from bean
	Green grain ('Eshet')	Unripe seed	Same method of preparations as green grain from bean
	'Kik wot' or 'Alcha wot'	Seed	Same method of preparations as 'Kik wot' or 'Alcha wot' from bean
<i>Lathyrus sativus</i>	'Shero'	Seed	The seed first washed and then boiled. Remove the water then after, dried and crushed so as to remove the cotyledon. The dried seed can ground and serve as 'Shero' for 'Wot' preparation

Appendix 5. List of medicinal plants collected from home garden and fields

No	Scientific Name	Family Name	Parts used	Method of preparation and application	Aliments cured
1	<i>Artemisia afra</i> Jacq. ex Wilk.	Asteraceae	Leaf	By smelling the leaves	To remove bad sprit
2	<i>Brassica nigra</i> (L.) Koch.	Brassicaceae	Seed	The seed roasted and finely ground. Water added to the flour and let them an hour to ferment. Served as food by mixing with 'bokelt' made from chickpea or pea or bean	Malaria

3	<i>Capparis tomentosa</i> Lam.	Capparidaceae	Root	Root shortly cut and hanging on the neck	Evil eye
4	<i>Lipidium sativum</i> L.	Brassicaceae	Seed	By boiling it, give to cow to drink	Anthrax
5	<i>Verbascum sinaiticum</i> Benth.	Scrophulariaceae	Root	The root dug out with olive handled stick and held between teeth.	Tooth ach
6	<i>Croton macrostachyus</i> Del.	Euphorbiaceae	Shoot	3-7 meristems from side branches taken and cooked by adding salt and butter and drink a cup of solution once.	Malaria
			Leaf	Exudates can be creamed over the skin.	Ring worm
7	<i>Datura stramonium</i> L.	Solanaceae	Leaf	Leaf juice applied once daily mixed with butter	Hair growth stimulant
8	<i>Hagenia abyssinica</i> (Bruce) J. F. Gmel.	Rosaceae	Leaf	One glass of juice of fresh leaf mixed with water solution of line seed and taken once.	Tapeworm
9	<i>Myrtus communis</i> L.	Myrtaceae	Leaf	Leaf powder Pasted with butter applied once a day	Ring worm
10	<i>Nigella sativa</i> L.	Ranunculaceae	Seed	Fried seeds wrapped in a piece of cloth and sniffed three times daily	Common cold
11	<i>Phytolacca dodecandra</i> L'Herit.	Phytolacaceae	Leaf	Juice extracted from fresh leaf and given to cow	Anthrax
12	<i>Plantago lanceolata</i> L.	Plantaginaceae	Root	Root powder is employed once daily to bandage wounds	Wounds
13	<i>Euphorbia abyssinica</i> Gmel.	Euphorbiaceae	Latex	The latex mixed with crashed garlic, salt and wheat flour. Applied once daily on infected part	Lash
			Root	One spoon root powder mixed with a cup of fresh milk. Give for dog	Rabbis virus
14	<i>Stephania abyssinica</i> (Dillon & A. Rich.) Walp.	Menispermaceae	Root	Cap of root juice given once to cattle	Anthrax
15	<i>Nicotiana tabacum</i> L.	Solanaceae	Leaf	Leaf juice pounded with and applied once through ear and nasal drop to expel the parasite	Leach
16	<i>Lycopersicon esculentum</i> Mill.	Solanaceae	Leaf		
17	<i>Rhamnus prinoides</i> L'Herit	Rhamnaceae	Leaf		
18	<i>Otostegia integerifolia</i> Benth.	Lamiaceae	Leaf		

19	<i>Carica papaya</i> L.	Caricaceae	Seed	The seed can be eaten together with the fleshy part.	Gastritis
20	<i>Cymbopogon citratus</i> (DC.) Stapf.	Poaceae	Root	5-10 spoon of root powder mixed with 1 liter fresh water, given to cow	Anthrax
21	<i>Eritrina brucei</i> Schweinf.	Fabaceae	Leaf	Leaf powder creamed on infected part.	Wound
22	<i>Lupinus albus</i> L.	Fabaceae	Seed	The seed roasted and ground. The powder creamed on infected part once daily for domestic animals.	Wound
23	<i>Malva verticillata</i> L.	Malvaceae	Root	Root inserted in to the vagina	Abortion
24	<i>Momordica foetida</i> Schumach.	Cucurbitaceae	Root	Root powder creamed daily on infected part of human	Wound
25	<i>Cucumis ficifolius</i> A. Rich.	Cucurbitaceae	Fruit	1-3 fruit roasted and can be given for sheep by adding salt.	Liver flock
			Root	The root dug out with horn handled knife and sqzued. One spoon of the filtrate can be given for children	Diaries
26	<i>Artemisia absintium</i> L.	Asteraceae	Leaf	Sniffing of the fragrant leaf removes bad sprit	Evil eye
27	<i>Carthamus lanatus</i> L.	Asteraceae	Root	The root is cut in to seven pieces about 3cm each and ground. The root powder mixed with water. The patient Can take a cup of it. Immersing a small finger not more than that can check the volume of the solution in a cup.	Snack bite
28	<i>Clematis simensis</i> Fresen.	Ranunuclaceae	Leaf and Stem	The leaf and steam chopped and mixed with water. The mixture stays 21 days to ferment and sprayed over on cereal crops.	Control pests
29	<i>Dracaena steudneri</i> Engl	Dracaenaceae	Leaf	The leaf squeezed and mix with 1 liter water and given to the cattle	Remove bad sprits from the animal
30	<i>Eucalyptus globules</i> Labill.	Myrsinaceae	Leaf	Boiled the leaf and the patient inhaled the steam	Cough
31	<i>Euphorbia petitiiana</i> A. Rich.	Euphorbiaceae	Leaf exodate	The milky exudates from the leaf is creamed over the infected skin	Ring worm
32	<i>Hygrophila schulli</i> (Hamih.) M. R. & S. M. Almeida	Athecantaceae	Leaf	Grinding the leaf and mixed with fresh butter and creamed over the infected skin	Skin diseases
33	<i>Jasminum grandiflorum</i> L.	Oleaceae	Apical meristem	Cut seven apical meristems from the plant by human teeth and given to the person bitted by snake mouth to mouth	Snake bite

34	<i>Leonotis ocymifolia</i> (Burm.f.) Iwarsson	Lamiaceae	Leaf	Squeezing the leaf and mixed with in one litter water and then give to cattle	Anthrax
35	<i>Linium usitatissimum</i> L.	Linaceae	Seed	Drinking a cup of the mucus by removing the seed early in the morning after boiling.	Gastritis
36	<i>Menthe spicata</i> L.	Lamiaceae	Leaf	The leaves are boiled with tea and are taken orally	Difficulty in urinati on
37	<i>Ruta chalepensis</i> L.	Ruthaceae	Stem and leaf	The stem and leaf immersed with hot tea and drink the solution.	Common cold.
38	<i>Senra incana</i> Cav.	Malvaceae	Leaf	After grinding the dried leaf take one spoon and mixed it in a cup of water. Drink the solution after shake	Diarrhea
39	<i>Tragia doryodes</i> M. Gilbert	Euphorbiaceae	Root	The root grinned and bandaged on hand	Evil eye
40	<i>Zehnaria scabra</i> (Linn. f.) Sond.	Cucurbitaceae	Leaf	The leaf can be boiled with water and the patient fumigated by the steam or inhaled the steam	Headache , Abdomin al pain
41	<i>Justicia schimperiana</i> (Hochst. ex Nees.) T. Anders.	Aca ntaceae	Root	The roots are grinded, then take one spoon and mixed with a cup of water. The patient drunk the mixture	Sexual transmitt ed diseases
			Leaf	Juice of seven shoot meristems that can be mixed with fresh water and drink a cup of the mixture	Hepatitis
42	<i>Calpurnia aurea</i> (Ait.) Benth.	Fabaceae	Leaf	The leaf squeezed and the fluid applied over the infected part in both human and live stock	Wound
43	<i>Citrus aurantifolia</i> (Christm.) Swingle	Rutaceae	Fruit juice	Rubbed the juice over the infected part of human body	Fungus
44	<i>Daucus carrota</i> L.	Apiaceae	Root	The fresh root can be eaten to stop menstruation	Menstrua tion
45	<i>Foeniculum vvulgare</i> Miller	Apiaceae	Leaf	The leaves boiled with tea or coffee and then drunk for stomach compliant and hypertension	Abdomin al pain
46	<i>Lippia adoensis</i> Hochst. ex Walp.	Verbanaceae	Leaf	Steaming the leaf by inserting it in boiled water and also drinking in cub	Fibril illness

47	<i>Persea americana</i> Mill.	Lauraceae	Fruit juice	The juice is creamed over hair for hair fungal treatment	Fungus
48	<i>Psidium guajava</i> L.	Myrtaceae	Fruit juice	Drink the juice that reduces serious effect of gastritis	gastritis
49	<i>Rumex nepalensis</i> Spreng.	Polygonaceae	Root	The root squeezed and is taken by a cup	Remove placenta after birth
50	<i>Senna singueana</i> (Del.) Lock	Fabaceae	Bark	Chewing the bark and drinking the fluid	Snake bite
51	<i>Vernonia amygdalina</i> Del.	Asteraceae	Leaf	Leaf extract (fluid) is taken orally (one cup)	Intestinal parasites
52	<i>Brucea antidysenterica</i> J. F. Mill.	Simaroubaceae	Fruit	Dried fruit finely Crushed and creamed on wounds (for human)	Wound
53	<i>Urtica simensis</i> Stedel	Urticaceae	Leaf	The fresh leaves could be cooked and eaten by 'injera'	gastritis

Appendix 6. List of tolerated plants and their use in the study area

No	Scientific name	Family name	Local name	Habit	Use	Place of the plant
1	<i>Brucea antidysenterica</i> J. F. Mill.	Simaroubaceae	Aballo	S	M	Fie
2	<i>Capparis tomentosa</i> Lam.	Capparidaceae	Gumero	S	M , Fence	Hg, fe
3	<i>Carissa spinarum</i> L.	Apocynaceae	Agam	S	Lf.	Hg, fe
4	<i>Carthamus lanatus</i> L.	Asteraceae	Yeset aff	H	M	Fie
5	<i>Clausena anisata</i> (Willd.) Benth.	Rutaceae	Lmch	S	Tooth brush	Hg, fe
6	<i>Clematis simensis</i> Fresen.	Ranunculaceae	Yeazo hereg	H	M	Hg, fe
7	<i>Cucumis ficifolius</i> A. Rich.	Cucurbitaceae	Yemdir emboy	S	M	Hg, fe
8	<i>Datura stramonium</i> L.	Solanaceae	Astenager	H	M	Hg
9	<i>Euphorbia petitiana</i> A. Rich.	Euphorbiaceae	Yegedie wottet	H	M	Fie
10	<i>Hygrophila schulli</i> (Hamih.) M. R.	Acantaceae	Yemesk shoh	H	M	Fie

11	<i>Jasminum grandiflorum</i> L.	Oleaceae	Tembelel	S	M	Hg, fe
12	<i>Leonotis ocymifolia</i> (Burm. f.) Iwarsson	Lamiaceae	Yefers zeng	H	M	Hg, fe
13	<i>Lolium temulentum</i> L.	Poaceae	Enkrdad	H	Weed, Foder	Fie
14	<i>Malva verticilata</i> L.	Malvaceae	Lute	H	M	Fie
15	<i>Maytenus arbutifolia</i> (A.Rich.) Wilczek	Celastraceae	Atat	S	Fence	Hg, Fie
16	<i>Mmomordica foetida</i> Schummach.	Cucurbitaceae	Yequra hareg	C	M	Hg, fe
17	<i>Ocimum lamiifolium</i> Hochst. Ex Benth.	Lamiaceae	Kese	H	Fragrant	Hg
18	<i>Phytolaca dodecandra</i> L'Herit.	Myrtaceae	Endod	S	M, Lf, Laundry	Hg, Fie
19	<i>Plantago lanceolata</i> L.	Plantaginaceae	Gorteb	H	M	Hg, Fie
20	<i>Rubus steudneri</i> Schweinf.	Rosaceae	Enjori	S	M, Fence	Hg, Fie
21	<i>Rumex abyssinicus</i> Jacq.	Poligonaceae	Mekmeko	H	Sp	Hg, Fie
22	<i>Rumex nepalensis</i> Spreng.	Polygonaceae	Yeberemilace	H	M	Fie
23	<i>Senra incana</i> Cav.	Malvaceae	Chifreg	S	M	Fie
24	<i>Solanecio gigas</i> (Vatke) C. Jeffrey	Asteraceae	Bothe	S	Fw, Lf, Compost	Hg, fe
25	<i>Stephania abyssinica</i> (Dillon & A. Rich.) Walp.	Menispermaceae	Yaytse hareg	H	M	Hg, Fie
26	<i>Tragia dorydes</i> M. Gilbert	Euphorbiaceae	Ablalit	C	M	Fie
27	<i>Urtica simensis</i> Stedel	Urticaceae	Sama	H	Food	Hg,fe
28	<i>Verbascum stelurum</i> Murb.	Verbaaceae	ketetina	H	M	Hg, Fie
29	<i>Zehnaria scabra</i> (Linn.f.)Sond	Cucurbitaceae	Hareg ressa	C	M	Hg,fe

Note: M= Medicine, Sp = Spice, Lf= Live fence, Hg, fe= homegarden fence site, Hg, Fie= home garden and field, Fie= field, Hg= homegarden

Appendix 7. List of fragrant plants collected in the study area and their method of application

No	Scientific Name	Family Name	Local name	Habit	Plant part	Method of utilization	Place of cultivation
1	<i>Artemisia absinthium</i> L.	Asteraceae	Ariti	H	Leaf	People cut the stem that have leaf and put it in to a box that contain clothes in it and after some days the cloth maintain the smell of the plant(it act as perfume)	Home garden
2	<i>Cymbopogon citratus</i> (D C.) Stapf.	Poaceae	Tejesar	H	Leaf	Leaves can be cute and served for its fragrant foliage in the flour of the house during spiritual and social ceremonies. It can also served to fumigate honey bee hives	Home garden
3	<i>Myrtus communis</i> L.	Myrtaceae	Ades	S	Leaf	Leaf powder used in flavoring butter and to extract a perfume, which women mix with butter to make a fragrant ointment for their hair	Home garden
4	<i>Ocimum lamiifolium</i> Hochst. ex Benth.	Lamiaceae	kessie	S	Leaf	Leaves can be cut and served for its fragrant foliage in the floor of the house during spiritual occasions of fasting day that can stay 16 days starting from August 1-16 in Ethiopian Orthodox Church.	Home garden
5	<i>Olea europea</i> L. sub sp. <i>cuspidate</i>	Oleaceae	Weyra	T	Leaf /Stem	Leaves and steam of the plant can fragrant pots that serve for water or milk collection. It can also fumigate the house to remove house fly and bad sprite	At fence site and farm field
6	<i>Otostogia integrifolia</i> Benth.	Lamiaceae	Tunjut	S	Leaf /Stem	The steams that have leaves can be burned in small pot to fragrance the house to have a pleasant smell, to remove house flies and bad sprite.	Home garden

Appendix 8. List of cereals, pulses and oil crops cultivate in the study area

No	Scientific Name	Family name	English Name	Local name	Crop category	Place of cultivation
1	<i>Avena sativum</i> L.	Poaceae			Cereals	Field
2	<i>Cicer arietinum</i> L.	Fabaceae	Chick pea	Shimbra	Pulses	Field

3	<i>Elusine coracana</i> (L.) Gaertn.	Poaceae	Finger milate	Dagusa	Cereals	Field
4	<i>Eragrostis tef</i> (Zucc.) Trotter	Poaceae	Tef	Tef	Cereals	Field
5	<i>Guizotia abyssinica</i> (L. f.) Cass.	Asteraceae	Niger seed	Nug	Oil	Field
6	<i>Helianthus annuus</i> L.	Asteraceae	Sun flower	Yeferenge suf	Oil	Field and home garden
7	<i>Hordeum vulgare</i> L.	Poaceae	Barely	Gebs	Cereals	Field
8	<i>Lathyrus sativus</i> L.	Fabaceae	Vetch	Guaya	Pulses	Field
9	<i>Linum usitatissimum</i> L.	Linaceae	Line seed	Telba	Oil	Field
10	<i>Lupinus albus</i> L.	Fabaceae	White lubin	Gbto	Pulses	Field
11	<i>Phaseolus coccineus</i> L.	Fabaceae		boleke	Pulses	Field and home garden
12	<i>Phaseolus lanatus</i> L.	Fabaceae	Lima bean	Adenguare	Pulses	Home garden
13	<i>Pisum sativum</i> L.	Fabaceae	Pea	Ater	Pulses	Field
14	<i>Sorghum bicolor</i> (L.) Moench	Poaceae	Sorghum	Mashela	Cereals	Field and home garden
15	<i>Triticum dicocoon</i> Schrank.	Poaceae	Polish wheat	Aja	Cereals	Field
16	<i>Triticum aestivum</i> L.	Poaceae	Wheat		Cereals	Field
17	<i>Triticum aethiopicum</i> Jakubz.	Poacea	Wheat	Tkur sende	Cereals	Field
18	<i>Triticum durum</i> Desf.	Poaceae	Wheat	Yedabo sende	Cereals	Field
19	<i>Triticum turgidum</i> L.	Poaceae	Wheat	Zenbolel sende	Cereals	Field
20	<i>Vicia faba</i> L.	Fabaceae	Fava bean	Bakela	Pulses	Field and home garden
21	<i>Zea mays</i> L.	Poaceae	Maize	Bokolo	Cereals	Field and home garden

Appendix 9. List of fruits and vegetables cultivated in the study area.

No	Scientific name	Family name	Local name	Crop type	Habit	Parts consumed
1	<i>Allium cepa</i> L.	Alliaceae	Qey shi nkurt	Vegetable	H	Bulb
2	<i>Allium sativum</i> L.	Alliaceae	Netch shinkurt	Vegetable	H	Bulb
3	<i>Beta vulgaris</i> L.	Chenopodiaceae	Keiy sir	Vegetable	H	Root
4	<i>Brassica carinata</i> A. Br.	Brassicaceae	Gommen /Gomenzer	Vegetable	H	Leaves
5	<i>Brassica oleracea</i> L.	Brassicaceae	Tiquelgomen	Vegetable	H	Leaves
6	<i>Brassica rapa</i> L.	Brassicaceae	Questa	Vegetable	H	Leaves
7	<i>Capsicum annum</i> L.	Solanaceae	Qaria	Vegetable	H	Fruit raw
8	<i>Carica papaya</i> L.	Caricaceae	Papaya	Fruit	T	Fruit raw
9	<i>Citrus aurantifolia</i> (christm.) Swingle	Rutaceae	Lomi	Fruit	S	Fruit raw
10	<i>Citrus aurantium</i> L.	Rutaceae	Komtate	Fruit	T	Fruit raw
11	<i>Citrus medica</i> L.	Rutaceae	Tringo	Fruit	T	Fruit raw
12	<i>Citrus sinensis</i> (L.) Osbeck	Rutaceae	Birtukan	Fruit	T	Fruit raw
13	<i>Cucurbita pepo</i> L.	Cucurbitaceae	Duba	Vegetable	H	Fruit
14	<i>Daucus carota</i> L.	Apiaceae	Carrot	Vegetable	H	Root
15	<i>Ipomea batatas</i> (L.) Lam.	Convolvulaceae	Sikuar dinch	Vegetable	H	Root
16	<i>Lactuca serulata</i> L.	Asteraceae	Selata	Vegetable	H	Leaves
17	<i>Lycopersicon esculentum</i> Mill.	Solanaceae	Timatim	Vegetable	H	Fruit
18	<i>Malus sylvestris</i> Miller.	Rosaceae.	Pom	Fruit	S	Fruit raw
19	<i>Mangifera indica</i> L.	Anacardaceae	Mango	Fruit	T	Fruit raw
20	<i>Musa x-paradisiaca</i> L.	Musaceae	Muz	Fruit	H	Fruit raw
21	<i>Persea americana</i> Mill.	Lauraceae	Avocado	Fruit	T	Fruit raw
22	<i>Prunus persica</i> (L.) Batsch	Rosaceae	Koke	Fruit	T	Fruit raw
23	<i>Psidium guajava</i> L.	Myrtacea	Zeitun	Fruit	S	Fruit raw
24	<i>Solanum tuberosum</i> L	Solanaceae	Dinich	Vegetable	H	Root

Appendix 10. Lists of spices and method of application in the study area

No	Scientific name	Family name	Vernacular name	Parts consumed	Method of preparation
1	<i>Aframomum corrorima</i> (Brawn.)Jonson	Zingiberaceae	Korerma	Seed	The seed, corarima, are widely used as spice in preparing 'Berbere'(hot red pepper sauce) by grinding with other ingredients
2	<i>Brassica nigra</i> (L.)Koch.	Brassicaceae	Senafech	Seed	The seeds used to make condiment, senafech, and spicy sauce used particularly fasting seasons called 'Sljo'
3	<i>Coriandrum sativum</i> L.	Apiaceae	Dnblal	Fruit	The fruit can be mixed with tef flour to flavor 'injera'
4	<i>Cuminum cyminum</i> L.	Apiaceae	Kemun	Fruit	The fruit is mixed with other ingredients and powdered to prepare 'Berbere'
5	<i>Curcuma domestica</i> Valetton	Zingiberaceae	Erd	Rhizome	The rhizome dried and powdered. Eventually add to 'Wot' to gives color.
6	<i>Foeniculum vulgare</i> Miller.	Apiaceae	Inslal	Leaves	The leaves used to flavor local alcoholic drink 'Arekie'
7	<i>Lepidium sativum</i> L.	Brassicaceae	Feto	Seed	The seed powdered and used as preparation of hot pepper sauce (mitmita)
8	<i>Mentha spicata</i> L.	Lamiaceae	Nana	Leaves	The fresh leaves used to flavor tea
9	<i>Nigella sativa</i> L.	Ranunculaceae	Tkurazmud	Seed	The seed is mixed with other ingredients and powdered to prepared hot pepper sauce. The seed also mixed with dough to flavor bread.
10	<i>Ocimum americanum</i> L.	Lamiaceae	Tosgn	Seed	The seed ground with other ingredients of 'Berbere' and 'Shero'
11	<i>Ocimum basilicum</i> L.	Lamiaceae	Besobla	Seed	The seed served as a spice in 'Berbere' and 'Shero' preparation and used for distillation of butter

12	<i>Rhamnus prinoides</i> L' Herit	Rhamnaceae	Gesho	Leaves	The leaf is mixed in fermented malt and used for flavoring the drinks 'Tej' and 'Tela'. The fermentation starter comes from the malt which is usually germinated barley, sorghum, finger millet, maize and wheat.
13	<i>Rosmarinus officinalis</i> L.	Lamiaceae	Rosemary	Leaves	The leaf is added on cooked meat to increase the flavor
14	<i>Rumex abyssinicus</i> Jacq.	Polygonaceae	Mekmeko	Root	The root can be used to spice butter
15	<i>Ruta chalapensis</i> L.	Rutaceae	Tenadam	Fruit	The fruit crushed and mixed with others and ground for the preparation of 'Berbere' and 'Shero'
16	<i>Trigonella foenum-graecum</i> L.	Fabaceae	Abish	Seed	The seed are mixed with other ingredients for the preparation of burbere and also added with flour of cereal crops to increase the flavors of 'injera'
17	<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Zngeble	Rhizome	The rhizome, which is dried and powdered and mixed with other ingredients for 'Berbere' or 'Shero' preparation

DECLARATION

I, Haimanot Reta Terefe, here by declare that this thesis is my original work and has never been submitted in any other university for the same purpose. All sources of materials for this work have duly been acknowledged. The author and the University of Addis Ababa reserve all rights to this work. No any material in any how can be reproduced what so ever with out the permission of the forestated right bearers.

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