



DILLA UNIVERSITY

SCHOOL OF GRADUATE STUDIES DEPARTMENT OF BIOLOGY

**PLANT SPECIES DIVERSITY AND THEIR DETERMINANTS IN THE
HOMEGARDENS OF KOCHERE WEREDA, SOUTH, ETHIOPIA**

M.Sc. THESIS

BY

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**plant species diversity and their determinants in the homegardenas of
Kochere wereda, south, Ethiopia**

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ACRONYMS

ANOVA : Analysis of variable

BoFED : Bureau of Finance & Economic Development

FAO : Food and Agricultural Organization

GPS : Geographical Positioning System

HG : Home Garden

IUCN : International Union for the Conservation of Nature and Natural Resources

IK : Indigenous Knowledge

m.a.s.l : meter above sea level

PGR : Plant Genetic Resources

SNNPR : South Nation Nationalities and Peoples Region

UNESCO : United Nation Education Scientific and Cultural Organization

UTM : Universal Transverse Mercators

WGS : World Geodetic System

ABSTRACT

The study was aimed to examine the determinant of useful plant species diversity and their use in the home garden of Kochere woreda, Gedeo Zone. The data was collected from six sample areas or kebeles selected by simple random sampling method, and 180 home gardens (quadrant) representative households were selected randomly in six kebeles, at 20m x 20m (400m²) for trees, 1m x 1m for herbs and 5m x 5m for shrubs were used within each of the main plot. The presence, absence, plant habit, altitude, ethno botanical use of each plant were recorded. Both descriptive and inferential statistics were used to analyze the data. To regress the independent variable (household socio economic character) with plant diversity, multiple linear regression was employed using SPSS software version 20. The diversity index, the Shan non-Wiener index (H') was used to measure the plant diversity in a given area. A total of 179 plant species belonging to 77 plant families and 151 genera were identified. The most dominant family was Fabaceae, followed by Astraceae and Poaceae. The explanatory variables such as family size, educational status, farm size, annual income, availability of planting material, the access to market significantly affected the plant diversity in home garden study area. The results indicated that the plant diversity in Midland was greater than in Highland agro ecological climate and the woreda had highly rich plant diversity in the home garden and it was calculated to be H' 2.2 and E 3.5. The data showed that the difference of plant species composition and diversity might be explained in the variation of altitude. The research result showed that for sustainable plant diversity in home garden in the study area, conservation of agro biodiversity and indigenous knowledge should be the concern of stalk holders.

Key word:- *Determinants, Home gardens, Kochere Woreda, Useful plant diversity*

1. INTRODUCTION

Biodiversity as the totality of genes, species, and ecosystems of a region (Davis, 2011), and plant diversity is a major component of biological diversity. It includes all plants, the habitat which they are found, and their interactions with each other and with their surroundings. The importance of home gardens in the production of food, medicine, income generation, and other useful products for human beings is widely recognized (Polegri and Negri, 2010). The genetic differences among them even within plant species, forms, cultivars and varieties (Davis, 2011).

Home gardens are regarded as traditional multispecies agro forestry systems with a complex structure and multiple functions (Hoogerbrugge and Fresco, 1993; Wiehle *et al.*, 2011); A home garden plant species is part of a household livelihood strategy and has gained prominence as a natural asset through which sustainable use of resources, particularly for the livelihoods of the poor, may be achieved. Homestead gardening systems provide an important contribution to sustainable agricultural production because of their potential to meet economic, social, ecological, and institutional conditions for sustainable livelihoods. A home garden also refers to the traditional land use system around a homestead, where several species of plants are grown and maintained by the household members and their products are primarily intended for the family consumption (Mitchell and Hanstad, 2004).

Diversity consistently measures higher in the tropics and lower in Polar Regions. Generally, Rain forests that have had wet climates for a long time have high biodiversity (Margot *et al.*, 2010). Terrestrial biodiversity declines from the equator to the poles (Hillebra, 2004) which seems to be the result of the warm climate. Strong correlations between environmental variables and species richness have been found for many taxa at all spatial scales across the globe, with the highest species richness occurring in warm and wet areas (Wright *et al.*, 1993). Environmental factors (altitude, latitude and longitude) can play decisive roles in shaping community structure and large scale species distributions (Peters *et al.*, 2013). The role of home gardens is multi-faceted and most importantly they have the potential to ensure food needs of communities by providing a year-round source of nutritious food to households who may not otherwise have the access to such food (FAO, 2010). Furthermore, they are identified as a sustainable and diverse agro forestry system that ensure conservation of a diversity of fruits, vegetables, spices and medicinal plants. Home gardens were characterized by different

vegetation strata composed of trees, shrubs and herbs in association with annual and perennial agricultural crops and small livestock within the house compounds (Kamla-Raj, 2010).

The determinates of the plant diversity and the composition of plant species in a homegarden can be classified into natural environmental factors such as climate, topography and relative humidity (Soemarwoto, 2000; Kumari, 2009); socio-economic characteristics of the household (Kehlenbeck and Maass, 2004), and characteristics of home gardens such as the type of tree crops available in the home-garden, and the size of the home-garden (Kehlenbeck *et al.*, 2007; Wiehle *et al.*, 2011). A number of ecological, evolutionary and historical factors are known to be determinant for species richness patterns and differences in species richness and composition between habitats (Nekola, 2013). Plant diversity in Homegarden is assumed to be determined by complex socio-economic and ecological factors (Trinh *et al.*, 2003 ; Ban, 2004). Species richness of each Homegarden was used as an estimate of plant diversity in HG. The socio-economic characteristics used were the same as above (age, gender, education level and main economic activity) while Homegarden characteristics included HG size and age, which were considered as covariates (Husson *et al.* , 2013).

Rapid environmental changes typically cause mass extinctions (Cockell and Charles, 2006; Davies and Watson, 2007); they are the challenges of plant diversity. Diverse genetic material could cease to exist which would impact our ability to further hybridize food crops and livestock against more resistant diseases and climatic changes (Archived, 2009).

Massive growth in the human population through the 20th century has had more impact on biodiversity than any other single factor (Dumont, 2012). Loss of biodiversity results in the loss of natural capital that supplies ecosystem goods and services (Costanza *et al.*, 1997). The emergence of humans has displayed an ongoing biodiversity reduction and an accompanying loss of genetic diversity, named the *Holocene Extinction*; the reduction is caused primarily by human impacts, particularly habitat destruction, Conversely biodiversity impacts human health in a number of ways, both positively and negatively (Sala *et al.*, 2011). Preserving home garden plant species diversity is a priority in strategic conservation plans that are designed to engage public policy and concerns affecting local, regional and global scales of communities, ecosystems, and cultures (Gascon *et al.*, 2007) . If effective policies are to be developed to conserve plant species diversity, then it is clearly important to understand the determinants of

biodiversity change as mediated through longer-term. Changes in land use Economics has a strong influence on land use, and thus on biodiversity, past and present (Barbier , 2007; Davies and Watson, 2007).

In this study, the goal is to examine socioeconomic household character and environmental variables (altitude) influence vegetation diversity, composition and structure with species richness. Species diversity and community structure were investigated by comparing community composition and species distributions among the two agro ecological climates. Specifically, the following two aims were addressed in this study: (i) to identify plant species diversity and composition across a range of sites varying in the environmental variables and (ii) to examine the effects of the socio-economic household character on plant species richness around homestead gardening system.

1.1 Statement of the problem

The availability of accurate data on homegarden resource is an essential requirement for home garden management and planning within the context of sustainable development. Knowledge of plant species in home garden and house hold characters is useful in identifying important elements of home garden plant diversity to conserve home garden plant species. Without a full assessment of the house hold characters and their relation to home garden plants, the diversity of the home garden plant will be severally handicapped. Various attempts have been made to study, the plant species diversity in home garden in different parts of the country. However, the plant species diversity and their determinants in the home garden has not be studied so far. Thus Kochere wereda home garden characterized by enset and coffee supported huge population but currently many challenges were surging, and among them are land fragmentation and the rapid population growth, market bases to grow plant species in home garden, local knowledge accultured and also food security problem of households as reported gedee zone agricultural department and Kochere wereda finance office(2008). In this line, it is paramount investigating how local factors shape ownership of home garden and how these factors coupled with garden features to determine plant diversity, and structure in homegarden are important questions to be addressed in the study area. Investigating these aspects of home garden is a prerequisite to ensure effective mainstreaming of future conservation and production policies.

1.2 Research questions

are going to be answered in this study:

- What are the determinants of plant species diversity in home gardens of Kochere Woreda ?
- What agro ecological climate plant diversity are rich in the home garden of Kochere Woreda ?
- How home garden plant species are affected in the study area ?

1.3 Objectives of the study

1.3.1 General objectives

The overall objective of this study is to study plant species diversity and their compositions and to explore determinants of home garden plant diversity in the six study area.

1.3.2 Specific objectives

The specific research objectives to be addressed in this study area

1. To study home garden plant species diversity, with special reference to Dega and Woyna Dega.
2. To identify the determinants plant species diversity in the home garden of study area.
3. To study threats of home garden plant species diversity in the study area.
4. To identify indigenous home garden plant species management in the study area.

1.4 Significance of the study

As of two objective, study revealed home garden plant diversity and important factors affecting different types of plant diversities, and home gardens contribution to house holds in terms of consumption. These findings would help to indicate the factors to be considered to maintain diverse home garden through various promoting systems and to mitigate limitations with appropriate solution. It may fulfill the necessity of identifying and recording the plant diversity in home garden. Secondly results would be helped to identify and strengthen the factors which highly influenced on plant diversity in home gardens. More over, these results make responsible sectors aware that whether their effort and objectives for home garden are in appropriate way or not. Major constraints to plant diversity were also useful for policy makers and government and extension services to reorganize their plans.

1.5 The scope of the study

The scope of this study is limited to only Kochere woreda in the Gedeo zone. The study covers all about the determinants and composition of plant diversity in home garden of Kochere woreda in general and the six kebeles in particular. This means that the results of the study will be generalized (concluded) for the target area (the Kochere woreda only). Therefore, the researcher can't conclude the result of this study to another woreda in the Gedeo zone. It is because that the target population is all the households who are residing in Kochere woreda of the Gedeo zone. So, other woreda in the zone are out of the interest of the researcher except for the Kochere woreda. The final conclusion of the determinants that affect the diversity and Composition of plant diversity in Kochere woreda of the Gedeo zone is identify.

2. LITERATURE REVIEW

2.1 Biological diversity

The term 'biodiversity' implies the integration of ecology and genetic in conservation theory was introduced by W.G.Rosen; It embodies diversity at each levels of biological organization the community, the species, the organisms, and the gene it forms the link between the evolutionary process from past, through present and future survival and adaptation and continuous evolution or decline and extinction (Bolger, 2001).

2.1.1 Concept of biological diversity

According to the convention of Biological Diversity (2000), biodiversity or biological diversity has been defined as “ the variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic systems and the ecological complexes of which they are part this includes diversity within species, between species and of ecosystems (Perlman, and Adelson,1997).Stated that biodiversity is the variety of life on earth the result of 3.6 billion years of evolution it comprises genes, species (with human being), and ecosystem. Genes is a part of biodiversity (basic component in living being which is responsible for expressing characters) that each individual inherits through parents, passes in to next generation giving specific characteristic diversity among genes offers various natural defense mechanisms to living being for instance natural capability of resisting to out breaks of diseases and pests which are also part of bio diversity. In one way, biodiversity may represent a form of biological insurance against the loss or poor performance of selected species (Naeem, 2005).

IUCN,(2003) described that species are the building blocks of biodiversity. More than 1.75 million species were identified by scientists, and estimated that there are perhaps, 10 million or more than have not been discovered these are continuously being explored with their potential benefits. A group of species and environment they interact with (entity) is called ecosystem. Ecosystems vary in size with the set of species and the environment such as forest to small pond on a rock. Concept to applied to real world regulatory and management problems. One way to escape the vagueness associated with the bio diversity issue is to identify measurable attributes or indicators or indices of biodiversity for use in environmental inventory, monitoring and assessment programs (Noss, 2004).

2.1.2 Plant diversity

Plant diversity is one of the many indicators of quality of life (Gowan *et al*, 2002). It includes all plants, the habitats in which they are found, their interactions with each other and with their surroundings, the genetic differences among them even within plant species, forms, and cultivars varieties an important finding which emerges through last two decades of population genetic research in plants is that species differ greatly in their levels and patterns of genetic variation, According to various sources, at least 1,750,000 living species form the stock of genetic biodiversity on our planet (Altieri, 1992). Among them for example between 25,000 and 75,000 medicinal plant species, a large number of which are used in the preparation of (traditional) medicine. However, the future use of these resources is treated by a development model that provokes the extinction of millions of species, the loss of traditional knowledge and appropriation of species by pharmaceuticals multinationals (Gowan *et al*, 2002).

2.1.3 Values of plant diversity

As a part of biological diversity, plant diversity also contributing to major provisioning of goods and enormous ecosystem services. Mainly all higher plants play an important role converting solar energy to chemical energy through photosynthesis initiating food production to whole world. Photosynthesis itself helps to regulate CO₂ level in the atmosphere by acting as a major input for production of carbohydrates in plant leaves. It has been serving through whole evolutionary process of plants even to maintain water cycle, through water uptake and evaporation (Grime, 1998).

All inhabitants on the planet are part of wider ecosystems based on wild plants and natural vegetation. For example, genes from the wild plants have been playing major roles in the breeding of new varieties of food crops and other cultivated plants (Maxted *et al.*, 1997). New medicines continue to be derived from wild species. In many countries natural and semi natural ecosystems provide many plant products essential for human welfare including fuel wood timber, fiber, medicinal plants, fruits, and nuts. Forest protect watersheds and thus help regulate the flow of water for drinking, hydro power, and irrigation. And wild nature, not the least wild plants contribute to the natural beauty of the world that people rightly cherish (IUCN, 1980).

2.2 Home garden (HG)

Home garden is an integrated system which comprises different things in its small area that produces a variety of foods and agricultural products including staple crops, vegetables, fruits medicinal plants (Agbogidi and Adolor, 2013). Although the majority of home gardening family grow for domestic needs, in villages some products (typically fruit like mangoes avacadoes and banana) are deliberately grown for market, are brought to market when in excess (Hein, 2007). Home gardens are small-scale agro forestry systems with a mixture of trees, shrubs, herbs and other cultivated crops located in the area surrounding a house, maintained and managed by those in the household (Fernandes and Nair, 2006). Home garden systems are fundamentally different from large scale agriculture: they use no chemical inputs, are not mechanized, and host high levels of diversity including agro biodiversity, non-cultivated plant diversity (Hylander and Nemomissa, 2008 ; Raheem *et al.*, 2008).

2.2.1 Uses of Home garden

Many studies show that major contributing factor plant diversity in the home garden is accessibility of food. To have easy and safe access to household food require mentor to maintain nutrient quality of the daily diet, people select food crops. The selection also depends on several factors; family preferences on different food, awareness about food, market prices of food and food safety etc. Commonly when food prices rises dramatically with different reasons as fuel prices, imports and exports floods and natural disaster trend of using diverse varieties in home gardening's is increasing. With a closer relation in food security household economy contribute as a factor for plant diversity in home gardens (Gilimani, 2005). The majority of those involved in gardening activities are elderly house hold members who often remain faithful to landraces they have inherited from prior generations. Households socio-economic status and patterns are often reflected in the genetic diversity of garden crops and plants, although the exact nature of the relationship is highly variable. Nevertheless, development of niche markets may reverse trend and revitalize cultivation of traditional crops or varieties, which may be commercialized as traditional specialties and provide income opportunities to gardeners (Polegri and Negri, 2010). The household makes choices of plants on the size and nature of the home garden system and its purposes, depending on their needs resources, preferences and market opportunities (Hope *et al.*, 2005).

2.2.2 Size of the home garden

The plant diversity initially increases with the size of home garden, next reaches a maximum and finally declines. The positive relationship between home garden size and plant diversity has been reinforced in many studies (Wiehle *et al.*, 2011), observed the opposite (Abebe, 2005) on the other hand, has argued that there is no relationship between either species richness and the farm size or species evenness and farm size.

2.2.3 plant diversity in the home garden

With the commercialization of agriculture it is expected that farmers tend to restructure their home-gardens to generate more monetary benefits, Such strategies may include devoting more land area for cash crops and replacing traditional non-commercial vegetables with cash crops (Soemarwoto and Conway, 2000) Which may eventually result in displacement of many indigenous crops (Kumari, 2009). Farmers to derive greater income from diversity rich home gardens (Zemedede Asfaw, 2001).

It has been commercialization of home gardens has enabled households to increase their incomes, although the same phenomenon has contributed towards reducing plant diversity, increases instability and social inequity (Abdoellah *et al.*, 2006). Abdoellah *et al.*, (2006) argue that treating homegardenas a stable method of in-situ conservation has become more challenging with the changes that have occurred in socio economic and cultural factors. In such a context, it could be argued that commercialization leads to the depletion of plant diversity in sustainable traditional agro-forestry systems. Consistent with this, a negative relationship between degree of market orientation and plant diversity was found in home gardens (Bernholt *et al.*, 2009) have found that though species richness on the farms has not been significantly influenced by market orientation of farmers, low-market orientated groups possess home gardens with high plant diversities compare to that of high market oriented groups. The same authors have concluded that commercialized home gardens can maintain species diversity with increased dominance of highly marketable species. Contradictory to this, Wiehle *et al.*, (2011), has found a positive relationship between market orientation and species richness in the home gardens.

2.3 Determinants of home garden

Factors that determined the plant diversity and the composition of plant species in a home garden can be classified in to three group natural environmental factors such as climate, soil type topography and relative humidity (Kumari, 2009) socio- economic characteristics of the household (Kehlenbeck and Mass, 2004) and characteristics of home gardens such as the type of tree crops available in the home garden, location and size of the home garden (Kehlenbeck *et al.*, 2007; Wiehle *et al.*, 2011).

The contribution of cultural and socio-economic factors in generating maintaining crop diversity in home gardens has received little attention (Brush, 2005) yet human cultures have pr found influence on the diversity of the ecosystems they belong to (Eyzaguirre, 2006) and it is often people's cultural and economic values which explain differences even among neighboring fields and gardens. By spending leisure time and work in home gardens families and communities turn them in to culturally constructed spaces (Eyzaguirre and Linares, 2004) where ethno botanical knowledge is actively preserved. Customs tradition and aesthetic preferences are instrumental in determining the overall aspect of the garden (Smithe *et al.*, 2006).

Different crops or varieties are maintained because of the significance of each in a family's traditions or preferences or because they fulfill aesthetic requirements. In high income societies. Access to road and involvement in off farm activities also found to be influencing the plant diversity. (Kumar, 2009; Abebe, 2005) have argued that distance to market negatively influence the plant diversity, When farmers have easy access to market they tend to grow more of a limited number of cash crops instead of planting many varieties in the home garden.

Relationship between plant diversity and household income is hypothesized to be positive as richer households tend to grow more crop varieties than poor households whose livelihood depends on return from farms (Mmom, 2009). (Winters *et al.*, 2006) the richer households may have a greater capacity to access the seeds for these crops. (Abebe, 2005) found that richness is positively related with household income, evenness of species is low in home garden owned by rich household compared to that of poorer households. (Kumari, 2009) has argued that the higher the household expenses, the higher the food plant density and the lower the total

plant diversity. The same author has observed that rich households in areas tend to plant more ornamental plants with higher economic values in their home gardens (Kumari, 2009).

According to (Abebe, 2005) age, education and gender of the farmer do not have any effect on the plant diversity. (Winters *et al.*, 2006) argue that the educated people tend to plant crop species evenly in the home-gardens. Home garden owners with high levels of education tend to cultivate a greater number of species, suggesting that farmers are capable of perceiving greater benefit in managing a greater number of species. Farmer easily accommodates new technologies, new species or new varieties, which in itself proves of interest, and could also be related to a higher level of education, or to more available information (Zemedu Asfaw, 2001).

(Abebe, 2005) has argued that family size affects only on the relative evenness of the number of functional groups of crops. have observed that plant diversity decreases with the increased dependency ratio (ratio of dependent to the adult labour) as households with more dependents compel to grow more of certain food items in their home gardens (Winters *et al.*, 2006).

Livestock keeping provides people with another important source of household food security by keeping a variety of domestic animals in their home gardens for several uses. Keeping these animals provide employment to rural farmers, food and can provide income (Njuki, 2001).

Among the natural agro ecological factors that affects on the plant growth, slope, altitude and texture of the land influence on the plant diversity and evenness. With the large variation in slope and the texture of plant there is a high plant density and with the increase in slope evenness of plant species increase, while for the altitude it is other way round (Winters *et al.*, 2006).

2.4 Threats to home garden diversity

The control of associated biodiversity is one of the great agricultural challenges that farmers face. On monoculture farms, the approach is generally to eradicate associated diversity using a suite of biologically destructive pesticides, mechanized tools and transgenic engineering techniques, and to rotating of crops (Vandermeer and John, 2011). Monoculture was a contributing factor to several agricultural disasters, If a wheat crop is destroyed by a pest we may plant a hardier variety of wheat the next year, relying on intraspecific diversity. We may forgot wheat production in that area and plant a different species altogether, relying on

interspecific diversity (Chivian and Eric, 2008). The habitat destruction, invasive species, pollution, human over-population and over-harvesting are the main threats (Moulton *et al.*, 1998). Deforestation and increased road-building are a significant concern because of increased human encroachment upon wild areas, increased resource extraction and further threats to biodiversity (IUCN, 2011). Factors contributing to habitat loss are; overconsumption, overpopulation, land use change, deforestation, pollution (air pollution, water pollution, soil contamination) and global warming or climate change (Michael, 2010). Genetic pollution leads to homogenization or replacement of local genomes as a result of either a numerical and/or fitness advantage of an introduced species (Aubry *et al.*, 2005). The massive growth in the human population has had more impact on biodiversity than any other single factor (Sala *et al.*, 2009).

2.5 Biodiversity conservation in the home garden

Home gardens, low-intensity agro-forestry plots, and abandoned temperate orchard meadows all tend to have high levels of biodiversity, and are known to be important for the conservation agro biodiversity (Altieri, 1992; Dietsch *et al.*, 2007) . Home gardens and other forms of agro ecosystems are important to the conservation of plant resources when it is considered that “these plant resources are directly dependent upon management by human groups, thus, they have evolved in part under the influence of farming (land use) practices shaped by particular cultures” Thus, diverse cultures apply distinct folk-scientific and aesthetic criteria to the selection of plants (Jain, 2008). Home gardens and other forms of agro ecosystems are important to the conservation of Ethno ecology has been described as “a way of looking” at land, and the relationship humans have with the environment, that incorporates the role of cognition in shaping behavior and management (Nazarea, 2008). It deals with human cognition of environmental components (plants, animals, water, soils) and the classification of its components within a given environment (Nazarea, 2008). With the proposition that home gardens and other agro forestry systems can serve as a reservoir for biodiversity, many non-governmental and governmental agencies are seeking ways to conserve existing agro ecological systems. However, with increasing food insecurity, climate change, and calls for agricultural intensification, conserving existing agro ecosystems, home gardens, and the diversity of plants and other organisms within them faces serious challenges (Lobell *et al.*, 2008; Norris, 2009).

2.6 Diversity indices

A diversity index is a quantitative measure that reflects how many different types species are in a dataset, and simultaneously takes into account how evenly the basic entities are distributed among those types. For a given number of types, the value of a diversity index is maximized when all types are equally abundant (Shannon and Weaver, 1948 ; Simpson, 1949).

Diversity measurements incorporate both species richness (S, the number of plant species in a community) and species Evenness (E, an estimate of species distribution within a community). Commonly used diversity indices include the Shannon-Wiener index (H') and Simpson's diversity index (E) present comprehensive reviews of various diversity indices but illustrates a problem with using only species richness as Jaccard's similarity index of diversity; More important, the evenness at which plant species are distributed should be closely linked to how that diversity affects ecosystem function(Magurran, 2004).

3. MATERIALS AND METHODS

3.1 Description of the study area

3.1.1 Location

Kochere wereda is located in, Southern Nation Nationalities Peoples Region state (SNNPRs), Gedeo Zone, within $06^{\circ}55'00''$ - $06^{\circ}75'00''$ N latitudes & $40^{\circ}00'00''$ - $42^{\circ}00'00''$ E longitudes of equator. It is situated in 420 km south east from Addis Abeba; 150km south of regional town Awassa and 67km east of zonal town Dilla. Its altitude 1700-2585M above sea level. The woreda is bordered with oromiya region in the north, Yirgachefe woreda in the south, Chelelektu town, which is located at, $038^{\circ}12'E$ and 1700 m above sea level, is the center town of the woreda administration (Figure 1).

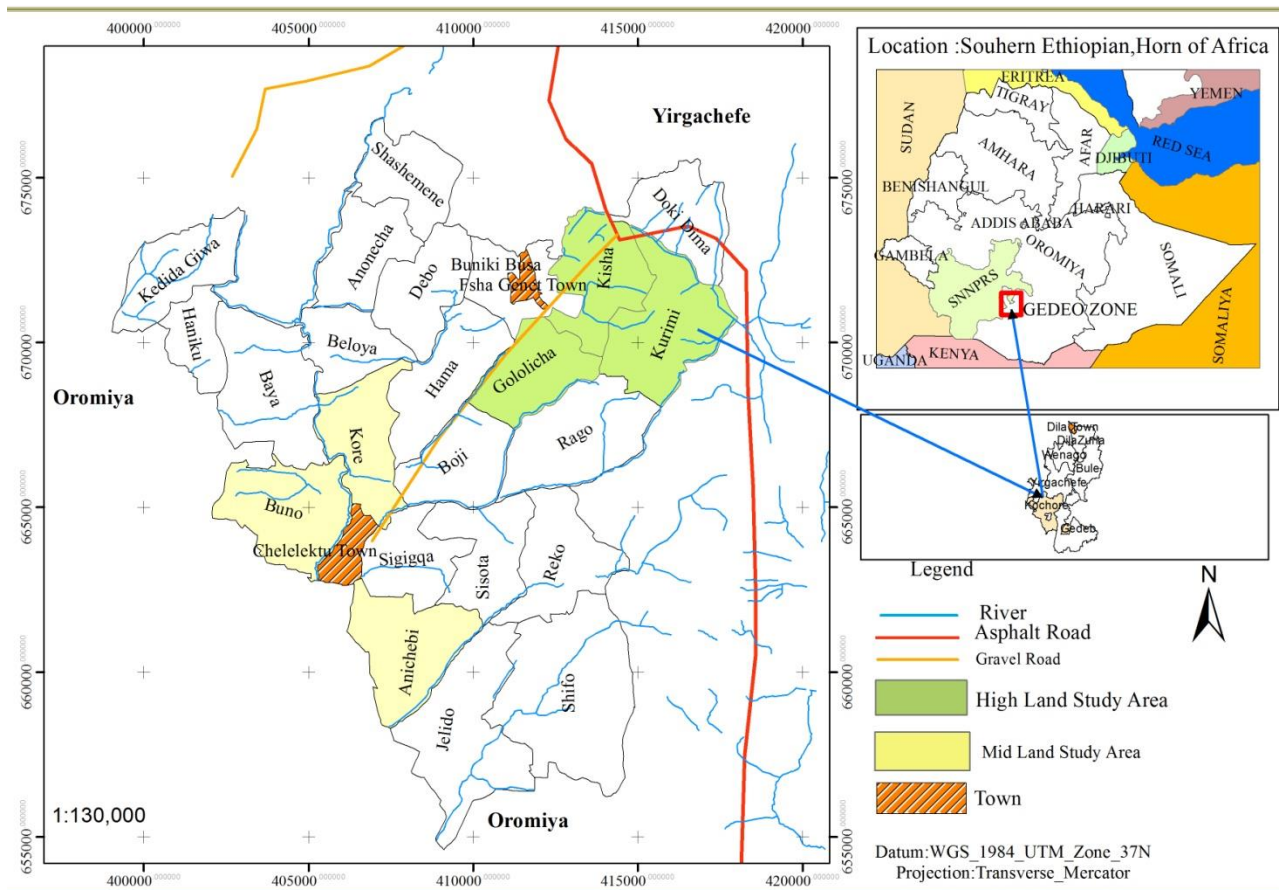


Figure 1. Map of the study area. source :- BoFED (2009)

3.1.2 Climate

The area is having bimodal rainfall distribution. The first rainy season is *belg* that extends from March to June. Second rainy season is *keremet*, from August to October. The mean monthly rainfall ranges from 28mm to 100 mm with mean monthly temperature of 10°C - 20°C. The altitude ranges from 1700 to 2585m. Natural climatic and soil structure play critical roles in plant diversity characterization and distribution efforts. The major proportion of the *woreda* constituted from *weyena dega* (79%) and *Dega* (21%). However, this classification does coincide with the traditional agro ecological classification of the country at large. For instance, the tradition agro ecological classification *Dega* ranges from 2300 to 3200m, *weyena dega* 1500-2300m and *kola* 500-1500m. (Figure 2).



Figure 2. Climadiagram of the area based on climate data from 2007-2016.
Data source: SMSA (2016)

Note: Temp=Temperature in °C; RF=Rain fall/ precipitation in mm; Dry periods are dotted while wet periods are shaded yellow

3.1.3 Topography, soil types, vegetation

Geography of the wereda is mainly a rocky landscape that is occupied of hills and valleys, the valleys between hills engaged by locally significant streams and rivers. The soil type generally is red brown clay loam and black grey loam (Tadesse Kippie 1994; KWADO, 2009) . Geologically, the soil emerged from the pre extraordinary volcanic parent theme through the biogeo chemical processes. Confined water sheds like river GELANA at the west river QONGA at north east and river JIRME at the south being the most important, several smaller water sheds and springs are found in the wereda that are the impending and actual advantage provides for the wereda people (KWADO,2009). Natural forest is not pragmatic in the area and only trace trees and shurbs are pragmatic that show the previous forest type. The main vegetation type of the wereda according to sebsebe Demissew et al (1996) moist ever green montane forest. In addition, well developed agro forestry systems to gether with man made state and community forests at Buno and Chelelektu areas are some to point out. Perennial crops such as coffea and Enset are the dominant in the study area.

3.1.4 Land use

The total area of the *woreda* is estimated to be 296 Sq. km with 25 peasant associations(BoFED, 2009). This comprises agricultural land (29600 ha; out of which 25985 ha is covered by perennial crops and 1,248 ha by annual crops), grazing land (507 ha), forestlands (377 ha), potentially cultivable land (609 ha), and others (874 ha). Further classification of the agricultural land was compiled for 18 coffea growing peasant associations. Accordingly, coffea has covered 12,187 ha (76%), enset 1672 ha (10%), annual crops 1,885 ha (12%) and fruit trees 196 ha (2%). From the total number of coffea growing peasant associations, 71% are found within altitude ranges of 1691 to 2300 m.a.sl, (Kochere wereda agriculitcher office, 2007 annual reports).

3.1.5 Livelihood

The livelihood of people in the *woreda* depends on agriculture (80%), livestock fattening (1%), crop and livestock production (1%), trade (10%), handcraft (3%) and others (5%). The major source of the household in priority order include coffea, enset, fruits, animals, and

animals' products Coffea is the major source of income for the households (Kochere *woreda* agricultural office, 2007 annual reports).

3.1.6 Population in house hold

According to the 2008 E.C planning report of rural development office of the *woreda* and projected for the year 2008 E.C, the total population of the *woreda* is 148,371 with the total of households 34292 about 26670 males and 7622 females and the majority of the population (91%) living in the rural kebeles and the rest in urban centers. The estimated population density of the wereda is 475 people per square kilometer on total area of 296 square kilometers (Gedeo Zone Finance department annual report 2008). The dominant ethnic group of the area being the GEDE'UFFA or Gedeo language followed by Afan oromo or oromo language and others (Kochere *woreda* finance office annual report 2008).

3.2 Methods

3.2.1 Sampling size

Sample size (n) was determined from the total number sampled area. The sample size is determined according to Yemane, (1967) statistical application. If the sample fraction $\frac{n_0}{N}$ is very small say, less than 5% "n₀" is considered as satisfactory, thus, (n₀ = n).

Where

N = the total population size in the sampled area (9906)

n₀ = sample size (180)

$$(\text{probability selection} = \text{Sample size} / \text{population size}) \quad 180 / 9906 = 0.01$$

or

$$S^2 = \text{variance of the number of plant diversity } (2)^2$$

$$\epsilon = \text{permissible error } (0.3)^2$$

$$\alpha = \text{alpha (the type I error) } 5\%$$

$$z = \text{the standard score in the normal distribution } (z \alpha / 2)^2 = (1.96)^2 = 3.8416$$

$$\text{When } n_0 = (z \alpha / 2)^2 (S)^2 / \epsilon^2 = 3.8416 * 4 / 0.09 = 170 \approx 180$$

$$= 0.01 < 0.05 \quad \text{there for the sample size was } 180$$

The sampling method that was used for this study was simple random sampling. as a source of census in order to identify the sample population, The number of households (Table 1) was provided by /village officers. The sampling unit of this study is households for socio-economic study, From the total of 26670 households head by male and 7622 femal (total 34292 household in the area) in 25 kebeles, the 6 sampled kebeles which contains 3148 female and 6758 male (total 9906 household of selected kebele) were randomly selected. From these 6 selected kebeles, the representative sample (123 male led household and 57 female led household the total is 180), the samples were allocated through quota sampling as the reперesentative of the wereda household from selected. From each kebele samples were selected randomly; a minimum of 11 and maximum 105 households were interviewed in each village where by other members of households were encouraged to give support to the head in order to get more accurate data and information. Each house hold in the sampled kebele selected based on the house holed which have farm land or home garden in the study area.

Table 1: Distribution of respondent in the study area

<i>Woreda</i>	Kebele	Total № of HHs	Total № HHs Sample
Kochere	Kurum	760	14
	Qisha	1076	19
	Gololicha	597	11
	Buno	5760	105
	Qore	923	17
	Hanichb	790	14

3.3 Method of data collection

3.3.1 Vegetation data

For the collection of plant species from home garden based on the vegetation habit, the quadrant was laid for woody or tree plant species 20mx20m² or 400m², for herb and shrub plant species 1m x 1m² and 5mx5m quadrant was laid within the main plot of home garden. During plant species collection a total of 180 sample home garden was laid out. Of these, 25 sample home garden for herb grass plant species. Within 6 PA a total of 180 sampled home garden were laid

for vegetation data collection. Plant inventory carried out by the local names and followed by botanical name. To relate the local names with Botanical names, different Botanical books were referenced (Welidemikele K, 1980). Flora of Ethiopian (ETH) was also used as reference in Addis Ababa. Other secondary information available include plant habit, their uses and area of growth.

3.3.2 Environmental data

Geographic information (slope and elevation, of the area) of each sample site of home garden was records Altitude measured by GPS used to describe the characteristics of each sample site (PA) (Appendix IV).

3.3.3 Socio economic data

Household characters was aimed to obtain household socio economic factor directly regress with plant diversity in home garden with different types of plant. Generally it covered the socio economic data of households including, age, education level, sex of the house hold, annual income, annual expenses, farm size, threat for home garden, source of planting materials, family size of house hold, and employment status, the total live stock unit (TLU), Access to market, Access to information, Extension service and Marital status of house hold, Final part of the questionnaire was designed to get information about factors which influence home gardening.

3.4 Method of data analysis

Both the descriptive and inferential statistics method were used. These included tables, averages, variances, frequencies and charts. By performing hypothesis, relationship among estimates of variables such as multiple linear regression and ANOVA were determined.

3.4.1 Focus Group Interview

After the introductory meetings and the identification of participant farmers, the focus group interview was conducted with a group composed of women, men, and youth representatives. Ten persons, representing the ten groups, were involved in the group discussions. A separate informal discussion was held with extension workers. This helped to make triangulation to validate the information given by different groups. In these interviews, information such as IK of each group in relation to methods of managing uses of plant species, selection criteria,

marketing of different plant species products and preference for tree species in different use category and household socio economic character data was collected.

3.4.2 Key informants

Key informant interviews were carried out with elder people and peasant association representatives, who know the history of the area very well. Ten key informants were selected from each peasant associations per major farming system. Subject to the appearance of prominent features and variations, key informants were represented from various wealth categories. They helped gathering information on the specific plant species uses and Threats facing on the plant diversity. Reconnaissance survey was conducted from September to December 2008 E.C to obtain an overview observation of the study and to obtain information from the woreda agricultural office and local communities(PA).

3.4.3 Structural analysis

All the plant habit of the species recorded in all quadrants were used in the analysis of the vegetation structure. The structure of the plants was described in terms of density, frequency and percentage. The following parameters and index were calculated to determine the vegetation structure.

Density (D) :- Is a county of individuals of a species within the sample quadrant. Counting was usually done in small quadrates placed several times in to vegetation communities under study and the sum of individual per species is calculated in terms of species density per convenient area unit such as a hectare (Mueller- Dombois and Ellenberg, 1974). Density was computed by converting the count from the total quadrants in to hectare basis.

$$\text{Density} = \frac{\text{Number of a species counted}}{\text{Sampled area in hectare (ha)}}$$

In this study, the frequencies of the plant species in all quadrats was computed. The higher the frequency, the more important the plant in the community. Although a high frequency value means that the plant is widely distributed through the study area. It is calculated as :-

$$\text{Frequency} = \frac{\text{No of quadrant in which a species occupy}}{\text{Total No of quadrants laid in the study area}} \times 100$$

3.4.4 Multiple linear regression model

The multiple regression model was used for when the response variable was quantitative and continuous and also used to examine the determinates of home garden plant species.

The multiple regression model for a response variable, Y , with observed values, y_1, y_2, \dots, y_n (where n is the sample size) and p size explanatory variables, $x_{p1}, x_{p2}, \dots, x_{pi}$ with observed values, $x_{1i}, x_{2i}, \dots, x_{pi}$. $i= 1, 2 \dots n$.

$$Y_{ij} = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_p x_{pi} + \varepsilon_{ij} \quad \text{for } Xi = 1, 2, 3 \dots n$$

Where,

Y_{ij} = response variable (The plant diversity of species).

x_i = the independent Variable that are influenced plant diversity in the home garden.

X_1 = the age of household

X_2 = family size of household

X_3 = the educational status of household

X_4 = farm size household

X_5 = the annual income of the household

X_6 = sharing of planting material

X_7 = access to market

X_8 = employment status

β_0 = constant term.

β_1 = Coefficients independent variables.

ε_i = error term.

The above equation has one key feature. It assumes that all individuals are drawn from a single population with common population parameters. The term ε_i is the residual or random error for individual i and represents the deviation of the observed value of the response for this individual from that expected by the model. These error terms are assumed to have a normal distribution with mean zero and variance σ^2 .

$\varepsilon_i = Y_i - \hat{Y}$ is normally distributed with mean zero and variance σ^2

3.4.4.1 Hypothesis testing for the significance of individual parameter

Was testing for the significance of the slope and Intercept of the fitted model, and it is used to test the coefficients of the explanatory variables.

1. $H_0: \beta_i = 0$ vs. $H_1: \beta_i \neq 0$ when $P_{\text{value}} < \alpha$ is reject H_0 and $P > \alpha$ is accept H_0 (null)
2. Alpha levels of significance *i.e.* ($\alpha=0.05$) we conclude at 5% level of significance that β is statistically significant . This implies that, the variable regression model is significant.
3. Conclusion: β_i is statistically significance if we reject the null hypothesis.

Analysis of variance (ANOVA) was used to examine or to test the significance of measurement or overall significance of the model.

3.4.5 Diversity index

3.4.5.1 Shannon index (H')

The Shannon index which means it assumes all species are represented in a sample and that they were randomly sampled. More value is given to the presence of each species than is given to the abundance of each species. In the Shannon index, p is the proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N), \ln is the natural log, Σ is the sum of the calculations, and R is the number of species. Thus the value between 1.5 to 4.5 that indicated the maximum diversity in the area and if the calculated value between 0 to 1.49 or less than 0 it show that poor diversity.

The Shannon index will be calculate

$$H' = - \sum_{i=1}^R p_i \ln p_i$$

H' = Shannon Index , P_i = Probability of the i the species

3.4.5.2 Evenness (E)

The Simpson index is a dominance index because it gives more weight to common or dominant species. In this case, a few rare species with only a few representatives was not affect the diversity. In essence, equal value is given to the presence of any species, allowing the abundance of those species to increase the diversity value for a given plant community. The Simpson's index values range between 0 and 1. The closer to 0 the value is, the more diverse to calculate Simpson's E , the square each proportion (p_i), sum these squared values, and take the reciprocal (divide one by the sum).

$$E = H / H_{\text{max}}$$

3.4.6 Phytogeographical relationship

The home garden plant species relationship among six sampled kebele in the study area (the species overlap in home gardens) , was assessed using Jaccard's similarity index (Van Tongeren , 1995). coefficient gives a value between 0 and 1, the closer the value is to 1, the more the home garden have in common. Complete home garden overlap is equal to 1; complete home garden dissimilarity is equal to 0.

The equation is: $J_j = J / J + b + c$

Where: J_j = Jaccard's similarity index

J = number of species common to both home garden

b = number of species found only in area.(A)

c = number of species found only in area(B)

4. RESULT AND DISCUSSION

4.1 Demographic and Socio economic aspect

The age of the respondents ranged from 18 to 60 years. On the basis of age groups, the respondents were classified into three categories; young age (15 -24 years old), middle age (25-54 years old) and old age (>55 years old). Number and percentage distribution of farmers according to their age group has been shown in (Table 2). The result of the age group revealed that the majority of the respondents were in the Old age category (51.6%).

Family size of the respondents ranged from 2 to 12 (Table 2). The family size of the respondents was classified into three categories. These were small (2- 4 members), medium (5-10 members), and large (more than 10 members). The Data presented in (Table 2) indicated that 60% of the respondents were in medium size. It is very common to live together with parents and with brothers and sisters and sometime with relatives It was noted that the percentage of joint families was higher in large farm categories. This might be one of the reasons for larger family size in large farm categories. (Abebe, 2005), has argued that family size affects only on the relative evenness of the number of functional groups of crops.

The education levels of the respondents were categorized into four groups (Table 2). These were illiterate (no schooling), primary level(class I- II), secondary level (class I - II), and above secondary level (college and university). Among the 180 total respondents in the area, majority of them (55%) are illiterate (no schooling) and only (2.2%) respondents were college graduates. According to (Abebe, 2005) age, education and gender of the farmer do not have any effect on the plant density. (Winters *et al.*, 2006), reported that the educated people tend to plant crop species evenly in the home-gardens.

Table 2. Age, Educational Status and Family Size of the Respondents

Category		Respondent	
		No	%
Age	15-24 years, young age (E. Pop based on agestructure(CSA2014).	31	17.23
	25 -54 years middle age ,, ,, ,,	56	31.12
	>55 years Old age ,, ,, ,,	93	51.67
Education	Illiterate	100	55.6
	primary level	51	28.3
	Secondary level	25	13.9
	Collage & above	4	2.2
Family size	2-4 members (Small)	33	18.3
	5-10 members (Medium)	90	50
	>10 members (Large)	53	29.44

E = Ethiopia

4.2 Diversity and Composition of home garden plant species

The total number of species that were observed and identified was 179 which include 151 genera and 77 families were recorded from 180 quadrants laid in the home gardens of the study area (Appendix I). The collected plant species have 19 use category for the local people. These 16 food plants species, 28 income generating (cash crops) plant species, 8 insect pollinated plant species, 14 fodder plant species, 14 fire wood plant species, 10 ornamental plant species, and the remaining have different use (Table 8). The major dominant plant species are *Ensete ventricosum* and *Coffea arabica* (organic coffee). Families with the largest number of species were Fabaceae represented by 17 (9.5%) species because they were grown in both agro ecology (dega and woina dega). furthermore, Most of the local farmers have cultivated these species. The next dominant families were Asteraceae 12 (6.7%), Poaceae 11 (6.1%), Lamiaceae 10 (5.6%), Solanaceae 9 (5%), Euphorbaceae 6 (3.4%), Rutaceae 6 (3.4%), Rosaceae 6 (3.4%). The remaining families were represented by four and less than four species 102 (56.9%) (Table 3). The majority of respondents were interested in growing useful plants in their home gardens.

Table 3: Frequency of collected plant family distribution (Appendix : IV)

Family	Species	
	No	%
Fabaceae	17	9.5
Asteraceae	12	6.7
Poaceae	11	6.1
Lamiaceae	10	5.6
Rutaceae	6	3.4
Solanaceae	9	5.0
Rosaceae	6	3.4
Euphorbiaceae	6	3.4
4 & < 4 species	102	56.9

4.3 Life forms of home garden plant species

The plant species collected were composed of 179 (Appendix I) out of these 87 (49%) trees, 54 (30%) Herbs, 22 (12%) Shrubs, and 16 (9%) Climbers (Figure 3). As indicated in the (Figure 2) about the habit of collected plant species, the dominant one is tree plant species because in Gedeo people culture, before cutting old tree, it is usual practice to plant young plants to replace the old one. This is termed as (GUDISA) in Gedeo language. The second reason is that there is not any practice of charcoal production in the area. These are the good aspects of Gedeo people culture concerning agro eco forestry.

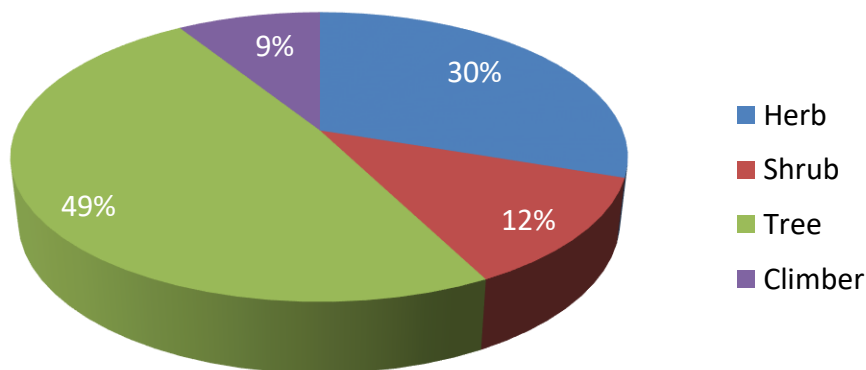


Figure 3: Life forms of home garden plant.

4.4 Plant diversity of home garden

The diversity of useful plant species in the study area was expressed by using diversity indices including Simpson diversity index and Shannon diversity index. The species richness or the number of species in the home garden that was expressed by Shannon index and Simpson index is the dominant index because it gave more value to dominant plant species. In this case rare species with only few representative will not affect the diversity of home garden. Their value ranged between 1.5 and 4.5 which is high species and 0 to 1.49 which is less in species richness. On the other hand the dominance value range between 0 and 1, the closer to 0, the more diversified the value is. Based on this theory, in the study area, there are two agro-ecological climates; dega and woina dega. In the case of dega, the calculated Shannon (H') value is 1.9 and evenness (E) value 0.7. On the other hand, the woina dega agro-ecological climate Shannon (H') value is 2.8 and evenness (E) is 0.3. This showed that woinadega agro-ecology in the study area has highly diversified species than dega. Generally, the calculated value of diversity index, (Shannon H' 2.2) and E (0.5) that reflect in the study area, is perfectly “even” which means all the species in the study area have an equal number (Appendix, II) and also (Table 4) showed that diversity of plant species in the woreda is highly diversified by home garden plant species. The decrease in species richness of agro-ecology, one which is found at the highest altitude, could be due to eco-physiological constraints. This includes constraints such as reduced growing season, low temperature and low productivity and other factors such as soil fertility and soil acidity. The soil PH decreases with increasing altitude and as a result, the soil acidity increases with rising altitude and these could be the possible reasons for declining of species richness and diversity with increasing altitude (Dereje Denu,2006). (Ewuketu *et al.*, 2014) also reported that the difference in species richness from place to place could be attributed to altitude, soil type and home garden size. the highland home garden dominated few unique plant species like *Hagenia abyssinica*, apple and mid land home garden except the unique species in dega. This identity check of species was the result of environmental factor (altitude) on the plant species.

Table 4: Species diversity among two agro ecology and wereda level (Appendix, II).

No	Study site	H	E
1	High land	1.9	0.7
2	Mid land	2.8	0.3
3	Woreda level	2.2	3.5

4.4.1 Density of selected plant species

Table 5 : Most abundant plant species in the study area

Species	Habit	Density/ha	%
<i>Arundinaria alpina</i>	H	570.13	13.91
<i>Arundodonax</i>	H	726.9	17.74
<i>Catha edulis</i>	S	774.1	18.9
<i>Coffea arabica</i>	S	897.5	21.9
<i>Cupresus lusitanica</i>	T	439.8	10.7
<i>Ensete ventricosum</i>	H	1990.4	48.5
<i>Eucalyptus camaldulens</i>	T	578.7	14.12
<i>Eucalyptus globulus</i>	T	431.8	10.53
<i>Grewia ferruginea</i>	S	300	7.32
<i>Hordeum vulgare</i>	H	307.77	7.5
<i>Juniperus procera</i>	T	330	8.05
<i>Melilotus suaveolens</i>	T	157.36	3.84
<i>Vernonia myriantha</i>	S	577.2	14.08
<i>Vicia faba</i>	H	467.63	11.41
<i>Zea mays</i>	H	764.02	18.64

The above table indicates the most abundant tree, shrub, climber and herb species in the study area and the whole abundance of the plant species was shown in Appendix, XI.

4.4.2 Frequency

Frequency is the indication of homogeneity and heterogeneity of given vegetation in which the higher number of species in higher frequency classes and low number of species in lower frequency classes show similar species composition while large number of species in lower frequency classes and small number of species in higher frequency classes indicates higher heterogeneity (lambrecht, 1989). The most frequent herb, climber, shrub, and tree species of this study area is given in table 6 .

Table 6 : List of the most frequent plant species in the study area

Species	Habit	N _o of quadrat present	Total quadrat sampled	%
<i>Albizia gummifera</i> (J. F. Gmel.) C. A. Sm.	T	85	180	47
<i>Arundinaria alpina</i> K. Schum	H	97	180	53
<i>Arundo donax</i> L.	H	109	180	60
<i>Canna x generalis</i> L. H. Bailey	H	133	180	73
<i>Casuarina equisetifolia</i> L.	T	122	180	67
<i>Catha edulis</i> (Vahl.) Forssk. Ex Endl.	S	89	180	49
<i>Coffea arabica</i> L.	S	97	180	53
<i>Croton macrostachyus</i> Del.	T	105	180	58
<i>Cucurbita pepo</i> L.	H	120	180	66
<i>Cupressus lusitanica</i> Mill.	T	89	180	49
<i>Dianthus caryophyllus</i> L.	C	116	180	64
<i>Dioscorea praehensilis</i> Benth	C	120	180	66
<i>Dombeya torrida</i>	T	138	180	76
<i>Ensete ventricosum</i> (Welw.) Cheesman	H	175	180	97
<i>Erythrina brucei</i> Schweinf	T	97	180	53
<i>Eucalyptus camaldulensis</i> Dehnh.	T	89	180	49
<i>Eucalyptus globulus</i> Labill.	T	88	180	48
<i>Hagenia abyssinica</i> (Bruce) J. F. Gmel.	T	73	180	40
<i>Hordeum vulgare</i> L.	H	121	180	67
<i>Juniperus procera</i> Hochst. ex Endl.	T	142	180	78
<i>Justicia schimperiana</i> (Hochst. ex Nees	T	104	180	57
<i>Lippia adoensis</i> Hochst. ex Walp. Var.	C	66	180	36
<i>Mangifera indica</i> L.	T	76	180	42
<i>Musa x paradisiaca</i> L.	H	94	180	52
<i>Passiflora caerulea</i> L.	C	91	180	50
<i>Peponium vogelii</i> (Hock. f.) Engl.	C	99	180	55
<i>Persea americana</i> Mill	T	113	180	62
<i>Podocarpus falcatus</i> (Thunb.) R. B. ex Mirb	T	99	180	55
<i>Rumex nepalensis</i> Spreng.	H	119	180	66
<i>Ruta chalepensis</i> L.	H	101	180	56
<i>Solanum nigrum</i> L.	H	112	180	62
<i>Syzygium guineense</i> (willd.)DC.	T	123	180	68
<i>Trichilia emetica</i> Vahl	T	123	180	68
<i>Vernonia amygdalina</i> Del	S	166	180	92
<i>Vernonia myriantha</i> Hook. F.	S	174	180	96

The above table shows the frequency and percentage values of herb, climber, shrub, and tree species in the study area. As large number of species in lower frequency classes and small number of species in higher frequency classes indicates higher heterogeneity. Thus the study area home garden species is heterogeneous in its diversity. A complete list of frequency of all plant species in the home garden study area is given in Appendix, X.

4.4.3 Home garden plant species similarity analysis

The plant species overlap in home garden across the six sampled study kebele was assessed using Jaccard's similarity index. The index used species presence – absence data in each kebele. In the process, the enumerated and recorded plant species were analyzed. The resulting values are multiplied by 100 to provide the percent. Similarity in plant species pair wise comparisons in six sampled kebele home garden (Table 7).

Table 7: Similarity index value across six study kebele in home garden Kochore .

Kebele	Kurum ₁	Qisha ₂	Gololicha ₃	Buno ₄	Qore ₅	Hanicebi ₆
Kurum ₁	1					
Qisha ₂	0.86	1				
Gololicha ₃	0.73	0.98	1			
Buno ₄	0.36	0.42	0.52	1		
Qore ₅	0.41	0.47	0.66	0.95	1	
Hanicebi ₆	0.57	0.53	0.71	0.90	0.97	1

Regarding the similarity on the species comparisons study area, kebele one shares more species with kebele two (86%) and three (73%) but comparatively small with kebele four (36%), five (41%) and six (57%). Kebele two shares more plant species with kebele three (98%) and comparatively less plant species with kebele four (42%), five (47%) and six (53%). Kebele three shares less plant species with kebele four (52%) and relatively similar with kebele five (66%) and six (71%). Kebele four equally shares plant species with kebele five (95%) and six (90%), kebele five shares more plant species with kebele six (97%) than any other kebele (Table 5). Generally the Jaccard's index across all pairwise comparison of area range from (36 - 98%) between all the kebeles. The maximum similarity was observed among kebele five and six (97%) and kebele two and three (98%), lowest similarity observed between kebele one and four (36%) and kebele one and five (41%). This is owing to continuation of most sampled home garden closest to each other and resemblance in altitudes that showed the accessibility of nutrient wanted by those species and the similarity of plants to that particular environment. This showed that kebele having nearly similar altitude have more plant species in common than kebele occupying unlike altitude. As Jari Oksanen, (2004) stated that, if two sites have similar vegetation, they have similar environment and if two sites have different vegetations, they have different environment.

4.5 Uses of home garden plant species

During survey, the inventory of home garden plants in study area showed there are multipurpose of plant uses for the local people (Table 8), and research result indicated 179 collected plant species. One of the important functions that home gardens plant diversity perform is to keep varieties plant species and uses of diversity alive from generation to generation. In home gardens children and visitors can learn from the family experts on different types of diversity and its multipurpose uses. This agreed with the work of (Havens *et al.*, 2014), who stated that, plants are not optional; they are essential to life and central to the future of human well-being. The importance of home gardens in the production of food, medicine and other useful products for human beings is widely recognized (Polegri and Negri, 2010).

Table 8: Use category of home garden plant species.

No	Use Category	No Species	%
1	Food	16	9
2	Medicinal	11	6.1
3	Farm tool	8	4.4
4	Ornamental	10	5.6
5	Ingredient	5	2.8
6	Shade	6	3.4
7	Cash crops	28	15.7
8	Stimulant	6	3.4
9	Beehive	9	5.0
10	Live fence	6	3.4
11	Cleaning agents	1	0.6
12	Charcoal	7	4.0
13	Cultural Values	4	2.2
14	Construction	8	4.4
15	Fiber production	5	2.8
16	Fire wood	14	7.8
17	Insect pollinat spp	8	4.4
18	Fodder	14	7.8
19	Multi purpose	13	7.2

4.5.1 Food use value

The good opening of the study area in home garden is that it cultivates Variety of food plant species. They have two agro ecological zones. This has its own importance to cultivate and harvest twice or more than that per year. For example, *Calpurnia aurea* (Boloke), *Cucurbita pepo* (bakula), *Ensete Ventricosum* (Wesho), *Hordeum vulgare* (So'a), *Mangifera indica* (Mango), (Appendix I) These plant species fulfill the gap of food security and the local farmers have a lot of trends to grow these varieties of food plant species in their home garden. The research finding demonstrated that from investigation of 179 home garden plant species 16 (9%) species are used for food in the study area. But most of the weredas population is still in food insecurity problem. The respondents suggested that, the major problem of food security was land fragmentation and population size increment per house holed in the study area. Plants are essential for food production. This idea was confirmed by (Khoury *et al.*, 2014), who reported that the majority of our food needs are met from home garden crops even plant species that provide wheat, sugar and rice are among the most significant contributors to per-capita calorie intake in 90% of countries around the world. In addition, thousands of species are grown

locally for food or used in traditional agriculture (Heywood, 2011). Many species of these plants contribute directly to meeting people's nutritional needs and improving their food security. While much attention is rightly given to people in chronic hunger (which affected around one in eight people (FAO, 2013), the significant one was danger of the 'hidden hunger' of micronutrient deficiency (affecting around 30% of the globe l population) (FAO, 2012) .

4.5.2 Cash crop

Home garden useful plant species are widely promoted in the study area as a source of income. As showed in table 6, 15.7%, from collected home garden plant species used as generating income to house hold to increase the financial status. During collecting plant species in filed observation, the dominant income generating plant species in the home garden of household are coffee, chat, sugarcane, and some exotic tree species like Eucalyptus. It is harvested twice or more per year. The seedling of coffee, chat, sugarcane and eucalyptus species are purposively cultivated in their home garden to provide income. In the study area, farmers widely recognized to grow income generating plant species in their home garden. The household makes choices of plants on the size and nature of the home garden system and its purposes, depending on their needs, resources, preferences and market opportunities (Hope *et al.*, 2005).

4.5.3 Medicinal value

Local people use variety of plant species for medicinal purpose. The parts of plant species that are used for this purpose include the seed plant, the leaves, roots, barks of the tree and flower parts. As indicated in; there are eleven medicinal plants which are well identified out of the collected plant species. This included *Hagenia abyssinica*, their seed parts heal the intestinal parasites of human being, *Combretum molle*, its liquid parts to stop the bleeding of wound when drop up on it, *Rumex nepalensis spreng*, their leaves heal abdominal pain, *Rumex abyssinicus*, the liquid that extract from it uses for ear pain when drop up on the ear. *Roosa richaria* when their leave mixed with food, it is used as appetizer and also abdominal pain by chewing it, *Prunus persica*, they are useful for headache, *Solanum tardere motum*, its seed is used for skin disease (Table 9) (Appendix, V). According to (IUCN, 1980) reported that, In many countries natural and semi natural ecosystems provide many plant products essential for human including medicinal plants.

Table 9 : Preferences ranking on significant medicinal plants from home garden
(I₁ - I₁₀ = key Informants)

No	Medicinal plant species	Preferences										Total	Rank
		I ₁	I ₂	I ₃	I ₄	I ₅	I ₆	I ₇	I ₈	I ₉	I ₁₀		
1	<i>Hagenia abyssinica</i>	9	4	10	10	10	9	10	9	10	10	91	1
2	<i>Rumex abyssinicus</i>	6	6	7	6	9	5	7	8	4	3	61	6
3	<i>Rosa richardiia</i>	10	3	8	6	5	8	6	8	5	2	51	7
4	<i>Rumex nepalensis spreng</i>	8	8	4	3	2	4	5	2	6	3	45	10
5	<i>Prunus persica</i>	7	6	3	4	2	5	1	3	3	4	38	11
6	<i>Solanum tardere motum</i>	5	2	5	6	3	2	7	8	3	3	46	9
7	<i>Cucurbita pepo</i>	2	6	8	6	7	10	9	7	9	9	73	4
8	<i>Cymbopogon bulbosus</i>	4	9	8	4	9	4	2	3	5	4	47	8
9	<i>Coffea arabica</i>	3	6	9	8	7	9	8	7	10	9	66	5
10	<i>Zingiber officinale</i>	5	10	8	9	9	10	7	6	8	3	75	2
11	<i>Eucalyptus globulus</i>	8	4	8	9	8	9	7	5	7	9	74	3

4.5.4 Farm tool and Construction

There are different types of trees found in the study area. From these, the farmers use some of the trees to make homefarm tool selectively. The selection criteria includes the color of tree, durability, softness, availability in the local area. The most important tree plants to utilize as home materials is *Hagenia abyssinica*. Now a day, this plant species is highly declining in number; followed *Cordia africana* and *Podocarpus falcatus* which are also declining; *Trichilia emetica* and *Syzygium guineense* are moderately declining; Ficus species and Eucalyptus species are rare to use as farm tool because their durability and strength is not preferable. As showed the respondents information rank in table 10. This is similar to the work of (Abebe, 2005) who reported that the farmers, are almost entirely dependent on their home gardens for their fuel wood consumption, and for most of other wood products. Obviously, the wood from these gardens is not used only for fuel, but also for different purposes; Such as construction of houses and fences, production of furniture, farm tools and house hold utensils.

Table 10: Preference ranking on home garden plants used as farm tool (I₁ - I₁₀= Key informants)

Scientific name	I ₁	I ₂	I ₃	I ₄	I ₅	I ₆	I ₇	I ₈	I ₉	I ₁₀	Total	Rank
<i>Cordia africana</i>	9	10	9	9	10	9	10	10	10	8	94	2
<i>Ficus species</i>	7	8	5	3	4	6	5	4	5	5	52	7
<i>Syzygium guineense</i>	8	6	6	4	5	8	7	6	6	7	63	6
<i>Trichilia emetica</i>	7	5	4	8	6	7	6	5	5	6	70	4
<i>Eucalyptus species</i>	6	5	7	5	3	5	4	3	2	3	43	8
<i>Hagenia abyssinica</i>	10	9	10	10	10	9	10	9	10	10	97	1
<i>Podocarpus falcatus</i>	9	8	9	8	9	10	9	9	10	9	90	3
<i>Polysphaeria parvifolia</i>	7	6	8	6	5	6	5	6	4	5	64	5

4.5.5 Cultural Values and religious conviction

The cultural beliefs associated with prominent tree species are gradually weakening due mainly to increasing exposure of the rural farm communities to modern and western-style teachings. In some places culturally venerated huge trees of various species, which are designated, as Shengo Trees are clearly visible. At present, these trees mainly serve to provide shade for elders that are meeting to resolve various social issues and to pray to their creator, God. No one is daring to cut and use any part of such trees. The species may vary from one area to the other. In the higher altitudes of the district such trees species as *dembi* and *udo* are the two known holy trees that grow in meeting places. Any tree that grows in such meeting places is traditionally blessed and people are forbidden from cutting. In one case, the recent ethnic disturbance in the Gedeo has been recognized to the natural uprooting of an old and appreciated *Podocarpus falcatus* tree in the study area PA. This caused many people in the area to be engulfed in fear. An elderly man is said to have fore told the incidence of threatening episodes following the falling of the tree. After the unlucky upheavals, many people coaxed to associate the two incidences. as a result, up on advice from an elderly wise man, one male and one female sheep were slaughtered after which the remains of the tree were acceptable to be sold to an urban dweller at a very cheap price, i.e., only 300 - 400 birr. The process of cultural discussions concerning the removal of the tree was estimated to have incurred about 300- 400 birr. so, no part of the tree was acceptable to stay in the area for horror of unsuccessful incidences. It is now planned by the local elders to

replace the dead tree with *Cordia africana*. A tree species locally known as wedesa is considered very durable for construction purposes. Its wood is quite tolerant to biological damage. However, the meaning associated with the name of the tree itself deprived discourages the farmers from using it.

4.5.6 Cattle feed, firewood, ornamental and live fence in the study area

A variety of Plant species trees are found integrated within a majority of the home gardens in the study area (Table 8). These plant species usually have multiple uses and provide, fodder 7.8%, firewood 7.8% and ornamental 5.6% for household uses. Because livestock are an integral part of the farming systems and are generally kept within homestead, fodder trees have special place in home gardens, especially in the mid land. The twigs and branches of fodder trees left after the leaves have been eaten are used as firewood for household cooking. Ornamental and live fence 3.4% species, however, are limited in type and number some common species are *Combretum collinum*, *Crotonmacrostachyus*, *Cupresus lusitanica*, *Dombeya torrida*. These species also used to fodder, firewood and *Cupresus lusitanica* also mostly known by live fence and Ornamental value in the study area .

4.5.7 Ingredient and stimulants plant species

A total of 179 species 5 species of ingredient, 6 stimulants species were documented. The two use categories together consisted of 6.2% of the total useful plant species documented. The most commonly stimulants and ingredient plant species in the majority of home gardens were *Aframomum corrorima*, *Allium species*, *Catha edulis*, *capsicum annum*, *dodonea angustifolia*, *coffea arabica* Appendix I.

4.6 Functional groups of crops

A total of 7 functional groups of crops were documented each represented by 3 to 15 species of crops (Appendix, III), and the largest 20%. Out of the average number of 7 crops per farm, root and tubers (20%), followed by vegetables (17%), grains 14%, fruit and oil crops 13%, cereals 12% contributed respectively (Figure 4). It should be noted that this proportion showed the number of crop species in the commodity groups and it doesn't have any relation with their abundance or area coverage in the home garden. For instance, fruit crops constituted 13% the average number of crop species, cereal they covered only 12% of the farm areas. On the other hand, coffee and chat, the dominant stimulant 11% crops on the home garden.

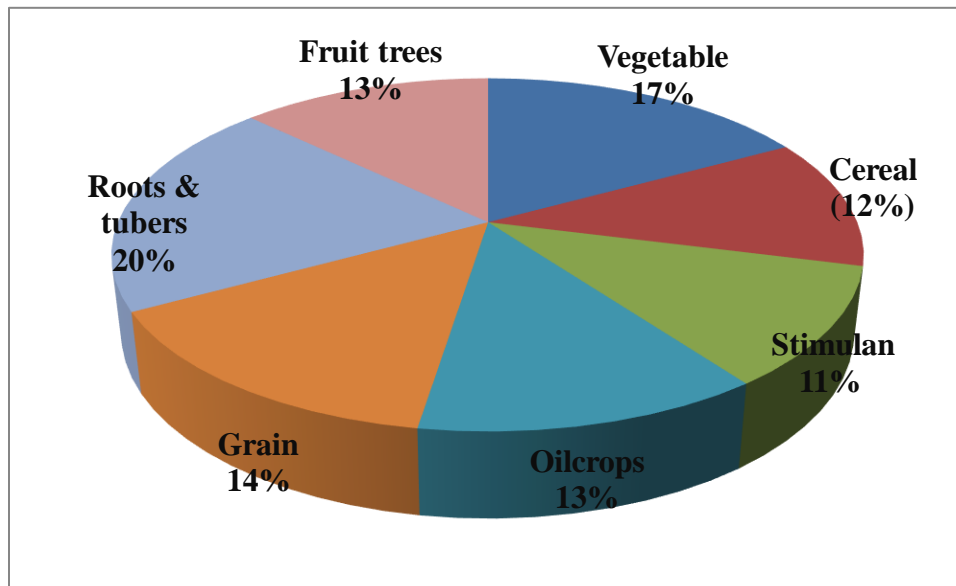


Figure 4 . proportion of functional groups of crops per farm

4.7 Socio –economic factors influencing useful plant diversity in home garden

Research result indicates that how much the explanatory variable included in the model explain the variation of the dependent variable (Y) or plant diversity. It shows the explanatory power of the independent variables, the adjusted R^2 ($0.82 = 82\%$) is interpreted as about 82 % of the total variation of dependent variables (plant diversity) is explained by the independent variables (factors) that are included in the regression model.

Table 11: The multiple linear regression model analysis output for the significant variables in home garden.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for β		
	β	Std. Error	β			Lower Bound	Upper Bound	
1	(Constant)	4.644	1001.94		.441	0.0160	-1536.827	2420.114
	Age of households	- 12.452	1173.14	-.146	-1.425	.0530	-13.3108	11.7968
	Total family size	52.313	45.579	.115	1.148	.0253	-37.689	142.315
	Education level	18.766	86.376	-.191	-2.151	.033	- 356.327	-15.205
	Farm size	25.93	133.529	.152	.943	.0347	-137.740	389.601
	Annual income of the HHs	.003	.020	-.054	-.142	.037	-.043	.037
	Employee	-23.50	257.403	-.148	-1.345	.0181	-854.432	162.115
	Source of planting martial	66.430	349.654	.053	.639	.04524	-466.934	913.937
	Access to market	29.552	363.613	.014	.011	.0412	-651.569	784.429

From the hypothesis testing the significance of individual parameters in (Table 11) show that the calculated multiple linear regression model was given below in

$$\hat{Y} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8$$

$$4.644 - 12.452X_1 + 52.313X_2 + 18.766X_3 + 25.93X_4 + 0.03X_5 + 23.501X_6 + 66.430X_7 + 29.552X_8$$

So : The multiple linear regression model analysis outcomes for the significant variables in home garden describe,

β_0 is (Constant) it indicate that the unknown independent variable that influence plant diversity

$\beta_1 X_1 = \beta_1$ is the amount indicator of the independent variable X_1 (Age of households)

$\beta_2 X_2 = \beta_2$ is the amount indicator of the independent variable X_2 (family size)

$\beta_3 X_3 = \beta_3$ is the amount indicator of the independent variable X_3 (Education level)

$\beta_4 X_4 = \beta_4$ is the amount indicator of the independent variable X_4 (Farm size)

$\beta_5 X_5 = \beta_5$ is the amount indicator of the independent variable X_5 (Annual income)

$\beta_6 X_6 = \beta_6$ is the amount indicator of the independent variable X_6 (Employment status)

$\beta_7 X_7 = \beta_7$ is the amount indicator of the independent variable X_7 (Sharing of planting martial)

$\beta_8 X_8 = \beta_8$ is the amount indicator of the independent variable X_8 (Access of market)

From the SPSS out put the p-values (sig.value) for testing the significance of the individual parameter of the variable are $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ and β_8 were discussed in (Table 12) that influence the plant diversity in the study area.

The value of the constant β_0 is ($\beta_0 = 4.644$). This indicated that the amount of the plant species diversity in the study area is about 441.64 when the value of the other variables were zero. In the absence of the variables included in the model, there was an amount of 4.644 plant diversity in the study area and this was because of the influence of other unmentioned variables in the model or analysis but present in the study area.

A total of sixteen (16) selected household characters to the study of socio economical character on plant species diversity in the home garden study area, 8(eight) of them significantly affect the plant diversity in the home garden (Table 11). The factors which were found to significantly affect the plant species diversity, their sig(p-value) is significant which is below 0.05 ($\alpha = 5\%$) (Table 9), such as family size of house hold, educational status of house hold, the land size of the house hold, the annual income of house hold, sharing planting material, the access of market, the agro forestry, and employment in the home garden. Their sig (p-value) result is 0.025, 0.033, 0.034, 0.037, 0.045, 0.041, 0.024 and 0.018 respectively. The above result

indicated that p-value from table (Table 11) is small that is less than $\alpha < 0.05$, the variables significantly influence the plant diversity in the study area. The remaining variable that is their p-value greater than ($\alpha > 0.05$) insignificant to plant diversity in the home garden of study area. Those variable were sex of the households ,marital status of the house hold, the total live stock units, the annual expenditure of house hold, special techniques in home garden, extension service, the treat of home garden.

1. Access to market

Access to market has direct relationship with plant species diversity in the home garden. The analysis result in (Table 11) showed that as the access of the market increases the plant diversity would be increased by the amount of 29.552 times. During investigation of market survey in the filed there were two areas: fiseha genet and chelelektu towns. They are far away from each other (17 km).We can conclude that the farmers in the study area were involved in growing of stimulant species. This is because of that the unit prices of the stimulant species (coffee, chat, tobacco) are so expensive and they are market- oriented species. It could be agreed that commercially oriented famers pay more attention on reaping short term commercial benefits from their home-gardens and hence they would not focus on longer term benefits that could be derived through enhanced biodiversity (Korale-Gedara *et al.*, 2012). This is similar to the work of (Hope *et al.*, 2005) who reported that the house hold makes choices with market opportunities. In the study area, the local people (house hold) wanted to grow plant species depending on market price or they tried to compare it with purchasing power. The plant species with effective price governs the type of plant species in the home garden households. In such context it could be agreed with, (Wiehle *et al.*, 2005), who found a positive relationship between market orientation and species richness in home gardens. And the result contradict with (Abebe, 2005).

2. Sharing planting material

Sharing planting materials among the study area of local people was adaptive culture and popular habit. It helped to enhance variety of home garden plant species among farmers and diversifies the number of plant species. Sharing of the verities of planting plant species materials would help greatly to conserve rare those plant species in the home garden. The result showed (Table 11) that the planting materials sharing increment among the house hold and the

plant diversity increases by the amount of 66.430 times. They have positive relationship with plant diversity. The local people believe that local varieties of plant species has high quality to yield and to local agro ecology in the study area. This concept goes with (Wickham, 1993) who suggested that indigenous knowledge is more than science.

3. Annual income

Table 11 showed that a single birr increment in the annual income of the house hold with the plant species diversity would be increased by the amount of 0.003 times. The house hold without additional sources of incomes grow less plant species and the household with more exogenous income were also more likely to grow varieties of plant species in their home garden due to easy access of buying varieties of plants species from the markets. The result agrees with the report of Mmom, (2009), who suggested that plant diversity and house hold income have positive relationship. (Winters *et al.*, 2006) also reported the richer households may have greater capacity to access of the seed from the market or elsewhere. Zemedede Asfaw (2001), also recommended that farmers to derive greater income from diversity rich home gardens.

4. Farm size

The data analysis result in (Table 11) showed that the farm size have positive relationship with home garden plant species diversity in the study area. To cultivation plant land is essential. When the land size increases in one hectare, the plant diversity increase by the amount of 25.93 times. This indicated that the house hold have large farm land chance (choice) to cultivate varieties of plant species in their home garden. This result is in agreement with the result of (Wiehle *et al.*, 2011), who suggested that there is positive relationship between home garden size and plant diversity.

5. Education status

The multiple regression model data analysis result indicated that educational status positively influences the plant diversity in the home garden of study area. When the household's educational level increases by 1 level the plant diversity increases by the amount of 18.766 times. There has been positive relationship between them (Table 11). Because of the scientific agricultural knowledge, different technology and practiced conservation have been effectively applied on the home garden of educated people (farmers), diversified varieties of plant species in their home garden are grown in the study area. But uneducated farmers to grow focus on cash crop and food plant. This finding agreed with the work of (Zemedu Asfaw, 2001), who suggested that home garden owners with high levels of education tend to cultivate a greater number of species because they easily adopt new technologies and new species or varieties.

6. Employee

The analysis of multiple regression result indicated that when the number of employ people increases in home garden the plant diversity decrease by the amount of -23.501 (Table 11) because of the employed people focus on the single species that found on the farm land and they don't consider about other cultivated plant species in the home garden. The agreement would be to work in farm land per day for the single species with the owner of farm land the other species was cut, field and even if the seedling of new generation plant species was ignored by the employer in the study area.

7. Family size

The data analysis result showed that as the family size of house hold increases, the plant diversity also increases by the amount of 52.313 times (Table 11). There is a positive relationship between large family size and plant diversity. When the labor of large family size is effectively used, there would be cultivate varieties plant species in their home garden. (Winters *et al.*, 2006) supports this finding suggesting that there is a positive relationship between large family size and plant diversity.

8. Age of house hold

The data analysis result indicated that in any age level of the house hold, the plant diversity has been constant. This is because of the fact that in any level of age category in the study area,

farmers have used equal agricultural technology in their farm land. The SPSS analysis result showed that the age level of farmers has no significant effect in plant diversity in the study area and the slash line indicates that in each level of age category, the plant species is constant. This result is similar with (Abebe, 2005), who recommended that age of the farmers do not have any effect on the plant diversity.

4.8 Threats to plant diversity in the home gardens of study area

The information showed that the range of family member per house hold was 5 to 10 (50%) (Appendix VI). This indicated that there is rapid population growth in the area and the educational status of the respondents was from six level of education categories 55% were illiterate. This shows that the majority of farmers in the study area are uneducated. Due to this, there is challenge in using agricultural technology in the home garden and also the majority of home garden is owned by old aged house hold in the study area which accounts for 51.67%. This implies that the youngster house hold have not more chance to cultivate varieties of plant species in home garden. These features seem to reduce plant diversity in the home garden of the study area.

4.9 Indigenous management on plant diversity in the home gardens of Kochere

Farmers in the study area practice indigenous knowledge on plant diversity in their home garden. They are keeping the local varieties of plant species by conservation, for instance, sharing local variety of plant seed with their neighbors. Mealy bag on coffee, enset and banana is treated using animal manure. The other disease is bacterial wilt that infects Enset and banana and they are protected by removing the infected plant by burning and keeping their working material (knife) from disease contamination, which means keeping the knife from cutting the infected plant so that the working material is not contaminated. Similarly, when matured coffee is invaded by parasitic plants that makes a net like surface up on the leaf part of the coffee, which decreases the yield is avoided by picking up the parasitic plant. They also shift plant species in their home garden to improve yield and the income they can generate. They focus on local plant species because they think that local varieties of plant species increase productivity. In addition to this, the development of local plant species is healthier than that of foreign plant species source, as claimed by the respondents. To sustain these local plant species, they duplicate them frequently. When they lose these plant species, they can borrow them from their friends and share it with their neighbors. This way the plant species would be kept in the environment. Furthermore, they prefer organic coffee due to their size and acceptance in the market. Moreover, according to the respondents, conservation is taking place for agroforestry and farmers are planting tree for keeping soil fertility to shade the local plant species and to get woods for constructing their houses. Yiridoe and Anchirinah, (2005) reported that, indigenous peoples have in-depth, varied and locally rooted knowledge of the natural world. for example, on crop domestication, soil management, and furthermore, can play a crucial role in managing natural resources, since they have rich and ancient cultures and regard their socio-economic, spiritual and environmental systems as strongly.

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

As indicated in this study, 179 species of plants that belong to 151 genera and 77 families were identified in home gardens. In the field of plant species collection, some of the species were known by both their scientific and local name; the others were only known by their local name. To obtain the scientific name for those species that are known only locally, identification of the names was made in herbarium (ETH) and their local name was cross checked by the local farmers' (respondents) carefully. Out of the identified families of plant species, Fabaceae were the largest number of species. The remaining families have four and less than four species. The analysis of Shannon and Simpson diversity measurement indicated that the species richness in the two agro ecological zones (climates) was diverse; the midland plant diversity was greater than the highland plant diversity. However, the evenness was higher in dega because of the dominance of single species *Ensete ventricosum*. The Jaccard's similarity coefficient showed that the species similarity in the area overlapped in both agro-ecological climates. From this point of view, the plant diversity analysis indicated high plant species richness and evenness in the area of the study. The local farmers practice of agro-forestry and forestry is used as shelters of shrub and herbaceous plant species in the home garden. From the collected plant species, nineteen main uses were identified, and enset is the dominant food plant species. Regarding income generating or cash crop species, coffee is the popular one. *Hagenia abyssinica* is also well known as medicine. The other plant species are generally used for socio-economic value. In the study area the home garden was dominated by cash generating plant species rather than food plant species, creating food insecurity and insufficiency.

Though there is inverse relationship between plant diversity and altitude, the socioeconomic factors were analyzed by multiple regression model to regress what factors affect plant diversity in the home garden. From these, eight of them have significant value which is less than 0.05 ($P < 0.05$) which significantly affect the plant diversity in the home garden. These include the farmers educational level, farm size, family member, access to market, annual income, sharing of plant species and employment status. The result of SPSS software data analysis indicated that the age level of the farmers does not show any effect in the diversity of species which means, in any age level the diversity was constant. The other seven factors, sex, marital status,

total livestock unit, annual expenditure, special technology, extension service and threat of plant species had insignificant effect on home garden in the study area.

The plant diversity in the study area indicated constant value ($\beta_0 = 441.64$). This shows that, the amount of the plant diversity in the area is about 441.64 times due to the effect of other variables which are not included in the model. The statistical analysis (ANOVA) also showed that, the plant diversity is affected in the home garden due to the influence of determinant factors ($P < 0.05$ level of significance). This study shows that the socioeconomic factors of household affected the local plant diversity. And, the respondents suggested that, man made agro forestry is increasing in the area through direct plantation by the local farmers, but the plant diversity in the natural forestry tended to be reduced.

5.2. Recommendation

Based on the research finding the following recommendation is forwarded

- Most of the farmers in the study area grow plant species in their home garden based on market access. However, the area has potential to cultivate varieties of plant species in home garden. Therefore, the local government should carefully plan and, organize implementation action to increase the plant diversity in their home garden.
- Homegarden plant species was under risk in study area. But national policy has already been developed for promotion of agriculture for household food security and environment protection. This was useful opportunity for increasing plant diversity in home gardens through their own benefits. Peoples' understanding about greener and cleaner environment provides a base to launch long term programs on gardening and conservation of natural resources. Thus government and nongovernmental sectors should have considerable rules to promote home gardens useful plant species.
- The farmers were not educated effectively to apply scientific technology on their home garden. Furthermore, the technology was not interrelated with their traditional knowledge. The research finding indicated that a considerable portion of the population (35.2%) were uneducated farmers. Therefore, the local government should create opportunity to promote indigenous knowledge with scientific agriculture or plant diversity by educating farmers.

- It was identified that the socioeconomic condition such as home garden size, family size, and the annual income of the farmers significantly affect plant diversity in home garden. A significant relationship was found to exist between home garden plant species diversity and food security in the study area. An increasing plant diversity in home garden improves household food security access. The farmers should be supported to maintain the species richness and there should be a need for action. In addition, awareness creation and fund searching program at agro biodiversity conservation should focus on the farmers of the study area.

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7. APPENDICES

Appendix I: List of plant species collected in this study

Use class:

IN= Ingridant, Md=Medicinal, Co=Construction of houses, Fw=Firewood, Or=Ornamental, Lf=Live fence, Fo=Fodder, ShF=Shade&Soilferitlity, Bh=Bee hive making, IP=Insect polleneted, Ch=Charcoal, Wm=Wetlands management plants, Cl=Traditional cleaning agents, Fn= Dry fencing, Is=Income source/ cash crops, St=Stimulants, F=Food Hm=Home material made, Mp=Multipurpose species, Fir= Fiber production, Nu= Locally no use,

No	Scientific Name	Local name	Family	Use of spp
1	<i>Acacia abyssinica Hochst. Ex. Benth</i>	Waaco	Fabaceae	Fw, Ch, Sf,
2	<i>Acacia Senegal (L.) Wild</i>	Waaco	Fabaceae	Fw, Ch, Sf,
3	<i>Aframomum corrorima (Braun) Jansen</i>	Kororima	Zingiberaceae	IS
4	<i>Agave sisalana Perrine ex Engel.</i>	Haanixi hidicho	Agavaceae	Or
5	<i>Ajuga integrifolia Buch.-Ham. Ex D. Don</i>	Gassale	Lamiaceae	Fw, Ch, Sf
6	<i>Albizia grandibracteata Taub.</i>	Danibaliquce	Lamiaceae	In,St
7	<i>Albizia gummifera (J. F. Gmel.) C. A. Sm.</i>	Goribe	Fabaceae	Nu
8	<i>Alcea rosea L.</i>	Abeba	Malvaceae	Fo
9	<i>Allium Sp. L.</i>	sunikurteshafixa	Alliaceae	Fw
10	<i>Allium cepa L.</i>	Diimoxasunikurte	Alliaceae	Md,Co,Fw
11	<i>Allium sativum L.</i>	Qulube	Alliaceae	Or
12	<i>Aloe L.</i>	Qararito	Aloaceae	In,Is
13	<i>Amaranthus caudatus L.</i>	Abeba	Amaranthaceae	In,Is
14	<i>Amaranthus hybridus L.</i>	Raafu	Amaranthaceae	Mp
15	<i>Ananas comosus (L.) Merr.</i>	Anannase	Bromeliaceae	Nu
16	<i>Annona squamosa L.</i>	Gishixa	Annonaceae	Or
17	<i>Arachis hypogeal L.</i>	Lewuze	Fabaceae	F
18	<i>Artemisia abyssinic Sch. Bip. Ex A. Rich.</i>	Cugene	Asteraceae	F,Is
19	<i>Artraxon micans (Nees) Hochst.</i>	Benna	Poaceae	F,Is
20	<i>Arundinaria alpine K. Schum</i>	Leema	Poaceae	Is
21	<i>Arundo donax. L.</i>	Shomboko	Poaceae	Md
22	<i>Asparagus africanus Lam.</i>	Serite	Asparagace	Nu
23	<i>Azadirachta indika neem A. J.USS</i>	Zaafe	Meliaceae	Mp

24	Anders <i>Lactuca sativa</i> L.	Abeba	Asteraceae	Mp
25	<i>Bersama abyssinica</i> Fresen.	Xibiro	Meliaceae	Md
26	<i>Beta vulgaris</i> L.	Qaysire	Chenopodiaceae	Shf
27	<i>Buddleja polystacha</i> Fresen	Dhuggo	Loganiaceae	Fw
28	<i>Brassica carinata</i> A.Br.	Shaana	Brassicaceae	F,Is
29	<i>Brassica oleracea</i> L.	Xiqiligomene	Brassicaceae	F,Is
30	<i>Brucea antidysenterica</i> J.F.Mill.	Laafa	Simaroubaceae	F,Is
31	<i>Brassica rapa</i> L.	Qosxa	Brassicaceae	F,Is
32	<i>Cajanus cajan</i> (L.) Millsp.	Atara ciatika	Fabaceae	Fw
33	<i>Calpurnia aurea</i> (Ait.) Benth.	Ceekata	Fabaceae	Fw
34	<i>Canavalia ensiformis</i> (L.) DC.	Boloqe	Fabaceae	Fw
35	<i>Canna indica</i> L.	Abeba	Cannaceae	F,Is
36	<i>Canna x generalis</i> L. H. Bailey	Qaara	Cannaceae	Or
37	<i>Capsicum annuum</i> L.	Miximixa	Solanaceae	Or
38	<i>Capsicum frutescens</i> L.	Dube qaara	Solanaceae	In,St,Is
39	<i>Carica papaya</i> L.	Papaya	Caricaceae	In,St,Is
40	<i>Casimiroa edulis</i> La Liave	Abukere	Rutaceae	F,Is
41	<i>Casuarina equisetifolia</i> L.	Shiwashuwe	Casuarinaceae	F,Is
42	<i>Catha edulis</i> (Vahl.) Forssk. Ex Endl.	Caate	Celasteraceae	Mp
43	<i>Celtis africana</i> Burm. F.	Motokomo	Cannabaceae	St
44	<i>Chrysanthemum coronarium</i> L.	Abeba	Asteraceae	Fw
45	<i>Cirtus</i> Sp.	Marara	Rutaceae	Or
46	<i>Citrus aurantifolia</i> (Christm.) Swingle	Loome	Rutaceae	F
47	<i>Citrus sinensis</i> (L.) Osb.	Buritukane	Rutaceae	Is,Is,Md
48	<i>Clematis hirsuta</i> Perr. & Guill.	Hajija	Ranunculaceae	Is,Is,Md
49	<i>Clerodendrum myricoides</i> (Hochst.) Vatke.	Abeba	Lamiaceae	Or
50	<i>Coffea arabica</i> L.	Buno	Rubiaceae	Or
51	<i>Colocasia esculenta</i> (L.) Schott.	Godare	Araceae	IS
52	<i>Combretum collinum</i> Fresen.	Rukenisa	Combretaceae	F
53	<i>Combretum molle</i> R. Br. Ex G. Don	Lalunixe	Combretaceae	Fw
54	<i>Commeliana africana</i> L.	Jeebe	Commelinaceae	Fw
55	<i>Cordia africana</i> Lam.	Weddesa	Boraginaceae	Fo
56	<i>Coriandrum sativum</i> L.	Abeba	Apiaceae	Mp
57	<i>Cosmos bipinnatus</i> Cav.	Abeba	Asteraceae	St
58	<i>Cosmos shimperi</i> Fish. & Mey.	Abeba	Asteraceae	Or
59	<i>Croton macrostachyus</i> Del.	Mokensa	Euphorbiaceae	Or

60	<i>Cucurbita pepo L.</i>	Baaqula	Cucurbitaceae	Mp
61	<i>Cupresus lusitanica Mill.</i>	Hinesa	Cupressaceae	F,Is
62	<i>Cymbopogon citratus (DC.) Stapf</i>	Hixicho	Poaceae	Mp
63	<i>Cymbopogon bulbosus Vahl</i>	Abeba	Poaceae	In
64	<i>Dahlia pinnata Cav.</i>	Abeba	Asteraceae	Or
65	<i>Daucus carota L.</i>	Kaarote	Apiaceae	Or
66	<i>Dianthus caryophyllus L.</i>	Qurunifude	Cryophyllaceae	F,Is
67	<i>Dioscorea praehensilis Benth</i>	Boina golaloka	Dioscoreaceae	Or
68	<i>Dioscorea sagittifolia Pax.</i>	Boina diimoka	Dioscoreaceae	F,Is
69	<i>Dodonea angustifolia L.F.</i>	Hanixaxe	Sapindaceae	F,Is
70	<i>Dombeya torrida</i>	Daanisa	Sterculiaceae	In
71	<i>Dovyalis caffra (Hook. F. & Harv.)</i>	Shiisha	Flacourtiaceae	Fw
72	<i>Dracaena afromontana Mildbr</i>	Sarite	Dracaenaceae	F
73	<i>Dracaena fragrans (L.) Ker Gawl</i>	Lanixe	Dracaenaceae	Shf
74	<i>Ekebergia capensis Sparrm.</i>	Haniku	Meliaceae	Fo
75	<i>Embelia schimperi Vatke</i>	Adaama	Myrsinaceae	Fw
76	<i>Ensete ventricosum (Welw.) Cheesman</i>	Weesho	Musaceae	MD,Fw
77	<i>Eragrostis tef (Zucc.) Trotter</i>	Xaafe	Poaceae	F,IS
78	<i>Erythrina brucei Schweinf</i>	Wollena	Fabaceae	F,Is
79	<i>Eucalyptus camaldulensis Dehnh.</i>	Diimoxa barizafe	Myrtaceae	Shf,Bh
80	<i>Eucalyptus globulus Labill.</i>	Golaloxa barizafe	Myrtaceae	co,Fw,
81	<i>Euphorbia ampliphylla Pax</i>	Abeba	Euphorbiaceae	Md,co,Fw
82	<i>Euphorbia cotinifolia L.</i>	Abeba	Euphorbiaceae	Fw
83	<i>Euphorbia pulcherrima Klotzsch.</i>	Sisa	Euphorbiaceae	Or
84	<i>Fagaropsis angolensis (Engl.) Dale</i>	Maa'na	Rutaceae	Or
85	<i>Ficus sur Forssk</i>	Ode'e	Moraceae	Fw
86	<i>Ficus sycomorus L.</i>	Ode'e	Moraceae	Shf,Ip,Bh,Co
87	<i>Ficus thonningii Blume</i>	Ode'e	Moraceae	Shf,Ip,Bh,Co
88	<i>Foeniculum vulgare Mill</i>	Dunibee'la	Apiaceae	Fw
89	<i>Gardenia ternifolia Schumach Schumach.</i>	Zaafe	Rubiaceae	Fo
90	<i>Grevillea robusta R.Br.</i>	Zaafe	Proteaceae	Fw
91	<i>Girardinia bullosa (Forsk) snowden</i>	Doobe	Urticaceae	Shf
92	<i>Girardinia bullosa (Steudel) Wedd.</i>	Doobe qunixuxo	Urticaceae	Fw
93	<i>Hagenia abyssinica (Bruce) J. F. Gmel.</i>	Heexo	Rosaceae	Mp
94	<i>Helianthus annuus L.</i>	Suufe	Asteraceae	F,Is
95	<i>Hibiscus acetosella Welw. ex Hiern</i>	Abeba	Malvaceae	Or

96	<i>Helichrysum formosissimum</i> (sch.Bip) A.Ric	Hanaxe	Asteraceae	Or
97	<i>Hypoestes triflora</i> (Forssk) Roem. & Schult	Laaleesa	Acanthaceae	F,Is
98	<i>Hibiscus rosa-sinensis</i> L.	Abeba	Malvaceae	F,Is
99	<i>Hordeum vulgare</i> L.	So'a	Poaceae	Or
100	<i>Ipomoea batatas</i> (L.) Lam	Maxaxash	Convolvulaceae	Bh
101	<i>Iresine herbstii</i> Lindl	Abeba	Amaranthaceae	Mp
102	<i>Jasminium grandiflorum</i> L.	Dikicha	Oliaceae	Nu
103	<i>Juniperus procera</i> Hochst. ex Endl.	Hinesa	Cupressaceae	F,Is
104	<i>Justicia schimperiana</i> (Hochst. ex Nees	Kishe	Acanthaceae	Hm
105	<i>Lantana trifolia</i> L.	Kese	Verbenaceae	Or
106	<i>Lagenaria siceraria</i> (Molina) Standl.	Buqe fahdixa	Cucurbitaceae	In
107	<i>Lantana camara</i> L.	Ci'atika so'a	Verbenaceae	F,Is
108	<i>Lippia adoensis</i> Hochst. ex Walp. Var. Koseret	Abeba	Verbenaceae	Or
109	<i>Linum unisatissimum</i> (pax)	Taliba	Asteraceae	Is
110	<i>Lycopersicon esculentum</i> Mill	Timatime	Solanaceae	F,Is
111	<i>Maesa lanceolata</i> Forssk	Moogo	Myrsinaceae	Is
112	<i>Malus sylvestris</i> Mill	Apple	Rosaceae	Fw
113	<i>Mangifera indica</i> L.	Mango	Anacardiaceae	Shf,Fw
114	<i>Manihot esculenta</i> Crantz	Titiko	Euphorbiaceae	Or
115	<i>Melilotus suaveolens</i> Ledeb.	Hixicho	Fabaceae	F
116	<i>Millettia ferruginea</i> (Hochst.) Bak.	.Xaxato	Fabaceae	F,Is
117	<i>Mirabilis jalapa</i> L.	Abeba	Nyctaginaceae	St
118	<i>Morus alba</i> L.	Gora	Moraceae	In
119	<i>Musa x paradisiaca</i> L.	Muuze	Musaceae	Md
120	<i>Myosotis abyssinica</i> Bois & Revt	Qarcabe	Boraginaceae	Or
121	<i>Nicotiana tabacum</i> L.	Tamibo	Solanaceae	St
122	<i>Nigella sativa</i> L.	Xiloxa qimame	Ranunculaceae	Or
123	<i>Ocimum basilicum</i> L.	Basibelo	Lamiaceae	F,Is
124	<i>Ocimum lamiifolium</i> Hochst. ex Benth.	Daamakase	Lamiaceae	Or
125	<i>Oenothera biennis</i> L.	Abeba	Onagraceae	Fo,Wm
126	<i>Olea europaea</i> L.	Ejerisa	Oliaceae	F
127	<i>Passiflora caerulea</i> L.	Oba	Passifloraceae	F,Is
128	<i>Passiflora edulis</i> Sims.	Koophe	Passifloraceae	F,Is
129	<i>Pelargonium zonale</i> (L.) 'Her	Abeba	Geraniaceae	Fw
130	<i>Pennisetum violaceum</i> (Lam.) L. Rich.	Kokeye	Poaceae	Or
131	<i>Peponium vogelii</i> (Hock. f.) Engl.	Surupha	Cucurbitaceae	F

132	<i>Persea americana</i> Mill	Abukato	Lauraceae	Cl
133	<i>Phaseolus lunatus</i> L.	Raaqixa qoqeye	Fabaceae	F,Is
134	<i>Phaseolus vulgaris</i> L.	Quphana hamara	Fabaceae	Mp
135	<i>Phoenix reclinata</i> Jacq.	Meexe	Arecaceae	Fw
136	<i>Physalis peruviana</i> L.	Shiisha	Solanaceae	Fw
137	<i>Phytolacca dodecandra</i> L Hèrit.	Haranija	Phytolaccaceae	F,Is
138	<i>Pisum sativum</i> L.	Atara	Fabaceae	F,Is
139	<i>Podocarpus falcatus</i> (Thunb.) R. B. ex Mirb	Biribirisa	Podocarpaceae	Nu
140	<i>Polysphaeria parvifolia</i> Hiern	Kurume	Rubiaceae	In,Is
141	<i>Prunus africana</i> (Hook. f.) Kalkm	Garibe	Rosaceae	F,Is
142	<i>Prunus persica</i> (L.) Batsch.	Koke	Rosaceae	Or
143	<i>Psidium guajava</i> L.	Zytona	Myrtaceae	Or
144	<i>Pycnostachys abyssinica</i> Fre.	Abeba	Lamiaceae	Md,In,Is
145	<i>Rhamnus prinoides</i> L 'Herit	Geeshe	Rhamnaceae	Nu
146	<i>Ricinus communis</i> L.	Qobo'o	Euphorbiaceae	Md
147	<i>Rosa abyssinica</i> Lindley	Ucho	Rosaceae	Md,In,Is
148	<i>Rosa x richardii</i> Rehd	Maxibasha	Rosaceae	F,Is
149	<i>Rosmarinus officinalis</i> L.	Abeba	Lamiaceae	Or
150	<i>Rumex abyssinicus</i> Jacq.	Xoshiqa	Polygonaceae	In
151	<i>Rumex nepalensis</i> Spreng.	Baliqane	Polygonaceae	Or
152	<i>Ruta chalepensis</i> L.	Sugete	Rutaceae	Fw
153	<i>Rhus Vulgaris</i> (steude)Wedd	Koophe	Anacardiaceae	Nu
154	<i>Saccharum officinarum</i> L.	Shonikora	Poaceae	F,Is
155	<i>Salvia leucantha</i> Cav.	Shashato	Lamiaceae	F,Is
156	<i>Salvia nilotica</i> Jacq.	Uketa	Lamiaceae	F
157	<i>Salvia splendens</i> Sellow ex Roem. & Schult	Abeba	Lamiaceae	F,Is
158	<i>Sesbania sesban</i> (L.) Merr	Dumbee'la	Fabaceae	Mp
159	<i>Solanecio gigas</i> (Vatke) C. Jeffrey	Deelo	Asteraceae	Or
160	<i>Solanum nigrum</i> L.	Tunaye	Solanaceae	Or
161	<i>Solanum tarderemotum</i> Bitte	Saana	Solanaceae	Co,Fw,Shf,Bh
162	<i>Solanum tuberosum</i> L.	Dinicha	Solanaceae	F,Is
163	<i>Sorghum bicolor</i> (L.) Moench	Mishinga	Poaceae	Or
164	<i>Sorghum dochna</i>	Xiniqisha	Poaceae	Lf,Fo
165	<i>Solanum indicum</i>	Hide	Solanaceae	Lf
166	<i>Stephania abyssinica</i> L.f	Abeba	Minispermaceae	F,Is
167	<i>Syzygium guineense</i> (willd.)DC.	Badesa	Myrtaceae	F,Is

168	<i>Tagetes erecta</i> L.	Abeba	Asteraceae	F,Is
169	<i>Tradescantia zebrina</i> Hort. ex Bosse.	.Abeba	Commelinaceae	F,Is
170	<i>Trichilia emetica</i> Vahl	Tala'a	Meliaceae	Nu
171	<i>Tragia brevipes</i> (Dillon&A.rich) Walp	Abeba	Lamiaceae	In,Is
172	<i>Triticum aestivum</i> L.	Dine	Poaceae	F
173	<i>Tropaeolum majus</i> L.	Abeba	Tropaeolaceae	Or
174	<i>Vernonia amygdalina</i> Del	Ebicha	Asteraceae	Nu
175	<i>Vernonia myriantha</i> Hook. F.	.Reeje	Asteraceae	Fw
176	<i>Vicia faba</i> L.	Baqela	Fabaceae	Nu
177	<i>Xanthosoma sagittifolium</i> (L.) Schott	Godare xiloxa	Araceae	Fi
178	<i>Zea mays</i> L.	Badala	Poaceae	F,Is
179	<i>Zingiber officinale</i> L.	Gaanijibelo	Zingiberaceae	Md, Is

Appendix II: Diversity index collected plant species in home garden

No	Botanical name of species	Localspp name	No Pi	pi	$Pi^2_{(n/N)^2}$	Pi In pi
1	<i>Nigella sativa</i>	X. qimame	3	0.0001	0.00000001	- 0.0009
2	<i>Acacia abyssinica</i>	Wacoh	21	0.0007	0.0000004	- 0.005
3	<i>Canna indica</i>	Abeba	45	0.001	0.000001	- 0.006
4	<i>Acacia senegal</i>	Wacho	17	0.0005	0.0000002	- 0.003
5	<i>Aframomum corrorima</i>	Corim	58	0.001	0.000001	- 0.006
6	<i>Agave sisalana Perrine</i>	Hanxih	33	0.001	0.000001	- 0.006
7	<i>Ajuga integrifolia</i>	Gasalle	25	0.0008	0.0000006	- 0.003
8	<i>Albizia grandibracteata</i>	Dambai	10	0.0003	0.00000009	- 0.002
9	<i>Albizia gummifera</i>	Gorbe	15	0.0005	0.0000002	- 0.003
10	<i>Alcea rosea</i>	Abeba	8	0.0002	0.00000004	- 0.001
11	<i>Allium sp.</i>	Shunk	205	0.006	0.00003	- 0.030
12	<i>Allium cepa</i>	Kulubi di	139	0.004	0.00001	- 0.022
13	<i>Allium sativum</i>	Kulubi	59	0.001	0.000001	- 0.006
14	<i>Aloe sp.</i>	Qararito	11	0.0003	0.00000009	- 0.002
15	<i>Amaranthus caudatus</i>	Abeba	7	0.0002	0.00000004	- 0.001
16	<i>Amaranthus hybridus</i>	Rafo	4	0.0001	0.00000001	- 0.0009
17	<i>Ananas comosus</i>	Ananas	15	0.0005	0.0000002	- 0.003
18	<i>Annona squamosa</i>	Gishta	9	0.0003	0.00000009	- 0.002
19	<i>Arachis hypogea</i>	Lawuze	27	0.0009	0.0000008	- 0.006
20	<i>Artemisia abyssinica</i>	Chugun	21	0.0007	0.0000004	-0.005
21	<i>Artraxon micans</i>	Benna	29	0.0009	0.0000008	- 0.006
22	<i>Arundinaria alpina</i>	Leema	105	0.003	0.000009	- 0.017
23	<i>Arundodonax</i>	Shombo	267	0.009	0.00008	- 0.042
24	<i>Asparagus africanus</i>	Sariti	5	0.0001	0.00000001	- 0.0009
25	<i>Azadirachta indica</i>	Nime	12	0.0004	0.0000001	- 0.003

26	<i>Bersama abyssinica</i>	Xibiro	7	0.0002	0.00000004	- 0.001
27	<i>Beta vulgaris</i>	Kaysire	17	0.0005	0.0000002	- 0.003
28	<i>Brassica carinata</i>	Xiqilgo	25	0.0008	0.0000006	- 0.003
29	<i>Brassica oleracea</i>	Kosta	87	0.002	0.000004	- 0.012
30	<i>Brassica rapa</i>	Lafa	34	0.001	0.000001	- 0.006
31	<i>Brucea antidysenterica</i>	Atara ci	19	0.0006	0.0000003	- 0.004
32	<i>Cajanus cajan</i>	Chekat	7	0.0002	0.00000004	- 0.001
33	<i>Calpurnia aurea</i>	Boloke	13	0.0004	0.0000001	- 0.003
34	<i>Canavalia ensiformis</i>	Abeba	201	0.006	0.00003	- 0.030
35	<i>Canna indica</i>	Abeba	14	0.0004	0.0000001	- 0.003
36	<i>Canna x generalis</i>	Kara	25	0.0008	0.0000006	- 0.005
37	<i>Capsicum annum</i>	Mitmita	58	0.001	0.000001	- 0.006
38	<i>Capsicum frutescens</i>	Papaya	59	0.001	0.000001	- 0.006
39	<i>Carica papaya</i>	Abukere	11	0.0002	0.00000004	- 0.001
40	<i>Casimiroa edulis</i>	Tside	10	0.0003	0.00000009	- 0.002
41	<i>Casuarina equisetifolia</i>	Chaate	129	0.004	0.00001	- 0.022
42	<i>Catha edulis</i>	Motoko	574	0.019	0.0003	- 0.075
43	<i>Celtis africana</i>	Abeba	18	0.0006	0.0000003	- 0.004
44	<i>Chrysanthemum coron</i>	Marara	9	0.0003	0.00000009	- 0.002
45	<i>Citrus sp.</i>	Lome	18	0.0006	0.0000003	- 0.004
46	<i>Citrus aurantifolia</i>	Burtuka	6	0.0002	0.00000004	- 0.001
47	<i>Citrus sinensis</i>	Fite	12	0.0004	0.0000001	- 0.003
48	<i>Clematis hirsuta Perr</i>	Abeba	2	0.00006	0.00000003	- 0.0005
49	<i>Clerodendrum myricoid</i>	Godare	8	0.0002	0.0000004	- 0.001
50	<i>Coffea arabica</i>	Buno	6462	0.219	0.047961	- 0.332
51	<i>Colocasia esculenta</i>	Rukensa	163	0.005	0.00002	- 0.026
52	<i>Combretum collinum</i>	Abeba	4	0.0001	0.00000001	- 0.0009
53	<i>Combretum molle</i>	Lalunte	11	0.0003	0.00000009	- 0.002
54	<i>Commeliana africana</i>	Jeebe	24	0.0008	0.0000006	- 0.005
55	<i>Cordia africana</i>	Wedesa	32	0.001	0.000001	- 0.006

56	<i>Coriandrum sativum</i>	Abeba	4	0.0001	0.00000001	- 0.0009
57	<i>Cosmos bipinnatus</i>	Abeba	13	0.0004	0.00000001	- 0.003
58	<i>Cosmos schimperi</i>	Hixicho	9	0.0003	0.00000009	- 0.002
59	<i>Croton macrostachyus</i>	Mokenis	39	0.001	0.0000001	- 0.006
60	<i>Cucurbita pepo</i>	Baquola	19	0.0006	0.00000003	- 0.004
61	<i>Cupressus lusitanica</i>	Hinesa	167	0.005	0.000002	- 0.026
62	<i>Cymbopogon citratus</i>	Abeba	7	0.0002	0.00000004	- 0.001
63	<i>Cymbopogon bulbosus</i>	Abeba	5	0.0001	0.00000001	- 0.0009
64	<i>Dahlia pinnata</i>	Karote	16	0.0005	0.00000002	- 0.003
65	<i>Daucus carota</i>	Abeba	58	0.001	0.0000001	- 0.006
66	<i>Dianthus caryophyllus</i>	Bohina	15	0.0005	0.00000002	- 0.003
67	<i>Dioscorea praehensilis</i>	Bohina	54	0.001	0.0000001	- 0.006
68	<i>Dioscorea sagittifolia</i>	Hixcho	76	0.002	0.0000004	- 0.012
69	<i>Dodonea angustifolia</i>	Danisa	10	0.0003	0.00000009	- 0.002
70	<i>Dombeya torrida</i>	Koshim	67	0.002	0.0000004	- 0.012
71	<i>Dovyalis caffra</i>	Choea	4	0.0001	0.00000001	- 0.0009
72	<i>Dracaena afromontana</i>	Lante	5	0.0001	0.00000001	- 0.0009
73	<i>Dracaena fragrans</i>	Sombo	4	0.0001	0.00000001	- 0.0009
74	<i>Ekebergia capensis</i>	Hanku	6	0.0002	0.00000004	- 0.001
75	<i>Embelia schimperi</i>	Wolena	4	0.0001	0.00000001	- 0.001
76	<i>Ensete ventricosum</i>	Wesho	14331	0.485	0.235225	- 0.350
77	<i>Eragrostis tef</i>	Xafe	249	0.008	0.00006	- 0.038
78	<i>Erythrina brucei</i>	Adama	11	0.0003	0.00000009	- 0.002
79	<i>Eucalyptus camaldulens</i>	Barzafe	167	0.005	0.000002	- 0.331
80	<i>Eucalyptus globulus</i>	Barzafe	109	0.003	0.000009	- 0.017
81	<i>Euphorbia ampliphylla</i>	Abeba	8	0.0002	0.00000004	- 0.001
82	<i>Euphorbia cotinifolia</i>	Abeba	6	0.0002	0.00000004	- 0.001
83	<i>Euphorbia pulcherrima</i>	Sisa	9	0.0003	0.00000009	- 0.002
84	<i>Fagaropsis angolensis</i>	Ensilale	14	0.005	0.000002	- 0.026

85	<i>Ficus sur Forssk.</i>	Ode	12	0.0004	0.0000001	- 0.003
86	<i>Ficus sycomorus</i>	Ode	9	0.0003	0.000009	- 0.002
87	<i>Ficus thonningii</i>	Ode	14	0.0004	0.0000001	- 0.0004
88	<i>Foeniculum vulgare</i>	Gambel	3	0.0001	0.00000001	- 0.0009
89	<i>Gardenia ternifolia</i>	Gravelia	2	0.00006	0.00000003	- 0.0005
90	<i>Grevillea robusta</i>	Giravile	19	0.0006	0.0000003	- 0.004
91	<i>Grewia ferruginea</i>	Reege	160	0.005	0.0000003	- 0.026
92	<i>Hagenia abyssinica</i>	Heto	2	0.00006	0.0000007	- 0.0005
93	<i>Helianthus annuus</i>	Abeba	4	0.0001	0.00000001	- 0.0009
94	<i>Hibiscus acetosella</i>	Abeba	3	0.0001	0.00000001	- 0.0009
95	<i>Hibiscus rosa-sinensis</i>	Abeba	5	0.0001	0.00000001	- 0.0009
96	<i>Hordeum vulgare</i>	So'a	216	0.007	0.00004	- 0.034
97	<i>Ipomoea batatas</i>	Maxu	297	0.010	0.0001	- 0.046
98	<i>Iresine herbstii</i>	Dikicha	3	0.0001	0.00000001	- 0.0009
99	<i>Jasminium grandifloru</i>	Kisha	7	0.0002	0.00000004	- 0.001
100	<i>Juniperus procera</i>	Hinesa	76	0.002	0.000004	- 0.012
101	<i>Justicia schimperiana</i>	Salata	14	0.0004	0.0000001	- 0.003
102	<i>Anders Lactuca</i>	Buke	126	0.004	0.00001	- 0.022
103	<i>Lagenaria siceraria</i>	Abeba	6	0.0002	0.00000004	- 0.001
104	<i>Lantana camara</i>	Hanash	8	0.0002	0.00000004	- 0.001
105	<i>Lippia adoensis</i>	Timatim	19	0.0006	0.0000003	- 0.004
106	<i>Lycopersicon esculentu</i>	Abaea	4	0.0001	0.00000001	- 0.0009
107	<i>Maesa lanceolata</i>	Aple	106	0.003	0.000009	- 0.017
108	<i>Malus sylvestris</i>	Mogo	16	0.0005	0.0000002	- 0.003
109	<i>Mangifera indica</i>	Mango	15	0.0005	0.0000002	- 0.003
110	<i>Manihot esculenta</i>	Titiko	1	0.00003	0.00000009	- 0.0003
111	<i>Melilotus suaveolens</i>	Xarato	1133	0.038	0.001	- 0.124
112	<i>Millettia ferruginea</i>	Abeba	3	0.0001	0.00000001	- 0.0009
113	<i>Mirabilis jalapa</i>	Gora	5	0.0001	0.00000001	- 0.0009
114	<i>Morus alba</i>	Ujubana	183	0.006	0.00003	-0.030

115	<i>Musa x paradisiaca</i>	Muze	17	0.0005	0.0000002	- 0.003
116	<i>Nicotiana tabacum</i>	Tambo	8	0.0002	0.00000004	- 0.001
117	<i>Ocimum basilicum</i>	Damaka	29	0.0009	0.0000008	- 0.006
118	<i>Ocimum lamiifolium</i>	Abeba	3	0.0001	0.00000001	- 0.0009
119	<i>Oenothera biennis</i>	Abeba	3	0.0001	0.00000001	- 0.0009
120	<i>Olea europaea</i>	Ejersa	2	0.0006	0.0000003	- 0.004
121	<i>Passiflora caerulea</i>	Kophe	2	0.0006	0.0000003	- 0.004
122	<i>Passiflora edulis</i>	Abeba	7	0.0002	0.00000004	- 0.001
123	<i>Pelargonium zonale</i>	Oba	1	0.00003	0.00000009	- 0.0003
124	<i>Pennisetum violaceum</i>	Surupa	128	0.004	0.00001	- 0.022
125	<i>Peponium vogelii</i>	Kokeye	3	0.0001	0.00000001	- 0.0009
126	<i>Persea americana</i>	Abukato	48	0.005	0.00002	-0.026
127	<i>Phaseolus lunatus</i>	Rakinta k	6	0.0002	0.00000004	- 0.001
128	<i>Phaseolus vulgaris</i>	Mexe	4	0.0001	0.00000001	- 0.0009
129	<i>Phoenix reclinata</i>	Shisha	2	0.0006	0.0000003	- 0.004
130	<i>Physalis peruviana</i>	Haranja	9	0.0003	0.00000009	- 0.002
131	<i>Phytolacca dodecandra</i>	Atara	278	0.009	0.00008	- 0.042
132	<i>Pisum sativum</i>	Kurume	1	0.00003	0.00000009	- 0.0003
133	<i>Podocarpus falcatus</i>	Birbirsa	3	0.0001	0.00000001	- 0.00009
134	<i>Polysphaeria parvifolia</i>	Garbe	23	0.0007	0.0000004	- 0.005
135	<i>Prunus africana</i>	Koke	8	0.0002	0.00000004	- 0.001
136	<i>Prunus persica</i>	Fawa	11	0.0003	0.00000009	- 0.002
137	<i>Psidium guajava</i>	Zaytone	9	0.0003	0.00000009	- 0.002
138	<i>Pycnostachys abyssinica</i>	Geshe	10	0.0003	0.00000009	- 0.002
139	<i>Rhamnus prinoides</i>	Abeba	5	0.0001	0.00000001	- 0.0009
140	<i>Ricinus communis</i>	Kobo	4	0.0001	0.00000001	- 0.0009
141	<i>Rosa abyssinica</i>	Abeba	3	0.0001	0.00000001	- 0.00009
142	<i>Rosa x richardii</i>	Matibas	4	0.0001	0.00000001	-0.0009
143	<i>Rosmarinus officinalis</i>	Toshiqa	3	0.0001	0.00000001	- 0.00009
144	<i>Rumex abyssinicus</i>	Balikan	17	0.0005	0.0000002	- 0.003

145	<i>Rumex nepalensis</i>	Sugete	28	0.0009	0.0000008	- 0.006
146	<i>Ruta chalepensis</i>	Shonkor	57	0.001	0.000001	- 0.006
147	<i>Saccharum officinarum</i>	Abeba	52	0.001	0.000001	- 0.006
148	<i>Salvia leucantha</i>	Ukete	1	0.00003	0.00000009	- 0.0003
149	<i>Salvia nilotica</i>	Abeba	3	0.0001	0.00000001	- 0.00009
150	<i>Salvia splendens</i>	Shashato	5	0.0001	0.00000001	- 0.0009
151	<i>Sesbania sesban</i>	Dumbela	6	0.0002	0.00000004	- 0.001
152	<i>Solanecio gigas</i>	Tunaye	9	0.0003	0.00000009	- 0.002
153	<i>Solanum nigrum</i>	Shana	15	0.0005	0.0000002	- 0.003
154	<i>Solanum tarderemotum</i>	Mishink	280	0.009	0.00008	- 0.042
155	<i>Solanum tuberosum</i>	Dinicha	6	0.0002	0.00000004	- 0.001
156	<i>Sorghum bicolor</i>	Abeba	39	0.001	0.000001	-0.006
157	<i>Syzygium guineense</i>	Badesa	3	0.0001	0.00000001	- 0.0009
158	<i>Tagetes erecta</i>	Abeba	2	0.00006	0.00000003	- 0.0005
159	<i>Tradescantia zebrina</i>	Tala 'a	1	0.00003	0.00000009	- 0.0003
160	<i>Trichilia emetica</i>	Dine	6	0.0002	0.00000004	- 0.001
161	<i>Triticum aestivum</i>	Abeba	214	0.007	0.00004	- 0.034
162	<i>Tropaeolum majus</i>	Godare	2	0.00006	0.00000004	- 0.001
163	<i>Vernonia amygdalina</i>	Reje	93	0.003	0.000009	- 0.017
164	<i>Vernonia myriantha</i>	Ebicha	156	0.005	0.00002	- 0.026
165	<i>Vicia faba</i>	Baqela	67	0.002	0.000004	- 0.012
166	<i>Xanthosoma sagittifolium</i>	Zaafe	8	0.0002	0.00000004	- 0.001
167	<i>Zea mays</i>	Badala	501	0.016	0.0002	-0.066
168	<i>Brassica Oleracea</i>	Shaana	23	0.0007	0.0000004	- 0.005
169	<i>Allium Porrum</i>	Telba	67	0.002	0.000004	- 0.012
170	<i>Linum unisatissimum</i>	Laalessa	84	0.002	0.000004	- 0.012
171	<i>Tragia brevipes</i>	Kalaala	15	0.0005	0.0000002	- 0.003
172	<i>Stephania abyssinica</i>	Hide	3	0.0001	0.00000001	- 0.0009
173	<i>Solanum indicum</i>	Xaaxees	8	0.0002	0.00000004	- 0.001
174	<i>Rhus Vulgaris</i>	Dobe	14	0.0004	0.0000001	- 0.003

175	Girardinia bullosa	Anano	9	0.0003	0.00000009	- 0.002
176	Ekebergia capensis	Xinqish	2	0.00006	0.00000004	- 0.0005
177	Sorghum dochna	Ciatika	67	0.002	0.000004	- 0.012
178	Cajanus cajan	Zaffe	2	0.00006	0.0000004	- 0.0005
179	Zingiber officinale	Ganigib	4	0.0001	0.00000001	- 0.0009
	Total sume of individual		29503		0.2854	2.2003

Appendix III: Functional groups of crops

Functional group species	Number of home gardens where found	Altitude
Vegetable	123	1700-2100m
Cereal	86	1950- 2585m
Stimulant	79	1700-2300m
Oilcrops	105	1700-2585m
Grain species	145	200-2585m
Roots & tubers	164	1700-2585m
Fruit trees	93	1700-1900m

Appendix IV : Families with their corresponding number of species and their percentage.

No	Family	Species	
		No	%
1	Astraceae	12	6.7
2	Agavaceae	1	0.5
3	Alliaceae	4	2.2
4	Aloaceae	1	0.5
5	Amaranthaceae	3	1.6
6	Annonaceae	1	0.5
7	Asparagaceae	1	0.5
8	Apiaceae	3	1.6
9	Acanthaceae	1	0.5
10	Anacardiaceae	1	0.5
11	Arecaceae	1	0.5
12	Amaryllidaceae	1	0.5
13	Asclepiadaceae	1	0.5
14	Araceae	2	1.1
15	Anacardiaceae	1	0.5
16	Bromeliaceae	1	0.5
17	Brassicaceae	4	2.2
18	Boraginaceae	1	0.5
19	Chenopodiaceae	1	0.5
20	Cannaceae	2	1.6
21	Cyperaceae	2	0.5
22	Caricaceae	1	0.5
23	Casuarinaceae	1	0.5
24	Celastraceae	1	0.5
25	Cannabaceae	1	0.5
26	Commelinaceae	2	1.1
27	Cucurbitaceae	3	1.6
28	Cupressaceae	1	0.5
29	Cryophyllaceae	1	0.5
30	Convolvulaceae	1	0.5
31	Combretaceae	1	0.5
32	Dioscoreaceae	2	1.1
33	Dracaenaceae	2	1.1
34	Euphorbiaceae	6	3.3
35	Fabaceae	17	9.4
36	Flacourtiaceae	1	0.5
37	Geraniaceae	1	0.5
38	Lamiaceae	10	5.6

39	Lauraceae	1	0.5
40	Leguminosae	1	0.5
41	Malvaceae	3	1.6
42	Meliaceae	4	2.2
43	Myrsinaceae	2	1.1
44	Musaceae	2	1.1
45	Myrtaceae	3	1.6
46	Moraceae	4	2.2
47	Meliaceae	1	0.5
48	Minispermaceae	1	0.5
49	Mimosaceae	1	0.5
50	Nyctaginaceae	1	0.5
51	Oliaceae	1	0.5
52	Onagraceae	1	0.5
53	Poaceae	11	6.1
54	Proteaceae	1	0.5
55	Passifloraceae	1	0.5
56	plantaginaceae	1	0.5
57	Phytolacaceae	1	0.5
58	Podocarpaceae	1	0.5
59	Polygonaceae	2	1.1
60	Papilionaceae	1	0.5
61	Rutaceae	6	3.3
62	Ranunculaceae	2	1.1
63	Rubiaceae	3	1.6
64	Rosaceae	6	3.3
65	Rhamnaceae	1	0.5
66	Simaroubaceae	1	0.5
67	Solanaceae	9	5.0
68	Santalaceae	1	0.5
69	Sapindaceae	1	0.5
70	Stilbaceae	1	0.5
71	Sterculiaceae	1	0.5
72	Tiliaceae	1	0.5
73	Tropaeolaceae	1	0.5
74	Urticaceae	1	0.5
75	Ulmaceae	1	0.5
76	Verbenaceae	1	0.5
77	Zingiberaceae	1	0.5

Appendix V: List of the most common medicinal plant in the study area

No	Medicinal plant	Disease	Part used	Preparation
1	<i>Hygena abyssinica</i>	Top warm	Seed	The seed prepared like powder & mix it with water than drink
2	<i>Rumex abssinicus</i>	Abdominal pine	steam	Chewing the steam part & swallow its water
3	<i>Roosa richaria</i>	Abdominal pine	leave	Chewing the leave and swallow it
4	<i>Rumex nepalensis spreng</i>	Ear disease	Liquid of leave	The liquid of leave drop in to ear
5	<i>Prums persica</i>	Had ace	leave	Smelling the leave
6	<i>Solanum torder motum</i>	influenza	leave	Cawing the leave & swallowing its water
7	Cucurbita pepo	Top warm	seed	The seed eat with food or the coked seed eat only
8	Cymbogon bulbosus	influenza	leave	The leave chewing & swallowed its water
9	Coffea arabica	wound	seed	The prepared powder dropped on the wound
10	Zingiber officinale	Abdominal pine	steam	The steam chewing & swallowed it
11	Eucalyptus globulus	Had ace	leave	Smelling the leaves

Appendix VI: Croup diseases in the home garden of Kochere sampled kebele

Croup disease	Total home garden	Ranking	%
Mealy bug	27	2	15
Parasitic plant	16	3	8.8
Xantho monas campestris	35	1	19.4

Appendix VII : Quadrate characteristics of the study area

No of quad rat	No of spp	Altitude	Latitude(N)	Longitude(E)	Aspect	Slop%
1	11	1837	06° 58' 525	40° 10' 047	W	22
2	10	1823	06° 58' 326	40° 10' 125	S	24
3	15	1825	06° 58' 298	40° 10' 108	SE	25
4	12	1819	06° 58' 425	40° 10' 042	SW	20
5	17	1835	06° 58' 426	40° 10' 065	SE	19
6	19	1818	06° 58' 518	40° 10' 017	SW	33
7	8	1819	06° 58' 620	40° 10' 023	SE	40
8	16	1812	06° 58' 612	40° 10' 039	SW	25
9	13	1832	06° 58' 655	40° 10' 063	S	28
10	12	1823	06° 58' 617	40° 10' 093	SW	16
11	15	1819	06° 58' 658	40° 10' 083	SE	12
12	8	1819	06° 58' 426	40° 10' 052	E	32
13	10	1829	06° 58' 018	40° 10' 028	SE	40
14	18	1819	06° 58' 067	40° 10' 026	W	20
15	14	1827	06° 58' 115	40° 10' 000	SW	14
16	9	1825	06° 58' 143	40° 10' 009	SE	33
17	8	1832	06° 58' 226	40° 10' 009	S	42
18	7	1817	06° 58' 208	40° 10' 032	S	31
19	5	1825	06° 58' 210	40° 10' 109	NE	23
20	6	1812	06° 58' 147	40° 10' 020	SE	26
21	11	1829	06° 58' 297	40° 10' 066	SW	22
22	15	1834	06° 58' 215	40° 10' 070	SE	25
23	10	1826	06° 58' 109	40° 10' 016	SW	15
24	4	1836	06° 58' 119	40° 10' 038	S	21
25	7	1819	06° 58' 215	40° 10' 067	SE	23
26	9	1821	06° 58' 117	40° 9' 044	SE	22
27	12	1829	06° 58' 197	40° 9' 030	SW	18
28	8	1811	06° 58' 223	40° 9' 105	S	24
29	17	1835	06° 58' 412	40° 9' 888	S	38
30	13	1830	06° 58' 314	40° 9' 952	SN	14
31	15	1691	06° 00' 493	40° 08' 368	NE	27
32	19	1698	06° 00' 493	40° 08' 168	W	24
33	11	1700	06° 00' 335	40° 08' 344	NW	25
34	16	1709	06° 00' 266	40° 08' 322	SE	20
35	10	1695	06° 00' 477	40° 08' 316	NW	28
36	13	1697	06° 00' 355	40° 08' 443	S	25
37	19	1703	06° 00' 341	40° 08' 436	SE	28
38	9	1723	06° 00' 344	40° 08' 255	W	19
39	8	1698	06° 00' 333	40° 08' 102	NW	17
40	16	1699	06° 00' 312	40° 08' 045	SW	18
41	12	1704	06° 00' 366	40° 08' 105	E	19
42	10	1700	06° 00' 067	40° 08' 234	N	20
43	8	1715	06° 00' 213	40° 08' 280	NE	21

44	11	1723	06° 00' 167	40° 08' 326	NW	27
45	7	1698	06° 00' 074	40° 08' 100	S	25
46	9	1695	06° 00' 332	40° 08' 115	SW	30
47	6	1700	06° 00' 145	40° 08' 189	W	16
48	5	1695	06° 00' 234	40° 08' 200	NW	24
49	9	1710	06° 00' 354	40° 08' 318	W	28
50	8	1698	06° 00' 523	40° 08' 298	S	18
51	7	1725	06° 00' 334	40° 08' 311	N	29
52	9	1699	06° 00' 435	40° 08' 217	NE	21
53	10	1730	06° 00' 098	40° 08' 256	NE	19
54	6	1698	06° 00' 123	40° 08' 109	N	21
55	7	1706	06° 00' 413	40° 08' 176	SW	23
56	9	1700	06° 00' 322	40° 08' 246	NW	32
57	5	1690	06° 00' 156	40° 08' 452	NW	25
58	4	1691	06° 00' 256	40° 08' 371	NE	22
59	9	1707	06° 00' 111	40° 08' 239	S	19
60	6	1723	06° 00' 321	40° 08' 265	SE	34
61	8	1709	06° 01' 335	40° 09' 168	NW	25
62	4	1723	06° 01' 322	40° 09' 220	S	19
63	7	1712	06° 01' 234	40° 09' 342	W	20
64	5	1734	06° 01' 345	40° 09' 376	SE	26
65	11	1728	06° 01' 312	40° 09' 300	NE	22
66	5	1706	06° 01' 266	40° 09' 297	NW	30
67	12	1712	06° 01' 433	40° 09' 345	N	21
68	11	1732	06° 01' 366	40° 09' 435	NE	27
69	9	1718	06° 01' 347	40° 09' 377	NW	24
70	8	1709	06° 01' 278	40° 09' 290	SE	18
71	10	1728	06° 01' 387	40° 09' 329	SW	20
72	8	1726	06° 01' 241	40° 09' 333	W	22
73	10	1721	06° 01' 344	40° 09' 438	E	30
74	12	1722	06° 01' 455	40° 09' 256	N	23
75	13	1733	06° 01' 213	40° 09' 348	SW	22
76	9	1719	06° 01' 456	40° 09' 432	NW	19
77	7	1725	06° 01' 333	40° 09' 365	SW	25
78	13	1737	06° 01' 265	40° 09' 299	E	18
79	7	1714	06° 01' 398	40° 09' 478	N	27
80	10	1710	06° 01' 377	40° 09' 412	NW	24
81	8	1729	06° 01' 433	40° 09' 341	NE	333
82	6	1720	06° 01' 377	40° 09' 421	NE	18
83	9	1715	06° 01' 322	40° 09' 389	SW	24
84	7	1726	06° 01' 387	40° 09' 438	E	21
85	5	1723	06° 01' 453	40° 09' 329	W	26
86	11	1718	06° 01' 368	40° 09' 455	NW	28
87	10	1745	06° 01' 290	40° 09' 297	SE	22
88	9	1739	06° 01' 289	40° 09' 377	SE	19
89	13	1754	06° 01' 375	40° 09' 208	SE	21

90	14	1738	06° 01' 300	40° 09' 109	NW	20
91	6	2356	06° 03' 297	40° 12' 560	N	30
92	5	2389	06° 03' 317	40° 12' 510	SW	26
93	4	2316	06° 03' 216	40° 12' 340	E	23
94	5	2323	06° 03' 355	40° 12' 200	E	19
95	6	2338	06° 03' 300	40° 12' 421	NW	21
96	7	2354	06° 03' 299	40° 12' 353	NW	25
97	4	2387	06° 03' 255	40° 2' 770	S	32
98	7	2390	06° 03' 278	40° 12' 561	E	35
99	8	2387	06° 03' 345	40° 12' 482	N	28
100	9	2329	06° 03' 275	40° 12' 653	NE	20
101	5	2400	06° 03' 324	40° 12' 552	SE	36
102	6	2410	06° 03' 312	40° 12' 776	W	38
103	7	2415	06° 03' 412	40° 12' 541	N	38
104	3	2390	06° 03' 417	40° 12' 389	S	29
105	4	2385	06° 03' 399	40° 2' 495	NW	27
106	5	2395	06° 03' 243	40° 12' 591	NW	24
107	8	2419	06° 03' 301	40° 12' 776	S	36
108	5	2375	06° 03' 327	40° 12' 643	SE	22
109	7	2412	06° 03' 279	40° 12' 517	NW	33
110	4	2388	06° 03' 366	40° 2' 540	S	32
111	3	2349	06° 03' 300	40° 12' 590	N	29
112	6	2376	06° 03' 410	40° 2' 532	W	26
113	4	2401	06° 03' 312	40° 12' 579	NW	40
114	7	2418	06° 03' 325	40° 12' 631	SE	38
115	6	2348	06° 03' 296	40° 2' 601	N	28
116	5	2323	06° 03' 290	40° 12' 509	E	25
117	8	2397	06° 03' 189	40° 2' 711	S	27
118	4	2419	06° 03' 260	40° 12' 642	SE	35
119	5	2339	06° 03' 363	40° 2' 591	W	20
120	7	2394	06° 03' 265	40° 12' 660	N	26
121	8	2353	06° 03' 300	40° 3' 660	SE	24
122	3	2367	06° 03' 325	40° 3' 543	E	30
123	6	2324	06° 03' 290	40° 13' 578	NW	28
124	7	2379	06° 03' 291	40° 13' 555	SW	26
125	5	2413	06° 03' 345	40° 13' 714	SE	32
126	8	2390	06° 03' 321	40° 3' 690	SE	30
127	9	2356	06° 03' 287	40° 13' 734	N	16
128	7	2378	06° 03' 314	40° 13' 656	NE	23
129	8	2400	06° 03' 277	40° 13' 680	SE	22
130	10	2398	06° 03' 280	40° 3' 723	SE	19
131	11	2389	06° 03' 324	40° 13' 659	N	18
132	9	2398	06° 03' 301	40° 13' 666	W	25
133	8	2413	06° 03' 310	40° 13' 598	E	27
134	12	2420	06° 03' 298	40° 3' 590	NW	30
135	10	2386	06° 03' 358	40° 3' 680	NW	19

136	5	2450	06°03'384	40° 13'645	SE	28
137	4	2359	06°03'289	40° 3'597	S	24
138	8	2341	06°03'340	40° 3'649	E	20
139	7	2350	06°03'288	40° 3'720	NW	23
140	9	2336	06°03'309	40° 13'675	SE	21
141	6	2380	06°03'259	40° 13'595	NW	19
142	11	2365	06°03'266	40° 3'657	E	25
143	9	2376	06°03'308	40° 13'643	W	27
144	7	2410	06°03'315	40° 13'672	E	32
145	8	2415	06°03'380	40° 13'650	N	24
146	5	2453	06°03'401	40° 13'689	NW	16
147	8	2417	06°03'299	40° 13'609	NW	19
148	9	2388	06°03'359	40° 13'731	SE	23
149	8	2363	06°03'320	40° 13'692	SE	20
150	11	2350	06°03'331	40° 13'723	N	24
151	6	2585	06°03'526	40° 14'280	SE	30
152	8	2534	06°03'520	40° 14'190	SW	25
153	7	2566	06°03'529	40° 14'168	N	22
154	5	2548	06°03'612	40° 14'208	NW	20
155	10	2585	06°03'577	40° 14'218	NE	15
156	9	2540	06°03'496	40° 14'220	S	32
157	8	2585	06°03'530	40° 14'165	SE	19
158	5	2563	06°03'550	40° 14'180	SE	34
159	4	2530	06°03'500	40° 14'231	N	40
160	7	2512	06°03'542	40° 14'262	W	28
161	9	2543	06°03'523	40° 14'173	NW	21
162	11	2537	06°03'514	40° 14'177	NW	27
163	8	2510	06°03'535	40° 14'217	SE	38
164	12	2499	06°03'561	40° 14'270	W	37
165	6	2579	06°03'540	40° 14'264	N	14
166	8	2554	06°03'501	40° 14'265	NW	30
167	6	2490	06°03'532	40° 14'261	S	22
168	12	2496	06°03'538	40° 14'279	S	32
169	13	2513	06°03'531	40° 14'198	SE	13
170	11	2539	06°03'527	40° 14'191	SW	12
171	9	2489	06°03'529	40° 14'261	W	45
172	9	2566	06°03'545	40° 14'271	E	12
173	8	2580	06°03'540	40° 14'275	S	23
174	7	2549	06°03'541	40° 14'189	SW	30
175	9	2497	06°03'500	40° 14'200	SE	16
176	10	2491	06°03'520	40° 14'208	SE	15
177	11	2567	06°03'517	40° 14'211	S	13
178	8	2580	06°03'523	40° 14'234	N	16
179	12	2585	06°03'518	40° 4'190	NW	20
180	10	2582	06°03'527	40° 14'267	NW	28

Appendix VIII : List of informants to this study with their sex, Age, Marital status, occupation and Religion

No	Name of informant	sex		Age	Education	Marital status	occupation	Religion
1	Barre Edema		F	62	illiterate	Married	Farmer	Christian
2	Getachw Tekebo	M		47	Diploma	Married	Teacher	„
3	Fekadu Tefera	M		42	Primary	„	Farmer	„
4	Gifaw Jibicho	M		53	„	„	„	„
5	Abu Jibicho		F	55	illiterate	„	„	„
6	Alemitu Zeleke		F	48	„	widow	„	„
7	Tefera Dereso	M		56	„	Married	„	„
8	Mikalu Tamirat	M		47	Primary	„	„	„
9	Kebede Alako	M		41	Diploma	„	Extetion w	„
10	Asefa Dori	M		68	illiterate	„	farmer	„
11	Asimamaw Tesifaye	M		52	„	„	„	„
12	Boru Burica	M		93	„	„	„	„
13	Asefa Bire	M		74	„	„	„	„
14	Kebede Boneya	M		36	Primary	„	„	„
15	Felekech Mariyam		F	57	illiterate	widow	„	„
16	Kinde Tolla	M		30	Secondary	Married	„	„
17	Kifile Bushe	M		25	„	„	„	„
18	Addisu Beriso	M		30	„	„	„	„
19	Woriku Elema	M		27	„	„	„	„
20	Shibru Baali	M		30	„	„	„	„
21	Klphe Gemede	M		35	„	„	„	„
22	Mulatu Shutule	M		36	„	„	„	„
23	Shiferaw Ebido	M		40	„	„	„	„
24	Tamiru Beyene	M		28	„	„	„	„
25	Milike Shete	M		55	illiterate	„	„	„
26	Yosefi Tanifo	M		27	Diploma	„	„	„
27	Abiyot Mariyam	M		30	Primary	„	„	„
28	Fikadu Geligelu	M		26	„	„	„	„
29	Worikinesh W/yohans		F	49	Secondary	widow	„	„
30	Adugn Fetene	M		26	Primary	Married	„	„
31	Mamo Neniko	M		35	„	„	„	„
32	Addisu Haylu	M		25	„	„	„	„
33	Aweke Yohanis	M		35	Primary	Married	farmer	Christian
34	Abirham Leku	M		64	„	„	Merchant	„
35	Tesifaye Shfulo	M		30	illiterate	„	farmer	„
36	Wude Shfulo		F	35	„	widow	„	„
37	Alemayw Kanike	M		35	Primary	Married	„	„
38	Kute Gobena	M		39	„	„	„	„

39	Getachw Worasa	M		44	Diploma	„	Teacher	„
40	Gidesa Maro	M		43	illiterate	„	farmer	„
41	Mariam Shalo	M		35	Primary	„	„	„
42	Dukele Temu	M		39	Secondary	„	„	„
43	Beriso Dido	M		49	illiterate	„	„	„
44	Ashenaf Abriham	M		36	Secondary	„	Pastor	„
45	Abush Ayele		F	32	illiterate	Widow	farmer	„
46	Netsanet Degife	M		26	„	Married	„	„
47	Getachw Guye	M		30	Secondary	„	„	„
48	Ashenaf Genene	M		35	illiterate	„	„	„
49	Ayele Tilahun	M		30	„	„	„	„
50	Bekele Shuntu	M		64	Primary	„	„	„
51	Tesema Oda	M		40	Primary	„	„	„
52	Yosef Genene	M		35	illiterate	„	„	„
53	Desiye Tilahun	M		35	„	„	„	„
54	Dinibilali Kurima	M		40	„	„	„	„
55	Birihanu Tefera	M		25	Primary	„	„	„
56	Negash Gedo	M		32	illiterate	„	„	„
57	Menigesh Sima	M		65	„	„	„	„
58	Birihanu Beriso	M		35	„	„	„	„
59	Alemitu Tefera		F	36	„	Widow	„	„
60	Dushye Kula		F	45	„	„	„	„
61	Tadese Wako	M		60	„	Married	„	„
62	Abriham Tadese	M		40	Primary	„	„	„
63	Birike Demise		F	51	illiterate	Widow	„	„
64	Gosaye Demise	M		50	Secondary	Married	„	„
65	Tarikw Alemayw		F	30	illiterate	Widow	„	„
66	Bahiri Sebisibe		F	35	Primary	„	„	„
67	Zinabwa Birihanu		F	38	illiterate	„	„	„
68	Dejene Demise	M		27	Secondary	Married	„	„
69	Teko Tura	M		75	illiterate	„	„	„
70	Shibru Teko	M		40	Secondary	„	„	„
71	Gurori Dukele		F	58	illiterate	Widow	„	„
72	Bogalech Beyene		F	55	„	„	„	„
73	Marisha Dukele	M		38	Primary	Married	„	„
74	Desalegn Gela	M		35	„	„	„	„
75	Fetino Tadese	M		28	Secondary	Married	Farmer	Christian
76	Mulatu Kebede	M		37	illiterate	„	„	„
77	Desta Guye	M		27	„	„	„	„
78	Abirham Deyaso	M		39	„	„	„	„
79	Azalech Abera		F	50	Primary	Widow	„	„
80	Bogalech Kebede		F	35	illiterate	„	„	„

81	Worikinesh Degefe		F	35	„	„	„	„
82	Birhanu Abush	M		40	Primary	Married	„	„
83	Tadese Jebo	M		35	illiterate	„	„	„
84	Legese Oliye	M		39	Secondary	„	„	„
85	Tsegaye Woriku	M		30	„	„	„	„
86	Temesigen Mamo	M		32	illiterate	„	„	„
87	Tefera Shalo	M		38	Primary	„	„	„
88	Gizachw Woriku	M		28	„	„	„	„
89	Asinakech Feysa		F	50	illiterate	Widow	„	„
90	Boge Denib		F	59	„	„	„	„
91	Kochina Shalo	M		70	„	Married	„	„
92	Asefa Demise	M		56	„	„	„	„
93	Wondu Asefa	M		32	„	„	„	„
94	Abebe Kochna	M		28	Primary	„	„	„
95	Fikadu Bekele	M		47	„	„	„	„
96	Shura Bekele		F	57	illiterate	Widow	„	„
97	Shento Bekele	M		35	Primary	Married	„	„
98	Shubo Tegeno		F	75	illiterate	Widow	„	„
99	Alemayw Dori	M		46	„	Married	„	„
100	Maru Bitu	M		93	„	„	„	„
101	Demena Boru	M		75	„	„	„	„
102	Fikadu Feyisa	M		38	Primary	„	„	„
103	Ayele Shento	M		58	Primary	„	„	„
104	Menigistu Maro	M		42	„	„	„	„
105	Alemayw Gole	M		45	illiterate	„	„	„
106	Kifile Demise	M		52	Primary	„	„	„
107	Bekele Maru	M		40	„	„	„	„
108	Tariku Tegeno	M		27	„	„	„	„
109	Bekele Jebo	M		63	Secondary	„	„	„
110	Ayele Seli	M		50	Primary	„	„	„
111	Shiferaw Dori	M		43	„	„	„	„
112	Kasu Banita	M		50	illiterate	„	„	„
113	Menigesh Hanifato	M		44	Primary	„	„	„
114	Kebede Arariso	M		44	„	„	„	„
115	Ayele Sesa	M		48	„	„	„	„
116	Woma Bire	M		47	illiterate	„	„	„
117	Kifile Shentu	M		44	Primary	Married	Farmer	Christian
118	Tesifaye Kanike	M		48	„	„	„	„
119	Ayele Tegeno	M		35	„	„	„	„
120	Tamiru Kanike	M		37	Secondary	„	G.workers	„
121	Mengistu Digafe	M		38	Primary	„	Farmer	„
122	Alemimesh Debalighe		F	57	illiterate	„	„	„

123	Abera Betane	M		29	Secondary	„	„	„
124	Zenebech Betane		F	30	illiterate	Widow	„	„
125	Aleminesh Asefa		F	35	„	„	„	„
126	Bogale Gobena	M		58	„	Married	„	„
127	Tariku Tadese	M		30	Primary	„	„	„
128	Maritu Brihanu		F	35	illiterate	Widow	„	„
129	Bayene Wenzu	M		70	„	Married	„	„
130	Demise Gani	M		65	„	„	„	„
131	Tadese Bati	M		52	„	„	„	„
132	Gedecho Denibe	M		80	„	„	„	„
133	Getachw Gedecho	M		45	„	„	„	„
134	Menigesh Horidofa	M		70	„	„	„	„
135	Asiregidw Denb	M		38	„	„	„	„
136	Tilahun Deyaso	M		22	„	„	„	„
137	Neniko Bilible	M		70	„	„	„	„
138	Alemayw Hijo	M		60	Primary	„	„	„
139	Tesema Godi	M		56	„	„	„	„
140	Horidofa Betaso	M		80	illiterate	„	„	„
141	Tsegaye Worasa	M		56	„	„	„	„
142	Niguse Kifile	M		44	„	„	„	„
143	Ayinalem Kebede		F	45	„	Widow	„	„
144	Mestawt Bekele		F	37	„	„	„	„
145	Tesema Gutu	M		65	„	Married	„	„
146	Tshaynesh Tadese		F	50	illiterate	Widow	„	„
147	Tesfaye Hijo	M		49	„	Married	„	„
148	Dukele Dumaro	M		75	illiterate	„	„	„
149	Ilifinesh Wakayo		F	60	„	Widow	„	„
150	Libo Halichaye		F	55	„	„	„	„
151	Niguse Wayu	M		40	„	Married	„	„
152	Aleme Jigiso	M		52	„	„	„	„
153	Gumi Genale	M		65	„	„	„	„
154	Idegi Seli	M		65	„	„	„	„
155	Alemayw Gobu	M		65	„	„	„	„
156	Gorife Gobu		F	66	illiterate	Widow	„	„
157	Jebo Gobena	M		70	„	Married	„	„
158	Tesema Jebo	M		48	„	„	„	„
159	Ayelech Hayile		F	60	illiterate	Widow	Farmer	Christian
160	Ayele Bora	M		65	Primary	Married	„	„
161	Asefa Wako	M		45	„	„	„	„
162	Hayile Asefa	M		47	Secondary	„	G.workers	„
163	Shubare Werera		F	70	illiterate	Widow	Farmer	„
164	Acule Bere	M		60	„	Married	„	„

165	Desalegn Alemu	M		35	„	„	„	„
166	Tariku Tadese	M		30	„	„	„	„
167	Birihanu Shnitu	M		50	„	„	„	„
168	Tesifaye Jariso	M		52	„	„	„	„
169	Abriham Alemu	M		31	Primary	„	„	„
170	Wako Betele	M		63	illiterate	„	„	„
171	Tadese Urago	M		55	Primary	„	„	„
172	Abera Ware	M		62	Secondary	„	„	„
173	Ayele Seli	M		65	Primary	„	„	„
174	Worikne Shiferaw	M		32	Secondary	„	„	„
175	Bogale Jigiso	M		46	illiterate	„	„	„
176	Denib Malidy	M		70	„	„	„	„
173	Wacu Arariso	M		72	illiterate	„	„	„
178	Tamiru Deyaso	M		65	„	„	„	„
179	Wako Denib	M		71	illiterate	„	„	„
180	Getachw Shiferaw	M		36	illiterate	„	„	„

Appendix IX: Threats to plant diversity in home garden of study area

No	Challenges	Key informant response	%	Source
1	Rapid population growth	Per house there is a minimum of 5 family member	50	BoFED& Respondent information
2	Food security	Feeding system less three times per day	65	Weredahealth office & Respondent information
3	Education level	Most of house hold are illiterate	55	Respondent information

Appendix X: The Frequency of plant species in the study area

Species	No of quadrat present	Total quadrat	Frequency	% Frequency
<i>Acacia abyssinica</i> Hochst. Ex. Benth	4	180	0.02	2
<i>Acacia Senegal</i> (L.) Wild	8	180	0.04	4
<i>Aframomum corrorima</i> (Braun) Jansen	3	180	0.01	1
<i>Agave sisalana</i> Perrine ex Engel.	3	180	0.01	1
<i>Ajuga integrifolia</i> Buch.-Ham. Ex D. Don	3	180	0.01	1
<i>Albizia grandibracteata</i> Taub.	2	180	0.01	1
<i>Albizia gummifera</i> (J. F. Gmel.) C. A. Sm.	85	180	0.47	47
<i>Alcea rosea</i> L.	1	180	0.005	.5
<i>Allium</i> Sp. L.	13	180	0.07	7
<i>Allium cepa</i> L.	2	180	0.01	1
<i>Allium sativum</i> L.	9	180	0.05	5
<i>Aloe</i> L.	3	180	0.01	1
<i>Amaranthus caudatus</i> L.	30	180	0.16	16
<i>Amaranthus hybridus</i> L.	24	180	0.13	13
<i>Ananas comosus</i> (L.) Merr.	8	180	0.04	4
<i>Annona squamosa</i> L.	3	180	0.01	1
<i>Arachis hypogeal</i> L.	7	180	0.03	3
<i>Artemisia abyssinica</i> Sch. Bip. Ex A. Rich.	4	180	0.02	2
<i>Artraxon micans</i> (Nees) Hochst.	10	180	0.05	5
<i>Arundinaria alpine</i> K. Schum	97	180	0.53	53
<i>Arundo donax</i> . L.	109	180	0.60	60
<i>Asparagus africanus</i> Lam.	5	180	0.02	2
<i>Azadirachta indica neem</i> A. J.USS	16	180	0.08	8
Anders <i>Lactuca sativa</i> L.	7	180	0.03	3
<i>Bersama abyssinica</i> Fresen.	1	180	0.005	.5
<i>Beta vulgaris</i> L.	5	180	0.02	2
<i>Buddleja polystacha</i> Fresen	28	180	0.15	15
<i>Brassica carinata</i> A.Br.	8	180	0.04	4
<i>Brassica oleracea</i> L.	20	180	0.11	11
<i>Brucea antidysenterica</i> J.F.Mill.	10	180	0.05	5
<i>Brassica rapa</i> L.	30	180	0.16	16
<i>Cajanus cajan</i> (L.) Millsp.	4	180	0.02	2
<i>Calpurnia aurea</i> (Ait.) Benth.	6	180	0.03	3
<i>Canavalia ensifomis</i> (L.) DC.	18	180	0.1	10
<i>Canna indica</i> L.	11	180	0.06	6
<i>Canna x generalis</i> L. H. Bailey	133	180	0.73	73
<i>Capsicum annuum</i> L.	6	180	0.03	3
<i>Capsicum frutescens</i> L.	9	180	0.05	5

<i>Carica papaya</i> L.	7	180	0.03	3
<i>Casimiroa edulis</i> La Liave	5	180	0.02	2
<i>Casuarina equisetifolia</i> L.	122	180	0.67	67
<i>Catha edulis</i> (Vahl.) Forssk. Ex Endl.	89	180	0.49	49
<i>Celtis africana</i> Burm. F.	6	180	0.03	3
<i>Chrysanthemum coronarium</i> L.	9	180	0.05	5
<i>Cirtus</i> Sp.	45	180	0.25	25
<i>Citrus aurantifolia</i> (Christm.) Swingle	8	180	0.04	4
<i>Citrus sinensis</i> (L.) Osb.	14	180	0.07	7
<i>Clematis hirsuta</i> Perr. & Guill.	4	180	0.02	2
<i>Clerodendrum myricoides</i> (Hochst.) Vatke.	23	180	0.12	12
<i>Coffea arabica</i> L.	97	180	0.53	53
<i>Colocasia esculenta</i> (L.) Schott.	34	180	0.18	18
<i>Combretum collinum</i> Fresen.	5	180	0.02	2
<i>Combretum molle</i> R. Br. Ex G. Don	12	180	0.06	6
<i>Commeliana africana</i> L.	21	180	0.11	11
<i>Cordia africana</i> Lam.	85	180	0.47	47
<i>Coriandrum sativum</i> L.	17	180	0.09	9
<i>Cosmos bipinnatus</i> Cav.	3	180	0.01	1
<i>Cosmos shimperi</i> Fish. & Mey.	10	180	0.05	5
<i>Croton macrostachyus</i> Del.	105	180	0.58	58
<i>Cucurbita pepo</i> L.	120	180	0.66	66
<i>Cupressus lusitanica</i> Mill.	89	180	0.49	49
<i>Cymbopogon citratus</i> (DC.) Stapf	7	180	0.03	3
<i>Cymbopogon bulbosus</i> Vahl	12	180	0.06	6
<i>Dahlia pinnata</i> Cav.	12	180	0.06	6
<i>Daucus carota</i> L.	9	180	0.05	5
<i>Dianthus caryophyllus</i> L.	116	180	0.64	64
<i>Dioscorea praehensilis</i> Benth	120	180	0.66	66
<i>Dioscorea sagittifolia</i> Pax.	15	180	0.08	8
<i>Dodonea angustifolia</i> L.F.	45	180	0.25	25
<i>Dombeya torrida</i>	138	180	0.76	76
<i>Dovyalis caffra</i> (Hook. F. & Harv.)	31	180	0.17	17
<i>Dracaena afromontana</i> Mildbr	7	180	0.03	3
<i>Dracaena fragrans</i> (L.) Ker Gawl	17	180	0.09	9
<i>Ekebergia capensis</i> Sparm.	9	180	0.05	5
<i>Embelia schimperi</i> Vatke	13	180	0.07	7
<i>Ensete ventricosum</i> (Welw.) Cheesman	175	180	0.97	97
<i>Eragrostis tef</i> (Zucc.) Trotter	45	180	0.25	25
<i>Erythrina brucei</i> Schweinf	97	180	0.53	53
<i>Eucalyptus camaldulensis</i> Dehnh.	89	180	0.49	49
<i>Eucalyptus globulus</i> Labill.	88	180	0.48	48

<i>Euphorbia ampliphylla</i> Pax	16	180	0.08	8
<i>Euphorbia cotinifolia</i> L.	19	180	0.10	10
<i>Euphorbia pulcherrima</i> Klotzsch.	20	180	0.11	11
<i>Fagaropsis angolensis</i> (Engl.) Dale	12	180	0.06	6
<i>Ficus sur</i> Forssk	77	180	0.42	42
<i>Ficus sycomorus</i> L.	54	180	0.3	30
<i>Ficus thonningii</i> Blume	43	180	0.23	23
<i>Foeniculum vulgare</i> Mill	9	180	0.05	5
<i>Gardenia ternifolia</i> Schumach Schumach.	5	180	0.02	2
<i>Grevillea robusta</i> R.Br.	88	180	0.48	48
<i>Girardinia bullosa</i> (Forsk) snowden	23	180	0.12	12
<i>Girardinia bullosa</i> (Steudel) Wedd.	33	180	0.18	18
<i>Hagenia abyssinica</i> (Bruce) J. F. Gmel.	73	180	0.40	40
<i>Helianthus annuus</i> L.	16	180	0.08	8
<i>Hibiscus acetosella</i> Welw. ex Hiern	17	180	0.09	9
<i>Helichrysum formosissimum</i> (sch.Bip) A.R	9	180	0.05	5
<i>Hypoestes triflora</i> (Forssk) Roem. & Schult	11	180	0.06	6
<i>Hibiscus rosa-sinensis</i> L.	10	180	0.05	5
<i>Hordeum vulgare</i> L.	121	180	0.67	67
<i>Ipomoea batatas</i> (L.) Lam	19	180	0.10	10
<i>Iresine herbstii</i> Lindl	10	180	0.05	5
<i>Jasminium grandiflorum</i> L.	22	180	0.12	12
<i>Juniperus procera</i> Hochst. ex Endl.	142	180	0.78	78
<i>Justicia schimperiana</i> (Hochst. ex Nees	104	180	0.57	57
<i>Lantana trifolia</i> L.	32	180	0.17	17
<i>Lagenaria siceraria</i> (Molina) Standl.	14	180	0.07	7
<i>Lantana camara</i> L.	12	180	0.06	6
<i>Lippia adoensis</i> Hochst. ex Walp. Var.	66	180	0.36	36
<i>Linum unisatissimum</i> (pax)	12	180	0.06	6
<i>Lycopersicon esculentum</i> Mill	21	180	0.11	11
<i>Maesa lanceolata</i> Forssk	23	180	0.12	12
<i>Malus sylvestris</i> Mill	11	180	0.06	6
<i>Mangifera indica</i> L.	76	180	0.42	42
<i>Manihot esculenta</i> Crantz	6	180	0.03	3
<i>Melilotus suaveolens</i> Ledeb.	8	180	0.04	4
<i>Millettia ferruginea</i> (Hochst.) Bak.	15	180	0.08	8
<i>Mirabilis jalapa</i> L.	12	180	0.06	6
<i>Morus alba</i> L.	88	180	0.48	48
<i>Musa x paradisiaca</i> L.	94	180	0.52	52
<i>Myosotis abyssinica</i> Bois & Revt	19	180	0.10	10
<i>Nicotiana tabacum</i> L.	88	180	0.48	48
<i>Nigella sativa</i> L.	14	180	0.07	7

<i>Ocimum basilicum</i> L.	24	180	0.13	13
<i>Ocimum lamiifolium</i> Hochst. ex Benth.	34	180	0.18	18
<i>Oenothera biennis</i> L.	9	180	0.05	5
<i>Olea europaea</i> L. subsp. <i>Cuspidate</i>	17	180	0.09	9
<i>Passiflora caerulea</i> L.	91	180	0.50	50
<i>Passiflora edulis</i> Sims.	12	180	0.06	6
<i>Pelargonium zonale</i> (L.) 'Her	15	180	0.08	8
<i>Pennisetum violaceum</i> (Lam.) L. Rich.	18	180	0.1	10
<i>Peponium vogelii</i> (Hock. f.) Engl.	99	180	0.55	55
<i>Persea americana</i> Mill	113	180	0.62	62
<i>Phaseolus lunatus</i> L.	10	180	0.05	5
<i>Phaseolus vulgaris</i> L.	5	180	0.02	2
<i>Phoenix reclinata</i> Jacq.	16	180	0.08	8
<i>Physalis peruviana</i> L.	19	180	0.10	10
<i>Phytolacca dodecandra</i> L Hèrit.	88	180	0.48	48
<i>Pisum sativum</i> L.	9	180	0.05	5
<i>Podocarpus falcatus</i> (Thunb.) R. B. ex Mirb	99	180	0.55	55
<i>Polysphaeria parvifolia</i> Hiern	18	180	0.1	10
<i>Prunus africana</i> (Hook. f.) Kalkm	17	180	0.09	9
<i>Prunus persica</i> (L.) Batsch.	9	180	0.05	5
<i>Psidium guajava</i> L.	88	180	0.48	48
<i>Pycnostachys abyssinica</i> Fre.	9	180	0.05	5
<i>Rhamnus prinoides</i> L Herit	19	180	0.10	10
<i>Ricinus communis</i> L.	101	180	0.56	56
<i>Rosa abyssinica</i> Lindley	55	180	0.30	30
<i>Rosa x richardii</i> Rehd	68	180	0.37	37
<i>Rosmarinus officinalis</i> L.	7	180	0.03	3
<i>Rumex abyssinicus</i> Jacq.	12	180	0.06	6
<i>Rumex nepalensis</i> Spreng.	119	180	0.66	66
<i>Ruta chalepensis</i> L.	101	180	0.56	56
<i>Rhus Vulgaris</i> (steude)Wedd	55	180	0.30	30
<i>Saccharum officinarum</i> L.	10	180	0.05	5
<i>Salvia leucantha</i> Cav.	56	180	0.31	31
<i>Salvia nilotica</i> Jacq.	18	180	0.1	10
<i>Salvia splendens</i> Sellow ex Roem. & Schult	5	180	0.02	2
<i>Sesbania sesban</i> (L.) Merr	18	180	0.1	10
<i>Solanecio gigas</i> (Vatke) C. Jeffrey	22	180	0.12	12
<i>Solanum nigrum</i> L.	112	180	0.62	62
<i>Solanum tanderemotum</i> Bitte	20	180	0.11	11
<i>Solanum tuberosum</i> L.	14	180	0.07	7
<i>Sorghum bicolor</i> (L.) Moench	23	180	0.12	12
<i>Sorghum dochna</i>	29	180	0.16	16

<i>Solanum indicum</i>	115	180	0.63	63
<i>Stephania abyssinica</i> L.f	18	180	0.1	10
<i>Syzygium guineense</i> (willd.)DC.	123	180	0.68	68
<i>Tagetes erecta</i> L.	26	180	0.14	14
<i>Tradescantia zebrina</i> Hort. ex Bosse.	17	180	0.09	9
<i>Trichilia emetica</i> Vahl	123	180	0.68	68
<i>Tragia brevipes</i> (Dillon&A.rich) Walp	30	180	0.16	16
<i>Triticum aestivum</i> L.	8	180	0.04	4
<i>Tropaeolum majus</i> L.	12	180	0.06	6
<i>Vernonia amygdalina</i> Del	166	180	0.92	92
<i>Vernonia myriantha</i> Hook. F.	174	180	0.96	96
<i>Vicia faba</i> L.	97	180	0.53	53
<i>Xanthosoma sagittifolium</i> (L.) Schott	7	180	0.03	3
<i>Zea mays</i> L.	172	180	0.95	95
<i>Zingiber officinale</i> L.	9	180	0.05	5

Appendix XI: Density and percentage of trees, shrubs, herbs and climbers

Species	Habit	Density	Density/ha	%
<i>Nigella sativa</i>	H	3	0.41	0.01
<i>Acacia abyssinica</i>	T	21	2.91	0.07
<i>Canna indica</i>	H	45	6.25	0.15
<i>Acacia senegal</i>	T	17	2.36	0.05
<i>Aframomum corrorima</i>	H	58	21.4	0.19
<i>Agave sisalana Perrine</i>	H	33	4.58	0.11
<i>Ajuga integrifolia</i>	H	25	3.47	0.08
<i>Albizia grandibracteata</i>	T	10	1.3	0.03
<i>Albizia gummifera</i>	T	15	2.08	0.05
<i>Alcea rosea</i>	H	8	1.11	0.02
<i>Allium sp.</i>	H	205	28.8	0.69
<i>Allium cepa</i>	H	139	19.30	0.47
<i>Allium sativum</i>	H	59	6.80	0.001
<i>Aloe sp.</i>	H	11	1.52	0.03
<i>Amaranthus caudatus</i>	H	7	0.97	0.02
<i>Amaranthus hybridus</i>	H	4	0.55	0.01
<i>Ananas comosus</i>	H	15	2.08	0.05
<i>Annona squamosa</i>	T	9	1.25	0.03
<i>Arachis hypogea</i>	H	27	3.75	0.09
<i>Artemisia abyssinica</i>	H	21	2.91	0.07
<i>Artraxon micans</i>	H	29	4.02	0.09
<i>Arundinaria alpina</i>	H	4105	570.13	13.91
<i>Arundodonax</i>	H	5234	726.9	17.74
<i>Asparagus africanus</i>	H	5	0.69	0.01
<i>Azadirachta indica</i>	T	12	1.67	0.04
<i>Bersama abyssinica</i>	T	7	0.97	0.02
<i>Beta vulgaris</i>	H	17	2.36	0.05
<i>Brassica carinata</i>	H	25	3.47	0.08

<i>Brassica oleracea</i>	H	87	12	0.29
<i>Brassica rapa</i>	H	34	4.7	0.11
<i>Brucea antidysenterica</i>	T	19	2.6	0.06
<i>Cajanus cajan</i>	S	7	0.9	0.02
<i>Calpurnia aurea</i>	S	13	1.8	0.04
<i>Canavalia ensiformis</i>	C	201	27.9	0.68
<i>Canna indica</i>	H	14	1.9	0.04
<i>Canna x generalis</i>	H	25	3.4	0.08
<i>Capsicum annuum</i>	H	58	8.0	0.19
<i>Capsicum frutescens</i>	H	59	8.1	0.19
<i>Carica papaya</i>	H	11	1.5	0.03
<i>Casimiroa edulis</i>	T	10	1.3	0.03
<i>Casuarina equisetifolia</i>	T	129	17.9	0.43
<i>Catha edulis</i>	S	5574	774.1	18.9
<i>Celtis africana</i>	T	18	2.5	0.06
<i>Chrysanthemum coron</i>	H	9	1.25	0.03
<i>Citrus sp.</i>	T	18	2.5	0.06
<i>Citrus aurantifolia</i>	T	6	0.83	0.02
<i>Citrus sinensis</i>	T	12	1.6	0.04
<i>Clematis hirsuta Perr</i>	C	2	0.2	0.006
<i>Clerodendrum myricoid</i>	H	8	1.11	0.02
<i>Coffea arabica</i>	S	6462	897.5	21.9
<i>Colocasia esculenta</i>	H	163	22.6	0.005
<i>Combretum collinum</i>	T	4	0.5	0.01
<i>Combretum molle</i>	T	11	1.5	0.03
<i>Commeliana africana</i>	C	24	3.3	0.08
<i>Cordia africana</i>	T	32	4.4	0.1
<i>Coriandrum sativum</i>	H	4	0.5	0.01
<i>Cosmos bipinnatus</i>	H	13	1.8	0.04
<i>Cosmos schimperi</i>	H	9	1.25	0.03

<i>Croton macrostachyus</i>	T	39	5.4	0.13
<i>Cucurbita pepo</i>	C	19	2.6	0.06
<i>Cupressus lusitanica</i>	T	3167	439.8	10.7
<i>Cymbopogon citratus</i>	H	7	0.9	0.02
<i>Cymbopogon bulbosus</i>	H	5	0.6	0.01
<i>Dahlia pinnata</i>	H	16	2.2	0.05
<i>Daucus carota</i>	H	58	8.05	0.1
<i>Dianthus caryophyllus</i>	H	15	2.0	0.05
<i>Dioscorea praehensilis</i>	C	54	7.5	0.1
<i>Dioscorea sagittifolia</i>	C	76	10.5	0.2
<i>Dodonea angustifolia</i>	S	10	1.3	0.03
<i>Dombeya torrida</i>	T	67	9.3	0.2
<i>Dovyalis caffra</i>	T	4	0.5	0.01
<i>Dracaena afromontana</i>	T	5	0.6	0.01
<i>Dracaena fragrans</i>	H	4	0.5	0.01
<i>Ekebergia capensis</i>	T	6	0.8	0.02
<i>Embelia schimperi</i>	T	4	0.5	0.01
<i>Ensete ventricosum</i>	H	14331	1990.4	48.5
<i>Eragrostis tef</i>	H	249	34.5	0.8
<i>Erythrina brucei</i>	T	11	1.5	0.03
<i>Eucalyptus camaldulens</i>	T	4167	578.7	14.12
<i>Eucalyptus globulus</i>	T	3109	431.8	10.53
<i>Euphorbia ampliphylla</i>	T	8	1.1	0.02
<i>Euphorbia cotinifolia</i>	S	6	0.8	0.02
<i>Euphorbia pulcherrima</i>	S	9	1.2	0.03
<i>Fagaropsis angolensis</i>	T	14	1.9	0.04
<i>Ficus sur Forssk.</i>	T	12	1.6	0.04
<i>Ficus sycomorus</i>	T	9	1.2	0.03
<i>Ficus thonningii</i>	T	14	1.9	0.04
<i>Foeniculum vulgare</i>	H	3	0.4	0.01

<i>Gardenia ternifolia</i>	T	2	0.2	0.006
<i>Grevillea robusta</i>	T	19	2.6	0.06
<i>Grewia ferruginea</i>	S	2160	300	7.32
<i>Hagenia abyssinica</i>	T	2	0.2	0.006
<i>Helianthus annuus</i>	H	4	0.5	0.01
<i>Hibiscus acetosella</i>	S	3	0.4	0.01
<i>Hibiscus rosa-sinensis</i>	S	5	0.69	0.01
<i>Hordeum vulgare</i>	H	2216	307.77	7.5
<i>Ipomoea batatas</i>	H	297	41.2	1.0
<i>Iresine herbstii</i>	H	3	0.4	0.01
<i>Jasminium grandifloru</i>	C	7	0.9	0.02
<i>Juniperus procera</i>	T	2376	330	8.05
<i>Justicia schimperiana</i>	T	14	1.9	0.04
<i>Anders Lactuca</i>	H	126	17.5	0.4
<i>Lagenaria siceraria</i>	C	6	0.8	0.02
<i>Lantana camara</i>	S	8	1.1	0.02
<i>Lippia adoensis</i>	C	19	2.6	0.06
<i>Lycopersicon esculentu</i>	S	4	0.5	0.01
<i>Maesa lanceolata</i>	T	106	14.7	0.3
<i>Malus sylvestris</i>	T	16	2.2	0.05
<i>Mangifera indica</i>	T	15	2.08	0.05
<i>Manihot esculenta</i>	H	1	0.1	0.003
<i>Melilotus suaveolens</i>	T	1133	157.36	3.84
<i>Millettia ferruginea</i>	H	3	0.4	0.01
<i>Mirabilis jalapa</i>	C	5	0.6	0.01
<i>Morus alba</i>	H	183	25.4	0.6
<i>Musa x paradisiaca</i>	H	17	2.3	0.05
<i>Nicotiana tabacum</i>	H	8	1.1	0.02
<i>Ocimum basilicum</i>	S	29	4.02	0.09
<i>Ocimum lamiifolium</i>	H	3	0.4	0.01

<i>Oenothera biennis</i>	H	3	0.41	0.01
<i>Olea europaea</i>	T	2	0.2	0.006
<i>Passiflora caerulea</i>	C	2	0.2	0.006
<i>Passiflora edulis</i>	C	7	0.9	0.02
<i>Pelargonium zonale</i>	H	1	0.1	0.003
<i>Pennisetum violaceum</i>	H	128	17.7	0.4
<i>Peponium vogelii</i>	C	3	0.41	0.01
<i>Persea americana</i>	T	48	6.6	0.001
<i>Phaseolus lunatus</i>	C	6	0.8	0.02
<i>Phaseolus vulgaris</i>	T	4	0.5	0.01
<i>Phoenix reclinata</i>	H	2	0.2	0.006
<i>Physalis peruviana</i>	C	9	1.2	0.03
<i>Phytolacca dodecandra</i>	C	278	38.6	0.009
<i>Pisum sativum</i>	T	1	0.1	0.003
<i>Podocarpus falcatus</i>	T	3	0.41	0.01
<i>Polysphaeria parvifolia</i>	T	23	3.1	0.07
<i>Prunus africana</i>	T	8	1.1	0.02
<i>Prunus persica</i>	T	11	1.5	0.03
<i>Psidium guajava</i>	T	9	1.2	0.03
<i>Pycnostachys abyssinica</i>	H	10	1.3	0.03
<i>Rhamnus prinoides</i>	S	5	0.6	0.01
<i>Ricinus communis</i>	S	4	0.5	0.01
<i>Rosa abyssinica</i>	S	3	0.41	0.01
<i>Rosa x richardii</i>	H	4	0.5	0.01
<i>Rosmarinus officinalis</i>	H	3	0.41	0.01
<i>Rumex abyssinicus</i>	H	17	2.3	0.05
<i>Rumex nepalensis</i>	H	28	3.8	0.09
<i>Ruta chalepensis</i>	H	57	7.9	0.1
<i>Saccharum officinarum</i>	H	52	7.2	0.1
<i>Salvia leucantha</i>	H	1	0.1	0.003

<i>Salvia nilotica</i>	H	3	0.41	0.01
<i>Salvia splendens</i>	H	5	0.6	0.01
<i>Sesbania sesban</i>	T	6	0.8	0.02
<i>Solanecio gigas</i>	H	9	1.2	0.03
<i>Solanum nigrum</i>	H	15	2.0	0.05
<i>Solanum tarderemotum</i>	H	280	38.8	0.9
<i>Solanum tuberosum</i>	H	6	0.8	0.02
<i>Sorghum bicolor</i>	H	39	5.4	0.1
<i>Syzygium guineense</i>	T	3	0.41	0.01
<i>Tagetes erecta</i>	H	2	0.2	0.006
<i>Tradescantia zebrina</i>	H	1	0.1	0.003
<i>Trichilia emetica</i>	T	6	0.8	0.02
<i>Triticum aestivum</i>	H	214	29.7	0.7
<i>Tropaeolum majus</i>	S	2	0.2	0.006
<i>Vernonia amygdalina</i>	S	93	12.9	0.31
<i>Vernonia myriantha</i>	S	4156	577.2	14.08
<i>Vicia faba</i>	H	3367	467.63	11.41
<i>Xanthosoma sagittifolium</i>	H	8	1.1	0.02
<i>Zea mays</i>	H	5501	764.02	18.64
<i>Brassica Oleracea</i>	H	23	3.1	0.07
<i>Allium Porrum</i>	H	67	9.3	0.22
<i>Linum unisatissimum</i>	H	84	11.6	0.2
<i>Tragia brevipes</i>	H	15	2.0	0.05
<i>Stephania abyssinica</i>	C	3	21.6	0.01
<i>Solanum indicum</i>	S	8	1.1	0.02
<i>Rhus Vulgaris</i>	T	14	1.9	0.04
<i>Girardinia bullosa</i>	H	9	1.25	0.03
<i>Ekebergia capensis</i>	C	2	0.2	0.006
<i>Sorghum dochna</i>	H	67	9.3	0.22
<i>Cajanus cajan</i>	S	2	0.2	0.006
<i>Zingiber officinale</i>	H	4	0.5	0.01