AGROBIODIVERSITY AND THE POTENTIAL ROLE IN DIVERSIFYING THE LIVELIHOOD OF LOCAL COMMUNITY IN BALE ECO-REGION, SOUTH EAST OF ETHIOPIA

MSc Thesis

By: Workalegn Asseffa Balcha

Major Advisor: Dr. Demeke Datiko (Ph.D)

Co-adviser: Gonfa Kewessa (Assistant Professor)

A Thesis Submitted in partial Fulfillment for the Requirements of Masters of Science Degree in Ecosystem and Biodiversity Conservation Department of Ecotourism and Biodiversity Conservation
School of Biodiversity and Natural Resources

MADDA WALABU UNIVERSITY

October, 2016

Bale - Robe, Ethiopia

DECLARATIONS

I Workalegn Asseffa Balcha, do hereby declare that, this Thesis is my original work and that it has not been submitted partially; or in full, by any other person for an award of a degree in any other university/institution.

Name Workalegn Asseffa Balcha

Signature…….

Date……..

APPROVAL

The undersigned certify that they have read and hereby recommend to the Madda Walabu University to accept the Thesis submitted by **Workalegn Asseffa Balcha** and entitled"Agrobiodiversity and the potential role in diversifying the livelihood of local communities in Bale Eco-Region", in partial fulfillment of the requirements for the award of Master of Science Degree in Ecosystem and Biodiversity Conservation.

Name of Major Advisor Dr. Demeke Datiko (Ph.D)

Signature……..

Date…

Name of Co-Advisor Gonfa Kewessa (Assistant Professor)

Signature---------..

Date……

Acknowledgements

I would like to thank my advisors Dr. Demeke Datiko (Ph.D) from Ethiopian Biodiversity Institute and Gonfa Kewessa (Assistance Professor) from Madda Walabu University for their wholehearted guidance and comments on the research work from the beginning from proposal development up to the final thesis write up.

My especial thank go to research teams including Gonfa Kewessa, Endalew Muluneh, Dr. Demeke Datiko, Dejene Nigatu and Lemma Tiki to allow me to participate in their research project funded by Farm Africa and SOS Sahel Ethiopia and coordinated by International Water Management Institute. I am also grateful to Dello Mena, Harrena Buluk, Dinsho, Adaba and Berbere Woreda Agricultural Office and Woreda administration for their cooperation and help during the period of field work.

I also extend thank to my family especially my wife Mesaye Girma for her help and my staff members Tesfaye Urgessa, Debele Habebe, Getachew Worku and Yosef Messele for their contribution during the research work is unforgettable in my life.

ACRONOMY

BER	Bale Eco-Region
BERSMP	Bale Eco-Region Sustainable Management Plan
BMNP	Bale Mountain National Park
CBD	Convention on Biological Diversity
CSA	Central Statistical Agency
FAO	Food and Agriculture Organization of the United Nations
FDG	Focus Group Discussion
SHARE	Sustainable Support for Horn of Africa Resilience
UNDP	United Nations Development Program

Table of Contents

Contents **Page**

List of Tables

List of Figures

Abstract

Agricultural biodiversity have significant role in food security, environmental protection, income generation and cultural values. Practice of mono-cropping has increased from time to time resulting into decrease in nutritious crops, income diversification, and increase in environmental problems and unsustainable natural resource use. The study was carried out in Bale eco region, South east of Ethiopia, between 2015 and 2016.The aim of the study was to identify agrobiodiversity that exist in the eco-region ,their role, their variation and perception of the community. Samples of 384 respondents were selected using simple random sampling technique from 10 Kebeles (villages) purposefully. Data was collected from 384 respondents using a semi structured interview with household. Ten focus group discussions (FGDs) (one per each kebele) were used as supplement of the interview. In addition field observations were used in order to identify type of crops currently cultivated and animal domesticated. Data was analyzed using SPSS version 20 software to generate Chi-square test and descriptive statistics to analyze the variation of agricultural diversity across the altitude in the eco region. There are different types of crops/plants and animal domestication in the area, that have significant variation ($P<0.05$) between the agro-ecology. The agricultural diversity plays different roles starting from food provision and income generation to environmental and spiritual values. Climatic condition, low productivity, disease, market opportunity, road accessibility and transportation are some of the challenges that affect the community in order to diversify their farm. So that agrobiodiversity need special attention in order to change the livelihood of the community. It need cooperation of stakeholders for improving the productivity of crops and animals, capacity of local community through training and improving infrastructural(like rood, irrigation scheme ,market) and improving post harvest system.

Key words: Agriculture, Agro-ecology, Farm diversification, Plant diversity, animal Production

1. Introduction

1.1 Background of the study

Agrobiodiversity is the result of natural selection processes and the careful selection and inventive developments of farmers, herders and fishers over millennia. Agrobiodiversity is a vital sub-set of biodiversity. Many people's food and livelihood security depend on the sustained management of various biological resources that are important for food and agriculture. Agricultural biodiversity, known as agrobiodiversity includes: harvested crop varieties, livestock breeds, fish species and non domesticated (wild) resources within field, forest, rangeland tree products, wild animals hunted for food non-harvested species, such as soil micro-biota, pollinators and other insects such as bees, butterflies, earthworms, greenflies; and Non-harvested species in the wider environment that support food production ecosystems (agricultural, pastoral, forest and aquatic ecosystems (FAO, 2004).

Biodiversity is essential to life on Earth. It provides resources such as food, medicine, fibers, fuel, and building materials, as well as intangible services, on which human kind relies. For people in developing countries, biodiversity is vital for survival. Biodiversity also forms an important part of people's belief systems and their cultural and spiritual values (Khadka and Verma, 2012). According to Chambers and Conway (1991), livelihood comprises the capabilities, assets, (stores, resources, claims and access) and activities required for a means of living. if livelihood is sustainable, it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets and provide sustainable livelihood opportunities for the next generation at the local and global level and in the short and long term.

According to Kremen (2007), human beings are highly dependent on the natural environment for their livelihoods. However, in the 21st century, the impact of environmental variability and climate change has significantly affected the livelihoods of the poor and marginal societies in developing countries. The use of environmental resources in order to satisfy the increasing demands of the world's ever-growing population is undermining the sustainability of the earth's ecosystem which is critical to our survival and high plant diversity within agricultural plots can yield higher production levels than systems with low plant diversity. Grassland experiments have shown that greater plant species diversity is correlated with greater temporal stability in annual

aboveground plant production, demonstrating that a more efficient and sustainable supply of food, such as fodder, can be enhanced by increasing biodiversity (Tilman *et al.*, 2006). Climate change involves long-term changes in mean temperature and/or rainfall patterns and increased climate variability, reflected by an increasing occurrence of severe climate events such as droughts and floods (Smit and Skinner, 2002). Poor, mainly subsistence-based and natural resource-dependent societies in developing countries are especially vulnerable to climate change. They are sensitive and exposed to natural hazards, and the severity and higher frequency of such hazards undermines the asset portfolio needed to adequately cope and to adjust to them (UNDP, 2007). For the millions of small farmers in developing countries already struggling to eke out vulnerable livelihoods, one major consequence is an increase in food insecurity. This is a particular risk in regions where climate acts both as an underlying chronic issue and a short-lived shock, as poor farmers often have a low ability to cope with shocks and to mitigate long-term stresses (Bohle *et al*., 1994).

To protect wild fauna and flora, eco-agriculture landscapes must provide protection of nesting areas from disturbance, diverse perennial cover for protection from predators, adequate access to clean water throughout the year, territorial access between dispersed population groups to ensure provide minimum viable populations genetically and demographically, all-season access to food from diverse sources, viable populations of predators and prey, healthy populations of other species with which they are interdependent (such as their pollinators), and biologically active soils. Many of these functions can be provided by healthy patches and networks of natural habitat, but production areas also play a critical role. To achieve these attributes in production areas, agricultural and conservation innovators are pursuing strategies such as minimizing agricultural pollution of natural habitats, managing conventional cropping systems in ways that enhance habitat quality, and designing farming systems to mimic the structure and function of natural ecosystems (Sara and Jeffrey, 2008). Biodiversity conservation in general can be taken to mean the protection, maintenance and/or restoration of living natural resources to ensure their survival over the long term. But it is variously defined depending on different values, objectives and world views (Elliott *et al*., 2011).

In general agrobiodiversity plays a critical in role in increasing the livelihood of inhabitant through diversifying the diversity of the area and this true for Bale eco-region. But due to expiation of farm land, increasing of human population, settlement ,Overgrazing, Deforestation

and Monocropping practices in these region in alarming rate the extent of the loss of agrobiodiversity during recent decades that affect the livelihood of the habitat (environmental, social, economical and spiritual) attention raised at both national and international levels to the need for preserving the genetic diversity, which represents a key component of sustainable agricultural development and food security in the world (FAO, 2004). This study aims to assess agrobiodiversity and its effect in diversifying the lively hood of local communities living in the same habitat.

1.2. Statement of the problem

Many people's food and livelihood security depend on the sustained management of various biological resources that are important for food and agriculture. Every life especially human being depend on and have a great interdependence with agricultural diversity (Nahusenay and Tesfaye, 2015). Biodiversity and especially agrobiodiversity are important assets that favor poor people's food security. Agrobiodiversity contributes to the achievement of sustainable livelihoods as it is an essential element of the natural resource base. The genetic resources are important for food and income security, health care, shelter, cultural and spiritual practices. This is true for many rural communities, in developing countries, as genetic resources are crucial elements for environmental risk management and food production (FAO, 2005).

Bale Eco-Region covers fourteen politically defined Woreda's in the Oromia Regional State of South-eastern Ethiopia and contains 576,856 hectares (ha) of tropical dry and moist forest. The moist forest comprises the second largest stand in Ethiopia, a quarter of which is found within the Bale Mountains National Park. Both moist and dry forests are threatened by the largely unregulated subsistence livelihood needs of the population, with diversity being cleared to procure land for crops and livestock grazing, as well as for timber and firewood (Dereje, 2015). According to Bekele *et. al., (*2010), Bale and Arsi are known by the production of wheat at which most of the land covered by wheat production that contribute for mono cropping. So the agricultural diversity is lost due to increasing of human population, expiation of farm land, overgrazing, deforestation, focusing of farmers on species of crops and animals; that is rather than diversification on specialization, that leads to mono cropping, loss of nutritional high value crops, loss highly resistance crop to disease, environmental pollution , minimizing income diversification and loss of cultural plants, generally that affect the livelihood of

community through environmental degradation. The study was to investigate agrobiodiversity and its effect on diversifying the livelihood of local communities in BER.

1.3. Objective of the study

1.3.1 General Objective

- The main objective of this study was to investigate agrobiodiversity and its effect in diversifying the livelihood of local communities in the BER.

1.3.2 Specific Objectives

- ✓ To identify types of agro-biodiversity that currently exists in the BER.
- ✓ To assess the role of agrobiodiversity in diversifying the livelihood of the communities in the BER.
- ✓ To identify the variation of agrobiodiversity with agro-ecology in the BER.
- ✓ To assess perception of local communities towards agrobiodiversity in the BER.

1.3.3. Research questions

- ✓ What are the types of agrobiodiversity in the BER?
- ✓ What is the role of agrobiodiversity in diversifying the livelihoods of the local community of BER?
- ✓ Is it variation of agrobiodiversity between agro ecology in the BER?
- ✓ How is the perception of local communities towards agrobiodiversity?

1.4. Scope of the study

The study was conducted in BER. Out of 14 Woredas that located in these BER five Woredas (Dinsho, Dello Menna, Berbere, Adaba and Harrena Buluk) were selected purposefully. The study focused on agrobiodiversity (crop and animal) that directly used by community, their existence, variation across the agro ecology, role of agrobiodiversity and challenges that affect the distribution and loss of agrobiodiversity. For collecting quantitative data for this research, 384 respondents were selected using simple random sampling technique and focus group discussions were conducted with 8-12 individual (men, youth and women) participants.

1.5. Significance of the study

Agrobiodiversity plays a great role in the diversifying and protecting the livelihood of the community. But the agrobiodiversity loss increasing from time to time due to; expansion of farm land, increasing of human population, illegal settlement, overgrazing, deforestation, mono cropping practices in the BER

This study provides valuable information on type of agricultural diversity, their role in the diversifying livelihood of the local community on different agro-ecology and the perception of the local community towards agricultural diversity and constraint for the loss of agrobiodiversity through investigating the potential role of agrobiodiversity on the livelihood of the community. In addition, it will help the governmental and nongovernmental organization to undertake different measures on the challenges of agricultural diversity that affect are local community.

2. Literature Review

2.1 Definition and concepts of agrobiodiversity

Agrobiodiversity is the result of natural selection processes and the careful selection and inventive developments of farmers; the entire range of the domestic crops used in world agriculture is derived from wild species that have been modified through domestication, selective breeding and hybridization. Most remaining world centers of diversity contain populations of variable and adaptable landraces as well as wild and weedy relatives of crops, all of which provide valuable genetic resources for crop improvement (Harlan, 1975). According to Vandermeer and Perfecto (1995), Agrobiodiversity is the biodiversity associated with the crops and livestock purposely included in the agro-ecosystem by the farmer, and which will vary depending on management inputs and crops spatial/temporal arrangements and also include all soil flora and fauna, herbivores, carnivores, decomposers, etc., that colonize the agro-ecosystem from surrounding environments and that will thrive in the agro-ecosystem depending on its management and structure. So the agricultural diversity play great role in conserving this diversity.

Biodiversity is essential to life on Earth; it provide resources such as food, medicine, fibers, fuel, and building materials, as well as intangible services, on which human kind relies. For people in developing countries, particularly in least developed contexts, biodiversity is vital for survival. Biodiversity also forms an important part of people's belief systems and their cultural and spiritual values (Khadka and Verma, 2012). O'keeffe *et al.*, (2013) described agro-biodiversity as 'a dynamic and constantly changing of relations between people, plants, animals, other organisms and the environment, always coping with new problems, always finding new ways.

Ethiopia has a large natural and cultural diversity with a big range of climates which result from of its topography and latitudinal position. The great plains of Ethiopia located a top of two massive highland plateaus, cloven into unequal halves by the Great Rift Valley. From the sweltering arid and semi-arid lands of the Ogaden in the Somali Region in the east, the lowlands bordering the Sudan in the West and Dalol in the Afar Region in the North, where Africa crashes into Arabia, the land sweeps up, rising through semi-arid lowlands and pockets of tropical jungle, mountain forests, and reaching afro-alpine pastures on the slopes of the Simen and Bale (Convention on Biological Diversity, 2009).

Ethiopia is also one of the major Vavilov centers of origin/diversity for many crops and their wild and weedy relatives. It is an important primary and secondary gene pool for many field crop species that are useful sources of germ plasm for economic traits in general and sources of genes resistant to diseases and pests in particular (Convention on Biological Diversity, 2009). According to Anteneh and Temesgen (2009) BER is one of the conservation international biodiversity hotspots and qualified for world heritage site and biosphere reserve listing.

2.2. Role of agrobiodiversity

2.2.1 Increasing the diversity of the area

Biodiversity refers to all species of plants, animals and microorganisms existing and interacting within an ecosystem. In agro-ecosystems, pollinators, natural enemies, earthworms, and soil microorganisms are all key biodiversity components that play important ecological roles thus mediating processes such as genetic introgression, natural control, nutrient cycling, decomposition, etc. The type and abundance of biodiversity in agriculture will differ across agro-ecosystems which differ in age, diversity, structure, and management. In fact, there is great variability in basic ecological and agronomic patterns among the various dominant agro-ecosystems (South wood and Way, 1970). Conservation of agricultural diversity in eco-agriculture landscapes embraces all three elements of agricultural biodiversity defined by the Convention on Biological Diversity: genetic diversity of domesticated crops, animals, fish and trees; diversity of wild species on which agricultural production depends (such as wild pollinators, soil micro-organisms and predators of agricultural pests); and diversity of wild species and ecological communities that use agricultural landscapes increase in the habitat (Convention on Biological Diversity, 2002).

Agro-ecosystems that are more diverse, more permanent, isolated, and managed with low input technology (i.e. agro-forestry systems, traditional poly cultures) take fuller advantage of work done by ecological processes associated with higher biodiversity than highly simplified, input-driven and disturbed systems (i.e. modern row crops and vegetable monocultures and fruit orchards (Altieri, 1995).

The United Nations Food and Agriculture Organization (2007) defines ecosystem as a “dynamic complex of plant, animal, and micro-organism communities and the non-living environment interacting as a functional unit “while ecosystem services are ‘the benefits people obtain from

ecosystems'. Ecosystem services are classified into three major categories: provisioning services (food, freshwater, fuel, wood etc); regulating services (climate, disease and water regulation, water purification etc) and cultural services (spiritual and religious, recreation and ecotourism etc.) (Butler & Oluoch-Kosura, 2006). However, these services are in decline due to man's continuous exploitation of the natural environment, which has a huge impact on the scale of land use (FAO, 2010).

2.2.2 Protecting habitats for freshwater and aquatic biodiversity

When agricultural development takes place in a natural environment, it tends to result in a heterogeneous mosaic of varying types of habitat patches spread across the landscape. The bulk of the land may be intensely managed and frequently disturbed for the purposes of agricultural production, but certain parts (wetlands, riparian corridors, hillsides) may be left in a relatively natural condition, and other parts (borders and strips between fields, roadsides, and adjacent natural areas) may occasionally be disturbed but not intensely managed. In addition, natural ecosystems may surround or border areas in which agricultural production dominates (Gliessman, 1990).

Protection or establishment of native vegetation buffers along streams, rivers and riparian systems is critical for biodiversity conservation Data from the US suggest a minimum buffer width of 25m to provide nutrient and pollutant removal, 30m to provide temperature and microclimate regulation and sediment removal, a minimum of 50m to provide detritus input and bank stabilization and over 100m to provide for wildlife habitat functions. Wetlands should be protected, and the critical function zone of wetlands should be maintained in natural vegetation. The latest guideline in North America is that at least 10% of a watershed and 6% of any sub-watershed should comprise wetlands (Blann, 2006). Molden *et al.,* (2005) emphasize the importance of re-establishing hydrological connectivity and natural patterns for aquatic ecosystems. Based on literature review and field experiments, Van Noordwijk *et al.,* (2005) conclude that watershed functions in agricultural landscapes can be effectively provided through strategic spatial configuration of perennial natural vegetation and planted vegetation, with maintenance of continuous soil cover enhancing infiltration.

Maintaining seasonal flood pulse dynamics in floodplains involves restoring floodplains and protecting them from developments that disconnect rivers through levees and water level

management (Blann, 2006). If floodplains must be used for agriculture, ecologists recommend using agro-forestry and other approaches compatible with natural cycles rather than monocultures requiring annual ploughing and fertilization (Sendzimer *et al:* 2007).

2.2.3 Agrobiodiversity and pest management

Nowhere are the consequences of biodiversity reduction more evident than in the realm of agricultural pest management. The instability of agro ecosystems becomes manifest as the worsening of most insect pest problems is increasingly linked to the expansion of crop monocultures at the expense of the natural vegetation, thereby decreasing local habitat diversity (Altieri and Letourneau, 1982). Plant communities that are modified to meet the special needs of humans become subject to heavy pest damage and generally the more intensely such communities are modified, the more abundant and serious the pests. The effect of the reduction of plant diversity on outbreaks of herbivore pests and microbial pathogens is well-documented in the agricultural literature (Andow, 1991; Altieri, 1994). Such drastic reduction in plant biodiversity and the resulting epidemic effects can adversely affect ecosystem function with further consequences on agricultural productivity and sustainability.

In modern ecosystems, the experimental evidence suggests that biodiversity can be used for improved pest management (Altieri and Letourneau, 1994). Several studies have shown that it is possible to stabilize the insect communities of agro-ecosystems by designing and constructing vegetation architectures that support populations of natural enemies or that have direct deterrent effects on pest herbivores. For example, at the landscape level, data demonstrates that there is enhancement of natural enemies and more effective biological control where wild vegetation remains at field edges and in association with crops (Altieri, 1994). These habitats may be more important as overwintering sites for predators or they may provide increased resources such as pollen and nectar for parasitoids and predators form flowering plants (Landis, 1994). Many studies have documented the movement of beneficial arthropods from margins into crops and higher biological control is usually observed in crop fields close to wild vegetation edges than in fields isolated from such habitats (Altieri, 1994).

In many cases, weeds and other natural vegetation around crop fields harbor alternate hosts/prey for natural enemies, thus providing seasonal resources to bridge gaps in the life cycles of insects and crop pests (Altieri and Letourneau, 1984).

2.2.4 Agrobiodiversity in Ethiopia Situation

Ethiopia is centre of origin for crops such as: sorghum, tef, coffee and enset, and is centre of diversity for many others such as: wheat, barley, and Ethiopian Mustard, Chickpea, Lentils and Finger millet. Ethiopia is recognized as an important source of the public goods associated with crop genetic diversity conservation, as it is a primary or secondary centre of diversity for several crops. The tremendous variation in altitude, temperature, rainfall, soil type and ecological settings, as well as the diverse social and cultural conditions together with different levels of market integration are some of the possible explanations for the existence of remarkable genetic variation of crop varieties in the country (McGuire, 2000). The number of crop accessions of Ethiopian origin that have been introduced to various international and foreign national crop improvement programs and seed companies is enormous: More than 1800 for wheat and more than 4500 for sorghum, around 2500 for barley and more than 900, large numbers are also reported for chickpea, lentil and finger millet (Smale and Bellon, 1999). Crop genetic resources are the product of the interaction between human and natural selection of the environment, yielding a set of domesticated crops and varieties used in agricultural production. Crop genetic resources are embedded in seeds and they are an important determinant of the characteristics and attributes of the crop species, together with environmental and human management factors. Farmers choose crops and seeds to provide a set of attributes that meet their specific production and consumption needs (Smale and Bellon, 1999).

The tremendous variation in altitude, temperature, rainfall, soil type and ecological settings, as well as the diverse social and cultural conditions together with different levels of market integration are in some of the possible explanations for the existence of remarkable genetic variation of crop varieties in the country. The resulting increased intensification, characterized by absence of fallowing, lack of technical change and total absence of conservation practices and furthermore complicated by frequent drought, is creating a high degree of land degradation and, The combination of, high population pressures, poor agricultural policy making, conflicts and environmental degradation have left Ethiopia a country with low agricultural productivity, high rates of food insecurity and high rates of dependency on external food sources. Recent estimates therefore, a decline of land and grain productivity (Shiferaw and Holden, 1997).

3. Materials and Methods

3.1. Description of the study area

3.1.1. Location

The study was conducted in the BER South-Eastern part of Ethiopia. It is located at about 400 km from the capital city, Addis Abeba.BER is situated between 6º29' – 7º10'N and 39º28' – 39º57'E. Fourteen districts (locally known as Woredas), namely Kokosa, Nensabo, Dodola and Adaba Woredas from West Arsi Zone, and Gololcha, Gasera, Sinana, Agarfa, Dinsho, Berbere, Goba, Goro, Harrena Buluk and Dello Menna Woredas from Bale Zone included in bale eco region. About 1,728,316 people live in the fourteen districts from this 61% live in Bale eco region (CSA population projection, 2013). Bale eco-region receives almost eight months of precipitation (March-October). Temperature varies from the lowest less than 7.5°C at the Sannate Plateau to over 25°C in Dello Menna (Dereje., 2015).The climate of Bale ranges from tropical in the Southeastern lowlands to alpine in the Northwestern highlands, the altitude varying between 400 and 4377m a.s.l. Among the Woredas, Berbere and Dello Menna are lowland areas, and Harena Buluk, Goro, Nensebo and most part of Gololocha and Agarfa are midlands. The remaining Woredas are highlands. The Eco-region receives bimodal rainfall

3.1.2. Agricultural activity

The eco-region is known by having two major seasons, namely Belg and Meher and irrigation is practiced in some areas. Agriculture is the predominant economic sector which is over 95% of the population engaged in this sector. The farming system is mixed both livestock and crop production which was characterized by subsistence methods and it pastoralist system. The overall farming system is strongly oriented towards grain production, Animal husbandry, coffee and honey production to sustain farmers' livelihoods. Types of crops that produced /cultivated in this eco-region is wheat ,barley ,oat, fab been, field pee ,maize, linseed, sesam and mung been are crops, vegetable potato, onion, cabbage, fruits papaya, mango and banana are produced . In the lowland used Forest Coffee as cash crop (Dereje., 2015).

).

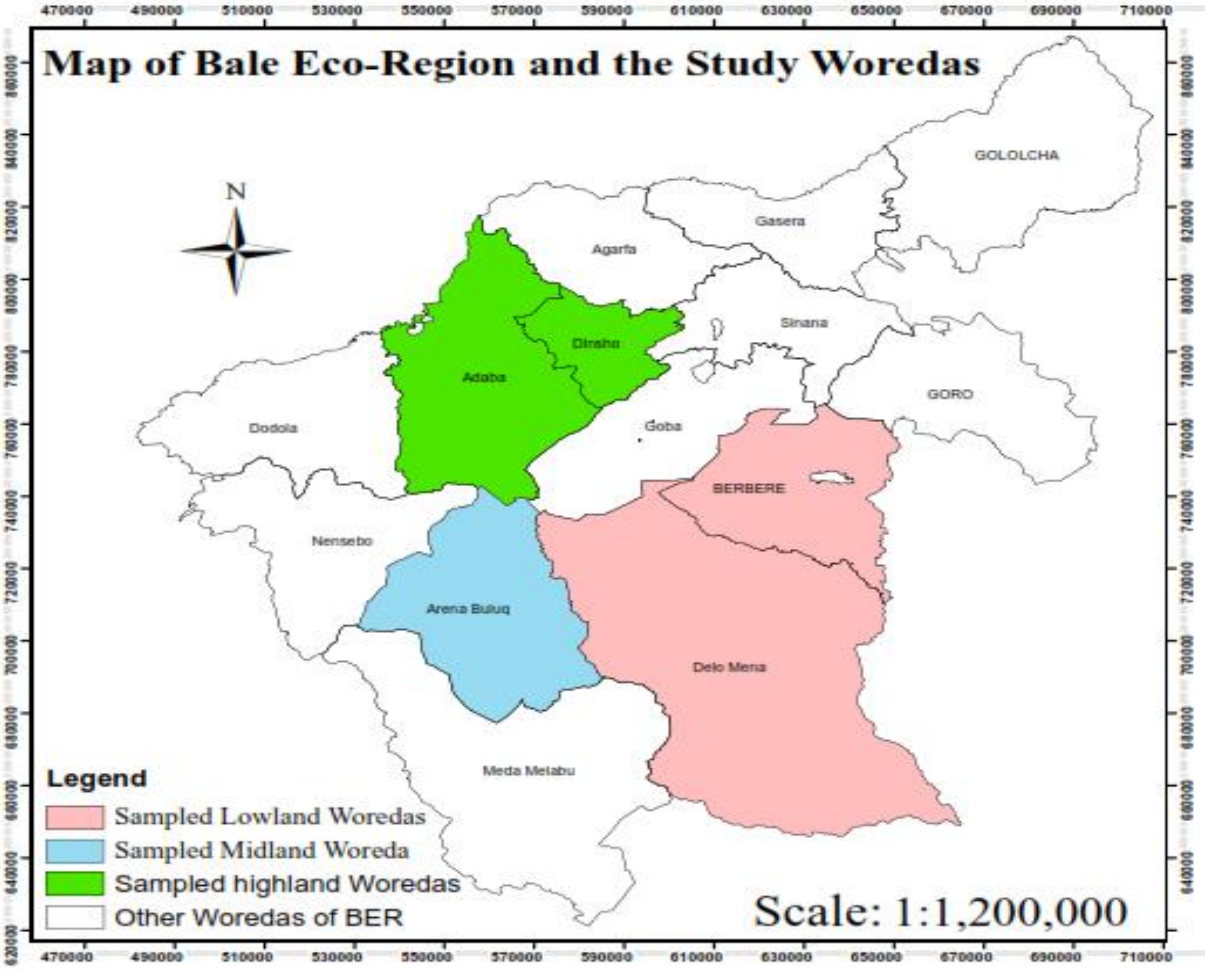

Figure 1: Map of Bale Eco-Region and the study area (By:Lemme Tiki*)*

3.1.3 Vegetation types and wild animals of the BER

The forests in the Bale Eco-region are mainly high forests composed of six forests formerly designated as "forest priority areas", namely, Aloshe Batu, Goro Bale, Harana Kokosa, Kubayu, Menna-Angetu and Adaba Dodolla. The eco-region is mapped as Afro mountain vegetation and considered to be part of the Afro Mountain. The natural vegetation, called Dega, weyna dega, kola in Amharic, is probably a mixture of closed forest in areas with higher rainfall and grassland, bush land, and thicket in other lower rainfall areas. The forest consists of *Podocarpus falcatus* and *Juniperus proccera*, often with *Hagenia Abyssinica*. There is an evergreen broadleaved mountain forest dominated by *Syzygium guineense*, and *Olea africana* .On the moist slopes of the Harenna forest, a shrubby zone of *Hagenia* and *Schefflera* grows along with *giant*

lobelias, *Lobelia gibberroa*. The total area of Bale Eco-region is 576,856 hek. In 2011, of which 193,000 ha is covered by the Bale Mountain National Park (BMNP)

The moist forest comprises the second largest stand in Ethiopia. The Herenna forest, covering the southern part of the massif, is the second largest stand of moist tropical forest in Ethiopia. The forests are host to globally unique and diverse fauna and flora, including a significant number of rare and endemic species. The forests in the Eco-region are threatened by the largely unregulated subsistence livelihood needs of the population, with forest being cleared to procure land for crops and livestock grazing, as well as for timber and firewood (BERSMP, 2006). Between 2001 and 2009 the average annual deforestation rate in the eco-region was 3.44%, ranging from 1 to 8% (Dupuy, 2009). Wild animals are not evenly distributed in the Eco-region. Common wild animals found in the Eco-region are Red fox, Giant mole rat, Mountain Nyala (Alieri, 1994), Hyena, Rhinoceros, Wild ass, Lion, Warthogs, Leopard, Olive, Baboons, Apes, Monkey, Birds, Dickers, Fish, Frog, Snakes and others. These wild animals are found in a scattered way.

3.1.4. Water sources

The BER is considered as the water tower of south-eastern Ethiopia, Somalia and Northern Kenya. According to recent studies, the Bale Eco-region supplies water for some 12 million people in the lowlands of southeast Ethiopia, Northern Kenya and Somalia. Total of 40 rivers arise in the area, contributing to five major rivers, namely the Web, Wabi Shebelle, Welmel, Dumal and Ganale (FARM Africa, 2008). These rivers are the only sources of perennial water for the arid lowlands of the eastern and southeastern Ethiopia, including the Ogaden and Somali agricultural belt (Dereje, 2015).

3.2. Research design

The type of research were descriptive that describe about the existence of agro biodiversity, their role, attitude of the community and challenges that affect/hinder the community in order to use agrobiodiversity.

3.2.1. Site selection and sampling design

In this study, multi-stage sampling procedure was employed (Figure 2). The Woredas in BER that are pilot areas for SHARE project were stratified into highland, midland and lowland agro-ecologies. Out of the total highland, midland and lowland Woredas of BER, five Woredas (two from highland Woredas, One from Midland and two from lowland Woredas) were selected purposively by expert recommendation from their strata. Accordingly, Adaba and Dinsho from highland Woredas, Dello Menna and Berbere from lowland Woredas and Harrena Buluk from midland were selected. From each Woredas two Kebeles that best represents the agro-ecologies of the Woreda were selected by expert recommendation through purposive sampling method.

The sample size was proportionally allocated to each Kebele to draw the sample households. Hence, sample households were selected from each Kebele by random sampling method using lottery technique from the sampling frame (*i.e. complete household lists)* of each Kebele. The sample size was calculated using a standard formula of Freund and Williams (1983):

$$n = \frac{(z)^2(pq)}{(d)^2} = \frac{(1.96)^2(0.5*0.5)}{(0.05)^2} = \frac{0.9604}{0.0025} = 384$$

Where: n is sample size, z is statistical certainty usually chosen at 95% confidence level (z = 1.96), p is proportion of population having desired characteristics (p = 0.5), q is 1-p and d is error accepted by researcher (5%).

.

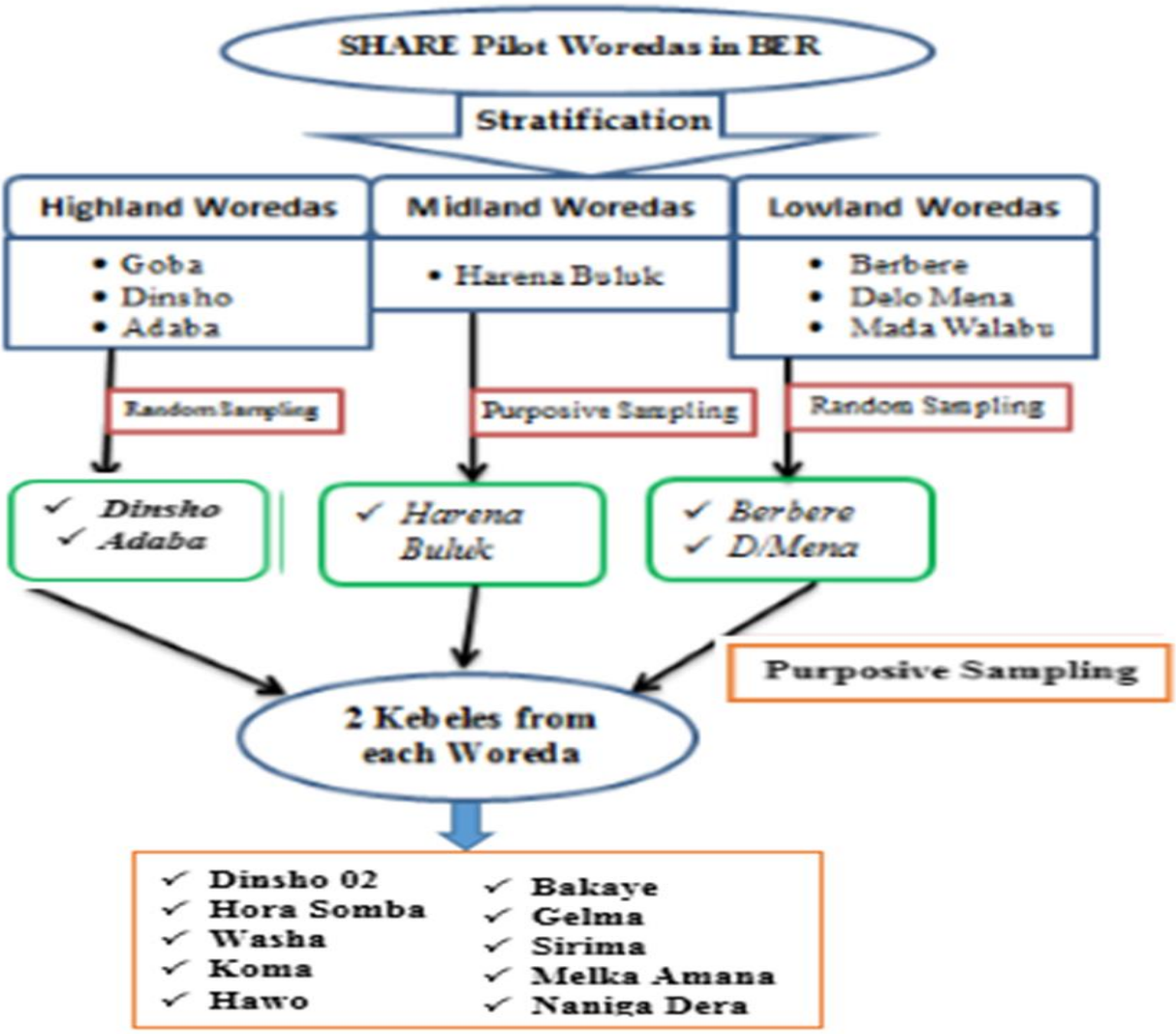

Figure 2: Sampling Frame work

Table 1:- Household head and sample size per kebele

No.	Name Of Woreda	Name Of Kebele	Number of household head	Sample Size
1	Dinsho	Dinsho-02	1776	17
		HorSoba	1880	18
2	Adaba	Koma	6582	63
		Washa	6059	58
3	Dello Menna	NanigaDera	4283	41
		Melka Amana	3865	37
4	Harena Buluk	Hawo	4283	41
		Bakaye	3134	30
5	Berebere	Sirrima	5328	51
		Galma	2925	28
	Total		40117	384

The participants of the FGD were purposively selected by using Kebele chair man, development agent and elders from the area among youths, women and elders of the study area. Ten FGDs that consisted an average of seven participants were participated and the meeting held together in order to get representative idea about the objective. In addition, For field observation 10/ten/ household headed sample were selected per Kebele systematically by using Kebele chair man, development agent and elders that live for a long period of time over the area by using wealth rank that is three farmer from highly wealthy(model farmer) four from medium farmer and three from lower wealth rank. This method were used to collect type of crop exist in BER.

Table 2 Sample frame work

No	Name Of Woreda	Name Of Kebele	No. Household Wealth Rank			Total
			Wealthy	Medium	Low	
1	Dinsho	Dinsho-02	3	4	3	10
		HoraSoba	3	4	3	10
2	Adaba	Koma	3	4	3	10
		Washa	3	4	3	10
3	Dello	NanigaDera	3	4	3	10
	Menna	Melka Amana	3	4	3	10
4	Harena	Hawo	3	4	3	10
	Buluk	Bakaye	3	4	3	10
5	Berebere	Sirrima	3	4	3	10
		Galma	3	4	3	10
	Total					100

3. 3 Method of data collection

Data was collected from primary sources between December 2015 and Jun 2016 through semi-structured interview, FGD and field observations. The same data collection methods was also used by Garnevska et al. (2006) (i.e. semi-structured interviews) in Bulgaria; for conducting similar and related studies. Therefore, semi-structured questionnaires were employed to collect information on background and socio-economic characteristics of the sample households, relevant information about the role of agrobiodiversity in diversifying the livelihoods of the communities and challenges on agrobiodiversity.

3.4. Data analysis

Data collected were analyzed with descriptive statistics and Chi-square using statistical Package for Social Science (SPSS) version 20 to analyze the variation in agricultural crops that cultivated on their land holdings and in different agro ecology of BER.

3.5 .Quality and ethical consideration

The researcher received official permit from Madda Walabu University, Dinsho, Adaba, Dello-Menna, Harrena Buluk, Berebere Woreda administration Bureau to conduct this study. Quantitative survey respondents and qualitative (FGD) informants were provided detail explanation on the overall objective of the study ahead of time. Interviews were administered on free will of interviewees and assured confidentiality and anonymity of the information obtained from them to use only for the intended research objectives

4 Results and Discussions

4.1 Demographic and Socio-economic information

Demographic information of respondents participated in this study is described in (Annex. 1). Most of study participants were predominantly male 93% from the total participant are and the rest 7% are female. Participation of few females in the study is due to cultural barriers that prohibited females. In relation to marital status 5% are single, 92 are married and 2% are widowed and 74% of the respondents were located under the productive age. In relation to education and their major source of income, most of the respondent which is 68% in low land, 62% in mid land and 77% in highland are informal educated and that join primary school. Their major source of food and income were mixed agriculture (crop and animal husbandry) (Annex 1).

4.2 Types of agrobiodiversity that currently exist in the BER

Ethiopia is a centre of origin and genetic diversity for a number of cultivated crops and has also a significant level of livestock genetic diversity. The diversity in agro-ecological systems influences the types of the farming and production systems as well as the distribution of the crop and livestock diversity. Diversity in both crops and livestock provides the opportunity to have access to a variety of food and income sources, particularly for farmers with limited resources. The communities that live in this eco-region use agricultural diversity for different purpose. Agrobiodiversity were the major source of food, income, energy, medicine, transportation, house construction material, input for their farm land, and in general agrobiodiversity play a greater role in day to day activity of the community (Annex 2). Bale eco-region was known by the diversity of crops and animals. In the region there were different types of crop and animal recorded that are used for community livelihood change. From agricultural diversity that are used by community cereal crop like wheat, barley, out, tef, maize and sorghum, pulse crop field pea, faba bean, lentil, chickpea, mung bean (mashoo), soya bean, oil crop like Sesame, linseed, Sunflower, Ethiopia mastered, peanut, vegetable like, garlic, kale, carrot, potato, tomato, onion, cabbage, fruit like banana, mango, papaya, apple, avocado and lemon ,from stimulant coffee, khat, tobacco, rahammnus and from livestock cattle, Sheep and goat, horse, donkey, camel, and hen are animals that some of the agrobiodiversity that are exist and used by the community in the BER (Table 4). From Crops/plants and animals used by farmers over the area greater

number of crop type cultivated on the midland than the other agro-ecology (Table 3). In relation to animal production camel was only located in lowland and midland rather than this, all kind of animals located in lowland were located in midland and highland (Table 4). Similarly different study show as large number of crops are grow in Ethiopia that include cereals (Tef, wheat, barley, sorghum and millet); pulses (fab bean, chickpea, haricot bean, field pea, lentil, soybean, and vetch); oilseeds (linseed, Niger seed, Ethiopian mastered, seasom, and groundnuts), vegetables (pepper, onion, tomato, carrot, cabbage, and kale), root and tubers (potato, enset, Sweet-potatoes, beet root); fruits (Apple, banana, citrus, papaya, mango and avocado); fibers (cotton and sisal); stimulants (coffee, tea, chat and tobacco) and sugarcane were cultivated and About million hectares of land is devoted to the cultivation of these crops in different agro-ecology of the country and these plants are vary from one agro-ecology to the other due to different factor (Dereje and Eshatu, 2003).So that the community that live in Bale eco region cultivate and domesticate different crop and animals respectively as a source of food, income, and other socio economic activities as well as for, cultural and environmental protection, which create low dependency on natural resource like forest in BER (Annex 2).

Table 3:- Type of Crop/Plant cultivated on different agro ecology of BER

				Agro ecology (n=100)		
No.	Crop species cultivated	Scientific name	Common English Name	Lowland	Midland	Highland
1	Cereal crop		Wheat	-	*	*
		Hardeum vulgare L.	Barley	*	*	*
		Triticum polonicum L.	Oat	*	*	*
		Eragrostis tef (Zucc.) Tratter	Tef	*	*	*
		Zea mays L.	Maize	*	*	*
		Saccharum officinarum L.	Sugar cane	-	*	-
		Sorgum bicolor(L) Moench	Sorghum	*	*	-
2	Pulse crop	*Pisum sativuma* L.	Field pea	*	*	*
		Vicia faba L.	Faba bean	*	*	*
		Lens culinaris	Lintel	-	-	*

		Cicer artinum L.	Chickpea	*	*	*
		Vigna radiate (L) Wilczek	Mung bean	*	-	-
		Phaseolus acutifolius A.Gray	Soya ben	*	*	-
3	Oil crop	*Linum unisatissimum* L.	Linseed	*	*	*
		Sesamum indicum	Sesame	*	*	-
		Guizotia abyssinica (L.f.) Cass	Niger seed	*	*	*
		Helianthus annus L.	Sunflower	*	*	*
		Nigella sativa L.	Ethiopian mustard	-	*	*
		Vigna subterranean (L.) Verdc	Groundnut	-	*	-
4	Vegetable	*Allium sativum* L.	Garlic	-	*	*
		Brassica integrifolia (west) O.E.schulz	Kale	*	*	*
		Daucus Carita L.	Carrot	-	*	*
		Solanum tuberosum L.	Potato	-	*	*
		Lycopersicon esculanta L.	Tomato	*	*	*
		Allium porrum	Leek	-	*	*
		Allium cepa L.	onion	*	*	*
		Brassica oleracea var.capitata	cabbage	-	*	*
		Beta vulgaris L.	Beet root	-	*	*
5	Fruit	*Musa paradisiacal* L.	Banana	*	*	-
		Mangifera indica L.	Mango	*	*	-
		Carica papaya L.	Papaya	*	*	-
		Malus sylverstris Miller	Apple	-	-	*
		Persea Americana Mill.	Avocado	*	*	-
		Citrus aurantifoilia (christm) Swingle	Lemon	-	*	-
6	Stimulant	*Coffea Arabica* L.	Coffee	*	*	-
		Chata edulis(Vahl,)Forssk.ex Endil.	Khat	*	*	-
		Nicotiana tobacum L.	Tobacco	*	*	*

		Rhamnus prinoides L.Herit	Rhammnus	-	*	*
7	spice	*Zingiber officinale* L.	Ginger	-	*	-
		Cinnamomum zeylanicum care.ex Blume	Cinnamon/Kenefa/	-	*	-
		Capsicum frutescens L.	Chill	-	*	*
		Tringonella foenum-graecum L.	Fenugreek/Abish/	-	*	*
		Capsicum frutescens L.	Pepper	-	*	-
		Ocimum basilicum L.	Rosemary Basil/Bosbila	-	*	*
	Total					

Note
"-"= Not cultivated
"*" = cultivated.

Figure 3**:** Agricultural diversity cultivated on different agro-ecology (*Field photo: by Workalegn Asseffa, 2016*)

B livestock

Table 4:- Type of Animal domesticated on different Agro-ecology in BER

No.	Livestock	Livestock type	Lowland	Midland	Highland
1	Cattle	Cow	*	*	*
		Oxen	*	*	*
2		sheep	*	*	*
		Goat	*	*	*
3	Poultry	Hen	*	*	*
		Mule	*	*	*
4		Horse	*	*	*
		Donkey	*	*	*
		Camel	*	*	-
		Beeping	*	*	*

4.3 Variation of agrobiodiversity across the BER

The dominant agricultural enterprises in all agro-ecology zones are small-scale subsistence crop farms in the highland and livestock rearing in the lowland. In relation to livestock domestication without Camel, all kind of animals located in lowland are located on the midland and in highland. But, the type of crop/ plant cultivated was varied in the eco-region. That means the community that live on different agro-ecology in the eco-region in order to change their livelihood and for fulfilling food security they cultivate different crop.

For example based on agronomic classification in the lowland from cereal crop like tef, maize and sorghum, pulse crop, soya bean, and mung bean (masho), oil crop like, sesame, Vegetable Onion, fruit, mango, banana and papaya, stimulant like coffee and Khat were cultivated. On the highland from cereal crop wheat and barley, Pulse and Oil crop like, Field pea and Faba bean, linseed, from vegetable potato and onion were cultivated and in the midland, almost all plants that cultivated in the highland and lowland were cultivated. This shows that there is crop species cultivation difference across the agro-ecology (Figure 5). These variation also significant for all of the crop species at ($p<0.05$) for cereal crop, and that cultivated in the BER (Table 5).

Table 5 the variation of crop species in different agro-ecology in chi-square

Type of crop species		Value	Df	Asymp. Sig. (2-sided)
Number of cereal crop species cultivated	Pearson chi-square	83.15	12	*0.000*
Number of pulse crop species cultivated	Pearson chi-square	1.181E2a	10	*0.000*
Number of Oil crop species cultivated	Pearson chi-square	35.999a	8	*0.000*
Number of fruit crop species cultivated	Pearson chi-square	1.134E2a	10	*0.000*
Number of Vegetable crop species cultivated	Pearson chi-square	1.082E2a	16	*0.000*
Number of spice crop species cultivated	Pearson chi-squire	56.415a	8	*0.000*

At the same time, the distribution of crop/ plant type was also different from lowland to highland parts of the eco region. According to farmers group discussion in the "lowland we are cultivating crops like maze, sorghum, sesame, Mung bean and some stimulant like coffee and fruit papaya ,mango and banana for food and income generally for changing our lively hood. There is different crops have the ability to cultivated on this area, But even this crop/plant have not take good product for us because they have not improved variety that take high product, resist disease and climatic condition and stored for a long time up to we get market. So, we are cultivating very limited species on this area". On the highland and midland also told as especially on the highland their only improved seed of wheat and sometime barley, So most of us cultivate wheat and barley on our farm land and we cultivate other crop /plant not for diversifying our farm land only for the sake of food even if it is possible. But know a day's our crop start to affect by disease like rust. Which affect our livelihood and create food insecurity problem".

Figure 4: Focus group discussion and Interviewee undertaken in BER (*Field photo by Elsabet Takele, 2016*)

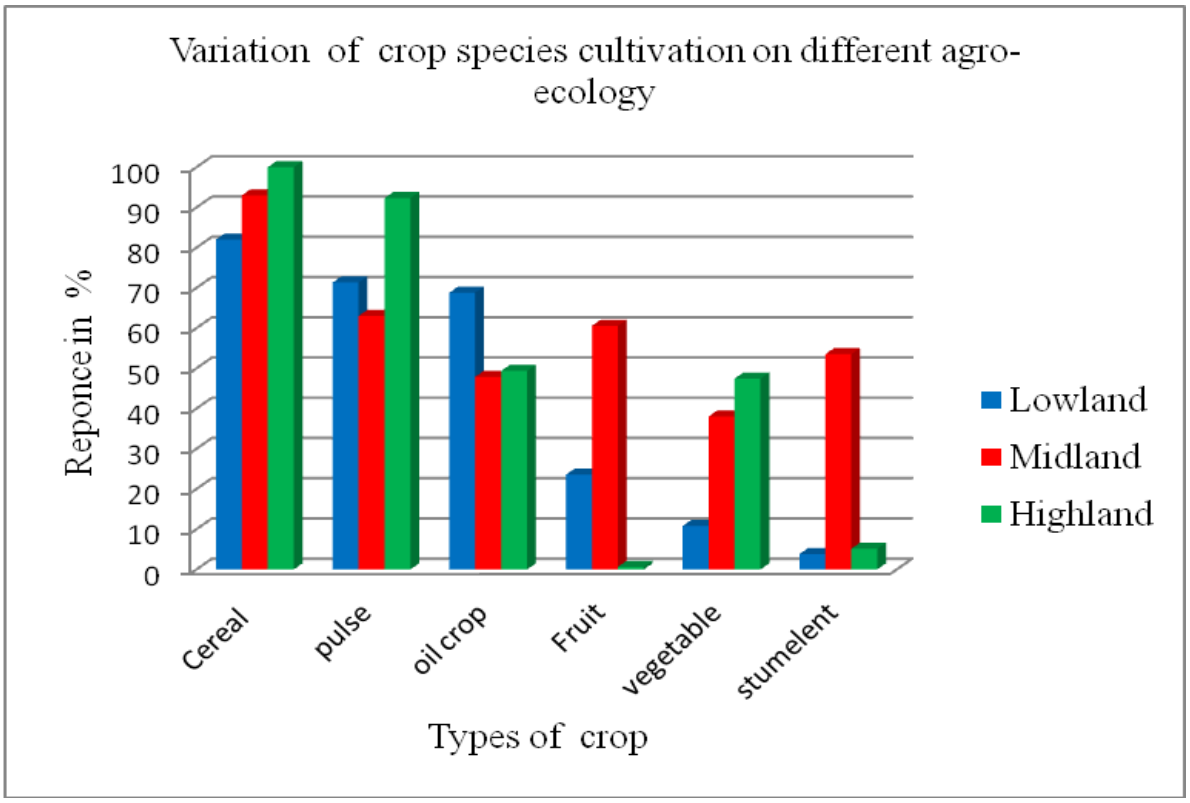

Figure 5:- Crop species produced in agro ecology BER (n=384)

4.3.1. Crop species cultivated

4.3.1.1. Cereal crop

In BER wheat, barley, oat, tef, Maize and sorghum are the major cereal crop that cultivated in the region. The farmer use this crops for changing their livelihood by using as source food, source of income, fodder, mulching, source of energy compost making for increasing the productivity of their land, medicine as well as cover of their home during home construction. Wheat and barley cultivation are dominant in highland parts of the eco-region than the other crop (Figure 6) That is 98% and 97% of respondents cultivate wheat and barley respectively. This crop is the major source of food and income in the highland part of the BER. tef, sorghum and maize are also the dominant cereal crop in the lowland as well as midland that use for source of food and income as the same to Wheat and Barley on the highland.

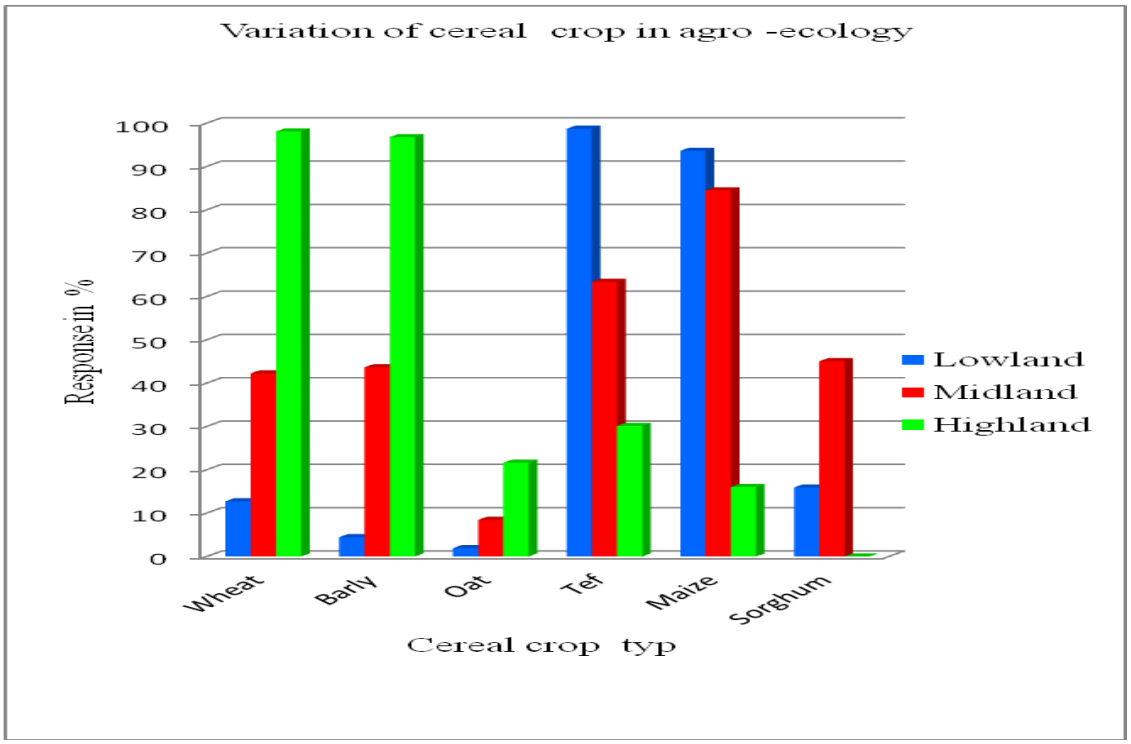

Figure 6: Cereal crop type cultivation variation in agro-ecology.

4.3.1.2 Pulse crop and Oil crop

In the region pulse crop like field pea, faba bean, lintel, soybean, chickpea and mung bean (Masho) and oil crop like linseed, sesame, black pepper, and sunflower, Ethiopian mustered and peanut are cultivated. Pulse crop use the farmer as the same to cereal crop for food, and

source of income especially mung bean (masho) and soybean from pulse and sesame from oil crop in the lowland used as major source of income and in the highland some farmer cultivate lentil and faba bean and field pea for source of income and food. In addition on the high land some farmer cultivate faba bean, lentil and field pea for increasing soil fertility of their farm land and increasing income. So that field pea and faba bean cultivated highly on the highland and soyabean cultivated highly on the midland and chickpea cultivated on the midland agro-ecology than other agro-ecology (Figure 7 and 8).

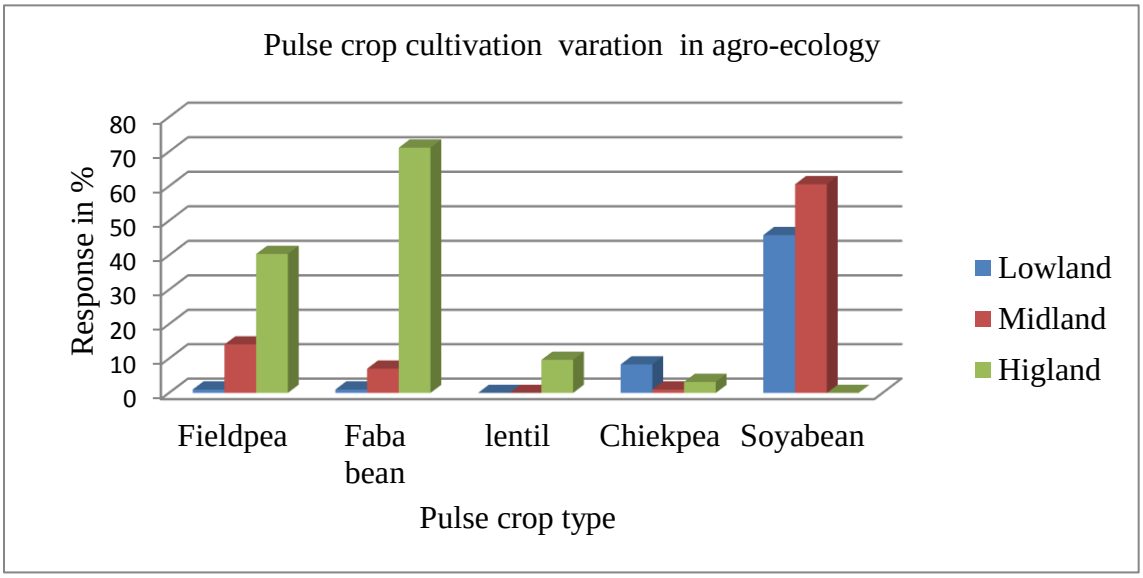

Figure 7:- Pulse crop type cultivation variation in agro-ecology (n=384)

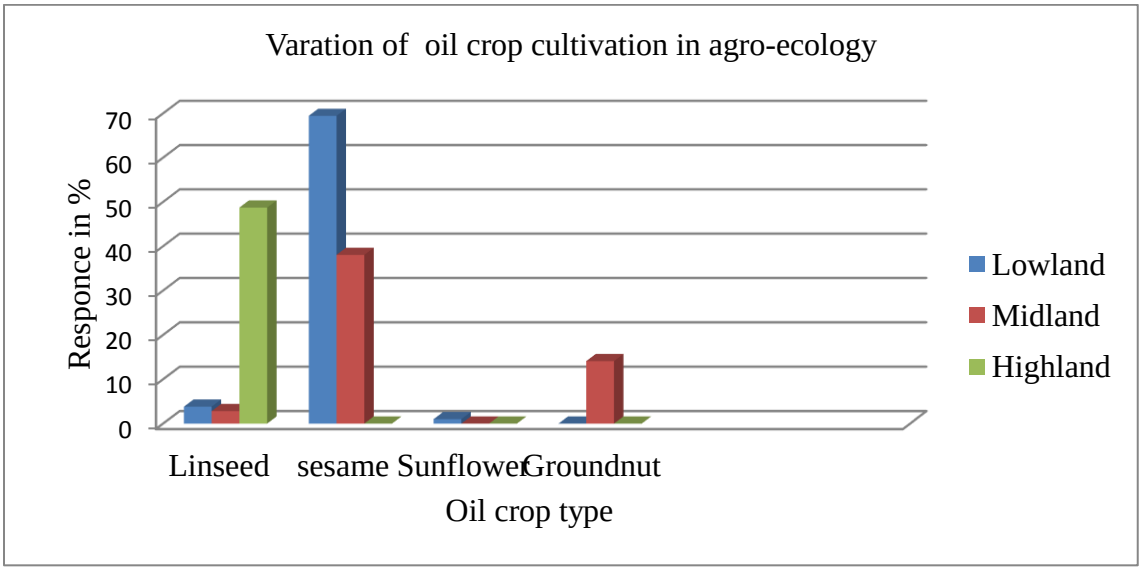

Figure 8:- Oil crop type cultivation variation in agro-ecology (n=384)

4.3.1.3 Vegetable, Fruit and stimulant production

Vegetables like Garlic, Kale, Carrot, Potato, Tomato, Onion, Cabbage, Beetroot and Chill, Fruit like, Banana, Avocado, Papaya, Apple, Lemon and Orange, from stimulant Coffee, Khat, Rhammnus and Tobacco were cultivated. Vegetable like Garlic, Kale, Carrot, Potato, Onion, Cabbage beet root are cultivate in the midland and highland parts of the eco-region (Figure 8). From this garlic, potato and onion are cultivated more on the highland than the other parts and kale, tomato and beetroot are cultivated more on the midland than the other. In fruit and stimulant production like vegetables, farmers cultivate those plants for different purpose such as for food, source of income (for diversifying their income) and for spiritual purpose. So that fruit and stimulant production also the other source of livelihood strategy of the community. Especially coffee and khat are the major source of income in the lowland and midland. Those plants also cultivated on different agro-ecology of the BER. So depending on the data all kinds of fruit and stimulants are more cultivated on the midland than the lowland and only apple are cultivated on the highland parts of the BER. (Figure 9 and 10)

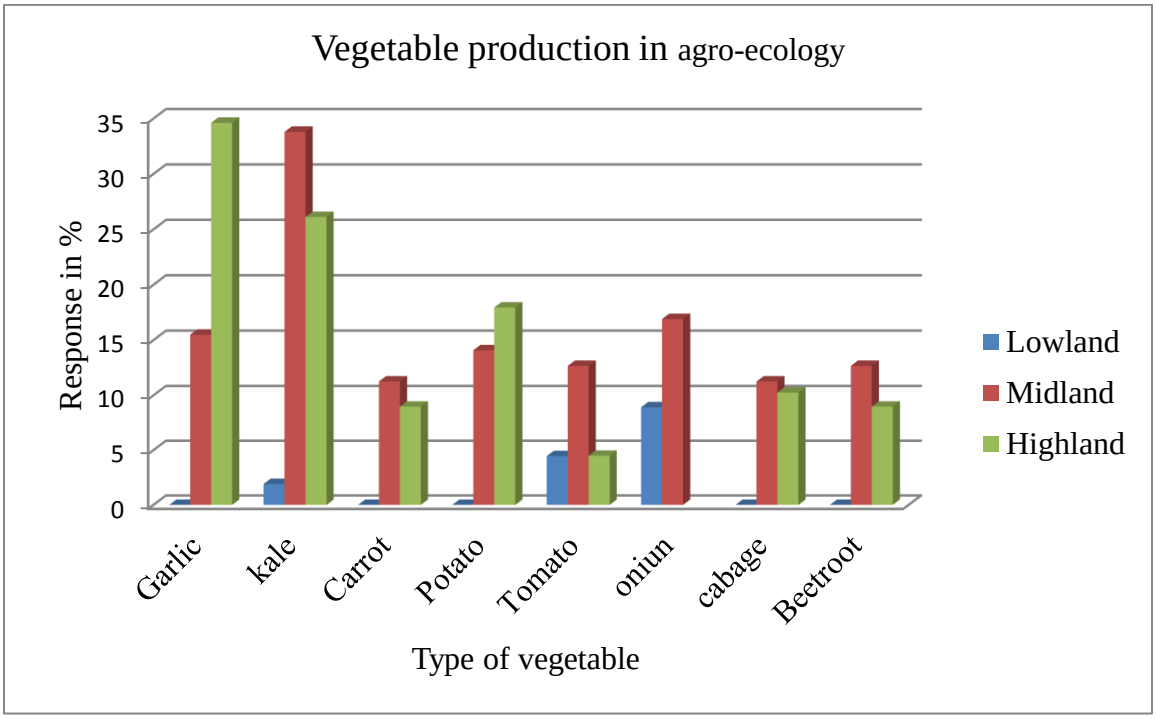

Figure 9:- Type of vegetable Cultivated on different agro ecology (n=384)

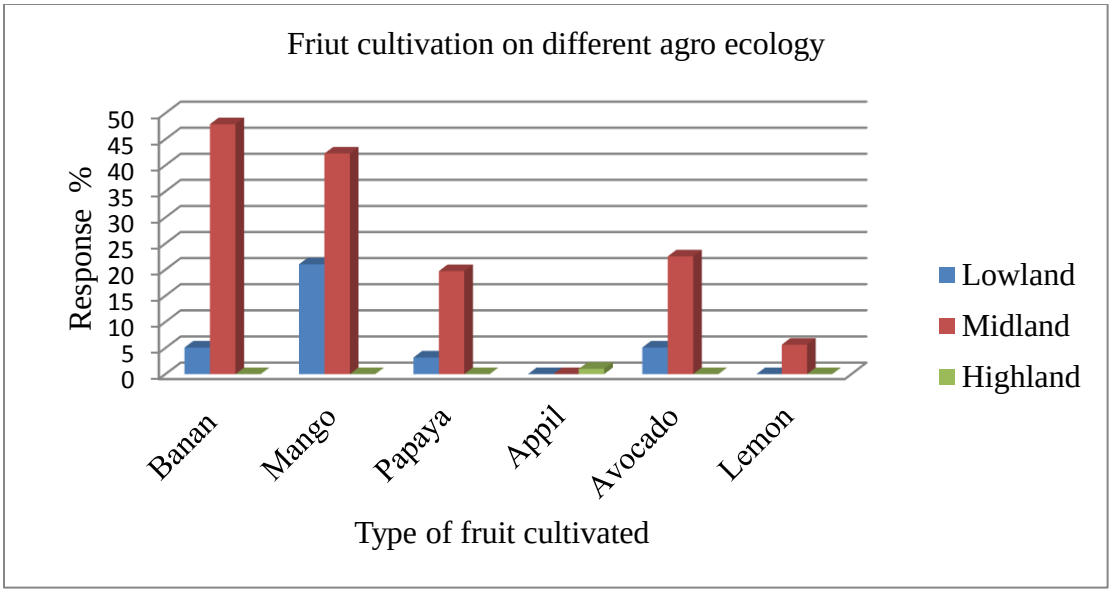

Figure 10: Fruit variation in agro-ecology (n=384)

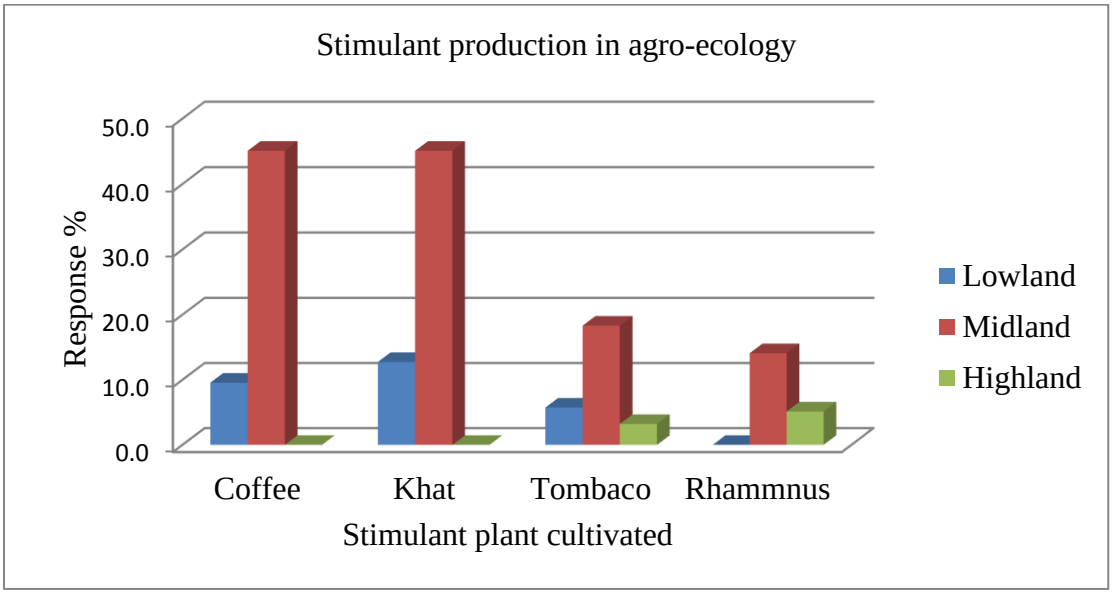

Figure 11**:-** Stimulant crop type cultivation and variation in agro-ecology (n=384).

4.3.2 Livestock production

Table 6:- Livestock production variation in the eco-region

	Respondent response in % (384)		
Livestock	***Lowland***	***Midland***	***High land***
Cattle	94	99	97
Sheep and Goat	83	76	83
Horse and donkey	68	62	76
Camel	39	1	0
Poultry	48	56	62

Source field data, 2016

In the eco-region cattle (cow, oxen), sheep and goat, horse and donkey, Camel and poultry are the major livestock that domesticated over the area (Table 6). Over the area livestock used for food, income, transportation and cultivation of their land. Especially in the low land livestock were the major source of food, and income. The number of livestock per household is different in the eco region. For example, the number of Cattle, Sheep and Goat and donkey higher in the lowland than that of midland and highland. In addition camel is only located in the lowland than other and beekeeping practiced on the midland than the lowland and highland. Especially on Hawo Kebele most of the farmer were practice beekeeping because the area were highly covered by forest, for that reason most the farmer use the forest through beekeeping.

According to focus group discussion in the lowland one participant said that our area were not productive due to different factor rather the area has large grazing land so we participate on livestock production. For example one person has up to 50 camel and one camel sold up to 20,000birr. So the livestock are the major source of food income and transportation in this area".

On the highland the farmer told us we are domesticate livestock for income, cultivating land, transportation and some time for food. But there is not grazing land due to all land changed to farm land so we domesticate only limited number of animals.

4.4 The role of agrobiodiversity in diversifying the livelihood of the local communities

Agricultural biodiversity or agrobiodiversity involves the diversity in agro-ecology, crops and livestock, farming and production systems. The values of agrobiodiversity therefore, remain the products of interrelated functions of biological, ecological and social factors. It increase the productivity, decrease land fragmentation, Protect dieses and weed from crop, increase the diversity over the area, manage the soil fertility on the farm land, diversify the income of the local community, create sustainable use of natural resource, Used to get nutritious food, keep the environment, increase ground water recharge/storage and used them as fodder for the livestock (Table 7). The role of the agrobiodiversity is not different all over the agro-ecology, which greater than 70% of the respondent agreed on the all role of agrobiodiversity. But on the lowland it might be due to factor that most the farmer participate on the livestock domestication they have information gap especially on the role of diversity of crop/ or plant. So their response becomes less than 70% on some role of agrobiodiversity role.

Table 7:- The role of agro biodiversity in the BER

	Respondent response in %		
Role of agro biodiversity	Agro-ecology(n=384)		
	Lowland	Midland	Highland
Increase productivity	87	92	87
Decrease land fragmentation	71	92	83
protect dieses, weed and crop problem	73	92	83
Manage/keep our soil and increase their fertility	71	90	71
Contribute to increase diversity over the area	68	90	100
To diversify my income	70	92	71
used to gate food and nutritious food	100	100	100
To keep soil	65	90	78
Increase ground water storage	62	90	74
Used as fodder the livestock	90	92	100

As stated above cultivating different crops have different value for the community. Depending this rural community cultivate different species of crops on their land at the average of two seasons of one year. But the number of species cultivated by farmer were vary across the agro-ecology. 15% of farmer at lowland cultivate one species, 34% of farmer at lowland and midland and 6% of farmer on highland cultivate two species,43% at lowland,38% midland and 58% on highland farmer cultivate three species, 2% on lowland,38% on midland and 36% of farmer on highland cultivate four species and only 28% of farmers cultivate in midland more than five types of species (Figure 12). That means on the lowland and highland as the number species increase number of cultivars decreased but On the midland some farmer cultivate five and more species. Generally there are significant variation at (X^2=1.99, df=10 P<0.05) between the agro-ecology on the cultivation of different crop. Those shows the diversity of species number that cultivated by farmer are high in the midland than the other. In general agrobiodiversity is source of everything for the community that create sustainable use of natural resource which play critical role in change of lively hood of the community especially by decreasing food insecurity of low land area and natural resource dependency over the eco-region.

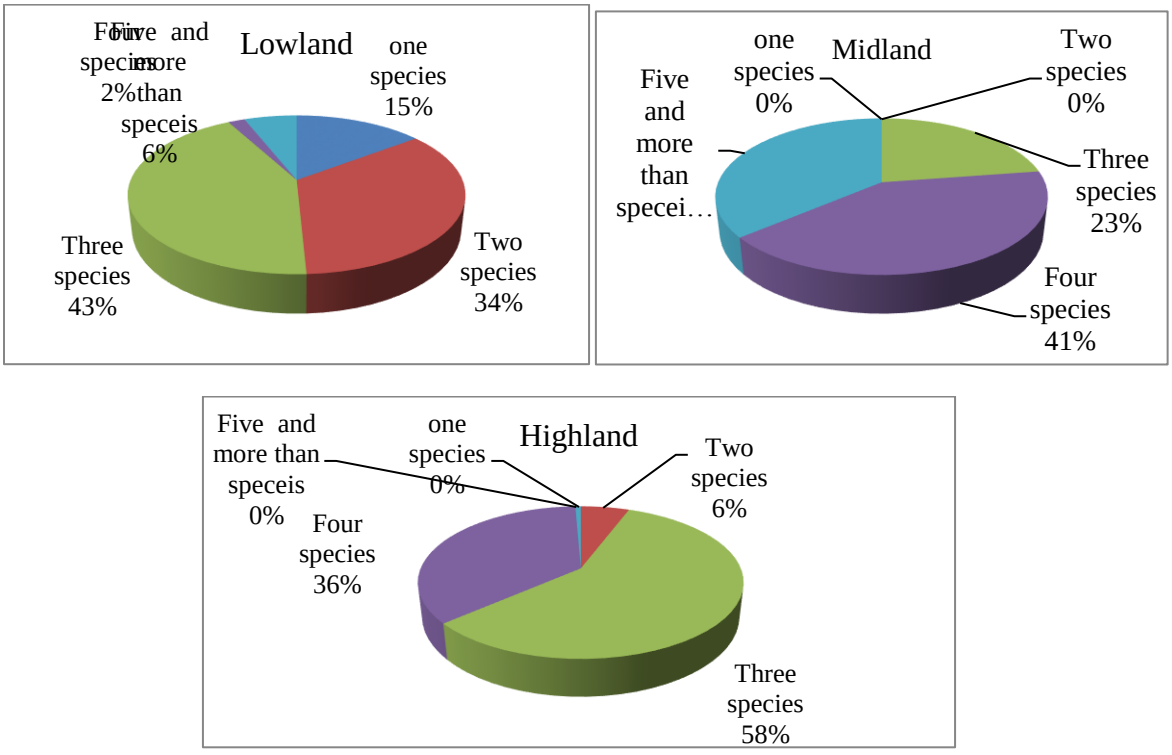

Figure 12: Number of crop species cultivated per house hold on different agro-ecology (n=384)

Similarly different study show that agrobiodiversity use for home consumption, as dietary sources during crises, provision of medicines, providing additional sources of income and local market sales, and in landscape management. However plants/crops and crop varieties and their use have often been vary (BhagMal, 1994). Barrett *et al.,* (2001) explained that diversification occurs for many reasons include: Risk reduction, Overcoming income instability caused by seasonality, Improving food security, Taking advantage of opportunities provided by nearby or distant labor markets, Generating cash to meet family objectives. It is often stated that pests will be less damaging in fields with a mixture of crops than in fields with a single crop also known as monocultures. This idea is based in part on the assumption that a given pest will find fewer acceptable hosts to feed or lay eggs in a more diverse field. (Andow, 1991). Various diversified farming system practices increase the uptake of nutrients into crop biomass and/or soils, thus enhancing fertilizer use efficiency while reducing loss of nutrients to air and water. Improved levels of soil organic matter generally enhance soil quality with respect to ten critical and interrelated functions within agro-ecosystems: biogeochemical cycling and retention of nutrients, soil aggregate formation and stability, water infiltration and water holding capacity, decontamination of water, pH buffering, erosion reduction, and promotion of plant growth (Mäder *et al.,* 2002; Reganold *et al;* 2010;Miao *et al.,* 2011). Agrobiodiversity might have critical role in poverty alleviation, environmental protection and socioeconomic value or generally in changing the livelihood of the community by creating sustainable use of natural resource.

4.5 Community perception towards the agrobiodiversity

Rural community that found on different agro-ecology cultivates different crops. Even their farming system is different on different agro-ecology. Depending on the number of crop type and livestock domesticate there is different perception towards using agricultural diversity, between the community as well as across the agro-ecology. In BER 52% on the lowland, 80% on the midland and 70% on the highland of the community have positive perception towards using agrobiodiversity (Figure 13) and this have significant variation on their perception between the agro-ecology at (X^2=20.03,df=2,P<0.05). There was perception deference on different agro-ecology towards agrobiodiversity usage.

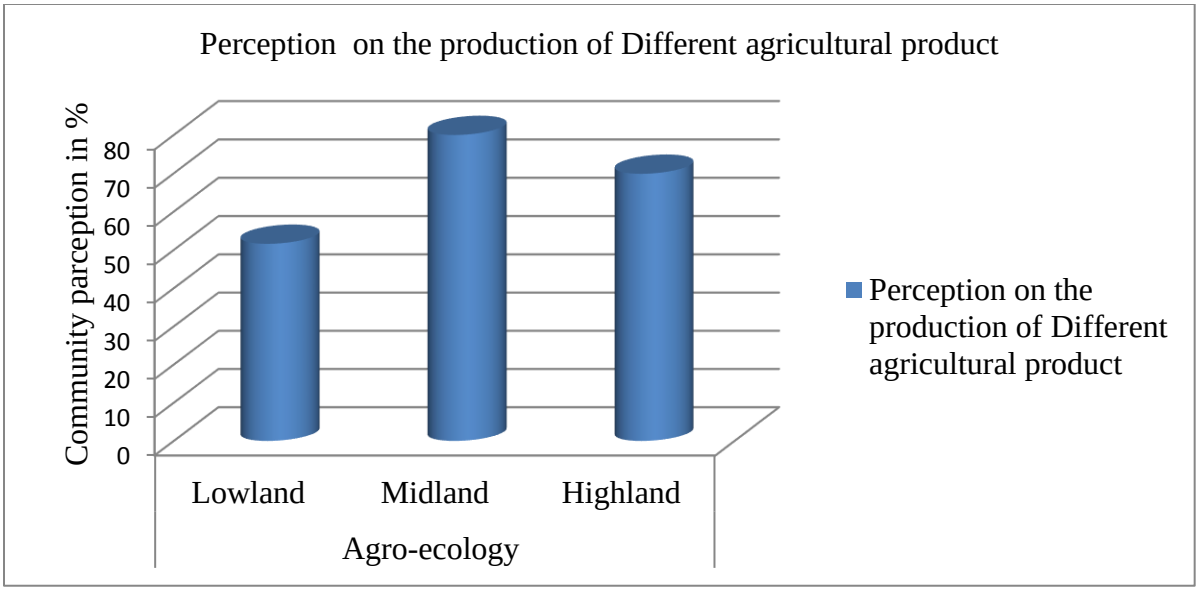

Figure 13:- Perception of local community towards using agricultural diversity in agro-ecology

According to Farmers focus group discussion on the lowland farmer said that " we want to cultivate different crop but there is different problem that affect us like climatic condition, dieses, shortage of water are the major reason" and on the highland ,without coffee and some spice all crop are cultivated but due to low productivity, shortage of land, erosion/land degradation and shortage of improved Variety we are cultivate only two or three crop type on our farm land and due to shortage of grazing land the number of our cattle that we domesticate were also very limited".

Similarly according to Dagne *et al.*, (2014) a farmer has a grain-legume rotation to provide the grain with nitrogen or a potato-beet-grain rotation to avoid disease in the potatoes. But this perception response was different among agro-ecology. In general farmer has a positive perception for cultivating different crop and domesticating animals. The people of the world feed up on various types of food. However 90% of the food is derived from plant materials and most of this are of high nutritional value. Farmers who have an array of crop selection criteria tend to maintain greater agrobiodiversity by planting different crops and varieties or land races to fulfill their diversified demands (Example yield, early maturity, drought resistance, market value, weed resistance, insect pest resistance, straw qualit y, palatability, and beverage quality.(Yemane *et al.*, 2006). Diversity of crops both in time and space to ensure harvest security or stability of production to promote diversity of diet and income

sources, to minimize crop failure risk, to reduce insect and diseases incidence and to ensure efficient use of labor. So those, the farmer have good perception towards using agricultural diversity (Tilahun and Miruttse, 2007). So that this might be due to the farmer found in the eco-region have interest, know and practice the value of agrobiodiversity that play great role on their day to day activity starting from food to the environmental protraction.

4.6 Challenges that affect agrobiodiversity

The diversity in crops and animals is essential for intensifying production in all farming and production systems. The yield at household level is sustained by cumulative outputs of the total crop diversity used. Under unfavorable conditions, failure of one crop is compensated by the yields of other crops where farmers grow several distinct varieties of crops in a single field, as a risk-minimization strategy against crop.

Agrobiodiversity distributions were different in type and in area coverage across the agro-ecology as well as household level due to different challenges. The challenges that affect the use and determine agrobiodiversity distribution through the eco-region were low productivity of crops and animals, climatic condition, market problem, shortage of water as well as irrigation infrastructure, Road problem in order to transport their product, Knowledge gap about agrobiodiversity, Weed, Disease and wild animal conflict are some of the major challenges that identified in the eco region. Their magnitude was different on different agro-ecology depending on collected data. According to focus group discussion also told us there are different crop cultivated on the all altitude but due to different challenge the community depend only limited number of species. So that, the community ranked the challenges depending on their effect throughout the eco-region (Table 8).

Table 8: Ranks of challenge on different agro-ecology of the BER

	Challenges in rank on different agro-ecology			
No	Type of constraint	Lowland	Midland	Highland
1	Low productivity of diversified variety	2nd	1st	1st
2	Climatic condition(harsh and unusual change of weather	1st	2nd	2nd
3	Problem of interest in order to cultivate different crop	9th	9th	8th

4	Market problem	3rd	3rd	4th
5	Shortage of irrigation water and land	4th	5th	3rd
6	Road problem	6th	4th	5th
7	Knowledge gap	7th	6th	7th
8	Extension	8th	7th	9th
9	Other (shortage of input, problem of wild animal, dieses ,weed and soil type)	7th	8th	6th

Even if the type of challenges that affect the agrobiodiversity distribution within the household and across the agro-ecology are the same, their rank were different across the agro-ecology that means for the same constraint there effect magnitude were different on different agro-ecology that cause distribution of agricultural diversity throughout the agro-ecology. For example climatic condition is the major/1st/ challenges in the lowland in order to use different agricultural diversity. But shortage of improved Varity of crop as well as animal is main problem in the highland and midland.

According to the farmer group discussion on the lowland "we have interest to cultivate different crop but there is problem of climatic condition like shortage of rain, high day and night temperature and shortage of productive crops and that resist harsh climatic condition and dieses, market, training and water scarcity are our major problem we have". The same to lowland the highland community told as majorly there was a shortage of diversified improved variety that have high productive and some technical support how we store crops that easily damaged like onion. Market also other problem".

Similarly some study also concluded agricultural diversity affected by different factor like climatic condition temperature, rain fall and wind speed, soil type, altitude, land tenure, market, transportation material and cost and some improved variety, disease, poor health, feed shortage are the main factor that affect the use and distribution of agrobiodiversity (ILCA, 1991; Schlapfer *et al.*, 2002).So that it might be due to the above risen the productivity and distribution agricultural diversity are affected across the eco region which increase the dependency of community on natural resource by affecting the lively hood of the community. For example in the low land the farmer cultivate Maize, Tef, Sesame but due to disease and insect most of the time they loss their product. In addition after they collect their products they are not get market

to their product. So that farmer due to their crop not to fulfill their need they gone to cut forest. And on the highland there is shortage improved species of crop and animal without wheat and barley, so that farmer in the high land they are focusing cultivating wheat and barley that create mono cropping and cause Rust disease attack early and decline market during harvesting time.

Road Problem at Sirrima Kebele

Erosion Problem at Malka Amana Kebele

Figure 14 Field Photo (*by workalegn Assefa, 2016*)

Agrobiodiversity also affected by age, gender, education have relationship with agrobiodiversity used by community on their land holding (Table 9). According data collected and analyzed there were positive relationship between age, Gender, education and diversity used by the community that means as age, and education level increase the cultivation of different crop increased in all agro-ecology and these also varied across agro-ecology. In addition to these the farmer on the focus group discussion told us "we are cultivating and domesticated different crop and animal respectively. Because different crop have different value for us like to conserve the major stable crop, for rehabilitating my farm land through fertility management, for income, traditional medicine and food but between the household depending on the age and education level of the house hold. For example elder house hold cultivate different crop than young people and also educated parts of community cultivate different crop than illiterate in order to get diversified crop and animal, for adopting different harsh condition, increasing productivity in over all of their activity of life and in relation to gender Women's household cultivate different crop more than that of male household". So that especially educating the community and women's have value in increasing the agricultural diversity that plays the major role in the

change of livelihood of the area. Similarly different study shows that small-scale farmers still make extensive use of the plant diversity present in their surroundings. They depend on the provisioning, regulating, supporting and cultural ecosystem services that biodiversity brings (Millennium Ecosystem Assessment, 2005). In addition as part of their livelihood strategies local and often only plant species in diversified cropping systems can be an important first step toward secure food provision. Under marginal production conditions in low-intensity agro-ecosystems, local breeds and crop varieties tend to be adapted to a range of environments through a process of human selection based on farmers' preferences and traditional knowledge (Mekbib, 2006).

Table 9 Relationship between some demographic character and agrobiodiversity use

Household chr.	Category	Type of Species cultivated	Lowland n=157	Midland n=71	Highland n=156
			Response%	Response in%	Response%
Age	18-30	One species of animal or plant	7		
		Two species(of plant, animal or plant and animal)	7		1
		Greater than three species(of plant, animal or plant and animal)	13.5	25	20
	31-46	One species of animal or plant	5		
		two species(of plant, animal or plant and animal)	10		2
		Greater than three species(of plant, animal or plant and animal)	16	32.20	33
	47>	One species of animal or plant	3		3
		two species(of plant, animal or plant and animal)	20.5		
		Greater than three species(of plant, animal or plant and animal)		42.8	41
Gender	Male	One species of animal or plant	15		
		two species(of plant, animal or plant and animal)	19		4
		Greater than three species(of plant, animal or plant and animal)	26.3	44.3	47
	Female	One species of animal or plant			

		two species(of plant, animal or plant and animal)	15		2
		Greater than three species(of plant, animal or plant and animal)	23.7	55.7	53
Education	Illiterate	One species of animal or plant	15		
		two species(of plant, animal or plant and animal)	8		5
		Greater than three species(of plant, animal or plant and animal)	11	23	21
	Informal education	One species of animal or plant			
		two species(of plant, animal or plant and animal)	12		1
		Greater than three species(of plant, animal or plant and animal)	18	32.9	28.3
	educated (starting from grade 1 to college and university	One species of animal or plant			
		two species(of plant, animal or plant and animal)	14		
		Greater than three species(of plant, animal or plant and animal)	21	44.1	44.7

5. Conclusion and Recommendations

Subsistence-based and natural resource-dependent societies are especially vulnerable to climate change. In such contexts, food security needs to be strengthened by investing in the adaptability of food systems. So improving agricultural productivity and farm level resilience to agricultural production shocks is a critical component of reducing poverty and improving the livelihood of the community and food security throughout the eco region. In the eco region the community perform different activities of farming like cultivating different crops and domesticating livestock which vary among agro ecology in crop species cultivated and number as well as kind of animals domesticated. Agrobiodiversity play different role in the community livelihoods such as for food, increase the productivity, decrease land fragmentation, protect dieses and weed from crops, increase the diversity of agrobiodiversity, manage the soil fertility, diversify the income of the local community, create sustainable use of natural resource, used to get nutritious food, keep the environment healthy, increase ground water recharge/storage and used them as fodder for the livestock. The farmer have positive perception on cultivating or using agricultural diversity but there are different challenges that affect their use or cultivation of this crop and domestication of animals. low productivity, climatic condition, interest, market, Shortage of irrigation water, Road accessibility problem, Knowledge gaps, disease; insect problem, human wild life conflict and shortage of grazing land are some major challenges that identified in agro ecology and this challenge are not the same on all agro-ecology of the BER in their magnitude. Therefore, it needs attention to aware the local people to diversify their agrobiodiversity and overcome the challenges of climate change and increase livelihood in the study area. Based on the findings of this study the following recommendations were forwarded;

- ***Increase the productivity of crops and animal through improving their variety:*** - The crop type and animal that located over the area were used for a long period of time. So that they are not productive, they easily attacked by disease and they were loss the resistance to harsh condition. So that in order to increase the productivity of this crop they need improvement crop variety and animal variety by depending on the agro-biodiversity objective(not only single variety) through the collaboration of researcher, agricultural expert, NGO's and farmer by itself.

- ***Manage grass land through community participation: -*** In the lowland eco region most of the grass land areas are damaged due to uncontrolled grazing system that affects feeding system of the livestock. So that in order to change this and improve the livestock productivity conserving / managing the grazing land through community participation were the immediate solution. Because if the community around that area organized by government and keep their area they have the ability to change the challenges occurred due to grazing land shortage.

- ***Increase major infrastructure that enhance agro-biodiversity over the area.***
  - ✓ ***Constructing irrigation scheme*** - there is a river or stream especially on the highland and mid land parts of the eco region there is different river are located so that constructing this structure have great advantage in producing different agricultural crop and change their lively hood of the community.
  - ✓ ***Road and transpiration*:-** Road and transportation available and the transport network will have a large influence on the distribution of agricultural systems and agricultural diversity. Many subsistence farms could not sell surpluses even if they had them because of the road and costs involved in transporting the surplus to the market place.
  - ✓ ***Creating diversified market opportunity*:-**On the area if there is market opportunity that has the interest of different crop with good price the farmer start to cultivate different crop and animal with good quality. So that the area need market network. eg like coffee market. This in general it is the role of government and NGOs

- ***Increasing the supply of post harvest technology and input*:-**Increasing the supply of different technology that play role in daily activity like post harvest technology, different ,drug for the animal, insect side, herb side

- ***Need collaboration*** of different stake holder like Madda Walabu University, Woreda and Zonal Agricultural office, Sinana research center and different Nongovernmental organization like SHARE project. For helping the community over the area through capacity building, research and supply off technology.

- ***Work on soil and water conservation as well as Water harvesting technology: -*** for controlling soil erosion, increasing water supply especially on the lowland part of the eco region.
- ***Work on gender through increasing women participation on different activities of agricultural diversity like research and technology adaptation.***

6. Reference

Altieri, M. (1994). Biodiversity and pest management in agro ecosystems. Haworth Press, New York.

Altieri, M. and Letourneau, D.K, (1984) Vegetation diversity and insect pest outbreaks.CRC *Critical Reviews in Plant Sciences* 2(2):131-169.

Altieri, M. (1995).Agro-ecology: the science of sustainable agriculture. Boulder west view press.

Altieri, M. and Letourneau. D. (1982). Vegetation management and biological Control in agro ecosystems, *Crop Protection,* 1(4): 405-430.

Andow, D. (1991).Vegetation diversity and arthropod population response. *Annual Review of Entomology*, 36(1):561-586.

Bohle, H., Downing, T. and Watts, M. (1994).“Climate change and social Vulnerability: Toward sociology and geography of food insecurity”. *Global Environmental Change*, 4(1): 37-48.

Blann, K. (2006). Habitat in agricultural landscapes: how much is enough? A state of the science literature review. Oregon, Washington D.C, Pp. 1-84.

BERSM (2006).Project proposal. Addis Ababa.

Boef. W., Peroni.A, Thijssen, M. and O’Keeffe, E. (2013). Promoting resilience and the Conservation of plant genetic resources. (1st *edn*). Wageningen University, Netherlands.

Bekele, H., Mulusew, F., Tadele, T., and Setegn, G. (2010). Agronomic performances disease reaction and yield stability of field pea (pisum sativum L.) genotypes in Bale Highlands, Ethiopia. *Australia Journal of crops*. 4(4):238-246.

Bhag, M. (1994). Underutilized grain legumes and pseudo cereals: their Potentials in Asia. FAO, RAPA Publication. Bangkok.

Barrett, D, Butler, C. and Oluoch- Kosura, W. (2006). Linking Future Ecosystem Services and future human well-being. Ecology and Society, 11(1): 1-30

CSA Population projection (2013) the Federal democratic Republic of Ethiopia central statically Agency central Agency..

Convention on Biological Diversity (CBD) (2009). Ethiopia’s 4th Country report.

Cochran, W.G. (1977). Sampling techniques. New York: Wiley. Pp. 428.

Chambers, R. and Conway, G. (1991). Sustainable Rural Livelihoods: Practical Concepts for 21st Century–IDSDiscussionPaperPp.296.

Dereje, T. (2015).Migration and Conservation in the Bale Mountains Ecosystem. International Institute for Sustainable Development, Canada. Pp.1- 28

Dereje, G. and Eshetu, A. (2003). Crops and agro-ecological zones. Senior Researchers, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia. Pp 1-47

Dagne, M., Jessica, R., and Meha, R. (2014). Farmers' perceptions of the impacts of human wildlife conflict on their livelihood and natural resource management efforts in Cheha Woreda of Guraghe Zone, Ethiopia. 8(1):67–77.

Dupuy,J. (2006). GIS Analyst Bale Eco-region sustainable management program

Eiders, E., Kremen, S., Greenleaf, A., Garber, K. And Klein, A. (2011).Contribution of Pollinator-mediated crops to nutrients in the human food supply. PLOS ONE.

FAO (2004). Building on Gender, Agro biodiversity and Local Knowledge Training Manual. Rome, Italy.

FAO (2005). Building on Gender, Agro-biodiversity and local knowledge. Rome, Italy.

FAO. (2010). Global Forest Resources Assessment. Rom, Italy.

Franzluebbers, A. (2004). Tillage and residue management effects on soil organic matter Soil organic matter in sustainable agriculture. CRC Press .Boca Raton, Florida, Pp. 227-268.

FARM Africa (2008). Bale Mountains Eco-Region Sustainable Development Plan: Report Phase I and II planning Workshops, Addis Ababa.

Feund, JE. And Williams, FJ. (1983). Modern Business Statistics. London; pitman

Gliessman SR. (1998).Agro-ecology: ecological processes in sustainable agriculture, Michigan Aann Arbor press

Garnevska, E., Edwards, J. R., & Vaughan, D. R. (2006). Farm diversification opportunities in Bulgaria the perceptions of farmers in the Plovdiv region – a preliminary analysis, *Journal of International Farm Management* 3(2).

Harlan, J.R. (1975). Our vanishing genetic resources. *Science* 188, 618–622Pp.

ILCA (1991). A handbook of African livestock statistic working document, international livestock center for Africa. Addis Abeba, Ethiopia.

Kremen, C. (2007). Managing Ecosystem Services: What Do We Need to Know about Their Ecology. *Ecology Letters*, 8: 468-479.

Khadka, M. and Verma, R. (2012). Gender and Biodiversity management in the greater Himalayes International center for integrated mountain development (ICIMOD) ,Kathmandu, Nepal

Mäder, P., Fliessbach, A., Dubois, D., Gunst, P. and Niggli, U. (2002). Soil fertility and Biodiversity in organic farming. *Science*, 296(5573):1694.

Miao, Y., Stewart, BA and Zhang, F. (2011). Long-term experiments for sustainable nutrient management in China: *Agronomy for Sustainable Development*, 31(2):39- 414.

Mekbib, F. (2006). Farmer and formal breeding of sorghum (Sorghum bicolor (L.) Moench) and the implications for integrated plant breeding. *Euphytica*, 152(2): 163-176.

McGuire, S. (2000). Farmers' management of sorghum diversity in eastern Ethiopia, In Almekinders and W. de Boef (Eds.) Encouraging Diversity: the conservation and development of plant genetic Resources, Intermediate Technology Publications. London

Millennium Ecosystem Assessment (2005) Ecosystems and human well-being: synthesis. MA, Island Press, Washington DC, USA

Mondelaers, K., Aertsens, J., and Van Huylenbroeck, G., (2009). A meta- analysis of the differences in environmental impacts between organic and conventional farming. *British Food Journal*, 111(10):1098-1119.

Molden, D., Tharme, R., Abdullaev, I. and Puskar, R. (2005). Water, food livelihood environment: maintaining biodiversity in irrigated landscapes. Paper presented to the Int. Eco-agriculture Conf. and Practitioners' Fair, Nairobi, Kenya.

Nahusenay, A. and Tessfaye, T. (2015). Roles of Rural Women in Livelihood and Sustainable Food Security in Ethiopia: A Case Study from Delanta Dawunt District, North Wollo Zone. *International Journal Nutrition and food. Science*, 4(3):343-355.

Park, S., Croteau, P., Boering, D., Etheridge, D., Ferretti, P., Fraser, Kim, P., Krummel, R., Langenfelds, A. and van Ommen, T. (2012).Trends and seasonal cycles in the isotope composition of nitrous oxide since 1940. *Nature Geo science* 5(4):261-265.

Roe, D., Thomas, D., Smith, J., Walpole, M. And Elloit, J. (2011). Biodiversity and Poverty: Ten Frequently Asked Questions – Ten Policy Implications, Institute for environment and Development.3Endsleigh street, London. 6 pp

Ramanjam, M., and Kadamban, D., (2001). Plant biodiversity of tropical dry evergreen forest Pondicherry region of south India and the role belief system in their Conservation biodiversity and conservation. *Northway and kluwer Academic publisher* 10:1203-1217.

Reganold, J., Andrews, P., Reeve, L., Carpenter-Boggs, C., Schadt, J., Alldredge, C., Ross, N., Davies, Zhou, J. and El-Shemy, H. (2010). Fruit and soil quality of organic and conventional strawberry agro ecosystems, PLOS ONE.

Reardon, T. and Webb, P. (2001). Non-farm Income Diversification and Household Livelihood Strategies in Rural Africa: Concepts, Dynamics and Policy Implications. *Food Policy*, 26(4), 315-331.

Smit, B. and Skinner, M. (2002). "Adaptation options in agriculture to climate change: A Typology. "*Mitigation and Adaptation Strategies for Global Change*, 7: 85-114

Sara, J. and Jeffery, J. (2008). Biodiversity conservation and agricultural sustainability: towards a new paradigm of 'eco agriculture' land escapes. *Soc.Land Biological Science.* 363(1491): 477–494.

South, W. and way (1970). Ecological back ground to pest management: proceeding of conference held at North Carolina state university, Carolina.

Schläpfer, F., Tucker, M. and Seidl, I. (2002). Returns from hay cultivation in fertilized low diversity and non-fertilized high diversity grassland, Environmental and Resource, *Economics*, 21(1): 89-100.

Smale, M. and Bellon, M. (1999). A conceptual framework for valuing on- farm genetic resources. In D. Wood and J. Lenne (eds.), Agro-biodiversity: characterization, Utilization, and Management. CABI International Walling ford.

Sendzimir, J., P. Magnuszewski, Z. Flachner, P. Balogh, G. Molnar, A. Sarvari, and Nagy. Z.(2007). Assessing the resilience of a river management regime: informal learning in a shadow network in the Tisza River Basin. *Ecology and Society 13*(1):11.

Shiferaw, B. and Holden, T. (1997). A Farm Household Analysis of resource Use and Conservation Decisions of Smallholders: An Application to highland Farmers in Ethiopia, *Discussion Paper*. Department of Economics and Social Sciences, Agricultural University of Norway, Norway.

Tilman, D, Reich, P and knops, J. (2006). Biodiversity and ecosystem stability in decade long grass land Experiment. Nature 441(7093):629-632.

Tilahun, T., and Mirutse, G. (2007). Ethno botanical study of medicinal plants used by people in Zegie Peninsula, North Western Ethiopia. *Journal of Ethno biology and Ethno medicine*, 9.

UNDP (2007). Fighting Climate change: Human Solidarity in a Divided World. Human development report 2007/2008. Palgrave- Macmillan, New York.

Vandermeer, J., Perfecto, I. and Philpott, S. (2010). Ecological complexity and pest control in organic coffee production: uncovering an autonomous ecosystem service. *Bioscience* 60(7):527-53.

Van Noordwijk, M., Agus, F., Verbist, B., Hairiah, K and Tomich, T. (2007). Watershed management. In Farming with nature: the science and Practice of eco agriculture, Island Press, Washington DC.

Van Noordwijk M. (2010). Climate change, biodiversity, livelihoods and sustainability in Southeast Asia Study and Research in Agriculture and Institute of Southeast Asian Studies, Laguna, pp 55–83.

Yemane. T., Berg, T., Bayush, Ts. and Tesema T., (2006). Farmer's management of finger millet (Eleusine corocana) diversity in Tigray, Ethiopia and implicates for on-farm conservation. *Journal of Biodiversity and Conservation*. 15: 4289- 4308.

7. Appendix

7.1 Wored Household questionnaire for local people in Bale Eco-Region

Introductory; Biodiversity is essential to life on Earth; it provide resources such as food, medicine, fibers, fuel, and building materials, as well as intangible services, on which human kind relies

Name of respondent----------

a. Sex---------- B. Family size---------- C. Age------- D. Occupation---------

2. Residence
   a. Kebele----------,
   b. Woreda----------
   c . For how long have you been a resident of this area----------?

3. Marital Statuses.

A) Single B) widowed C) Married

4. Types of house hold A/male headed B female headed C female managed
5. Education Status A) Illiterate C/. High school/7-12
   B/ Elementary /1-6/ D/. College and university
6. Religion A) Orthodox B) Muslim C) Catholic D other
7. What is your major source of income?

   A Animal husbandry B/crop production c/Vegetable production D other

8. For how long have you been farming (in years)---------
9. Do you have cultivated land? Yes/no If yes who Owen it? A/ myself B/ spouse C/ Both husband and wife
10. How the land acquired? A/ Given by government B/given by parents C/inherited D/bought, E/rent F/other specify
11. Is land certified? A/yes B/No ,if yes who name is on the certificate A/husband B/wife C/both
12. On which type of farm Activity your participation is active?

    A On field crops/field farm B Animal Husbandry C Home garden D All

13. What type of crops duo you cultivate on your farm land?

A) Cereals B) vegetables C) fruit

D) Pulse crops E) Oil crops F other /specify/

14 Do you know the agriculture diversity? A/yes B/No

15 If yes select the type of agricultural diversity that you are used?

No.	**Crop species**	**Select**	**Variety selected**	**Their purpose**
A	**Cereal crops**			
1	Wheat			
2	Barley			
3	Oat			
4	Teff			
5	Maize			
6	Sorghum			
	If other specify			
B	**Pulse crop**			
1	Field pea			
2	Feb. been			
3	Lentil			
4	Chickpea			
5	Soybean			
	If other, specify			
C	**Oil crops**			
1	Lin seed			
2	Sesam/selit			
3	Ethiopian mustered			
4	Sun flower			
5	Guzatia			
6	Ground nut			
3	If other, specify			
D	**Fruit crops**			
1	Banana			
2	Mango			
3	Papaya			
4	Apple			
5	Orange			
6	Gishta			
7	Avocado			
8	Lemon			
9	Tinkish			
10	Sugar cane			
	If other, specify			
E	**Vegetable crops**			
1	Onion			
2	Cabbage/tekur			

	gomen			
	White cabbage			
4	Garlic			
5	Carrot			
6	Potato			
7	Tomato			
8	Beetroot			
9	Flower cabbage			
	If other specify			
F	**Spice Crops**			
1	Zinger			
2	*Kurunfud*			
3	*Cinnamon /Kenefa*			
4	Chill			
5	*Tekur Azmud*			
7	*pepper*			
8	*fenugreek*			
G	***Stimulants***			
1	coffee			
2	*chatt*			
3	Tobacco			
4	*Rahummans*			
	If anther			
H	**Type of tree used**			
1	Eucalyptus			
2	*Hyginia Absinca*			
3	*Juniperus proccera*			
4	If anther			

16 Do you have livestock? Yes/No, if yes

17 . Mention the type of animals do you have in these house hold

No .	Animal	Select	Variety selected	Their purpose
A	**Cattle**			
1	Caw			
2	Oxe			
B	**Shoat**			
3	Sheep			
4	Goat			
	Specify if other			
C	**Equine**			
1	Camel			
2	Meal			
3	Donkey			
4	Horse			
D	**Poultry**			
	Hen			

	If other specify			
C	Bee keeping			

Description

Inc =for income ,Ntr=For nutrition Fd=Food, Slc=For soil conservation , Sfm=Soil fertility management, Wdc=Weed control, Pst =Pest Control, Fdr =Fooder, Mcn =Medcine, Con=Constraction, Frn=Furniture, Orn=Ornament , EVP=Enviromental protaction , Trn=Transportation, DINC=diversifying income, Clt=Cultural propose

18 How was the livestock acquired? 1/bough 2/given 3/inherited 4/others/specify

19 Can agro biodiversity have value A/ Yes B/ No

20 if yes select and take example on the role of agro biodiversity that you know.

No.	The value agro biodiversity	Select and take example
1	Contribute to increase productivity and food security.	
2	Reduce the pressure of agriculture on fragile areas, forests and endangered species.	
3	Contribute to sound pest and disease management	
4	Conserve soil and increase natural soil fertility and health.	
5	Contribute to the increase of diversity over the area.	
6	Diversify products and income opportunities	
7	Help maximize effective use of resources and the environment.	
8	Improve human nutrition and provide sources of medicines and vitamins.	
9	Conserve ecosystem structure and stability	
10	Keep water quality.	

22. What is your perception/Interest on agro biodiversity?

A/Positive B/ Negative

23. Is it the difference between farmers in using agro bio diversity?

A/yes B/ No

25 If Yes Why?

No	Types of problems	Put in rank /1-8/
1	Lack of improved variety	
2	Lack of interest	
3	Climatic problem	
4	Market problem	
5	Water shortage	
6	Road accessibility	
7	Problem of awareness	
8	Extension problem	
9	If other	

7.2. Check List.

Number of participant ----------

1. Do you know importance of agricultural diversity?
2. Mention the types of agrobiodiversity /Crops, livestock/ in species that used by the community
3. Mention the effect of agrobiodiversity on livelihood of the habitat in the
   - ✓ Environmental

   - ✓ Economical

   - ✓ Cultural value

   - ✓ Social benefit in increasing productivity
4. Is it variation of using agricultural diversity between agro ecology and house hold level?
5. If yes, Why?
6. What is the perception of the community towards agro biodiversity?
7. What is the challenge that hinders you for using agricultural diversity?

7.3 Check list for field Observation.

1. To identify types Agricultural diversity used by the community at farm land and Home garden.
    - This include
        - ✓ Crop
        - ✓ Animal

Annex 1 **Scio-economic and demographic character of the respondent**

Variable	Lowland		Midland		Highland		Total	
	Frequency	%	frequency	%	frequency	%	frequency	Frequency
Age(years)								
<30	29	19	19	21	20	14	68	18
31-46	89	57	36	52	91	56	216	56
46>	39	24	16	27	45	30	100	26
Total	157	100	71	100	156	100	384	100
Sex							0	0
Women	11	6	3	4	11	7	25	7
Men	146	94	68	96	145	93	359	93
Marital status							0	0
Single	13	8	3	4	5	3	21	5
Married	140	89	67	94	148	96	355	92
widow	4	2	1	1	3	1	8	2
Total	157		71		156		384	100
Education							0	0
Illiterate	28	13	14	27	24	17	66	17
Informal education	82	44	17	30	52	38	151	39
1-6	41	24	34	32	49	39	124	32
7-12	20	13	6	11	27	6	53	14
college and university	0	0	0	0	4	0	4	1
Total	157		71		156		384	100
Major Source of Food and income								
✓ Animal Husbandry	7	4	3	4	0	0	10	3
✓ Crop production	8	5	32	45	61	39	101	26
✓ Mixed(crop and Animal domestication	142	90	36	51	95	61	273	71
Total	157	100	71	100	156	100	384	100

Annex 2. The Role of different crop for the community

A. lowland

No.	Crop species cultivated	Crop type	Food	Income	Transportation	construction	Soil fertility management	Fodder	cultural purpose	Land preparation
1	Cereal crop									
		Teff	*	*				*		
		Maze	*	*				*		
		Sugar cane		*				*		
		Sorghum	*	*		*		*		
2	Pulse crop	lintel								
		Chickpea	*	*			*	*		
		Mashoo	*	*						
		Soya been	*	*			*			
3	Oil crop	linseed								
		Sesam		*				*		
		Tekur azmud		*						
		Sunflower		*		*				
		Guzatia		*				*		
4	Vegetable									
		kale	*	*						
		onion	*	*						
5	Fruit	Banana								
		Mango	*	*						
		Papaya	*	*						
		Avocado	*	*						
6	Stimulant	Coffee		*						
		Khat		*						
		Tobacco		*						
7	Livestock	Cattle	*	*						*
		Sheep and goat	*	*						
		Horse and Donky		*	*					*
		Camel	*	*	*					
		Hen		*						
		Beekeeping		*						
	Total									

B Midland

No.	Crop species cultivated	Crop type	Food	Income	Transportation construction	Soil fertility management	Fodder	cultural purpose	Land preparation
1	Cereal crop	Wheat	*	*	*		*		
		Barley	*	*	*	*	*		
		Out	*	*	*	*	*		
		Teff	*	*			*		
		Maze	*	*			*		
		Sugar cane		*			*		
		Sorghum	*	*	*		*		
2	Pulse crop	Field pea	*	*		*	*		
		Fab bean	*	*		*	*		
		Lintel		*		*			
		Chickpea	*	*		*	*		
		Mashoo		*		*			
		Soya been	*	*		*			
3	Oil crop	Linseed		*		*			
		Sesame		*			*		
		Ethiopian mustard		*					
		Sunflower		*	*				
		Guzatia		*					
		peanut		*					
4	Vegetable	Garlic	*	*					
		kale	*	*					
		Carrot	*	*					
		Potato	*	*					
		Tomato	*	*					
		Onion	*	*					
		Cabbage	*	*					
		Beetroot		*					
5	Fruit	Banana	*	*					
		Mango	*	*					
		Papaya	*	*					
		Avocado	*	*					
		Lemon		*					
6	Stimulant	Coffee		*					
		Khat		*					

		Tobacco		*								
		Rahummas		*								
7	spice	Ginger		*								
		Kenefa		*								
		Chill	*	*								
		Fenugreek/Abish		*								
8	Livestock	Cattle	*	*								*
		Sheep and goat	*	*								
		Horse and Donkey		*	*							*
		Camel	*	*	*							
		Hen	*	*								
		Beekeeping		*								
	Total	43										

C Highland

No.	Crop species cultivated	Crop type	Food	Income	Transportation	construction	Soil fertility management	Fodder	cultural purpose	Land preparation
1	Cereal crop	Wheat	*	*		*		*		
		Barley	*	*		*		*		
		Out	*	*		*		*		
		Teff	*	*				*		
		Maze	*					*		
2	Pulse crop	Field pee	*	*			*	*		
		Faba been	*	*			*	*		
		Linseed		*			*			
		Chickpea	*	*			*			
3	Oil crop	Lintel		*			*			
		Tekur azmud		*						
		Sunflower		*		*				
		Guzatia		*						
4	Vegetable	Garlic	*	*						
		kale	*	*						
		Carrot		*						
		Potato	*	*						
		Tomato	*							
		Alangale	*	*						
		onion	*	*						
		cabbage		*				*		
		Beetroot		*						
5	Fruit	Banana								
		Apple		*						
6	Stimulant									
		Tobacco		*						
		Rhummans		*						
7	spice									
		Chill		*						
		Fenugreek		*				*		
8	Livestock	Cattle	*	*						*
		Sheep and goat	*	*						

	Horse and donky		*	*				*
	Hen	*	*					
	Beekeeping		*					
Total								

Figure 15 Field photo during field work (*By workalegn Asseffa, 2016)*