THE ROLE OF TRADITIONAL KNOWLEDGE IN AGROFORESTRY PRACTICES IN DAWURO ZONE SOUTHERN NATIONS NATIONALI TIES AND PEOPLES REGIONAL STATE OF ETHIOPIA

M.Sc Thesis

By

Dagnachew Bekele Wakaine

December, 2012

Jimma, Ethiopia

THE ROLE OF TRADITIONAL KNOWLEDGE IN AGROFORESTRY PRACTICES IN DAWURO ZONE SOUTHERN NATIONS NATIONALI TIES AND PEOPLES REGIONAL STATE OF ETHIOPIA

M.Sc Thesis

Submitted to the School of Graduate Studies
Jimma University College of Agriculture and Veterinary Medicine
In partial fulfillment of the Requirements for the Degree of Master of Science in Natural Resource Management (Watershed Management)

By

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December, 2012
Jimma, Ethiopia

APPROVAL SHEET

Jimma University College of Agriculture and Veterinary Medicine

Graduate studies

As thesis adviser, we here by certify that we have read and evaluated the thesis prepared by Dagnachew Bekele Wakaine entitled. The role of Traditional Knowledge in Agroforestry Practices in Dawuro Zone, Southern Nations Nationalities and People's Regional State Ethiopia we recommend that it be submitted as fulfilling thesis requirement.

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DEDICATION

To my beloved wife, W/o Lidatwa H/miskal and my father, Ato Bekele Wakaine and my mother W/o Zanabech Charamo

STATEMENT OF AUTHOR

This thesis is my original work. It has never been submitted in any form to other university and it has never been published nor submitted for any journal by another person. This thesis has been submitted in partial fulfillment of the requirements of M.Sc degree at Jimma University College of Agriculture and Veterinary Medicine and it has been deposited at the university library to be made available to borrowers under the rules and regulation of the library

Name: Dagnachew Bekele Wakaine

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Place Jimma University

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BIOGRAPHICAL SHEET

The researcher was born on March 13, 1966 G.C at SNNPR: Dawuro Zone Mareqa District. He attended his elementary and junior secondary school education at Waken primary and junior secondary school and completed his secondary education in 1985. He joined Jimma Teachers Training Institute, which is named now a day Jimma Teachers Training College, in September 1987 and completed in 1988 with a certificate.

After his graduation, he was employed at Ministry of Education and served more than 18 years in SNNPR in Mareqa District by teaching profession in elementary, junior and senior secondary schools. In 2001 he joined Awassa Teachers Training College summer in serves program in the department of Geography and graduated in diploma on October, 2004. After one year service at Waka senior secondary school, he joined Arbaminch University in summer program on 2005 foer degree program and graduated in October, 2009 in Geography and Environmental study.

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ACKNOWLEDGEMENTS

Above all I thank and respect God for his endless support and guidance in my life, ups and down during different hardships in the course of this study. I am very grateful to my advisors Dr. Dabela Hunde and Mr Co- advisor Mr. Hiriko Dibaba for their unreserved assistance and encouragement throughout my study period. Their guidance and inspiration made this study a reality. My special thanks also go to key informants and respondent households in each peasant association for their kind respect and allowing me to collect data both from them and their homegarden and on farmlands, devoting their precious time despite their busy schedule during the harvesting season. Kebele administrators of Eyesuse, Gozohasho and Tarhca zuria were very friendly and open in providing requested information.I would like to acknowledge the financial support provided for the research work by the Jimma Unversity School of Graduate Studies.I am very thankful to the former Mareqa adimenstaretion leader Ato Batisa Wagasho and later to Ato Malku Mashesha for their willing to grant me sponsership to continue of my education.I also thank Ato Tariku Akalue, Mareqa district Educational leaders, who let me to collect my salary regularly.

I am also grateful for my w/o Yirgalem Hailu, for her help to take picture while I was collecting data. I am also deeply indebted to the ones closest to me, who with their constant support, encouragement and friendship have enabled me see this thesis work to its completion especially, Ato Dereje Demisse, Ato Fetene Sawngezaw and Ato Tadela kaberte, who has always been there for me.

Last and most importantly, I would like to thank my wife W/o Lidetau Hailemeskel, Mom, W/o Zanabech Charamo, Dad, Ato Bekele Wakaine who has always been there for me. Without their, none of this would have been possible, thanks Mom and Dad. I would like also to thank my children and relatives: Tsedeke Dagnachew, Barakete Dagnachew, Ealies Dagnachew and Yilekal Dagnachew, My sister Tadelech Bekele and others their endurance when I was away from them for the long periods of time during my study and research work.

LIST OF ACRONYMS

ADLI	Agriculture Development Lead Industrialization
AEZ	Agro-Ecological Zone
DA	Development Agent
DBH	Diameter at Breast height
E	Evenness
FAO	Food and Agricultural Organization
FGD	Focus Group Discussion
HH	Households
ICRAF	International Center for Research in Agroforestry
IK	Indigenous knowledge
Ln	Log base$_n$
MAR	Mareqa Annual Report
m.a.s.l	Meters Above sea Level
N	Total Number of Population
n	Number of sample Households
PA	Peasant Association
P_i	Proportion of Individuals of the i^{th} Species or the Abundance
SNNPRS	Southern Nations, Nationalities and Peoples Regional State
SPSS	Statistical Packages for the Social Sciences

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ABSTRACT

The traditional knowledge of deliberate maintenance of species diversity is important for biodiversity conservation. A growing population needs food, construction wood and arable land among other things to satisfy human needs. Traditional knowledge for managing agroforestry practices is essential in contributing to these needs. There is limited scientific research on traditional agroforestry practices in Mareqa District. Therefore, the objective of this study was to assess of traditional agrofor erstry practices in homegardens and on farm tree and shrub species.It also identified the diversities of tree and shrub species in traditional agroforestry practices and analyses the socioeconomic implicatio ns of traditional agroforestry practices to the local community livelihood in Dawuro Zone southwest; Ethiopia. The study district was purposely selected. Semi-structured interview of 120 randomly selected households from the total of 908 were interviewed to assess the traditional agroforestry practices. To complement the data focus group discussion and key informants interview were used. Species data were collected from 102 plots laid on 9 transects in three agro Ecological zones (AEZ) of Mareqa District. Interview data on traditional knowledge of agroforestry practices was analyzed using SPSS software version 16.0 and summarized into tables, graphs and others are narrated qualitatively. The results revealed 41 homegardens and 36 on farm tree species are common to all AEZs of the study site. Farmers of each AEZs in this study planted and retained tree species for their benefit. Species diversities showed that from 102 sample plots 27 species, 13 species and 11 species from 2.7/ha,1.2/ha and 1/ha of land from dega, wayne- dega and kola AEZs identified respectively. In dega AEZs the Shannon's diversity index was 2.156 and Evenness was 0.4675. The result of analyzed species diversity in three different AEZs checked by Turkey's test indicated non significant difference (P>0.05) in species diversity in wayne dega and kola. About 17.6% of respondents confirmed tree fruit products are intended primarily for household (HH) consumption and for income generation. Key informants revealed that most of tree management are made by the men from the HH due to cultural management system. It was noted that thinning makes the trees equivalent to being largered in diamet er and about 20.6 % of respondents explained that local people manage tree species by thinning. Abou t 50, 37and 2 of respondents agreed the importance of traditional knowledge for conservation of speci es diversities in each AEZs areas respectively. The tree species have multiple uses. This was evidenced by 23.5 % of species are used as food source, 22.5% of species used for construction,20.6% of species used for shade, 15.7% of species are used for income generation. Furthermore, as local community believed that to bring positive attitude on planting indigenous tree species on their farm and HGs should be promoted to enhance the traditional knowledge in agroforestry practices and the plants species sustainability. Therefore, the present study showed that local people of Mareqa district have di verse management of agroforestry practices that helped them to maintain diversity of tree and shrub s pecies *in their homegardens and on their farms. Hence, priority and consideration should be given fo r planting indigenous trees species with multiples uses which are important for improving community' livelihoods. Equally important is the traditional knowledge of agroforestry practices need be properly supported by extension services and prompted by enhanced further research and an enabling policy.*

Keywords: Agroforestry, Diversity, Traditional, Shannon diversity, Evenness, Richness, Dawuro.

1. INTRODUCTION

1.1. Background

Indigenous knowledge and biodiversity are complementary phenomena essential to human development. Scientific and indigenous knowledge (IK) have in the process of modernization, often been progressively more separated or 'alienated' each other. It has been widely assumed that there is a vast difference between these two types of knowledge. IK has earlier been seen as backward, static and a hindrance to modernization (Appleton *et al.,* 1995). IK is now widely recognized to be an extensive, diverse, unique, complex and sophisticated body of knowledge that the people have gained over many generations. It is believed that incorporating the local people, by recognizing and embracing their knowledge in planning processes, will create a feeling of local ownership and responsibility in development projects and there by create greater participation and better prospects for a successful project (Kristensen, 2004). Very little of this knowledge has been recorded, particularly in the African context, the indigenous knowledge of deliberate maintenance of diversity of domesticated and non-domesticated plants and animals characterizes farming systems across the African continent as well as in most other parts of the world, providing an important for systematic in situ maintenance of genetic resources (Michael, 1992).

The terms indigenous knowledge and traditional knowledge are often used interchangeably **(**UNESCO, 1994-2003).The term 'indigenous knowledge' denotes the traditional understanding of a community which has originated, grown and lived in a specific area (WIPO, 2001). Indigenous knowledge is therefore 'naturally possessed' by a particular community and its content may be as broad as human experience: from history, to astronomy, biology, health and agriculture. The process of validation of this form of knowledge involves its use and usefulness in the real world (Bhola, 2002). This concept of a distinct indigenous world view recognizes the belief system inspired and protected by indigenous knowledge and values, and the shared belief that indigenous societies are characteristic of the creative adaptation of a people to an ecological order (Battiste and Henderson, 2000). Traditional ecological knowledge' consists of three interrelated components: local people's beliefs about their relationship with the natural environment biological knowledge of soil conditions,

species and their growing conditions and possible uses, actual exploitation and management practices (Berkes, 1999).

Agroforestry practices on small-holder farms are rapidly becoming an important aspect of most traditional farming systems. Population growth, increasing pressure on natural resources, increasing commercialization of products, land fragmentation and the use of modern inputs have resulted in the use of agroforestry like most systems, these agroforestry systems are constantly facing pressure of change brought about by demographic, economic, technological and social pressures (Abebe, 2005).

Agroforestry commonly practiced by integrating trees with other crops planted in a multi-storied fashion, which "diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels (Cox, 1995). Despite the overall diminish in the extents of biodiversities of the natural forests in Ethiopia; traditional tree managements in the form of agroforestry have given refuges for a considerable number of native tree species on homegarden and scattered (on-farm tree) agroforestry system is one of the most obvious traditional practices across most agroecosystems in the highlands of Ethiopia.

The distinctive contribution to production is to obtain tree, crop and livestock products from the farm the past decades' interest in agroforestry practices has been increased from time to time substantially (Gezon and Freed, 2008). Agroforestry systems are structurally complex and floristically diverse, can contribute significantly to the conservation of biodiversity within fragmented landscapes and also contribute to natural forest conservation and development program (Harvey and Villalobos, 2007).

Furthermore, about 53 % of all indigenous tree species identified from Bungoma, western Kenya were recorded from on-farm management units of smallholders. These on-farm management units are homegardens, live fences, coffee- and banana-groves and annual cropping fields and the special pattern of distribution of various vegetation structures as well as mixture with diverse tree-based on-farm plots are interesting features with regard to

floristic and diversity at a landscape level (Backes, 2001). According to Abebe (2005) in southern Ethiopia traditional land management practices involving the combined production of trees and agricultural crops/animals on the same piece of land. In varieties of African environments, traditional agroforestry systems sustained people for generations, the inter-cropping of trees with millet and sorghum in west-Africa is known to be successful (Rochleau *et al*., 1988).

There are several types of traditional agroforestry practices in different part of Ethiopia, Coffee shade based, scattered trees on the farm land, homegardens, woodlots, farm boundary practices, trees on grazing lands some of the known examples of traditional agroforestry practice (Azene, 2007). There are also well-established and accepted traditional agroforestry systems in Ethiopia, one of the most popular of such systems are the Sidama traditional agroforestry land use system has been emerged over centuries, economic and social developments, currently it represents one form of sustainable agricultural system managed by local communities (Altieri and Anderson, 1986).

Growing population needs more food, firewood, arable land, and construction wood, plough handles and others. Although the people depend almost exclusively on mixed agriculture, the sector's performance has so far remained very poor and productivity per unit area is low, trees would be grown in a scattered form over a crop field, usually between 1–20 trees per hectare to minimize impact on the companion crop. In such mixed intercropping, lopping and pollarding of trees would be practices include *Cordial africana* intercropping with maize in Bako in western Ethiopia; *Acacia albida*-based agroforestry in the Highlands and Debrezeit area (Hoekstra *et al*., 1990).

The promotion of agroforestry is a strategy to the alternative wasteful land-use practices in the country. It is also acknowledged and has become a key component in many development programmers and sustainable agriculture in Ethiopia. Therefore, usually employed as part of the solutions for land and water degradation as well as to substitute shortages of food, fuel

wood, cash income, animal fodder, and building materials in sub-Saharan Africa (Rocheleau *et al.*, 1988).

1.2. Statement of the Problem

More than a billion people from the under developed countries are not able to meet their basic needs. The gap between awareness of the community, limited scientific research on traditional agroforestry practices and poor land use system in indigenous and traditional agroforestry practices is extremely wider, ever before in the history. Only 20 percent of the world's population consumes 86 percent of the total food production and rest 80 percent consumes only 14 percent of the total production (Shrestha and Shrestha, 1999).

Cultivating trees, agricultural crops and pastures and/or animals in intimate combination with one another spatially or temporally is an ancient practice that farmers have used throughout the world (Tolunay *et.al*, 2007). Despite the efforts made to develop Ethiopian agriculture over the years, the problems of food shortage and malnutrition and land degradation still remain and is the greatest threat to the survival of several households. The traditional diversification of farmlands, which has been the source of sustenance in rural Ethiopia, has been largely reducing due to increased cash cropping. The land use system is associated with the decrease in the size of holding both for arable and non arable lands. Thus, there is continued trend towards the conversion of forested and marginal lands to agricultural lands, resulting in massive environmental degradation and a serious threat to sustainable agriculture and forestry. The decrease in the size of land holding is related to population explosion.

Number of populations dramatically increases and they have high demands towards food, fuel wood, construction wood and arable land to satisfy these utilities, government organizations and donor agencies have planned different agroforestry technologies. Collection of information on the existing agroforestry practices and identifying its constraints is a prerequisite for agroforestry research and development work in the study areas. Hence, traditional agroforestry practices in assessment species diversity were conducted in Dawuro Zone south west Ethiopia: These efforts have failed, due to lack of understanding farmers'

experiences and to scaling-up of technologies which meets farmers' aspirations and which adopted by them (Nyeko *et al.*, 2002). Many strategies do not consider the local traditional knowledge. Therefore, it is important to start any planning and implementation activities by combing the farmers' indigenous knowledge and professionals' knowledge Abebaw (2006).

But the use of traditional knowledge for managing agroforestry practices and awareness of the community, limited scientific research on traditional agroforestry practices and poor land use system in indigenous and traditional agroforestry practices in the study area need research attention. In order to fill this gap, the present study has focused on assessment of traditional knowledge on agroforestry practices in homegarden and on farm tree and shrub species diversities managed in traditional agroforestry. It also attempts to analyze the socioeconomic implications of traditional agroforestry practices to the local community of Dawuro Zone, South west, Ethiopia.

1.3. Objectives

1.3.1. General objectives

To assess traditional knowledge on agroforestry practices and analyze socioeconomic implications of traditional agroforestry practices to the local community livelihood in Dawuro zone South west; Ethiopia

1.3.2. Specific objectives

1. To investigate the Role of traditional knowledge in agroforestry practices in Dawuro zone south west Ethiopia
2. To assess the existence of traditional agroforestry practices of homegarden and on farm species diversity in each agroecological zones of the study area.
3. To identify and document the use (socioeconomic implications) of agroforestry species in the study area

1.2.3. Research questions

1. What is the traditional knowledge of agroforestry practices in Dawuro zone south western Ethiopia?
2. Are there home garden and on farm tree /shrub species managed by traditional agroforestry practices in different AEZs of in the study site?
3 What are the purposes of agroforestry species ranking by key informants in the study area?

1.3. Significance of the Study

Farmers' in three ecological zones of the study area was a driver of farming system to meet the diverse needs with same cultures, economic back grounds and aspiration. Even within a given zone comprehensive understanding of farmers in indigenous and traditional knowledge of agroforestry practice is crucial in designing future research and development strategies. Therefore, the outcomes of the study can be used to formulate conservation polices and strategies to integrate traditional agroforestry practices in production system by supporting with an enabling policy .This work plays its own share for researchers, planners and developmental organizations to utilize the result of this study in modifying research and technology intervention.

1.4. Scope and Limitation of the Study

The study was conducted in three agroecological areas to collect analyze and documents farmers' indigenous knowledge of agroforestry practices in Mareqa District of Dawuro Zone .The findings of the study can be used by different agroecological zones and socio-economic characteristics of indigenous knowledge of agroforestry practices. The study is limited by the fact that the collected data come from sample house hold survey due to shortage of time, accessibility of the kebele and fund. This may hinder investigating farmers' decision behavior for identification of agroforestry practices in the whole population of the study area. More over the study leans towards households' decision on farmer's indigenous knowledge of agroforestry practices. Thus, this research work was playing its own share for researchers and extension organization to utilize the result of this study.

2. LITERATURE REVIEW

2.1. Theoretical Concepts of Traditional Agroforestry Practices

From the very beginnings of agriculture, many farmers maintained or actively included trees as part of their agricultural landscapes. Trees provided shade, shelter, energy, food, fodder and many other goods and services that enabled the farmstead to prosper traditional agroforestry system takes the form of trees scattered on crop fields, woodlots, homestead tree planting and multi-storey in homegarden (Eyasu, 2002).

In sub-Saharan Africa, biophysical conditions are more marginal and socio-economic conditions are more diverse. Diverse tree species can be observed on farmers' managed landscapes in Ethiopia (Motuma *et al.,* 2008). However, *Eucalyptus*es always dominate in terms of stem density (per hectare or per farm) and preference ranking throughout the highlands. *Eucalyptus* woodlot is expanding rapidly due to the growing demands for its wood products. In most places in the highlands of Ethiopia (north and south) the growing demand for wood and wood products is inspiring farmers to convert farm plots to *eucalyptus* woodlots (Dereje, 2009).

A homegarden is a micro-environment composed of a multi-species (annual to perennial, root crops to climbers etc), multi-storied and multi-purpose garden situated close to the homestead (Hodgkin, 2002; Mathewos, 2008). The increased consideration of traditional, tree-based land use practices and the widening of the focus from the field to the landscape scale in agroforestry science have made links between agroforestry and the conservation of diversity more relevant and more obvious. Schroth *et al* (2004) identified and discussed tree roles of agroforestry diversity conservation on a landscape scale. The provision of supplementary secondary habitat for species that tolerate a certain level of disturbance the reduction of rates of conversion of natural habitat in certain cases; and the creation of a more being and permeable 'matrix' between habitat remnants compared with less tree-dominated land uses, which may support the integrity of these remnants and the conservation of their populations.

Agroforestry practices have often been shown to increase levels of wild biodiversity on farm land, and it is hypothesized that they are also able to play a supporting role in the conservation of diversity in remnants of natural habitat that are interspersed with farm land in tropical land use mosaics.

According to Amacher *et al* (2004), the behavioral factors underlying tree planting decision and linking tree planting to fuel issues, there are limited studies to make detailed characterization about the extent of on-farm tree cultivation and management practices, the proportion of households in different regions who have adopted these practices. Cooke *et al* (2008) also emphasized that more careful empirical analysis, particularly at the household level, is essential especially for the choice and targeting of fuel wood related interventions. According to Hansen *et al* (2005) investigate tree planting under customary tenure systems in Malawi. On some research findings, over 149 crop species were identified in homegardens of central Sulawes of Indonesia (Kehlenbeck and Mass, 2004). In southern part of Ethiopia too, the study in Loma and Gena Bosa woredas of Dawuro Zone revealed that the recorded plant species (214) in the plots of the sampled homegardens, showed high diversity (Mathewos, 2008), the Sidama homegurden agroforestry systems are honored for having high diversity of about 198 plant species out of which 78 species were identified as cultivated crops and the rest are tree/shrub species (Abebe, 2005).

It is now widely acknowledged by the scientific community and by development agents that success in development is more likely to be achieved when local people's knowledge is taken into account in project planning and development (COMPAS, 2004). Research and documentation are necessary before indigenous knowledge can be incorporated into resource management. Documentation is also an important element in conserving and protecting this knowledge (Higgins, 2000). According to Boogaard *et al (*2006), four factors contribute to a frame of reference: knowledge, experience, values and interests. Experiences is there where traditional management of resources such as on-farm trees and forest has emerged over a century's cultural and biological development and represents accumulated indigenous knowledge of farmers.

2.2. Traditional Knowledge in Agroforestry Practices and Species Diversity

Traditional agroforestry practices are an important system for the maintenance of biodiversity besides their primary function in crop production, household food security and nutrition. The high diversity of crops in homegardens allows year-round production of food, reduces risk of production failure, reduces risk of pests and diseases, increases productivity and output flexibility, and improves the microclimate and soil conditions (Abebe, 2005).

Local knowledge is now widely recognized to be an extensive, diverse, unique, complex and sophisticated body of knowledge that the people have gained over many generations. It is believed that incorporating the local people, by recognizing and embracing their knowledge in planning processes, in development projects and there by creates greater participation and better prospects for a successful project (Kristensen, 2004).

Using indigenous knowledge can be of perhaps greatest importance in managing homegurden and on farm tree, when new solutions are searched for the term 'indigenous knowledge' is defined as knowledge "unique to a particular culture and society" (World Bank, 1998) which has been acquired within a community and passed on from one generation to another (Bhattarya and Tripathi, 2004) by people who have had "direct experience and contact with the environment" (Kristensen, 2005). Furthermore, IK can be a useful source of information when setting realistic goals and priorities in planning development interventions (Kristensen, 2004). Even though, it can be highly risky to group together Bhattarya and Tripathi (2004) claimed that scientific knowledge alone cannot contribute holistically to the development of rural communities and societies around the world. Therefore, local participation and IK have an important role to play in improving this situation and achieving sustainable management in many parts of the world (Prado and Weber, 2003). Global processes of rapid changes as well as lack of capacity and facilities needed to document, evaluate, validate and protect such knowledge, not to put traditional knowledge in danger of being lost (SciDev, 2002).

However, despite the presence of on farm trees and homegarden diversity in tropical farming systems since the very beginnings, knowledge about their use to consider the relation between on farm tree crops and homegurden diversity are important for environmental suitability for the first roughly two decades of agroforestry research, agroforestry scientists were mostly concerned with the sustainable production of agricultural goods, especially food, and this line of research has lost none of its relevance. However, over the last decade or so, scientists have also become interested in the environmental services that agroforestry practices may provide to local and even global society by maintaining watershed functions, retaining carbon in the plant–soil system and, most recently, by supporting the conservation of biological diversity (Schroth *et al.,* 2004).

It is likely, however, that the two kinds of knowledge can complement each other and compensate for each others' strengths and weaknesses in many fields (Bhattarya and Tripathi 2004), not least in the development of sustainable forestry practices. A fruitful dialogue between researchers, professionals and the local population can perhaps result in new ways of thinking and the discovery of novel and unexpected solutions to diversity management problems. In addition to biodiversity conservation, homegarden and on-farm trees are very important for their roles in environmental or ecological maintenance. In many part of the world, research results revealed that some scattered trees/shrubs in traditional agroforestry land use systems improve the fertility of the soil, improve microclimate, maintain soil moisture and also improve the yields of the crops underneath (Anon, 1999).

2.3. Traditional Agroforestry practices and Socio-economic influence.

According to Abdullah *et al (2001)* the diminution of biodiversity due to converting primary forest is frequently unsustainable. Agricultural lands have increased in many tropical countries. To resolve the problem, developing sustainable agricultural system is very crucial. The long aged practices of tropical traditional agroforestry systems mainly homegardens are generally regarded as sustainable production systems. Ethiopia has given special attention to

the economic development by the use of agricultural development led industrialization (ADLI). The role of agricultural sector as an engine of economic development of the country depends among other things on the sustainable and efficient use of the land resources. The current trend of the agroforestry practices in the country is important for economic development. Furthermore Nyeko *et al (2002)* found out that farmers indigenous knowledge and management of their agroforestry practices is important for the development and scaling-up of technologies and extension approaches that meet farmers aspirations and are thus likely to be adopted by them research and evolution is thus necessary before indigenous knowledge can be incorporated important element in conserving and protecting this knowledge (Higgins, 2002). It is also an input to the knowledge of agroforestry practices which add on food to diversity.

The homegarden is a small-scale traditional agricultural ecosystem practiced around houses. Plant domestication by societies through selection of useful species from the wild is still currently taking place in some traditional agricultural systems (Zemede, 2004; Mathewos, 2008). According to Fernandes (1990) and Nair (1990) the evolution of homegardens possibly started from shifting cultivation practices that were used to overcome problems of resources and to ascertain rights to land resources. Hence, homegardens have been described as 'living gene banks' in which a variety of germaplasm, in the form of indigenous varieties, landraces and rare species thrive side by side and has been preserved through generations (Tesfaye, 2007). Homegardens are relatively fertile and they are more intensively cropped than other field systems. Williams (2004) described it as microcosm that has all features and qualities of environment and generally as multi-storied and multi-purpose (Bennett-Lartey *et al*., 2006). This heterogeneous environment of homegardens favours the growing conditions for a wide diversity of useful plants. Homegardening and on farm became an important strategy for food production, introduction and adaptation of new species, and for conservation of germaplasm, ecosystem, agricultural practices and know-how of indigenous people.

3. MATERIALS AND METHODS

3.1. Description of the Site

The Study District, Mareqa, is located in Dawuro Zone at 6.59^0 -7.34^0 N latitude and 36.68^0 -37.52^0 E longitudes at altitudinal range between 550-2820 meters above sea level in Southern Nations, Nationalities and Peoples Region (SNNPR) (Mathewos, 2008). It is one of the 13 zones in the region and bounded with Hadiya Zone in the North, Kembata Tembaro Zone in the Northeast, Wolayta Zone in the East, Gamo Gofa Zone in the South, and Konta Special Wereda in the West within SNNPR and Jimma Zone in Oromya Region. It is also found in between Omo River from North to South and Gojeb River from Northwest to North (Anon, 2004). Tercha is the main town located at about 507 kms southwest of Addis Ababa across Shashemene and Wolayta, 282 Kms away from Awassa, town of SNNPR and 180 km from Jimma (Terefe, 2003). Out of the five district of the Zone, the study area covers one district by the name Mareqa Wereda has an area of 46,220 hectares, with average density of 13 persons per km2 making the district one of the sparsely populated in kola region. But in dega and Wayne-dega area densely populated 60 persons per square kilometer (M.A.R, 2011) the district is administratively divided in to 32 kebele (30 rural and 2 rural towns) (Figure 1). The study was carried out in the kola and Wayne-dega areas of the two drought stressed Tercha Zuriea and Gozosasho kebeles and from dega Eyessuse kebele selected on the agroforestry practices in different agroecological zones of Mareqa District. The altitude of the study area ranges between 1300-2374 m.a.s.l.

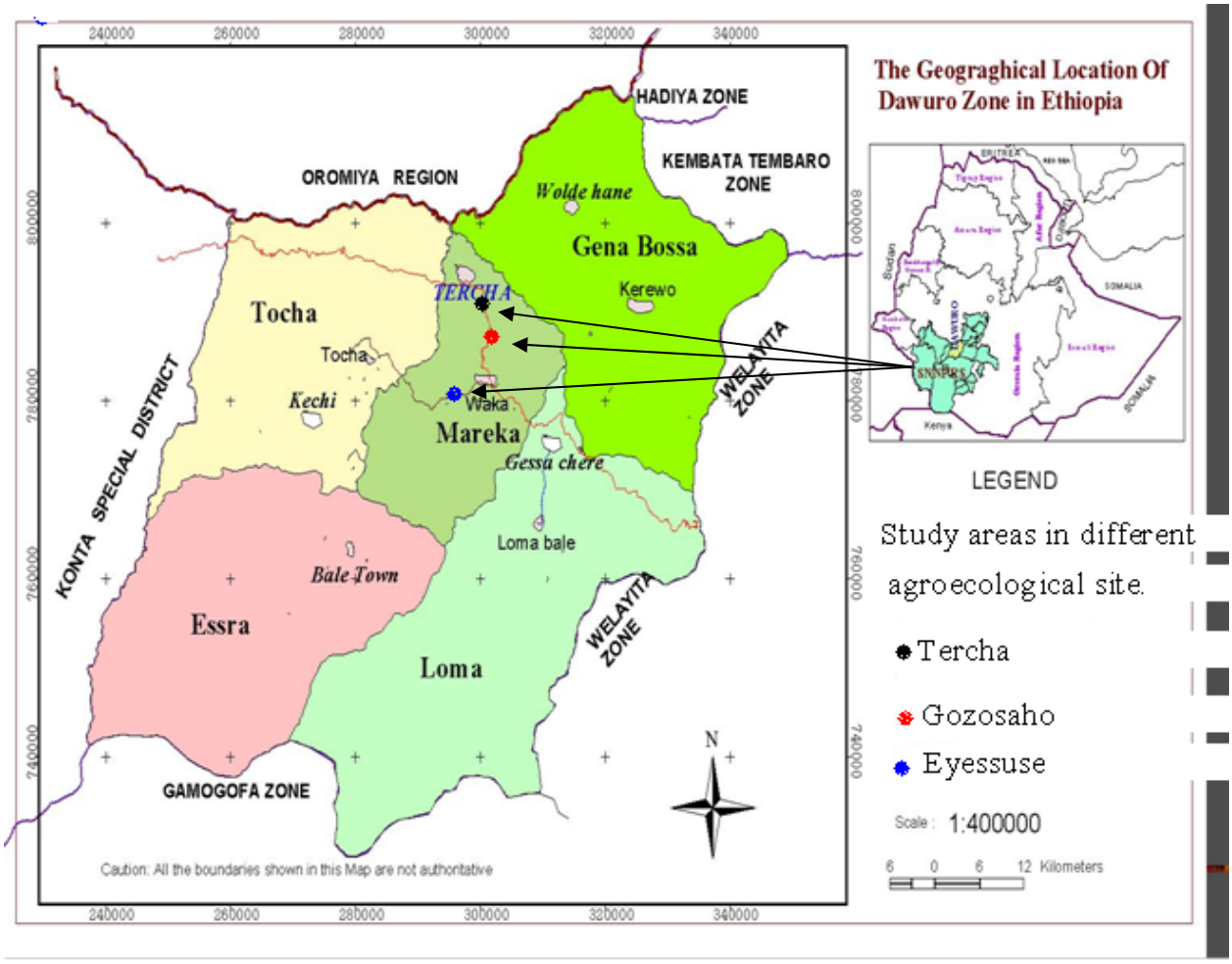

Figure 1. Map of the study sites in Dawuro Zone (Ethiopia) Modified from (Anon, 2004).

3.1.1. Demography

The study sites consist of sub-humid types of agro ecological zones containing deciduous woodland with elevation 1300-2374m.a.s.l. Having to *Persea americas,Carissapinarum,Steno petala.Cordiaa africa, Ficus sycomors, Coffee arabica, Ensete ventricosum* and others grow in homegarden and on farm area and the vegetation varies from semi-desert types in kola areas to broad-leaved evergreen forest types in the dega agroecological areas.

According (M.A.R, 2011) to housing and population census of Ethiopia in (2007) the total population of Mareqa District is about 142,004, male 73,573 female 68, 412 and total land area of study site is 46, 220 ha from this present land use is 20,701ha, cultivated 16,172.17ha, covered by bush shrubs and under settlement 6,202ha and the land which allotted for grazing 2,060ha forests cover 752.33ha and remaining 332.50 ha for the others.

People in the study area are the Dawuro people and have unique cultural practices and social structure. The word "Dawuro" means an impregnable, powerful and heroic people (Data, 1997), (Terefe, 2003: Mathewos, 2008). Dawuro belongs to the family of the Omotic peoples in southern Ethiopia. The language, which is locally called "Dawroothuwa or Dawuro qaalaa", uses a Latin script (Anon, 2005) and it is classified as a dialect of the central Omotic languages along with Gofa, Gamo, Wolayta, Konta, and others people (Data, 1997; Terefe *et al.,* 2003). Until the introduction of Christianity in the 17th Century, the Dawuro people were followers of traditional religion. But nowadays most of the people are Christians, (Protestant and Orthodox) followers.

Agriculture is the main economic activity and livelihood source of the people of the study area. It is characterized as small scale subsistence mixed farming zone where crop and livestock production are interacting in the system (M.A.R, 2011). The principal agricultural activity is crop cultivation which is entirely rain fed with livestock rearing as secondary activity, The cropping system is dominated by maize 40 %, teff 10 %, wheat 15 %, sorghum 2 %, barely 3 % and enste 30 % the average cereal yield may not exceed 30 quintal per hectares livestock production is the second most important economic activities such as source of

income; draft power food and transportation. It provides dung that is important for both fuel and mourning crop fields. In the present the study area cattle 117,043, sheep 47,338, hens 39,788, goat 27,808, horses 5,587, mule 5,277, donkey 3,787 (M.A.R, 2011).

3.1. 2. Climate of the Study Area

The Mareqa Districts annul temperature ranges between 16°C-29°C while the mean annul temperature is 21°C. The annul range of rain fall between 900 mm-1800 mm and the period markedly a great variability in occurrence and volume (M.A.R, 2011). The types of rain fall in the region are relief type during summer season convectional type during autumn and spring season. Agro-climate of the region is commonly referred to as dega, Wayne-dega and kola where there is complex interaction between the relatively highest agricultural potential exhaustive resource usages (DZMS, 2011).

3.1. 3. Vegetation

The vegetation varies from semi-desert types in lowland areas to broad-leaved evergreen forest types in the highlands; some of the dominant homegarden and on farm tree species are *Ficus sycomorus, Erythrina abyssinica. Ensete ventricosum cheesman, cordia africana* and *Syzygium guineense* (Willd.)*. subsp guineense* and other indigenous species and some remnant tree species can be dominant in the study area. Under the present condition, the vegetation cover has been reduced to some extent and replaced by cultivated fields, grazing land and settlement and few indigenous plantations with remnant tree species. Currently, vegetation consists of evergreen or semi- evergreen and deciduous trees 2-5 meter small trees, bushes and/or shrubs and occasionally larger trees are much scattered (MAR, 2011). Wood lots and protection forests have been planted mainly along roadsides, in protected community forests. In general, the population in Dawuro Zone shares a cultural identity from enset vegetation of what is referred in Ethiopia as “Enset Culture Complex”, which is commonly characterized by high population density sustained by high yields of enset from small plot of land.

3. 1. 4. Soil and Topography

The area has rugged topography and the terrain of the land is sloppy in nature. The mountains and high plateaus have cool temperature moderated by the altitude and abundant rainfall. In kola agroecology of the study site near Zoa River and adjacent areas are dry and hot. The areas near river' gorges are not inhabited due to their unfavorable climatic conditions such as drought and due to the prevalence of diseases like malaria and trypanosomiasis. Majority of the population is engaged in subsistence agricultural activities combining both crop production and livestock rearing (mixed farming). Most of the soil in the study area has good physical properties and uniform profile, porous from clay to clay loam in texture and low base saturation and which are suitable for agriculture. Soil is one of the main factors determining the growth of plants in and around the home garden. For example, coffee can grow best on deep, free-draining, loamy soils, with good water holding capacity and slightly acidic soil (Anon, 1999; Kimani *et al.,* 2002; Lewis Ivey *et al.,* 2003). Soil fertility is important for good production. The potential production of crops is due to the presence of suitable altitude, ample rainfall, optimum temperature and fertile soil (Girma, 2004).

3.2. Methods

3.2.1. Sampling procedures

The study area was purposely selected based on the assumption of the agroforestry practices homegardens and on farm trees/shrub species assessment and sampled plot were laid on transect walk 40, 32 and 30 total 102 from dega, wayne-dega and kola respectively following (Watson and Eyzaguirre, 2002).

Tree assessment was carried out on traditional knowledge of agroforestry practices, their socio-economic and ecological contribution to conservation from three peasant associations (PAs) and conducted both household survey and tree assessment, these were undertaken to gather and collect.

Wealth ranked about nature of wealth of householders with respect to the community according to their wealth categorize by key informants as resource poor, resource medium and resource rich peoples on species diversities from HHs base on the local knowledge and prefer matrix ranking and pair wise method used selective species diversities for required information. The purpose of wealth ranking was to investigate how households in different agroecological areas manage and use homegarden and on farm wood plant resources. Prefers matrix ranking farmers on their favorite plants in their homegarden and on farm species diversity and pair wise ranking to compare between two kinds were a choice for ranking was applied. It is more useful for exploring the reasons why people prefer one possibility over another because of function of species and its improvement of livelihood in the communities of the study site and species richness, evenness, abundance and its frequency is defined as the percentage of diversity recorded and checked by Tukey's test and total land area were assessed for this study from Mareqa District.

Sample size determination

After getting the total number of household heads living in each selected villages, the next step were determining total sample size of the survey population, based on the established sample frame of the selected villages. Following this, total sample size was determined using probability proportional to sample size-sampling technique (Cochran, 1977).

$$no = \frac{Z^2 * (P)(q)}{d^2} \longrightarrow n_1 = \frac{no}{(1 + no / N)}$$

Where;

n_o = desired sample size (Cochran's, 1977) when population greater than 10000

n_1 = finite population correction factors (Cochran's,1977) formula less than10000

Z = standard normal deviation (1.96 for 95% confidence level)

P = 0.1 (proportion of population to be included in sample i.e. 10%)

q =is 1-P i.e. (0.9)

N = is total number of population

d =is degree of accuracy desired (0.05)

Based on Cochran's (1977), population correction factors a total of 120 sample household heads were selected using simple random sampling techniques for the study. Allocation of the number of sample households in each agroecological area was proportional to the number of household heads living in each sample village.

Household survey: For the purpose of this study, the head of the selected households were interviewed using a structured interview which covers a broad range of issues relevant in the process of assessment of indigenous and traditional agroforestry practices (Appendix 1). The structured interview was pre-tested by administering it to selected 6 respondents to evaluate the structured interview of quantitative data. On the basis of the results obtained from the pre-test, necessary modifications were made on a structured interview. Six enumerators and one researcher administered the household survey.

Homegarden and on farm tree assessment was administered to a sample of 120 household, from the total of 908 households from three agroecological zones of the study site. The stratification was 53 household from Eyessues dega agroecology 40 householders from gozoshaso wayne- dega agroecology and 27 householders form Tercha Zuriea kola agroecology Peasant Associations (PAs) selected for homegarden and on farm tree assessment from 102 farm plots selected from six villages (sub Kebele). A stratified random sampling approach was employed to draw samples in order to select representative farmers from each social class. Key informants were selected from six village five from Temanjyashe (sub keble), five from kontre (sub keble) and four from Shasho (sub keble), four from Sadame (sub keble) thre from Tercha Zuriea (sub keble) and three from Ensolla (sub keble) following tech nique developd by Grandine, (1988) later modified by Crowely, (1997). Therefore, in total of 24 key informants were selected from the six villages.

Table 1. Sampled households and of key informants

Agroecology	Total number of households	Household interviewed	Key informants in six study sites
Eyessues (dega) AEZs	408	53	10
Gozoshaso (wayne-dega)AEZs	300	40	8
Tercha Zuriea (kola) AEZs	200	27	6
Total	908	120	24

The aim of the household interview was to generate and verify quantitative data about the socio-economic and ecological roles of traditional agroforestry practices and to ascertain socio-economic (family size, farm size and educational statues) that affect agroforestry practices. Accordingly the variables used in analysis traditional agroforestry practices were presented. (Table 1).

Focus Group Discussion (FGD): key informants was conducted on household survey, basic descriptive information were collected at the kebeles and at village level. This technique helped to acquire useful and detailed information and discussion was made with randomly

selected (6 - 10) farmer's respondent under the guidance of a researcher. Checklist was prepared to guide topics for open-ended discussion with group of farmers (Appendix 2).

Key Informant Interview: The key informants are persons who are knowledgeable about agroforestry practices come in to agreement by a structured interview and to have a detailed insight into indigenous and traditional agroforestry practices in the areas, in-depth interviews and discussion covering different topics were also held with district agricultural experts, DAs, better-informed farmers and opinion leaders to verify the responses and to obtain additional information.This helped to capture some points that did not clearly come out from household i nterview.

3.2.4. Types, sources and methods of data collection

Types and sources of data of species diversity from each AEZs

The research was designed to assess traditional knowledge in agroforestry practice and plant diversity in three kebele on the target farm and homegarden species. Data were obtained from both primary and secondary sources. Primary sources were collected using a structured interview with both closed and open ended questioners for eliciting information from respondents that were randomly selected house hold from each agro ecological areas. Prior to conducting the interview pre-test of the interview was made. Key informants and the researcher were administering a structured interview at each Peasant Association (PA) to test its accuracy and efficiency in eliciting the required data. Also secondary data used for this study was collected from published and unpublished material such as office records and relevant reports, research papers and census records.

Methods of data collection

For such interwoven research issues with a combination of methods were used to collect relevant data. These include a structured interview schedule (individual interviews), focus group discussions, key informant interviews, and vegetation/tree assessment methods, which

were applied to collect detailed data on traditional knowledge on agroforestry practices In each transect walk between plots were 200 m difference in the agroecological areas, totally nine transect walk (3 from each agroecological area was made both on farm tree and homegarden diversity assessment) vertically and horizontal 20mX20m or (400 m^2). Prior to data collection the enumerators were selected and intensively six trained in the methods of data collection. The enumerators were agricultural technicians employed for the purpose of data collections.

3.2.7. Data analysis

Quantitative data from household a structured interview survey were coded, entered into Excel spreadsheet, and analyzed by using SPSS software Version16.0.

To determine species richness of each farm practices, species index (S), the total number of tree/shrub species on farm was calculated. This index does not indicate the relative proportion or abundance of a particular species on the farm. Therefore, the Shannon index (Shannon and Wiener, 1949) and Evenness measure (E) were used. Shannon's index takes into account the evenness or abundance of species (Peet, 1974). Shannon's diversity index (H^1) is low when few species are more abundant than the others and high when the relative abundance of the different species in the sample is even. It is calculated using the following formula.

Shannon Diversity Index

$$H = \sum_{i=1}^{s} - (P_i * \ln P_i)$$

Where:

H = the Shannon diversity index
P_i = fraction of the entire population made up of species i
S = numbers of species encountered
$\sum$ = sum from species 1 to species S

However, an additional measure of evenness (E), was calculated to compare the observed distribution for the maximum possible even distribution of the number of species in the

sample. The measure of evenness (E) or equitability is the ratio of observed diversity to maximum possible diversity and it is calculated using above formula.

$$\text{Evenness (E)} = H^1 / H^1_{max} = \sum_{i=1}^{S} P_i \text{ Ln } P_i / \text{ ln s}$$

Where *S*= the number of species

P_i = the proportion of individuals of the i^{th} species or the abundance of the i^{th} species expressed as proportion of total cover.

$\text{Ln} = \text{Log base}_n$

E has values between 0 and 1.0 where 1.0 represents a situation in which all species are equally abundant. The above indices are generally referred to as alpha diversity, indicate the richness and evenness of species within a locality but they do not indicate the identity of the species and where they occurs. Hence, variation in the composition of the species within different AEZs was determined. Similarity indices measure, the degree to which the species composition of different species is alike was analyzed too. Many measures existed for the assessment of similarity or dissimilarity between vegetation of sample plot choice available, by using Beta diversity (β) of SØrensen's community index of similarity (SØrensen, 1948). It is based on species numbers alone and does not take species abundance into account.

$$I \text{ (SØrensen)} = 2c / (2c+a+b)$$

where 'a' is the species number of assemblage A, 'b' the number of species in assemblage B, 'c' the number of species common to A and B because of Beta diversity (β) of SØrensen's community index of similarity.

4. RESULTS AND DISCUSSION

4.1 Socio economic characteristics of sampled households

The socio-economic characteristics of the sample households in this study sites were assessed for the purpose of the current study. Accordingly male (47.5 %) and female (52.5 %) study married (92 %) and divorced (10 %) HH of the community have interviewed. As a result in this study site socio economic characteristics of the community indicate that (89.2%) of their household participate on frame filed work and (90.2%) of the household participate in planting homegarden species. According to key informants interview result, livelihood of communities improved by participation of planting homegarden and on farm trees /shrubs/ species. The primary educational level (42 %) of the HH improved their income by homegarden tree /shrubs/ species of agroforestry practices. As a result species diversities the main income sources of the community which covered the educational cost, clothing and other home consumption cost (Table 2).

Table 2. Sampled variables of households in different AEZs of the study site

Socio-economic environment		Percent of total
Household head	male	47.5
	female	52.5
Land holding (size)	1. 0.25-0.5hac	2.9
	2. 1-1.5hac	50.0
	3. 2-4hac	47.1
How often participate	always	90.2
in homegarden	Rare	9.8
Marital status of the HH	Married	90.2
Marital status of the HH	Divorced	9.8
Participation in farm field work	yes	89.2
	no	10.8
Education level of the HH	not educated	15.7
	read and write	19.8
	primary school	42.0
	Others	22.5

HH = Household

4.1. 1. Indigenous Knowledge of Agroforestry Species in Study Area

4.1.1. 1. Tree /plant diversity in agroforestry practices

In this study Tree /plant diversity management in agroforestry practices were seen to be remarkable. The results indicated that about (12.7 %) of respondents confirmed that the tree species were managed by coppicing. The harvest from coppicing can be used to produce firewood and charcoal. It was noted that thinning makes the trees equivalent to being larger in diameter and about (20.6 %) of respondents in this study managed tree species by thinning (Table 3). It was also noted that coppice sprouts which is equivalent to straight stem is important consideration in management of coppicing. The other tree–management practice further mentioned was pruning almost (23.5 %) of respondents confirmed in the study area also noted for the protection from splash erosion which would have destroyed the crop. In general, the types of management employed vary from one agroecological zone to the other. Key informant group discussion that suitable time for cutting coppice trees is the beginning of December up to the end of April or shortly before the rainy season.

It was mentioned that the cutting of trees on June, July and August were caused decomposed. It was preferred to cut trees near the ground at a height of 5-30 cm mainly to protect the sprouts from splitting by wind and to obtain more sprout. It was noted that coppicing avoids the need to replant trees after harvesting. Generally, the most important farmers' indigenous tree management include thinning, pruning, controlling lopping, watering and coppicing are known homegarden and on farm tree management practices identified in each agroecological zone. As a result, *Persea americana, Syzygium guineense, Croton macrostachyus and Cardia africana* were rated as highly coppicing tree species if cut at an appropriate time easily regenerate after copping. In line wih this similar finding reported by (Biruk, 2006). Household agroforestry practices on farm trees/shrubs management in the study areas was in some extent sustainable (Table 3).

Table 3. Percentage of respondents using various tree- management practices

Plant diversity	Thinning	pruning	lopping	coppicing
Croton macrostachyus	0	25	13	12
Erythrina abyssinia	0	23.5	12.7	12.7
Syzygium guineense	0	23	0	13
Persea americana	22	20	30	14

4.1.1.2. Plant diversity management decisions and AF practices in different AEZs of the study

The result indicates that the decisions on farm species diversity in different agroecological areas taken by men of household. The tree-management decisions according to respondent's response about 11.7% *Acaicia abyssinica,* 5.8% *Cardio africana,* and 16.5% *Moringa stenopetala* decision were made by men (Table 4). It was also verified that most of the decisions of tree management were made by the men from the households due to cultural management system which is different from (Mathewos, 2008) studies of homegarden spices, condiments and medicinal plants management which is done mostly by women (Table 4).

Table 4 Plant species managements decision at homegarden and on farm species in the study plots

Species	*Managed by*	Frequency	Percent
Acaicia abyssinica	men	12	11.7
Brassica oleracea	women	12	12.7
Capsicum frutescens .	women	14	13.6
Cordia africana	men	14	13.6
Echinops kebericho	men	18	17.5
Ensete ventricosum	women	23	22.3
Moringa stenopetala	men	17	16.5
Total		**102**	**100.0**

4.1.1.3. The contribution of IK for AF practices in each AEZ of the study area

The results of this study revealed that across all agroecological sites homegarden and on farm tree species diversity major sources of household livelihood. About 50 %, 37 %, 20 % of respondents are agreed with importance of traditional knowledge for conservation of species diversities in dega, wayne- dega, and kola agroecological areas respectively. In addition to that about (107) respondents confirmed that traditional knowledge plays important role for species sustainability and about (13) of the respondents explained traditional knowledge was not important for species sustainability (Table 5).

Table 5. Informant's response on the importance TK importance for species sustainability

Agroecology	IK important for species sustainability	Not IK important for species sustainability	Total
Dega	50	3	53
Wayne- dega	37	3	40
Kola	20	7	27
Total	**107**	**13**	**120**

The traditional knowledge of community was identified according to key informant's group discussion and Focus Group Discussion (FGD). The results indicate that traditional knowledge of the community preserve plant diversity around the church, local grave and spiritual ceremonial places forests or kasha in Dawuro language. They are respected protected forests (kasha) and big trees as the elderly members of community and cultural leaders. This is because they believe that "God" destroys them and whole community if they cut big tress and (kasha) from culturally protected area.

In the study area communities after the death of some body on his/ her grave/ tomb planting selective indigenous tree species is common. Because they believe that the type of planted species on his/her grave/tomb refers dead person's strength on his/her life time and protecting the grave/tomb from replacement of others and this cultural species planting actively important for conservation and sustainability of species diversity. This view was informed by Focus Group Dissection (FGD) and key informant group discussion. The result is similar with

the report of Mathewos for indigenous knowledge of Loma and Gena Bosa Distracts community of Dawuro (Mathewos, 2008).

The study results indicated that traditional knowledge of leather processing artisans in Dawuro Zone Mareqa District for smoothing leather use the species called Gantwa (local name) *Amaranthus caudatus* and use castor been *Ricinus communis* (Xeema in Dawurao language) seed as an ink for painting and drawing different pictures on leather processing activities. Such traditional knowledge going on in study area as it was realized from participant observation and key informants interview and Focus Group Dissection (FGD). The reasons mentioned above all are cultural. This cultural activity has its own contribution for biodiversity conservation and sustainability.

Moreover, local people have accumulated knowledge that helped farmers to manage species for various uses. The study results indicate that (100 %) dega agroecology applied a certain ensete species which is infected by bacterial wilt. The communities use an option for controlling bacterial spread by uprooting the infected enset from the ground. They may unknowingly cut a leaf of infected species in this case they through in to fire to control the bacterial wilt spread. Planting species called Olomo (local name) scientifically known as *Pycnostachys abyssinica* which is to destroy bacterial wilt spread; another option is to rotate the enste plot with other crops such as taro and barley and also plant bacterial resistant variety of enset called Mazya (Local name) scientifically known as *Ensete ventricosum*. Community believes that for propagation of ensete and other species planted when moon appears because of the planted species were not decay. A similar finding is reported in Dawuro (Data, 1997).

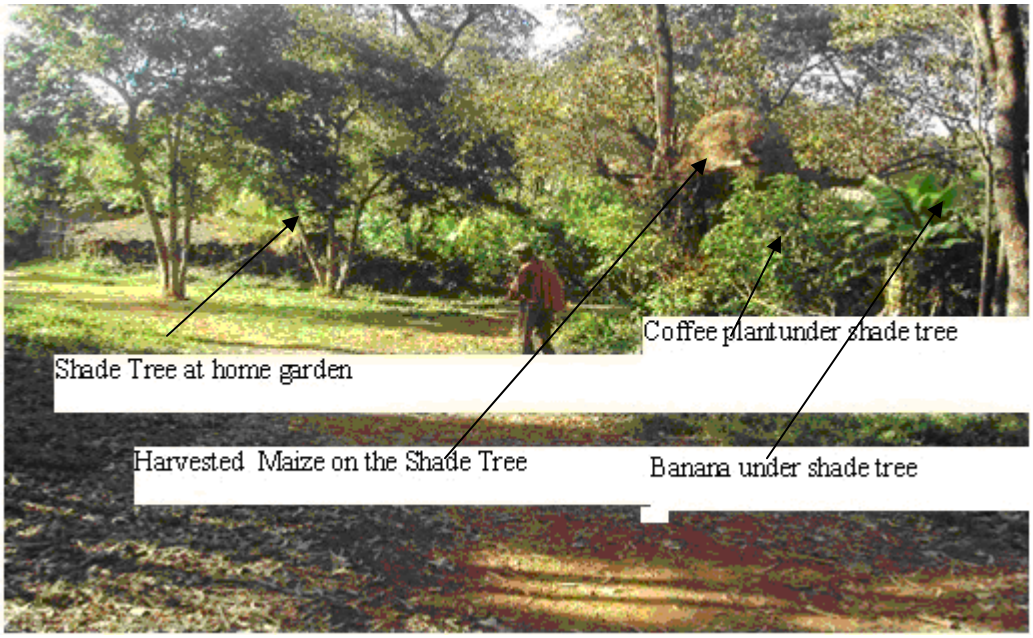

Figure 2. On farm species for various purposes in the study site.

The results showed that in wayne-dega agroecological zone species were managed for multiple purposes. Some of the uses which were identified in the homegarden areas of wayne-degas AEZs, trees are important regularly used for shade, growth of tree /shrubs under shade and collection of harvested crops. It also serves in protection of crops from pastes and weevils' infection for long period of time. Studies indicated that homegarden and on farm tree conservation, development and sustainable utilization of the country's resources should involve the participation of the people and benefit the communities concerned and should include the prohibition of excess resource extraction and land use of farming and grazing in the priority forest areas (Appendix 8). Moreover, it is decisive to establish the people's rights and their responsibilities to create multiple opportunities for better livelihood through the local diversity management. Poverty reduction is closely linked with natural resource conservation, because poor people in developing countries depend on natural resources for their livelihoods (Danida, 2007). It is therefore important to ensure sustainable management of these resources.

4.1.1.4. Homegarden and on farm tree species management on sampled plots

Homegardens are rich in species diversity than in areas far away from home due to hipping and spreading of household wastes at the homegardens. According to the informants, the importance of hipping and spreading of house hold wastes for manuring their homegardens for planting species diversities such as Brassica *oleracea, Capsicum frutescens, Ensete ventricosum and Mangifera indica* in order to develop their income and improving their livelihood by planting varies species at homegardens (Figure 3). A similar finding is reported in Kefa (Zemede, 2004).

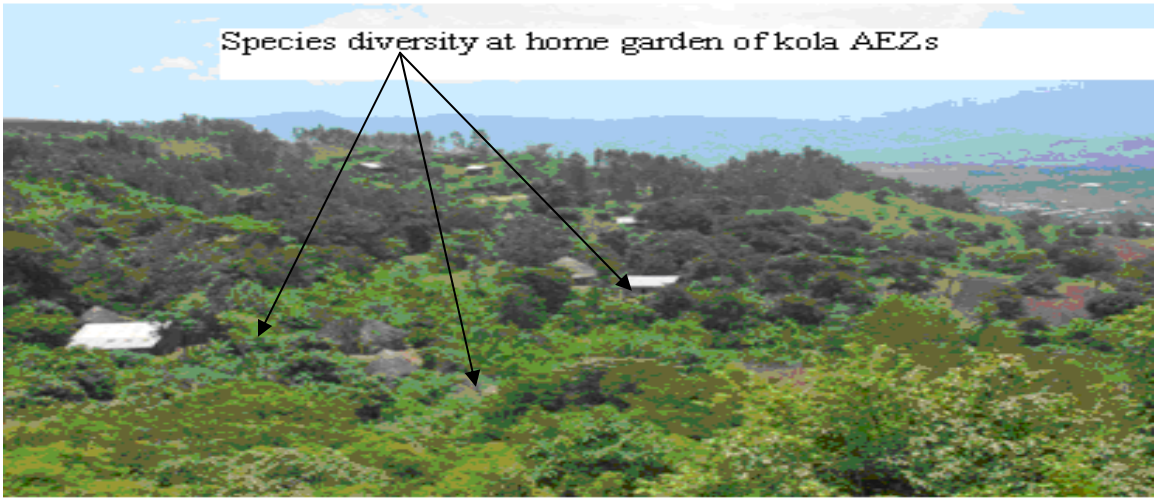

Figure 3. In Dawuro Tercha Zuria study site homegardens species richness in kola AEZs

On the other hand, the culture of the community obligating individuals planting various species and managing them on their homegarden and on farm area has important contribution for sustainability of species. The individual who cannot properly mange species diversity at homegarden and on farm land is neglected from social activities such as ekube, eider and dabo etc. The community stops cooperation with him on any social activities, as this view informed by focus group (FGD) and key informants discussion in the study areas of each agroecological site (Appendix 2). As result the nature of homegardens and on farm species diversity in the study area is rich and tree species number generally decreases away from the h

ouse, while number of individuals of single species like *Ensete ventricosum, Brassica olerace a and Capsicum frulesces, Cordia africana, Mangifera indica Persea americana and Cordia africana* species were grown increases.

4.1.1.5. Constraints of on farm trees/shrubs management in each agroecological areas of the study site

Community of three different agroecological areas of the study sites listed different constrains like poor land use in agroforestry practices, land shortage, animal damage, lack of transport accessibility, climatic influence including an unexpected rain fall and fluctuation and lack of awareness with respect to not planting right tree species at appropriate place during the planting season (Table 6).

Nevertheless, the nature of the constraints varies from one agroecological zone to others. According to informants response in dega agroecological area, animal damage on species diversity is about 26.2 % and about 19.4 % of land shortage for planting diversified species in this study. About 14.6 % wayne-dega and kola agroecology informants described that poor land use in agroforestry practices is the main problem of planting and surviving trees/shrubs (Appendix 9). About 17.5 % of the households in the three agroecological areas of the study site explained that lack of transport hinders marketing freshly harvested vegetables and other cash crops and about 14.6 % of informants informed that in wayne dega and kola agroecological area of the study site also has climatic influence (drought) are constraints to expand on farm planting and homegarden tree/shrub species (Table 6). Similar findings reported about tree/shrub managements constraints by (Biruk, 2006).

Table 6. Constraints of home garden and on farm tree management in different AEZs

	Frequency	*Percent*
Animal damage	27	26.2
Climatic influence	15	14.6
Lack transport	18	17.5
Lack of awareness	17	17.5
Land shortage	20	19.4
Poor land use in agroforestry practices	5	4.9
Total	102	100.0

4.2. Plant Diversity of on farm and HGs each Agroecological Sites in Dawuro

4.2.1. Species diversity collected for analyses from different AEZs of study site

The major findings in this study revealed that 17 at homegarden and 34 on farm total 51 tree/shrubs species (Table 6). As a result homegarden and on farm plots species diversity collected for analyses.

Table 7. Identified homegarden and on farm tree/shrub species in each AEZs

Scientific name	nich	Family name	Dawro name	Use
Acacia abyssinica Hochst. ex Benth	On-farm	*Fabaceae*	Odoruuwa	Shade tree &Constriction
Arundinaria alpina K. Schum	On-farm	*Poaceae*	Woosha	Constriction
Arundo donax L	On-farm	*Poaceae*	Usuntha	Constriction
Brassica oleracea L.	*homegarden*	*Brassicaceae*	Asotiya santha	Source of food
Capsicum annuum L.	*homegarden*	*Solanaceae*	Bambbariya	Source of food
Capsicum frutescens L.	*homegarden*	*Solanaceae*	Miximixuwa	Source of food
Carica papaya L.	*homegarden*	*Caricaceae*	Paappa	Source of food
Carissa spinarum L.	On-farm	*Apocynaceae*	Laadiya	Source of food
Casimiroa edulis La Llave	*homegarden*	*Rutaceae*	Kasmiriya	Source of food
Casuarina equisetifolia L.	On-farm	*Casuarinaceae*	Faranjjiya xiidaa	Shade tree & Constriction
Catha edulis (Vahl) Forssk. ex Endl.	*homegarden*	*Celastraceae*	Jimaa	Cawing
Citrus aurantifolia (Christm.) Swingle	*homegarden*	*Rutaceae*	Loomiya	Medicinal planet
Citrus sinensis (L.) Osb.	*homegarden*	*Rutaceae*	Birttukaniya	Income generation
Colocosia esculenta (L.) Schoott	*homegarden*	*Araceae*	Boyina	Source of food
Coffea arabica L.	*homegarden*	*Rubiaceae*	Bunaa/Tukkiyaa	Mulled stimulant &Income
Combretum molle R. Br. ex G. Don.	On-farm	*Combretaceae*	Sobuwa	Constriction
Cordia africana Lam.	On-farm	*Boraginaceae*	Moqothaa	Shade tree & Constriction
Croton macrostachyus Del.	On-farm	*Euphorbiaceae*	Anka	Shade tree & Constriction
Cuperssus lusitanica Mill.	On-farm	*Cuperssaceae*	Xiida(CadiyaHayithawa)	Shade tree & Constriction
Dioscorea abyssinica Hochst. ex Kunth	On-farm	*Dioscoreaceae*	Boyiiya	Source of food
*Dombeya torrida (*J.F. Gmel.) P. Bamps	On-farm	*Sterculiaceae*	Looluwa|Boshshuwa	Shadetree
Echinops kebericho Mesfin	*homegarden*	*Asteraceae*	Bursa	Medicinal planet
*Enset ventricosum (*Welw.) Cheesman	*homegarden*	*Musaceae*	Utha	Source of food
Erythrina abyssinica Lam. ex DC.	On-farm	*Fabaceae*	Borttuwaa(Gadhaawa)	Shade tree& soil fertility
Eucalyptus globules Labill.	On-farm	*Myrtaceae*	Barzzafiya (Bootha)	Constriction and fire wood
Euphorbia candelabrum Kotsschy	On-farm	*Euphorbiaceae*	Qaaqaa (Gadhaawa)	Constriction

Continuous

***Ficus sycomorus* L.**	**On-farm**	***Moraceae***	**Wolaa**	**Shade tree**
***Gnidia glauca (*Fresen.) Gilg.**	**On-farm**	***Thymelaeaceae***	**Migraa**	**Fire wood &fodder**
***Grevillea robusta* A.cunn. ex R. Br.**	**On-farm**	***Proteaceae***	**Gravilliyaa**	**Constriction**
***Maesa lanceolata* Forssk.**	**On-farm**	***Myrsinaceae***	**Gegecuwa**	**Fire wood**
***Juniperus procera* Hochst. ex Endl.**	**On-farm**	***Cuperssaceae***	**Xiida (Abashawa)**	**Shade tree & Constriction**
***Justicia schimperiana (*Hochst. ex. Nees) T. Anders.**	**On-farm**	***Acanthaceae***	**Santhaliya/Taadaqaa**	**Medicinal planet**
***Malus sylvestris* Miller**	***homegarden***	***Rosaceae***	**Appliya**	**Source of food**
***Mangifera indica* L.**	**On-farm**	***Anacardiaceae***	**Manguwa**	**Source of food**
***Milettia ferruginea (*Hochst.) Bak.**	**On-farm**	***Fabaceae***	**Zaagiya**	**Shade tree**
***Musa x paradisiacal* L.**	**On-farm**	***Musaceae***	**Muuziya**	**Source of food**
***Ocimum canum* Sims**	***homegarden***	***Lamiaceae***	**Zitiituuwa**	**Source of food**
***Pennisetum thunbergii* Kunth**	**On-farm**	***Poaceae***	**Bar77eya**	**Source of food**
***Persea americana* L.**	**On-farm**	***Lauraceae***	**Abokatuwa**	**Source of food**
***Phoenix reclinata* Jacq.**	**On-farm**	***Ariaceae***	**Zambaa**	**Shade tree**
***Polyscias fulva* (Hiern.) Harms**	**On-farm**	***Araliaceae***	**Kalshaa**	**Shade tree& bee harvesting**
***Prunus africana* (Hook.f.) Kalkm.**	**On-farm**	***Rosaceae***	**Ontha**	**Shade tree**
***Prunus persica* (L.) Batsch**	***homegarden***	***Rosaceae***	**Kokiya**	**Food source**
***Pycnostachys abyssinica* Fresen.**	***homegarden***	***Lamiaceae***	**Olomuwa**	**Medicinal planet**
***Saccharum offiicinarum* L.**	***homegarden***	***Poaceae***	**Shonkoraa**	**Income genaration**
***Syzgium guineense var. macrocarpa* (Engl.) F. White**	**On-farm**	***Myrtaceae***	**Wodentha**	**Shade tree**
Syzygium guineense* (Willd.) DC. *subsp guineense	**On-farm**	***Myrtaceae***	**Ocha**	**Shade tree**
***Vernonia theophrastifolia* Schweinf. ex Oliv. & Hiern**	**On-farm**	***Asteraceae***	**Buuzuuwa**	**Fire wood**
***Vepris danellii* (Pichi-Serm.) Kokwaro**	**On-farm**	***Rutaceae***	**Cawulaa**	**Medicinal planet**
***Vernonia amygdalina* Del.**	**On-farm**	***Asteraceae***	**Garaa**	**Medicinal planet**
***Terminalia schimperiana* Hochst.**	**On-farm**	***Combretaceae***	**Ambbiya**	**Constriction**
Voculor no species diversity	**51**			

AEZ= Agroecological zone

4.2.2. Diversity of traditional agroforestry species in different AEZs of the study site

The result indicates that the study area was rich in both homegarden and on farm tree/shrub species diversity. From the total 14.8 %, 7.60% and 44.9 % in dega, wayne-dega and kola agro ecological area homegarden and on farm tree assessed respectively (Table 8). List of the identified species for different agrecologies are indicated (Apendices 8, 9 & 10). Some of the differences in number of species richness in dega, wayne- dega and kola agroecological areas were because of fertile soil, sufficient rain fall and suitable temperature for species growth period. Similar findings were reported by Girma (2004).

Concerning the tree inventory, the study had 22 seedlings of indigenous tree species whose DBH< 2.5cm from dega, wayne-deg and kola AEZs and in the same way 13 indigenous mature tree species whose DBH > 10 cm assessed for this study. Totaly 35 indigenous tree species were counted, recorded and measured for this study. As result from dega agroecology a total of 15 species that is 10 seedlings and 5 mature indigenous tree species were recorded; in the same way from waynae dega agroecology a total of 13 species that is 8 seedlings and 5 matured tree species and from kola agroecology a total of 7 species that is 4 seedlings and 3 matured tree species recorded of indigenous types were counted and recorded for this study.

As the result at old stage mature tree species decline from year to year this is because of use by the community for various purposes such as for timbering, for grazing land and new farm land deforesting indigenous species there was increase to some extent in seedlings some extent increase from year to year and this indicate in the study area there was sustainability of species biodiversity. This was evidenced by inverted j on the graph of diameter at breast height (DBH) (Figure 2). A similar pattern is reported by Thompson *et al.*(2006).

Table 8. Identified plant species diversities in dega, wayne-dega and kola agroecological area for this study

Species	Dega AEZs		Total	100%	Wayne dega AEZs		Total	100%	Kola AEZs		Total	100%
	Home garden species	on farm species	species	percent	Home garden species	On farmspecies	species	percent	Home garden species	on farm spees	species	percent
Acacia abyssinica	0	3	3	3.7	0	1	1	7.60	0	0	0	0
Brassica oleracea	4	0	4	14.8	0	0	0	0	0	0	0	0
Cordia africana	0	0	0	0	0	0	0	0	0	0	1	9.09
Capsicum annuum	1	0	1	3.4	1	0	0	0	0	0	0	0
Capsicumfrulesces	6	0	6	22	1	1	1	7.60	0	0	0	0
Ensete ventricosum	4	0	4	14.8	1	0	0	0	2	0	2	18
Erythrina abyssinia.	0	4	4	14.8	0	1	1	7.60	1	0	0	0
Mangifera indica	1	0	1	0	2	0	0	0	0	1	1	9.09
Moringa stenopetala	0	0	0	0	2	0	0	0	1	1	2	18
Moringa stenopetala	0	0	0	0	0	1	1	7.60	2	2	4	44.9
Syzygium *guineense*	0	2	2	7.4	0	1	1	7.60	0	1	1	9.09
Persea americana	1	1	2	7.4	0	1	1	7.60	0	0	0	0
Total	17	10	27	100	7	6	13	100	6	5	11	100

4.2.5. Trends in tree growing practices

The tree/shrub species identified in all AEZs are used for a wide range of purposes. Holden *et al* (2005) analyzed the potential of tree planting to improve household welfare in the less favored areas of Amhara region, using a bio-economic model. They considered particularly the potential of planting *Eucalyptus* trees as a strategy to alleviate poverty in a less-favored area of the Ethiopian highlands. In this study the respondents that in each agroecological areas homegarden and on farm tree planting trend assessed as result species planting trends (17.6 %) increase and (15.7 %) decreasing (Table 9). As result in Dega agroecological area of the study site *Persea americana* are the most frequent and abundant species occurring in (38 %) and *Erythrina abyssinica* (36 %), *Syzygium guineense* (35 %) total recorded from 40 plots. In wayne-dega agroecological areas the most frequent and abundant species were *Persea americana* (24 %) from 32 plots and from kola agroecology the most frequent and abundant are *Mangifera indica* (23 %) from 30 farm plots (Table 9).

One hundred twenty households confirmed that they changed farm species cover compared to the past. The present tree/shrub planting nature has increased little about (38.5 %) of *Brassica oleracea* highly increased species informed by key informant's group discussion. The cause of increasing species cover change in the study area was the interest of community planting various species on their homegarden and on farm lands for income generation and understanding tree /shrub planting advantages of improving their livelihood status. But the indigenous species diversity is highly decreased. The reason is that community gives priority for planting income generating tree species rather than for other purposes. This report differs from Abebaw, (2006) percentage of respondents' who identified trees/shrubs decrease over time in PA of study site (Table 9).

Table 9. Tree/ shrubs species increases over past 7 years in each AEZs of the study site.

Species/ Shrub	Tree/ Shrub species change in the past 7 years and present.	*Frequency*	*Percent*
Acacia abyssinica	Decrease little	20	19.6
Brassica oleracea	Increase little	39	38.2
Cordia africana	Decrease	16	14
Mangifera indica	not changed	6	5.9
Moringa stenopetala	no idea	3	2.9
Persea americana	increase	18	17.6
Total		102	100.0

4.2.6. On-farm trees planted and retained in each agro ecological area

Farmers of each agroecological area in this study planted and retained (a farm original vegetation some of them are not local) existing tree species for their benefits. About 40 % of the respondents in dega AEZ explained that *Persea americana* was retained *the* total planted 38 % with previously existing *Persea americana and the term retained indicate that* before planting the seedlings of planting species. About 37 % *Erythrina abyssinia* retained from the total of 36 % planted previously existing *Erythrina abyssinia* and out of 35 % the planted *Capsicum annuum* the 35 % of it was retained (Table 10). In wayne-dega AEZ respondents explained that 29 % of *Persea americana tree were* planted from the total of 30 % retained previously existing *Persea americana*. About 27 % *Erythrina abyssinica* planted from the total of 29 % retained with previously existing *Erythrina abyssinica*, About 30 *%* of *Capsicum annuum* retained from the total of 28% planted previously existing *Capsicum annuum* (Table 10). In kola agroecology:

About 25 % *Erythrina abyssinica* species planted from the total of 26 % retained. with previously existing *Erythrina abyssinica*, About 24% *Persea americana* planted from the total of 25% retained previously existing *Persea americana* and About 23 *% Capsicum annuum*.planted from the total of 26 % retained previously existing *Mangifera indica* (Table 10). There was similar tree species conservation and methods of planting in the study area and each agro ecological areas the dominate tree species were identified and the management strategy and conservation systems were also observed. The causes for this planted and retained similarity in

the study areas are communities have the same culture, management strategy and conservation methods (Table 10).

Table 10. Plant diversity planted and retained trends of each AEZs

Agro ecology Zone	Species	Frequency		Percent planted and retained	
		Planted	Retained	Panted	Retained
Dega (NHH=40)	*Capsicum annuum*	37	40	35	35
	Erythrina abyssinica	30	34	36	37
	Persea americana	35	38	38	42
Wayne- dega (NHH=32)	*Capsicum annuum*	26	29	28	30
	Erythrina abyssinica	24	27	27	29
	Persea americana	37	42	29	30
Kola (NHH=30)	*Capsicum annuum*	25	29	23	26
	Erythrina abyssinica	23	27	25	26
	Persea americana	24	27	24	25

NHH = number of households, Retained = tree/ shrubs preserved from original species by management

A wide variety of traditional agroforestry practices and their combinations were observed on the homegardens and on farm tree in dega, wayne dega and kola agroecological area. Similar finding reported by (Biurk, 2006) these tree/shrub species are managed in different traditional agroforestry practices.

4.2.7. Species diversity

The local people of Dawuro managed diversified plants through vertical and horizontal in their homegardens as well as on farm area in order to generate different benefits (Table 11).

As a result in this study species diversities showed that from a total of 102 sample plots 27 species,13 species and 11 species from 2.7/ha,1.2/ha and 1/ha of land from dega, wayne-dega and kola agroecological site homegarden and on farm identified respectively. In dega agroecogical zone the Shannon's diversity index was 2.156 and Evenness was 0.4675, (Table 6) Tukey test indicated non significant different($P>0.05$) in species diversity in wayne-dega

and kola (Table 6). Hence, in the cause of agroecological connectivity of the study area, species diversity in some extent was the same.

Homegarden and on farm tree/shrub species on the farmers managed landscapes of the dega, wayna- dega and kola are to some extent similar. Few differences in species diversity in and around each homegarden and on farm tree species were identified in each agroecological area of the study site. These variations came from different sources: size of homegarden (annuals, perennials and biennials of different species are cultivated in small sized HGs) and on farm, socio-economic background (the poor cultivating income generating species), and altitude (diversity increases with elevation), different soil fertility level, climatic influence such as drought.

In this study, dega agroecological area beta diversity differs from that of wayne dega and kola agro ecological areas because of the community of the study area in these area have similar homegarden and on farm tree management strategy. On farm species composition dissimilarities increase with increasing distance between the interviewed sites. The trend shows that as distance between the sample sites increases the beta diversity of species increases. The range of distance in km between the sites lies between 6 km and 27 km. on-farm species composition dissimilarities between increases with increasing altitudinal differences between the sites. The result shows that as the difference in altitude between the sites increase the beta diversity of species also increases.

This further indicates that the structure of HGs and on farm area and the management system of plants in homegardens and on farm area similar in agro ecological areas of the study site. This is because of cultures of the community (Appendix 4). Species diversity, calculated for the agroforestry practices (homegarden, and on farm agroforestry practices), within each agroecological areas of the study site using Shannon diversity index indicated that there was non significant difference ($P > 0.05$) for all AEZs of the study site similar to the report on diversity of homegardens in Loma and Gena Bosa wereda (Mathewos, 2008).

The mean difference in the study areas of dega, wayne- dega and kola agroecology indicated by beta diversity index which 1% and 0 % analyzed and recorded in dega, wayne- dega -dega and kola agroecological areas of the study site (Table 11). Similarly, the mean species evenness calculated for the different agroforestry practices did not show statistically significant difference ($P > 0.05$) for the kola and the wayne- dega zones. However, for the wayne- dega and the kola zones species evenness of homegardens was statistically significantly differ according to the results of beta Diversity. Hence, in dega homegarden and on farm tree species were rich than that of wayne- dega and kola agroecological area (Table 11).

Mean evenness of species for the homegardens was lower when compared with both home garden and on farm agroforestry practices in the wayane- dega and kola agroecoogical areas of the study site. Similarly, the average species richness of home gardens of wayane- dega and kola differ significantly ($p > 0.05$) from species richness of both homegardens and on farm agroforestry practices of the dega agroecological areas of the study areas. Likewise, in the dega agroecological areas the species richness of homegarden and on farm agroforestry practices were little differing significantly. Therefore in this study three agroecological sites were rich in home garden and on farm species diversities (Table 11).

Table 11. Shannon's diversity index, evenness and richness across each AEZs

Identified species	Diversity index	Agro ecology														
		40 Plots in Dega AEZs					32 Plots in Wayne dega AEZs					30 Plots in kola AEZs				
		Species Frequency					Species Frequency					Species Frequency				
		P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	p 1	P2	P3	P4	P5
Acacia abyssinica		30	20	28	25	22	10	7	4	12	8	5	3	2	5	5
Brassica oleracea		25	30	20	33	18	7	9	10	8	8	4	4	3	4	5
Capsicum annuum		15	20	25	19	26	0	0	0	0	0	0	0	0	0	0
Capsicum frulesces		17	16	18	25	20	6	4	5	7	8	4	4	5	5	2
Cordia africana		30	30	17	30	30	7	9	5	10	6	4	5	4	5	3
Echinops kebericho		25	30	20	25	20	6	10	5	10	6	4	5	5	4	6
Ensete ventricosum		25	30	36	30	30	9	9	9	6	8	4	4	3	5	3
Erythrina abyssinia.		25	30	35	24	28	9	6	5	5	9	4	6	5	3	3
Mangifera indica		20	30	28	20	27	5	10	6	5	9	4	3	3	2	5
Moringa stenaptala		30	30	30	25	35	6	9	9	7	9	4	3	4	3	5
Persea americana		25	30	30	36	30	10	9	5	7	8	4	3	5	3	3
	Shannon's diversity index	2.156					1.978					1.637				
	Mean Evenness (E)	0.4675					0.7232					0.8632				
	Mean Richnes	11					10					10				
	Beta Diversity	1					0					0				
	Alpha diversity	**27**					**13**					**11**				
	Tukey test	12					10					10				
	p-value	1.83					2.10					2.90				
	surved land /ha	2.7/ha					1.2/ha					1/ha				

Code.*Beta Diversity: 0 = indicate similar species diversities. 1= indicate different species diversities.*ha=heate
p1= plot2, P2=plot2, P3=plot3, P4=plot4 and P5=plot5

Shannon's index accounts for both abundance and evenness of the species diversity in the three agroecological areas, Species evenness refers to how close in numbers each species in the study sites. Species richness is the number of different species represented in the landscape of the study site in different agroecological area .Beta diversity the total species diversity in the landscape which is determined by two different things, the mean species diversity at the habitat level and the differentiation among AEZs Alpha diversity that the total species diversity in different agroecological areas of the study site and Turkey's test, is a single-step multiple comparison procedure and statistical test. It is used to find means that are significantly different from each other. P-value is the probability of obtaining a test statistic at least as extreme as the one that was actually observed, assuming that the null hypothesis is true or not which show in the AEZs of the study site and served land /ha in this study indicate in different AEZs indicate data collected sites in different AEZs.

4.2.8. Diversity of traditional agroforestry species

Diversified traditional agroforestry practices that maintained rich species diversity and production of different tree/ shrubs species for various purposes in homegarden and on farm have been observed. Species have been planted and retained on farm land different agroecolgical area. The findings also confirmed well and supported with other similar studies (Prado and Weber, 2003) in which reported that it was local participation and IK an important roles to play to improve planting various species for sustainable management in many parts of the world.

Moreover, the results of the present study examined homegarden and on farm tree species richness in traditional agroforestry practices. According to Tesfaye (2005), a total of 120 tree/shrub species without including fruit trees and coffee from the homegarden of Sidama and among this 21 exotic tree/shrub species were recorded. Species dissimilarities occurred by individual's management system, rain fall, temporal, and elevation differences.

For instance in the homegardens of southern Ethiopia, dissimilarities in the composition of tree species increased with increasing geographical distance and elevation differences between the sites (Tesfaye, 2005). In this study site, the dega, wayne dega and kola agroecological area various indigenous tree species of mature tree and seedlings assessed and indicated the sustainability of species. In each agroecological areas various tree species diversity were investigated from different homegardens and on farm land. Comparison of the past and the present scenario of planting various species on their homegarden and on farm lands is substantially enhanced. This is because of community's knowledge in tree planting reward improving their livelihood status. Cooke *et al. (*2008) reported that the household level is essential especially for the choice and targeting of fuel wood related interventions.

4.3. Multi-purpose Agroforestry Plant Species in the Study area

4.3.1. Multi-purpose use on farm tree and HGs species in the study sites

Farmers have nurtured trees on their farms, pasture land and around homes for millennia to satisfy their livelihood needs. These trees were later on defined as multi-purpose trees which provide fodder, firewood and also replenish nutrients in soil. The multi-purpose natures of trees in each agroecological areas maintained by traditional agroforestry practices of the study site were identified. Some of uses of tree species are firewood, medicine, fodder, construction and income generation identified in each agroecological zones (AEZs) of the study site. The dominant species in the study site were *Cordia africana; Echinops kebericho* and *Mangifera indica*. The more uses a plant has for local people, the more conservation of that plant resource through cultivation and protection in and around homegardens and farm areas. However, the size of homegarden, the agroecology and the type of soil and individual needs determine the number and type of each species grown in the homegardens. In addition, almost all of the identified species were known to have multiple uses (Table 12).

In the study informants identified about 23.5 % of species used as food source, 22.5 % of species used for construction, 20.6 % of species used for shade, 15.7 % of species used for income generation, 6.9 % of species used for medicinal value (Table 12). Accordingly, *Brassica oleracea* in dega agroecological areas of the study site is used for income generation, food

source, soil fertility top rank followed by *Cordia africana* uses. Similarly Hodgkin (2002) reported that homegarden is a micro-environment composed of a multi-species.

Table 12. Multiples use diversity of on farm tree and HGs species across AEZs.

Species	Use	*Frequency*	*Percent*
Acacia abyssinica	Shade and fire wood	24	23.5
Brassica oleracea	food source & income	23	20.6
Cordial africana	Shade and construction	7	6.9
Echinops kebericho	medicinal plant	5	4.9
Enset ventricosum	as food source	6	5.9
Moringa stenopetala	food source and shade	21	22.5
Persea americana	as food source &shade	16	15.7

4.3.2. Major cash source in agroforestry practices in the study area

In this study, homegarden and on farm diversity refers to the traditional land use practices around a homestead. Several species of plants are planted and maintained by households and their products are intended primarily for household consumption and for cash (income generation). A tree fruit production is a major activity in the study site identified. About 17.6% of respondents explained that *Mangifera indica,* 16.7% of *Capsicum annuum, Cordia africana* 24.5% are some of commercial tree species used as a source of income in each agroecological sites of the study area (Table 13).

Table 13. Major income sources in different agro ecology of in the study site

Species	Frequency	Percent
Acacia abyssinica	13	12.7
Brassica oleracea	9	8.8
Capsicum annuum.	6	5.9
Capsicum frutescens	5	4.9
Cordia africana	25	24.5
Ensete ventricosum	3	2.9
Mangifera indica	18	17.6
Moringa stenopetala	17	16.7
Persea americana	6	5.9
Total	**102**	**100.0**

The results of the present study revealed that across each agroecological zone homegarden and on farm tree plantations are the major sources of household livelihood. The practice of agroforestry served as a mechanism for farmers for planting multiple species as a source of food and cash. The predominant farm based economic activities in the study area are home garden and on farm tree production (commercial tree species production and tree fruit production). In addition to other benefits the scale of products produced in homegardens significantly improves the family's financial status. The contributions of homegarden and on farm commercial tree growing to household income generation is used to maintain or improve living conditions especially to purchase household materials, crop seed, and agricultural tools and cover health, education and festival costs. Income sources are specifically higher in the whole study sites. The trend of agroforestry practices planting of different species in homegarden and on farm is important in order to improve the livelihoods of the community (Table 13). Eyzaguirre and Linares (2004) reported that homegardens and farm diversity involve the management of multipurpose trees, shrubs, annual and perennial agricultural crops, herbs, spices, medicinal plants and animals on the same land unit, in a spatial arrangement or on a temporal sequence.

Multi-purpose agroforestry plant /tree species

In this study site, multi-purpose nature of trees was identified in each agroecological areas. Although a number of trees can be used for the same purpose in the homegarden and on farm tree, the others were with multiple uses. A number of studies reported that home gardens and on farm trees are producing a high percentage of fruits and vegetables consumed by homegardening families. Farmers always plant valuable fruit tree and other cash crop trees in home gardens that add to the high diversity of the homegardens. According to Subedi *et al* (2004) homegardens with their intensive and multiple uses provide for households when food is scarce. Some important uses of tree species are firewood, medicine, fodder, construction and income generation identified in each ecological zone. A homegarden is a micro-environment composed of a multi-species (annual to perennial, root crops to climbers etc), multi-storied and multi-purpose garden situated close to the homestead (Hodgkin, 2002). As the number of on-farm cash generating tree/shrub species increases the number of non-cash generating trees/shrub species

proportionally decreases. Multipurpose tree species on the farm are fast growth nature compared to other indigenous species.

4.3.4. Key informants wealth ranking based on AF tree /shrub species in the study area

4.3.4.1. Resource distribution based on land holding size

The majority of the respondents in the study sites of dega and weyna dega agroecology had a small land holding/tenure with different range. As a result, the allocation of land from 0.25-4 ha differences were recorded during data collection in each agroecological area of the study site. The average total area of the surveyed farms in three PAs is 2.4 hectares and the overall mean farm size per household in all the studied areas is 1.8 hectare. The pattern of distribution of resources in each agroecological area was *Persea americana, Syzygium guineense,Erythrina aby ssinia, Ensete ventricosum Cordia africana, Capsicum frulesce, Echinops kebericho and Acacia abyssinica* in dega ,wayne- dega and kola agroecological recarded and their average numbers depend up on land holding size and total survey land in each agroecological area. The interviewed farmers explained that they planted trees on their farm boundary for various purposes. But much of their land was already allocated for crop production and grazing to feed their families and they do not have extra land to plant trees .In this study, the homegarden and on farm tree in each agroecological areas of the study site were dominated by species use for construction and food source. There was no significant correlation found between farm sizes and resource wealth background of the household heads. This implies that resource rich farmers do not necessarily have large land sizes (Table 14).

Table 14. Species diversity, plot and land holding size in/ ha/ in each AEZs

Agro-ecology zone	Species	Total survey Plot/ha	Maximum individual land holding size	Minimum individual land holding size	Mean /ha in each agroecology
Dega	*Ensete ventricosum* *Echinops kebericho* *Erythrina abyssinia* *Persea americana*	2.7ha	2ha	.25ha	
Wayna-dega	*Cordia Africana* *Capsicum frulescens* *Syzygium guineense* *Persea americana*	1.2	2.25ha	1ha	1.8ha
kola	*Acacia abyssinica* *Capsicum frulescens* *Cordia Africana* *Syzygium guineense*	1ha	4ha	1ha	
Total		4.9ha		-	1.8ha

ha= hectares

4.3.4.2. Wealth ranking by key informants

According to the key informants classification three wealth categories were identified: resource poor, resource medium and resource rich for wealth ranking based on farm tree and homegarden species diversities land size income source and livestock population used as criteria. Each key informant was then asked to give the criteria he/she used.

Accordingly, resource poor people's land holding size was 0.25-0.5 hectares in homegarden and on farm area were limited number of cash source species diversities not more than 2 -5 in number both on farm land and homegardens, livestock population also limited more than two in number and limited income sources not more than 1000 birr/a year. Resource medium people's land holding size was 1-1.5 *hectares* species diversities in homegarden and on farm area were better than that of resource poor 5-10 species diversities and cash source species diversities were more than 10 in number and more than 15 livestock population annual income more than 5000 birr/ a year. On the other hand resource rich people's land holding size 2-4 *hectares* and the species diversities at homegarden, on farm and cash source species were more than 15 in number and over 50 livestock population as income sources more than 10,000 birr/a year identified for this study. The ranking criteria used by key informants in each PA of each agroecological zone are presented in (Table 15).

Table 15. Wealth ranking of key informants in each AEZs of study site

Criteria	Resource poor	Resource medium	Resource rich
Owned land from 0.25- 0.5 hectare	1	X	X
Owned species number not more than 5 in HGs and on farm land	1	X	X
Owned cash source species not more than 2 in HGs and farm land , two cattle and limited about 1000 birr income / year	1	X	X
Owned land from 1-1.5 hectares	X	1	X
Owned species more then 5 and less than 10 in HGs and on farm land	X	1	X
Cash source species in number not more than 10 in his HGs and on farm land, more than 15 livestock population, 5000 birr income / year	X	1	X
Own land more than 2-4 hectare	x	x	x
Own species in number more than 10 at HGs and on farm land	X	X	1
Cash source species in number more than 10 more than 50 cattle and 10,000 birr income / year	X	X	1

Code: 1 = value x= no value

4.3.4.3. Preface matrix ranking on species diversity

Preface matrix ranking is one of the methods of ranking about their favorite plants in their homegarden and on farm land by taking into account several attributes (Fire wood, constriction, medicine, fodder, food source, shade and soil fertility) at a time. There exists accumulated knowledge that helps farmers to manage trees for various uses.

The multi-purpose nature of trees is valued by farmers. Although a number of trees can be used for the same purpose, preferences for selecting them depend upon several factors such as fast growing, ease of management, ease of establishment and good market demand. *Acacia abyssinca* is ranked first in providing many uses followed by *Brassica oleracea*, *Capsicum frutescens* and *Echinops kebericho* at homegarden areas (Table 16). Although *Moringa stenopetala* is preferred in providing many uses such as food source and income generation, *Mangifera indica* is the most preferred tree species in the area because of its fast growth characteristics, ease of establishment and management and high demand in the study area (Table 16).

Table 16. Farmers preferences of plant species according to uses in the study area

Tree/ shrubs	Fire wood,	constriction,	medicine	fodder,	food source	shade	soil fertility	Total	Rank
Acacia abyssinca	x	-	-	x	-	x	x	4	2
Brassica oleracea	-	-	-	-	X	-	X	2	6
Capsicum frutescens.	-	-	X	-	X	-	-	2	6
Echinops kebericho	-	-	X	-	-	-	-	1	8
Erythrina abyssinica	X	-	-	-	-	X	X	3	4
Mangifera indica	X							1	8
Moringa stenopetala	X	-	-	X	X	X	-	4	2
Syzygium guineense	X	-	X	X	X	X	-	5	1
Persea americana	X	-	-	-	X	X	-	3	4

X= can used for the selected use type

Pair wise ranking on species diversity

In each agroecological area of the study sites species was identified for ranking. Accordingly in dega agroecology *Persea americana* stood 1st because of its importance for income generation and shade purpose; *Acacia abyssinica* ranked 2nd because of its income generation and shade; *Erythring abyssinica* ranked 3rd for the use of fire wood and soil fertility nature and Cordia *africana* ranked 4th based on its importance as shade and lumbering; *Mangifera indica by* its income generation and food source ranked 5th (Table 17).

In wayne-dega agroecological area *Cordia africana* stood 1st based on its shade and lumbering porpuse; *Persea americana* 2nd by its shade and income genaration, 3rd *Mangifera indica* for its income generation. *Acacia abyssinica ranked* 4th. its shade and income genaration. *Erythring abyssinica* from the species benefits such as soil fertility nature and fire wood purpose 5th in the same way in kola agroecological area. *Acacia abyssinica* stood 1st because of species shade purpose and growing of other species under shade; *Cordia Africana* and *Mangifera indica* according to species economic importance and shade ranked *2nd Persea americana* ranked 4th by its income generation and as food source alternatively shade propose and *Erythring abyssinica* ranked 5th by its fire wood and alternatively shade propose. Finally the community from these types of ranking which species for what uses ranked they understand easily use their measures of conservation techniques (Table 17).

Table 1.Pair wise ranking by key informants on species diversity in each AEZs of the study areas

Agroecology	Species	In/k1 *Acacia abyssinica*	In/k 2 *Erythrina abyssinica*	In/k 3 *Persea americana*	In/k 4 *Mangifera indica*	In/k 5 *Cordial africana*	Total	Rank
Dega	*Acacia abyssinica*	er	er	ac	ac	ac	6	2
	Cordia africana	ac	er	p	p	co	3	4
	Erythrina abyssinia	p	er	p	p	co	5	3
	Mangifera indica	ac	er	p	m	co	2	5
	Persea americana	ac	p	p	m	p	9	1
Weyna dega	*Acacia abyssinica*	ac	ac	p	m	co	3	4
	Cordia Africana	co	co	co	co	co	8	1
	Erythrina abyssinica	ac	er	p	m	er	2	5
	Mangifera indica	m	m	p	m	co	6	3
	Persea americana	p	p	p	p	co	7	2
Kola	*Acacia abyssinica*	ac	ac	ac	ac	p	8	1
	Cordia Africana	co	er	co	co	co	5	2
	Erythrina abyssinica	ac	er	p	m	co	2	5
	Mangifera indica	ac	ac	p	m	m	5	2
	Persea americana	ac	ac	p	m	m	4	4

Code: In/k1……Ik5= individual key informants
ac =*Acacia abyssinica* er= *Erythrina abyssinica* p= *Persea americana* m= *Mangifera indica* Co= *Cordial africana*

5. CONCLUSIONS AND RECOMMENDATION

5.1. Conclusions

The results of the study revealed that there are diverse traditional agroforestry practices in Mareqa District of Dawurao Zone of Ethiopia. It indicated that in this study area is rich in both homegarden and on farm tree/shrub species diversity, species richness in dega, wayne dega and kola agroecological areas. In the study area communities have rich experience of managing agroforestry species in each agroecological areas of the study area. They manage the agroforestry species by planting and retaining for their multiple benefits in their homegardens and on farm. Homegarden and on farm tree/shrub species are managed on landscapes of the dega, wayne dega and kola not significantly varied ($P>0.05$) in species composition. The few differences observed migth come from different sources such as size of homegarden, socioeconomic background, altitude and different soil fertility level. Turkeys test the result of Shannon diversity index between three agroecology also indicated that there was no significant difference ($P>0.05$). The mean difference is also indicated by beta diversity index, Evenness, calculated for the different agroforestry practices, did not show statistically significant difference ($P>0.05$). According to the trend analysis most of the households confirmed that they changed their farm species cover recently compared to the past. The cause of increasing species cover change was the interest of community to plant various species on their homegarden and on farm lands for income generation and other multiple uses, but the indigenous species diversity is highly decreased. The reason is that community gives priority for planting income generating tree species rather than the indigenous ones. The most important farmers' traditional agroforestry tree management includes thinning, pruning, controlling lopping, watering and coppicing. It was also confirmed that most of the decisions of tree management were made by the men from the households due to cultural management and conservation methods. The results of this study revealed that across all agroecological sites homegarden and on farm tree species diversity are major sources of household livelihood. Key informants further explained that species diversity is well protected around the church, local grave and spiritual, ceremonials areas, because the community believe that "God" destroys them if they cut big trees and grooves locally known as "kasha' which is

culturally protected area. The results also revealed that the traditional knowledge applied a certain enset species which is infected by bacterial wilt when controlling bacterial spread uproot the infected enset from enset and planting species locally 'Olomo' i.e. *Pycnostachys abyssinica* which is to protect bacterial wilt spread. However, the local community explained that they have faced various constrains like shortage of land, animal damage, lack of transport accessibility to market their agroforestry produce, climatic variability including an unexpected rain fall and fluctuation. Agroforestry are found to have multiple uses such as fuel, medicine, fodder and construction.

5.2. Recommendation

According to this study findings, it worse to recommend further research on the multiple uses of the agroforestry species of plants to enhance their contribution in food and nutrition security through enhanced local livelihoods. It is also esential to integrate traditional agroforestry practices with modern knowledge to enhance the agroforestry sector and its contribution to people's livelihood.

6. REFERENCES

Abdoellah, O.S.,Takeuchi, K., Parikesit Gunawan, B and Hadikusumah, H.Y., 2001. Structure and function of homegarden: A Revised. Proc. Seminar 'Toward Harmonization between Development and Environmental Conservation in Biological Production'. University of Tokyo, Japan:167-185p.

Abebaw, Z., 2006. Farmers indigenous knowledge in managing agroforestry practices inLay-Gayint district, south Gonder zone, Ethiopia, MSc Thesis, Hawssa university, wondogent. 82p.

Abebe,T., 2005. Diversity in homegarden agroforestry systems of southern Ethiopia. PhDDissertation, Wageningen University, The Netherlands

Altieri, M. A., and Anderon, M. K., 1986. An ecological basis for the development of alternative agricultural systems for small farms in the third world. American Journal of Alternative Agriculture **1**: 30-38.

Amacher, G. S., Ersado, L. Hyde, W. F., Osario, A., 2004. Tree planting in Tigrai, Ethiopia: the importance of human disease and water microdams. Agricultural System **60**:211-225.

Anon, 1999. Ethiopia Cradle of Wonder bean *Coffea arabica* (*Abyssinica*). CTA,Addis Ababa, Ethiopia.36 p.

Anon, 2004. *Regional Atlas*. Southern Nations, Nationalities and People's Regional State Coordination of Finance and Economic Development, Bureau of Statistic and Population (BSP), Awasa.99 p.

Anon, 2005. *The Gospel of Luke in Dawro*. The Bible Society of Ethiopia (BSE), Addis Ababa, Ethiopia. 123p.

Appleton, H., Fernandez M-E., 1995. Claiming and using indigenous knowledge. In: Missing links, Gender Equity in Science and Technology for Development. International Development Research Centre (IDRC).p 55-83.

Azene,B., 2007. Useful trees and shrubs of Ethiopia: Identification, propagation, and management in 17 Agro-ecological zones. Nairobi:RELMA in ICRAF Project: 552p.

Backes, M.M., 2001. The role of indigenous trees for the conservation of bicultural diversity in traditional agroforestry landuse systems: The Bungoma case study In-situ conservation of indigenous tree species. Agroforestry *Systems* **52**: 119–132.

Bartlett, 2001.The growing significance of international corporations and the search for optimal management practices within these organisations has resulted in major impacts to the field of human resource development.71p.

Battiste and Henderson, 2000. Protecting Indigenous Knowledge and Heritage. Saskatoon, SK: Purich Publishing Ltd.

Bennett Lartey, S. O., Boateng, S. K., Markwei, C. M., Asante, I. K., Ayernor, G. S., Anchirinah V. M., Odamtten G. T., Abbiw D. K., Ekpe, P., Vodouhe R., and Eyzaguirre P. B., 2006.Home garden systems in Ghana and their Contribution to Germplasm flows. *Plant Genetic Resources Newsletter* **146**: 33-38.

Berkes, F. 1999. Role and significance of 'tradition' in indigenous knowledge. Indigenous Knowledge and Development Monitor 7(1):19p.

Bhola. H.S., 2002. "Reclaiming Old Heritage for Proclaiming Future History: The Knowledge for Development Debate in African Contexts". *Africa Today*, Vol.49 No.3, pp.3-21.

Biruk, A., 2006. Woody species compostion and roles of traditional agroforestry practices across different agroecological zones in south eastern L angano ,Oromiy

Boogaard, B.K.,Oosting,S.J. and Bock, B.B., 2006. Elements of societal perception of farmanimal welfare*:* A quantitative study in the Netherlands.

Cochran, W.G., 1977. Sampling Techniques. John Wiley & Sons:New York. 74-76 p.

COMPAS, 2004. Bridging local knowledge and global science Coen Reijntjes (ed.) In: *COMPAS* magazine for endogenous development No.**7:** 41-43.

Cooke, P., Köhlin, G., Hyde, W.F., 2008. Fuelwood, forests and community management: evidence from household studies. Environment and Development Economics **13**:103-136p.

Cox, P.A. , 1995. *Samoan Americans.* Gale Encyclopedia of Multicultural America2:1186-1197.

Crowley,E.L.,1997. Rapid data collection using wealth ranking and other techniques. International Centre for Research in agroforestry and tropical soil biology and fertility program. ICRAF, Nairobi.16p.

Danida,2007.Community-based natural resource management technical note Danida, RoyalDanish Ministry of Foreign Affairs: 9p

Data,D.1997.Rural Livelihoods and Social Stratification among the Dawro, Southern Ethiopia. MSc. Thesis Presented to the School of Graduate Studies, Addis Ababa University, and Addis Ababa, Ethiopia: 136p.

Dereje, J.2009. The expansion of *Eucalyptus* plantation by small holder farmers and its drivers: the case of Arsi Negelle district, southern Oromia Ethiopia. MSc thesis, Hawassa University, Wondo Genet College of Forestry and Natural Resources, Awassa.
drances.TheonlinejournalfoAfricanstudies.http://www.african.ufl.edu/asq/v3/v3i2a2.htm

Eyasu,E. 2002. Farmers' perceptions of soil fertility change and management. SOS Sahel and ISD, Addis Ababa.

Eyzaguirre, P.B.,and O.F., Linares. 2004. Editors of Home Gardens and Agrobiodiversity. Smithsonian Books, WashingtonD.C

Fairhead, James 1992 Indigenous Technical Knowledqe and Natural Resources Management in Sub-Saharan Africa: A Critical Overview. Kent Natural Resources Institute.

FFA Forestry (2010). Forestry CDE State: Tree Measurement and Cruising Materials.
gardens workshops: contribution of home gardens to *in situ* conservation of plant genetic resources in farming systems, 17-19 July 2001, Witzenhausen, Federal Republic of Germany: International Plant Genetic Resources Institute, Rome.

Gezon,L.,and Z..Freed.B. 2008.AgroforestryandconservationinnorthernMadagascar: HopesandHi (accessed on 23/10/2008).

Girma,A.(2004). Diversity in pathogenicity and genetics of Gibberlla xylarioides (Fusarium xylarioides) populations and resistance of *Coffea spp.* in Ethiopia, Jimma, Ethiopia.79p.

Grandin, B. 1988. Wealth Ranking in Smallholder Communities: a Filed Manual, Nottingham, England: Intermediate Development Technology Publication, UK. 49p.

Hansen, J..D.,Luckert, M.K.,Minae, S.,Place,F.2005. Tree planting under customary tenure systems in Malawi: impact of marriage and inheritance patterns, AgriculturalSystems 84:99-11.

Harvey, A.C., Villalobos, J.A.G. 2007. Agroforestry systems conserve species-richbut modified assemblages of tropical birds and bats. Biodivers conserv **16**:2257-2292.

Higgins,C.2000/2002. Indigenous knowledge and occidental science: How both form of knowledge can contribute to an understanding sustainability. *In* proceeding of, from science to management and back: a science forum for southern interior ecosystems of British Columbia.C.Hollstedt, K.Sutherland, and T.Innes (eds.) Southern Interior Forest Extension and Research Partnerships, Kamloops, B.C., 147-151.p.

Hodgkin, T. 2002. Home gardens and the maintenance of genetic diversity. In: Watson JWand Eyzaguirre PB. editors. Home gardens and *in situ* conservation of plant genetic resources in farming systems, 17-19 July 2001, Witzenhausen,

Hoekstra, D. E., Torquebiau and B. Bishaw eds.1990. Agroforestry: potentials and research needs for theEthiopian highlands. No. 21. ICRAF, Nairobi, Kenya: 115p.
http://www.millenniumassessment.org/documents/bridging/papers/woodley.ellen.pdf

Kehlenbeck,K.,and Maass,B.L.2004. Crop diversity and classification of homegardens in Central Sulawesi, Indonesia. Agroforestry systems **63**. 53-62 p.

Kimani, M., Little T., and Vos, J. G. M. 2002. Introduction to *Coffee* Management Through Discovery Learning. CABI. African Regional Centre, Nairobi, Kenya.2 p.

Kristensen, M. (2004) The case study among Kristensen, M., Aarhus.p. 53-66

Kristensen, M.2004-5. The importance's of local knowledge in natural resource management – study among the Gourounsi people in Burkina Faso. In: Kirkebjerg Due, M., Kristensen, M., Lykke, AM. and Nielsen I. (weds) SEREIN Occasional Paper, 17.Aarhus.53-66p

Lewis Ivey, M. L., Miller, S. A., Hakiza G, J., and Geiser D, M., 2003. Characterization

Mathewos, A. 2008 Ethnobotany of Spices, Condiments and Medicinal Plants in Loma and Gena Bosa Woredas of Dawro Zone, Southern Ethiopia. A Thesis Submitted to the School of Graduate Studies in Addis Ababa University in Partial Fulfilment of the Degree of Masters in Biology (Dryland Biodiversity). 120p.

Michael, W. D. M. 1992. Indigenous knowledge, biodiversity conservation and development. Keynote address at the international conference on conservation of biodiversity in Africa: Local initiatives and institutional roles, 30 August-3 September 1992, Nairobi, Kenya.

Motuma,T. Zenebe, A. Mulugeta , L., and E, Karltun. 2008. Woody species diversity in a changing landscape in the south-central highlands of Ethiopia. Agriculture, Ecosystem and Environment **128**.52 -58p

Nair, P.k.R. 1990. The prospects for agroforestry in the tropics. *World Bank technical paper* No 131. World Bank, Washington DC.

Nyeko, P. Edwards-Jones, G,Day, R.K., and Raussen, T. 2002. Farmers' knowledge and perceptions of pests in agroforestry with particular reference to *Alnus* species in Kabale district, Uganda. crop protection. Vol. **21**, No. 10.929–41p. of the Coffee Wilt Pathogen in Uganda. Phytopathol. **93.** 550 p.

Peet R.k., 1974. The measurement of species diversity. Annual Review of Ecology and systematics. **5**.285-307

Prado, J., and Weber, C., 2003 Facilitating the Way for Implementation of Sustainable Forest Management.The Case of Chile. Instituto Forestal (INFOR),Santiago, Chile http;// www.maf. Govt. nz/mafnet/unff-planted-forestr meeting/conference papers/facilitating –the way –for implementation.htm (assessed 1 May 2005)

Rocheleau, D.Weber, F., and Field-Juma, A. 1988. Agroforestry for dry land Africa. ICRAF, Nairobi, Kenya. 311p.

SØrensen, TA. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species contents, and its application to analyses of vegetation of Danish commons. *Biol. Skr., Kongl. Danske Vidensk. Selsk*. 5: 1-34.

Schroth, G. Fonseca, G.A.B., Harvey, C.A., Gascon C., Vasconcelos, H.L., and Izac, A.-M.N. 2004.Agroforestry and Biodiversity Conservation in Tropical Landscapes Island Press, Washington.

SciDev.2002 http://www.scidev.net/dossiers/index.cfm?fuseaction=dossierfulltext&Dossier=7 (assessed 25 October 2012) *Source. RRA Notes, (1988). Issue* ***3****..11–15p, IIED London*
Shannon, C.E., and Wiener, W.,1949. The mathematical theory of communication. The University of Illinois Press.

Subedi, B..P., 2004. *Linking plant-based enterprises and local communities to biodiversity conservation in Nepal Himalaya*. New Delhi: Adroit Publishers
systematics. **5**.285-307

Terefe, D.2003. Study to Enhance Local Governance and People's Participation in Dawro Zone: Household Survey-Prepared for Action Aid Ethiopia, Addis Ababa. 65p. (Unpublished)

Tesfaye, H. 2007. An Ethnobotanical Study of Medicinal Plants Used by Local People in the Lowlands of Konta Special Woreda, SNNPRs, Ethiopia. MSc. Thesis Presented to the School of Graduate Studies, Addis Ababa University Addis Ababa.111 p.

Thompson, I. D., Ortiz, C., Jastrebski., and D, Corbett. 2006. A comparison of prsim plots and modified point-distance sampling to calculate tree stem density and basal area. Northern Journal of Applied Forestry. **23**: 218-221p.

Tolunay, A.; Alkan, H.; Korkmaz, M., and Fïlïzbïlgïn, S. 2007. Classification of traditional agroforestry practices in turkey. International journal of Natural and Engineering science **1**(3):41-48 p.

UNESCO. 1994-2003. Register of Best Practices on IndigenousKnowledge.United Nations Educaitonal, Scientific and Cultural Organization.

Watson, J.W. and P.B., Eyzaguirre, Ed. 2002. Proceeding of the second international home

Williams, D.E.2004. The Conservation and Evolution of Landraces of Peanuts and Peppers. In: Home Gardens and Agrobiodiversity.256-265p. (Eyzaguirre,P. B. and Linares, O. F. eds.), Smithsonian Institution, Washington.

WIPO (World intellectual Property Organization). 2001. *Intellectual Property and Indigenous Knowledge (2001 Report)*. Geneva: WIPO.

World Bank.1998 Indigenous Knowledge For Development A Framework F Action.Knowledgea nd Learning Center,AfricaRegion,http://www.world bank.org/afr/ik/ikrept.pdf (assessed 1 May 2005)

Zemede, A.2004. The Enset Based Home Gardens of Ethiopia. In: Home Gardens and Agrobiodiversity.123-147p. (Eyzaguirre P. B., and Linares O. F. eds.), Smithsonian Institution, Washingto

7. APPENDICES

Appendix 1. Questions for Key Informant Interview:

1. Do you harvest any product from homegarden and on- farm diversity?
2. What are the homegarden and on farm plant products that you often sell?
3. What problems do you face to harvest/collect homegarden and on farm plant products?
4. How does the income from homegarden and on farm diversity contribute to you?
5. What do you think about homegarden and on farm diversity situation in the past and present?

Appendix 2. Questions for Focus group discussion

1. What advantages/ benefits do you obtained from agroforestry practices?

2. What general option do you have to improve the current efforts of agroforestry?

3, What efforts are there by government, NGO, community and specially district-Government's office with regard to agroforestry practices?

4. What type of IK do you practices on your culture for protecting of your species from disease?

5. Do you have culture preserved (protected) species diversity?

Appendix 3. PA-I to assess the indigenous knowledge agro forestry Practices

7. Type of land use in different agroecological zones, the size of your farm area in local unit / how you obtain?

No	Land use type	Size	How did you obtain

Key for type of landuse: 1= Homestead, 2= Cropland, 3= Woodlots, 4= Wasteland, 5= Fallowland, 6= Grazingland, 7= others

Key for means of land possession:1= Inherited, 2= Lease, 3= Contract, 4= Redistribution of land,

8 General farm Characteristics

8..1 Trees in traditional (IK) farming system

8.2 Have you ever planted trees/shrub on your farm.

1) Yes 2) No

8.3 have you ever maintained trees/shrub on your farm?

1) Yes 2) No

9. If yes, what species in what number and when

	Tree/shrub species	Number of planted or maintained								Total	Source of seedling	
		<2000		2001		2002		2003				
		P	M	P	M	P	M	P	M			

Key for sources of seedlings: 1= Self raised, 2= Self regenerate, 3= Wildling, 4= MOA 5. Nursery

10. How did Home garden and on-farm tree change over the past 7 years?

on different agroecological zones.

a) Decreased much d) Increased a little

b) Decreased a little e) substantially increased

c) Not changed f) No idea.

11. Do you think that the IK of agroforestry practices of current generation attitude is possible to change?

(1). Yes ☐ (2). No ☐ (3). Do not know ☐

12. Do you believe that the (IK) of agroforestry practices to be improved homegarden and on farm diversity?

(1). Yes ☐ (2). No ☐ (3). Do not know (4) Is ☐ necessary

13. What do you think (IK) of agroforestry practices of the homegarden and on farm area compare in the past and present? ☐ ☐ ☐

(1). Increased (2). Decrease (3). Do not know

14. Species priority preference to plant/ maintain

N	Agroecolo	Tree/shr	Importan	Reaso	function or	Growt

o	gy	ub Species preferenc e	ce	n	position of a species(nich e)	h status Fast Slowl y	

Key source for niche: 1=Homestead, 2= Crop filed, 3= Woodlots, 4= Wasteland, 5= Fallowland, 6=Grazingland, 7 = Farm boundary, 8= others

Key source for reason: 1= For soil fertility, 2= For fodder, 3= For soil and water conservation 4= For cash generation, 5= For food, 6= For shad, 7= For social purpose,

15. Type of indigenous knowledge to use for on farm tree? Management practices? In different agroecological zone

No	Agroecology	Species	Management	Reason	Niches

Key for management: 1=Thinning, 2= Pruning, 3= Stocking control, 4= fertilizing, 5= Watering, 6= Lopping

16. Trees/ shrubs On farm used for cash generation/ sale Y☐ N☐

17. What problems did you encounter in maintaining and growing trees/shrubs and how did you solve them in different agroecological zones

No	Agroecology	Species	M	P	Problem	Solution

M- Maintaining P- planting

Appendix 4 On- farm tree and HGs diversity recording list in different AEZs area

c c c e	Species	Plot-1		Plot-2			Pot-3			Plot-4			Plot-5		
		N c	Altitude	A	No	Altitude	Aspect	No	Altitue	Aspect	N c	Altitude	Aspect	No	Altitude	Aspect

Appendix 5. Part- II Tree Counting Format

Name of the enumerator---------- Inventory sheet number----

P.A----------Village---------- Zone-------District----

Name of the household---------- Date----------

Code1 (HG)=homegarden and on farm tree

Inventory	Agroecology	On –farm trre	Homegarden species	Total
Area/ha/				
Plot No				
1				

Key ST =on farm tree diversity Hs =home garden diversity
I = Indigenous species, E = Exotic species

Appendix 6. PART III HH survey on agroforestry practices in Mareqa district remark.

Identify key multipurpose agroforestry species

18. General information

18.1 Household head: Male--- ☐ -Femal- ☐

01 Code of respondent ---------- P.A----------

18.2 Sex (M/F)----------Household number-------- Interviewer------

18.3 Marriage status: Single/ Married / divorced / widow ---------- Date-----

19. Household characteristics

19.1. Number of persons lives in your household by age/gender (use X)

No	Age								Level of education	Relations to HH heads	Participation in field work	
	Male				Female							
		5-10	10-20	>20	<5	5-10	10-20	>20			Y/N	How often?

Key to education: 1=No education, 2= Can read only, 3= Can read and write, 4=Primary school, 5=Secondary school, 6= Higher education

Key to how often: 1=Always, 2= Rarely 3=Very rarely

I Instraction: Answer the following questions according to the type of question naries

20. What does the homegurden condition and trends of your area look like?------

a) Homegurden various species cover of the area: increasing/decreasing

b) Homegarden diversity cover of the area: increasing/decreasing

c) What do you do to satisfy your homegurden specise need

21 . Homegarden traditional farming system

22. Do you plant tree/shrubs, ye ☐ No ☐ for fodder production if yes where do you plant?

23. Do you have trees? 1. Yes------2. No-------

a) If yes, indicate the species name, the preference with its rank?

Species type	Ranking score and use diversity	
	No of uses	Rank

Reasons for preference(attitude): r1=firewood; r2= construction; r3= sale; r4=fruits; r5= medicine; r6=farm implements; r7=shade; r8= bee keeping; r9= soil fertility improvement; r10=fodder; r11= amenity; r12=lumber; r13 = fumigation;r14 =washing household materials ;r15=charcoal.

24. If yes, indicate the species name and their niche with the farms?

Species type	No of trees/niches(function or position of a species)									

Niche: n1=home garden; n2=on farm; n3= grazing land; n4= farm boundary; n5= gully areas; n6=woodlots; n7=; live fence; s8=road side; S9=grazing land; 10=other/specify/

25. List the multipurpose tree species indifferent agroecological zone of homegarden

Agro ecology	Species Amharic name	Local name	Use	Part used

26. Which plants are utilized as live fence and shade tree species in different AEZs of HGs?

Agro ecology	Species Amharic name	Local name	Use	Part used

27. Management practices (Responsibility) of homegarden and farm tree species in different agro-ecological zone of the study sites

Agroecology	Preferred tree species	Niche	Management practice	Who manages/division of labor/	Who makes decision	Reasons for managing

Niche: n1=home garden; n2=on farm tree

28. How do you get trend of the community in plating the homegarden diversity during the study period?

(1). Very poor ☐ (2). Poor ☐ (3). Moderate ☐ (4). Good ☐

(5). Very good ☐

29. How do you evaluate the current homegarden diversity production and importance?

(1). Very poo ☐ (2). ☐ (3). Mo ☐ (4). G ☐

(5). Very good ☐

20. How do you evaluate the existing on farm diversity productivity. (1). Very low

☐ . Low (☐ Moderate ☐ H High

31. How do you evaluate the on farm diversity productivity in the past (7 years)?

(1). Very lo ☐ (2). L ☐ (3). Mo ☐ (4). ☐

Appendix 3. HGs and on farm species in each AEZs of the study site.

Scientific name		Family name	Dawro name	Use
Acacia abyssinica Hochst. ex Benth	On-farm	*Fabaceae*	Odoruuwa	Shade tree & Constriction
Arundinaria alpina K. Schum	On-farm	*Poaceae*	Woosha	Constriction
Arundo donax L	On-farm	*Poaceae*	Usuntha	Constriction
Brassica oleracea L.	*homegarden*	*Brassicaceae*	Asotiya santha	Source of food
Capsicum annuum L.	*homegarden*	*Solanaceae*	Bambbariya	Source of food
Capsicum frutescens L.	*homegarden*	*Solanaceae*	Miximixuwa	Source of food
Carica papaya L.	*homegarden*	*Caricaceae*	Paappa	Source of food
Carissa spinarum L.	On-farm	*Apocynaceae*	Laadiya	Source of food
Casimiroa edulis La Llave	*homegarden*	*Rutaceae*	Kasmiriya	Source of food
Casuarina equisetifolia L.	On-farm	*Casuarinaceae*	Faranjjiya xiidaa	Shade tree & Constriction
Catha edulis (Vahl) Forssk. ex Endl.	*homegarden*	*Celastraceae*	Jimaa	Cawing
Citrus aurantifolia (Christm.) Swingle	*homegarden*	*Rutaceae*	Loomiya	Medicinal planet
Citrus sinensis (L.) Osb.	*homegarden*	*Rutaceae*	Birttukaniya	Income generation
Colocosia esculenta (L.) Schoott	*homegarden*	*Araceae*	Boyina	Source of food
Coffea arabica L.	*homegarden*	*Rubiaceae*	Bunaa/Tukkiyaa	Mulled stimulant &Income
Combretum molle R. Br. ex G. Don.	On-farm	*Combretaceae*	Sobuwa	Constriction
Cordia africana Lam.	On-farm	*Boraginaceae*	Moqothaa	Shade tree & Constriction
Croton macrostachyus Del.	On-farm	*Euphorbiaceae*	Anka	Shade tree & Constriction
Cuperssus lusitanica Mill.	On-farm	*Cuperssaceae*	Xiida(CadiyaHayithawa)	Shade tree & Constriction
Dioscorea abyssinica Hochst. ex Kunth	On-farm	*Dioscoreaceae*	Boyiiya	Source of food
*Dombeya torrida (*J.F. Gmel.) P. Bamps	On-farm	*Sterculiaceae*	Looluwa|Boshshuwa	Shadetree
Echinops kebericho Mesfin	*homegarden*	*Asteraceae*	Bursa	Medicinal planet
*Enset ventricosum (*Welw.) Cheesman	*homegarden*	*Musaceae*	Utha	Source of food
Erythrina abyssinica Lam. ex DC.	On-farm	*Fabaceae*	Borttuwaa(Gadhaawa)	Shade tree& soil fertility
Eucalyptus globules Labill.	On-farm	*Myrtaceae*	Barzzafiya (Bootha)	Constriction and fire wood
Euphorbia candelabrum Kotsschy	On-farm	*Euphorbiaceae*	Qaaqaa (Gadhaawa)	Constriction
Ficus sycomorus L.	On-farm	*Moraceae*	Wolaa	Shade tree
*Gnidia glauca (*Fresen.) Gilg.	On-farm	*Thymelaeaceae*	Migraa	Fire wood &fodder
Grevillea robusta A.cunn. ex R. Br.	On-farm	*Proteaceae*	Gravilliyaa	Constriction
Maesa lanceolata Forssk.	On-farm	*Myrsinaceae*	Gegecuwa	Fire wood
Juniperus procera Hochst. ex Endl.	On-farm	*Cuperssaceae*	Xiida (Abashawa)	Shade tree & Constriction
*Justicia schimperiana (*Hochst. ex. Nees) T. Anders.	On-farm	*Acanthaceae*	Santhaliya/Taadaqaa	Medicinal planet
Malus sylvestris Miller	*homegarden*	*Rosaceae*	Appliya	Source of food

Mangifera indica L.	On-farm	*Anacardiaceae*	Manguwa	Source of food
*Milettia ferruginea (*Hochst.) Bak.	On-farm	*Fabaceae*	Zaagiya	Shade tree
Musa x paradisiacal L.	On-farm	*Musaceae*	Muuziya	Source of food
Ocimum canum Sims	*homegarden*	*Lamiaceae*	Zitiituuwa	Source of food
Pennisetum thunbergii Kunth	On-farm	*Poaceae*	Bar77eya	Source of food
Persea americana L.	On-farm	*Lauraceae*	Abokatuwa	Source of food
Phoenix reclinata Jacq.	On-farm	*Ariaceae*	Zambaa	Shade tree
Polyscias fulva (Hiern.) Harms	On-farm	*Araliaceae*	Kalshaa	Shade tree& bee harvesting
Prunus africana (Hook.f.) Kalkm.	On-farm	*Rosaceae*	Ontha	Shade tree
Prunus persica (L.) Batsch	*homegarden*	*Rosaceae*	Kokiya	Food source
Pycnostachys abyssinica Fresen.	*homegarden*	*Lamiaceae*	Olomuwa	Medicinal planet
Saccharum offiicinarum L.	*homegarden*	*Poaceae*	Shonkoraa	Income genaration
Syzgium guineense var. macrocarpa (Engl.) F. White	On-farm	*Myrtaceae*	Wodentha	Shade tree
Syzygium guineense (Willd.) DC. *subsp guineense*	On-farm	*Myrtaceae*	Ocha	Shade tree
Vernonia theophrastifolia Schweinf. ex Oliv. & Hiern	On-farm	*Asteraceae*	Buuzuuwa	Fire wood
Vepris danellii (Pichi-Serm.) Kokwaro	On-farm	*Rutaceae*	Cawulaa	Medicinal planet
Vernonia amygdalina Del.	On-farm	*Asteraceae*	Garaa	Medicinal planet
Terminalia schimperiana Hochst.	On-farm	*Combretaceae*	Ambbiya	Constriction
Voculor no species diversity	51			

Appendix 4. In Dega Agro-ecological zone home garden and on farm tree characteristics of the elevation gradient

Altitude masl	*home garden species type*				*on farm tree species type*				PAs
	Local name	Am name	Scientific name	Family name	Local name	Am name	Scientific name	Family name	Eyessuses
1800-2373m	Asotiya santha	Gomen	*Brassica oleracea* L	Brassicaceae	Woosha	Karkhya	*Arundinaria alpina* K. Schum	Poaceae	Eyessuses
1800-2373m	Jimaa	Chate	*Catha edulis* (Vahl) Forssk. ex Endl.	Celastraceae	Faranjjiya xiidaa	Tide	*Casuarina equisetifolia* L.	Casuarinaceae	Eyessuses
1800-2373m	Boyina	Godera	*Colocosia esculenta* (L.) Schoott	Araceae	Jimaa	Chate	*Catha edulis* (Vahl) Forssk. ex Endl.	Celastraceae	Eyessuses
1800-2373m	Bunaa/Tukki yaa	Coffee	*Coffea arabica*L	Rubiaceae	Xeemaa	Gulo	*Ricinus communis* L.	Euphorbiaceae	Eyessuses
1800-2373m	Bursa	*Kebericho*	*Echinops kebericho* Mesfin	Asteraceae	Anka	Besana	*Croton macrostachyus* Del	Euphorbiaceae	Eyessuses
1800-2373m	Utha	*Ensete*	*Ensete ventricosum (*Welw.) Cheesman	Musaceae	Loomiya	Lome	*Citrus aurantifolia* (Christm.) Swingle	Rutaceae	Eyessuses
1800-2373m	Appliya	Apple	*Malus sylvestris* Miller	Rosaceae	Borttuwa	Korcha	*Erythrina abyssinica* Lam. ex DC	Fabaceae	Eyessuses
1800-2373m	Zitiituuwa	Zitiituuwa	*Ocimum canum* Sims	Lamiaceae	Barzzafiya (Bootha	Birezafe	*Eucalyptus globules* Labill.	Myrtaceae	Eyessuses
1800-2373m	Abokatuwa	Abokado	*Persea americana* L	Lauraceae	Gegecuwa	kalwa	*Maesa lanceolata* Forssk	Myrsinaceae	Eyessuses
1800-2373m	Kokiya	Koke	*Prunus persica* (L.) Batsch	Rosaceae	Xiid	Tide	*Cuperssus lusitanica* Mill	Cuperssaceae	Eyessuses
1800-2373m	Shonkoraa	Shonkora agada	*Saccharum offiicinarum* L.	Poaceae	Santhaliya/Taad aqaa	Santhale	*Justicia schimperiana (*Hochst. ex. Nees) T. Anders	Acanthaceae	Eyessuses
1800-2373m					Zaagiya	Beribera	*Milettia ferruginea (*Hochst.) Bak.	Fabaceae	Eyessuses
1800-2373m					Zambaa	Zambaba	*Phoenix reclinata* Jacq	Ariaceae	Eyessuses
1800-2373m					Kalshaa	-	*Polyscias fulva* (Hiern.) Harms	Araliaceae	Eyessuses
1800-2373m					Ontha	Tikre enchate	*Prunus africana* (Hook.f.) Kalkm	Rosaceae	Eyessuses
1800-2373m					Olomuwa		*Pycnostachys abyssinica* Fresen.	Lamiaceae	Eyessuses
1800-2373m					Ocha	Dokuma	*Syzygium guineense* (Willd.)	Myrtaceae	Eyessuses

							DC. *subsp guineense*		
1800-2373m					Buuzuuwa	Anfare	*Vernonia theophrastifolia* Schweinf. ex Oliv. & Hiern	Asteraceae	Eyessuses
1800-2373m					Cawulaa	-	*Vepris danellii* (Pichi-Serm.) Kokwaro	Rutaceae	Eyessuses

Appendix 5. In weyna dega Agro-ecological zone home garden and on farm tree

Altitude masl	*home garden species type*				*on farm tree species type*				PAs
	Local name	Am name	Scientific name	Family name	Local name	Am name	Scientific name	Family name	
1600-1743m	Paappa	Paapya	*Carica papaya* L.	Caricaceae	Laadiya	-	*Carissa spinarum* L.	Apocynaceae	Gozosasho
1600-1743m	Miximixuw	Miximixta	*Capsicum frutescens* L	Solanaceae	Jimaa	Chate	*Catha edulis* (Vahl) Forssk. ex Endl.	Celastraceae	Gozosasho
1600-1743m	Kasmiriya	Kasmire	*Casimiroa edulis* L Llave	Rutaceae	Boyinaa	-	*Dioscorea abyssinica* Hochst. ex Kunth	Dioscoreaceae	Gozosasho
1600-1743m	Jimaa	Chate	*Catha edulis* (Vahl) Forssk. ex Endl.	Celastraceae	Moqothaa	Wanza	. *Cordia africana* Lam	Boraginaceae	Gozosasho
1600-1743m	Loomiya	Lome	*Citrus aurantifolia* (Christm.) Swingle	Rutaceae	Borttuwa	Koricha	*Erythrina abyssinica* Lam. ex DC	Fabaceae	Gozosasho
1600-1743m	Borttuwaa	Koricha	*Erythrina abyssinica* Lam. ex DC	Fabaceae	Birttukaniya	Birttukene	*Citrus sinensis* (L.)	Rutaceae	Gozosasho

	(Gadhaawa)						Osb.		
1600-1743m	Boyiea	Ocino	*Colocosia esculenta* (L.) Schoott	Araceae	Qaaqaa (Gadhaawa	Kukikale	*Euphorbiacandelabrum* Kotsschy	Euphorbiaceae	Gozosasho
1600-1743m	Bunaa/ Tukkiyaa	Bunna	*Coffea arabica* L.	Rubiaceae	Wola	Warika	*Ficus sycomorus* L.	Moraceae	Gozosasho
1600-1743m	Utha	*Ensete*	*Enset ventricosum (*Welw.) Cheesman	Musaceae	Migraa	-	*Gnidia glauca (*Fresen.) Gilg.	Thymelaeaceae	Gozosasho
1600-1743m	Zitiituuwa	Zitiituuwna	*Ocimum canum* Sims	Lamiaceae	Gravilliyaa	Gravilliya	*Grevillea robusta* A.cunn. ex R. Br.	Proteaceae	Gozosasho
					Manguwa	Manguwa	*Mangifera indica* L.	Anacardiaceae	Gozosasho
					Abokatuwa	Abokado	*Persea americana* L.	Lauraceae	Gozosasho
					Zambaa	Zitiituuwa	*Phoenix reclinata* Jacq.	Ariaceae	Gozosasho

Appendix 6. In kola Agro-ecological zone Home garden and on farm tree Crhacteristics of the elevation Gradient

Altitude masl	*home garden species type*				On farm tree				PAs
	Local name	Scientific name	Am name	Family name	Local name	Am name	Scientific name	Family name	
1300-1374	Bambbariya	*Capsicum annuum* L.	Barebara	*Solanaceae*	Laadiya	-	*Carissa spinarum* L.	*Apocynaceae*	Tercha
1300-1374	Miximixuwa	*Capsicum frutescens* L.	Miximta	*Solanaceae*	Jimaa	Chate	*Capsicum frutescens* L.	*Celastraceae*	Tercha
1300-1374	Paappa	*Carica papaya* L.	Paapya	*Caricaceae*	Sobuwa	-	*Combretum molle* R. Br. ex G. Don.	*Combretaceae*	Tercha
1300-1374	Kasmiriya	*Casimiroa edulis* L Llave	Kasmire	*Rutaceae*	Moqothaa	Waniza	*Cordia africana* Lam.	*Boraginaceae*	Tercha
1300-1374	Jimaa	*Catha edulis* (Vahl) Forssk. ex Endl.	Chate	*Celastraceae*	Borttuwa	koriche	*Erythrina abyssinica* Lam. ex DC.	*Fabaceae*	Tercha

1300-1374	Loomiya	*Citrus aurantifolia* (Christm.) Swingle	Lomyie	*Rutaceae*	Barzzafiya (Bootha	Bhrizafe	*Eucalyptus globules* Labill.	*Myrtaceae*	Tercha
1300-1374	Birttukaniya	*Citrus sinensis* (L.) Osb.	Birttukane	*Rutaceae*	Wola	Warika	*Ficus sycomorus* L.	*Moraceae*	Tercha
1300-1374	Boyina	*Colocosia esculenta* (L.) Schoott	Godara	*Araceae*	Gravilliyaa	Gravilliya	*Grevillea robusta* A.cunn. ex R. Br.	*Proteaceae*	Tercha
1300-1374	Bunaa/Tukkiya a	*Coffea arabica* L	Buna	*Rubiaceae*	Manguwa	Manguwa	*Coffea arabica* L.	*Rubiaceae*	Tercha
1300-1374	Abokatuwa	*Persea americana* L.	Abokdo	*Lauraceae*	Muuziya	Muze	*Musa x paradisiacal* L.	*Musaceae*	Tercha
					Zambaa	Zambaba	*Phoenix reclinata* Jacq.	*Ariaceae*	Tercha
					Wodentha	Dokuma	*Syzgium guineense var. macrocarpa* (Engl.) F.White	*Myrtaceae*	Tercha

11 Species diversity commonly or neutral identified AEZs of the study sites

Species only found in Dega		Species only found inWayne dega but not found in dega		Species commonly found in kola and Wayne dega	
Homegarden	On farm	Homegarden	On farm	Homegarden	On farm
Malus sylvestris Miller	*Arundinaria alpina* K. Schum	*Carica papaya* L.	*Carissa spinarum* L.	*Capsicum annuum* L.	*Carissa spinarum* L.
Prunus persica (L.)	*Ricinus communis* L.	*Citrus aurantifolia* (Christm.) Swingle	*Ficus sycomorus* L.	*Capsicum frutescens* L.	*Capsicum frutescens* L.
Kebericho	*Croton macrostachyus* Del		*Gnidia glauca (*Fresen.) Gilg.	*Carica papaya* L.	*Combretum molle* R. Br. ex G. Don.
Brassica oleracea L	*Maesa lanceolata* Forssk		*Mangifera indica* L.	*Casimiroa edulis* L Llave	*Cordia africana* Lam.
	*Justicia schimperiana (*Hochst. ex. Nees) T. Anders			*Catha edulis* (Vahl) Forssk. ex Endl.	*Erythrina abyssinica* Lam. ex DC.
	*Milettia ferruginea (*Hochst.) Bak.			*Citrus aurantifolia* (Christm.) Swingle	*Eucalyptus globules* Labill.
	Prunus africana (Hook.f.) Kalkm			*Citrus sinensis* (L.) Osb.	*Ficus sycomorus* L.
	Pycnostachys abyssinica Fresen			*Colocosia esculenta* (L.) Schoott	*Grevillea robusta* A.cunn. ex R. Br.
	Vernonia theophrastifolia Schweinf. ex Oliv. & Hiern			*Coffea arabica* L	*Coffea arabica* L.
	Vepris danellii (Pichi-Serm.) Kokwaro				