The Dynamics of Indigenous Knowledge Pertaining to Agroforestry Systems of Gedeo: Implications for Sustainability

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Submitted in accordance with the requirements for

the degree of

Doctor of Philosophy

In the subject

Geography

at the

University of South Africa

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November, 2013

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I declare that "**The Dynamics of Indigenous Knowledge Pertaining to Agroforestry Systems of Gedeo: Implications for Sustainability"** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

''When a knowledgeable old person dies, a whole library disappears'' African Proverb

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Signature DATE: November, 2013

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Acronyms

ANOVA: Analysis of Variance

CBD: Coffee Berry Diseases

CIP: Coffee Improvement Program

CSA: Central Statistical Authority

CSO: Charity Service Organization

DA: Development agent

EPRDF: Ethiopian People Republic Democratic Front

FAO: Food and Agricultural organization

FGD: Focus Group Discussion

GZEFDO: Gedeo Zone Economic and Finance Development Office

HAB: Household Asset Building

IK: Indigenous Knowledge

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

PSNP: Productive Safety Net Program

SD: Standard Deviation

SLUF: Sustainable Land Use Forum

TEK: Traditional Ecological Knowledge

UNCED: United Nation Center for Environment and Development

The Dynamics of IK Pertaining to Agroforestry System of Gedeo: Implications to Sustainability

Abstract

This dissertation is conducted in Gedeo, with the aim of revealing the dynamics of IK of agroforestry system of Gedeo. The dynamics were seen from the perspective of the intergenerational variation in IK acquisition and transmission. The study investigated drivers of IK changes and continuities and the implications to sustainability. The study employed an interdisciplinary approach whereby geographical concepts and approaches were supplemented by anthropological and developmental psychology approaches and concepts. Thus, an exploratory mixed research approach was used. The dynamics were seen by employing cross-sectional approach. Thus, synchronic data were collected from several sources, by employing ranges of qualitative and quantitative tools. The respondents were drawn from the local people and agricultural experts. Accordingly, 72key informants were chosen through purposive and snowball sampling. To determine the spatio-temporal variation of IK, 290 informants aged between 12 and 65 were chosen using multistage stratified sampling. For the household survey, 252 participants were selected using multistage stratified and systematic random sampling. The qualitative data were analyzed using thematic content analysis and case summary while for quantitative data mean, standard deviation, ANOVA, chi-square, and t-test were employed. The analysis results have shown that the agroforestry system exhibits both indigenous and modern practices. The indigenous practices, which sustained for longer time through generational transfer, appear to be engulfed by modern practice. The study identified knowledge and skill gap between young people and adults. The gap is more significant in normative dimension of IK. This can be attributed to declining rate of IK transmission and acquisition among successive generations, which in turn is attributed to weak contact between young people and adults, and changes in the lifestyle of the young people. Besides, biodiversity loss, demographic pressure, modernization, introduction of market economy, and top-down development approach are among the drivers of the gradual loss of IK. The gradual loss of IK was to have an impact on sustainability of the system. This calls for concerted efforts to maintain the sustainability of IK through revitalization of IK transmission and acquisition. Finally, joint effort is required to document IK, include in school curriculum, and integrate with the modern practices.

Key Terms: Indigenous Knowledge, Agroforestry system, IK transmission and acquisition, eco-cognitive dimension, practical dimension, normative dimension,

Acknowledgement

I have no words to thank my Almighty God who brought me up, helping me assiduously in all my way to success. My continual success is definitely attributed to God's consistent help. I would have been nowhere without the support of God.

I would like to pass my deepest appreciation and thanks to my supervisor, Dr. Aklilu Amsalu, who guided me to such a splendid achievement. I am very much happy to have him as a promoter. His critical and very constructive comments were so much supportive and to the point as well. I learnt a lot from his very critical and constructive comments.

My mother and father, you brought me up and you invested much on me but you did not get the chance to see the fruit of your unreserved efforts. Your soul could sense that your little kid that you left alone with all burden of looking after your sons has now grown up very well. He did not let you down. May you rest in peace? I thank you for what you did.

Ethio, my beloved wife, you deserve a lot of credit. Your thrilling encouragement, support and affection were sources of energy to accomplish my mission. You are very special to me. You suffered a lot being with me all the time, particularly during the pregnancy of our third child. My wonderful daughters, Niya, Soli, and Solome, do you know how much I hurt you by depriving your right to enjoy with me? I do appreciate your tolerance.

Dear beloved brothers (Nago, Gutu and Mekonnen) I thank you for the moral and financial support you have given me and for understanding me whenever I am not beside you because of my work. My best friend Tesfish, you were like my elder brother while you were here in Ethiopia and being abroad. I never forget your consistent advice, support and encouragement. Tesfish, I never forget the support of your beloved wife, Karen Townsend as well. Her comments were so critical and supportive.

All participants of this research, who gave me your precious time and energy, please accept my appreciation and thanks. Particularly I am indebted to Senay, Adane, Wondwosen, Negalign, Dagnachew,Tesfaye, Berhan, Mamush and others who helped me a lot in collecting data for my research, mobilizing local people and also in translating language. My deepest appreciation also goes to Ato Lukas Shanka, Natural resource management experts of the Gedeo zone.

Asebe, you have helped me a lot. You were so close to me all the time, encouraging me to work hard and have at least a publication. Dr. Ongay Oda, you took your precious time and went through the dissertation word by word. Your comments and suggestion were very much constructive. I really appreciate your unreserved efforts. I would like to thank my staff members (Dr. Bogale, Dr. Amare, Dr. Senbet, Asnake, Geremew,Yilma, Aimiro, Eshetu, Solomon and others) for their consistent support and encouragement.

Finally yet importantly, I would like to extend my sincere appreciation to Dr. Melanie, Head of Department of Geography, for her very kind support and prompt response to my quires. I also want to acknowledge UNISA for giving me the chance to pursue my PhD, funding my dissertation, providing me training on research methodologies in collaboration with SANTRUST program. The contributions of staff members of UNISA regional center in Ethiopia, particularly, Ms. Tsige, Mr. Meseret, Ms. Simret, Ms. Selamawit and others are unforgettable.

Abiyot Legesse

CHAPTER ONE

INTRODUCTION

1.1 Traditional Agroforestry System

Agroforestry is an ancient agricultural form of forestland management. It is believed that it started in the earliest time when human beings began to domesticate plant and cultivate tree species and agricultural crops in intimate combination (Arnold, 1987). The origin of agroforestry system is also often associated with the time when man started to practice slash and burn, or the art of utilizing trees to restore soil fertility during a fallow period (Torquebiaua, 2000). Many scholars note that traditional agroforestry historically precedes experimental one (Rusten & Gold, 1999; Nair, 2007). This system is believed to be common in the highland and hilly parts of Asia, Latin America and Africa (King, 1987).

An agroforestry system is 'a dynamic, ecologically based natural resource management system that, through the integration of trees on farms and in the agricultural landscape, seeks to diversify and sustain production for increased social, economic and environmental benefits for land users at all levels' (Casey, 2004). According to Ernest & Lundgren(2005), it is a form of sustainable land use system that simultaneously and sequentially combines trees with crop or animal production. It is a stable form of land use other than natural forests in most high rainfall hilly areas with steep slopes and nutrient poor soils as the trees grown in the system provide protective cover for soils and also augment soil fertility (Sayer, 1991). Moreover, its potential to combine production with much needed conservation makes it an important rural land use system (Carne, 1993). Most of the tropical countries living in the hillside choose agroforestry practices that combine trees and crops.

Agroforestry system can have protective, regulative and productive functions similar to forest ecosystems (UNESCO, 1978). Conservation of soil and water, and the supply of food and raw materials are the immediate benefits people derive from these functions. They can also promote biodiversity, thrive without agrochemicals, and sustain year-round yields (Reyes et al., 2005). Moreover, appropriate agroforestry system improves physical soil properties, maintain soil organic matter, and promote nutrient cycling. Above all, they offer a unique set of opportunities for alleviating poverty, providing ecosystem services in both low income and industrialized nations, and

have an enormous potential to utilize and stabilize fragile or degraded ecosystems (Swaminathan, 1987; Nair, 2007).

The importance of agroforestry was well recognized by all people around the world. For example, the Rio Earth Summit held in 1992 spelt out the role it plays in sustainable land management. It is well highlighted in Agenda 21 of the Summit, which states that agroforestry practices are one of the best options of sustainable land management. Moreover, agenda 21 in chapters 11 (combating deforestation), 12 (managing fragile ecosystems: combating desertification and drought), 13 (managing fragile ecosystems: sustainable mountain development), 14 (promoting sustainable agriculture and rural development) and 15 (conservation of biological diversity) of this important global action plan states that agroforestry practices fulfill the objectives described by UNCED (UNCED, 1992).

Since recent times, agroforestry has received due attention as an alternative land-use practice that is resource efficient and environmentally friendly. Multiple outputs and the flexibility of having several options for its management make agroforestry an attractive alternative to conventional agriculture and forestry for farmers in many parts of the tropical regions of the world.

Traditional/indigenous agroforestry system is most common among the rural community of Africa and other developing countries. It is one of sustainable eco-system; many centuries old, representing generation of farmers' experiences (Everett, 1999). There are numerous examples of traditional agroforestry practices involving combined production of trees and agricultural crops on the same pieces of land in many parts of Africa. This traditional agroforestry system has sustained people for generations, and contributed to improvements in food security, regional and national economies and environmental resilience (Eyasu, 2002). Moreover, potentially it is a rich source of knowledge for both scientific and non-scientific communities about the cultivation of woody perennials, non-woody annuals in different time and space arrangements with annual crops (Rusten & Gold, 1999).

The traditional agroforestry system is also common in the rural parts of Ethiopia. It is an old age practice, which is believed to have started since the introduction of agriculture in the country (Brandt, 1984; Zemede & Ayalew, 1999). Such system was reported to be common in the highlands of Haraghe (Poschen, 1986), Gedeo (Tadesse, 2002), Sidama (Zemede, 2003; Tesfaye, 2005), Tigray (Asseged, 1996; Atakilti, 1996; Tesfaye, 1996), and North Western Ethiopia (Yesanew, 1998). The

system appears to be very common in coffee producing region of eastern Ethiopia (Demele & Assefa, 1991; Mitiku & Abdi, 1994), Southern Ethiopia (Zebene, 2003; Tadesse, 2002; Tesfaye, 2005).

It is obvious that the country has lost significant amount of biodiversity through destruction of forests for various purposes. The current estimate indicates that the forest resource of the country is being lost at rate of 2%. Recent estimate by FAO (2010) indicates that forest resource of the country has declined from 15.1 million hectare in 1990 to 12.2 million in 2010.

Several attempts have been made to minimize the loss of forest resources and to increase the forest cover, among which forest conservation through expansion of agroforestry system is the major one. The government has put efforts to conserve the forest resources of the country through designing forest policy. The traditional agroforestry system practiced in different parts of rural Ethiopia reported to have a multitude of purpose from forest, soil, and water resource management and sustainable livelihood strategies perspectives (Tadesse, 2002; Mesele et al., 2011). The system is reported to have a huge contribution to biodiversity conservation by maintaining the forest resources and considered as the best alternative to combat land degradation.

The traditional agroforestry of the Gedeo in Southern Ethiopia is one such a stable system which supports a very dense population of up to 500 persons per km^2 (Tadesse, 2002; Tesfaye, 2005). The Gedeo agroforestry system depends exclusively on indigenous knowledge of the local people. The Gedeo agroforestry system is believed to have started in the earliest times when the local people began to clear the dense forest to cultivate both annual and perennial crops (Tadesse, 2002; Mesele et al., 2011). Thus, the Gedeo traditional agroforestry system takes the forms of crops, fruit trees and/or livestock introduced to forestland.

1.2. Problem Statement

Agroforestry is a way of life and survival strategy for Gedeo farmers living in the higher, middle and lower altitudes (Tadesse, 2002). It has been practiced since long time and hence it is the oldest and traditionally intensified land use system (Tadesse, 2002; SLUF, 2006). The agroforestry system has been supporting large number of population as it consists of enset[1]((*Ensete ventricosum* (Welw.)

[1] A staple perennial crop widely grown in the region

Cheesman), which has a high population carrying capacity (Beven & Pankhrust, 1996). It is capable of supporting populations as high as 1200 per km^2, which is most unlikely to happen in a landscape characterized by steep topography. Consequently, the Gedeo had been relatively self-sufficient and are able maintain stable rural livelihoods for decades despite high population pressure and very rugged topography.

In this system, indigenous trees and agricultural crops are arranged sequentially in time and space. The system is mainly composed of an organized mix of mosaics of crops (starting from annual herbs through medium aged enset and coffee (30 years) to long living multipurpose trees of coffee, enset, crop and tree components (Tadesse, 2002; SLUF, 2006; Bogale, 2007). It is a multipurpose system in which trees are arranged in relatively high degree of species diversity, planted in a densely manner, and generally has a multi-strata structure. It consists of various practices such as home gardens, forest village gardens, coffee shade and boundary agroforestry (Tadesse, 1994; Mesele & Nigussie, 2008). Tadesse (2002) and SLUF (2006) noted that the traditional agroforestry system of Gedeo was one of the most effectively, efficiently and sustainably utilized land use system in the country.

The reliance of the agroforestry system on knowledge of the local people is one of the principal factors behind such magnificent land use system. The local people have meticulously harnessed nature's potential to accommodate the ever-inflating human and animal population. They successfully achieved this goal without compromising the economic and ecological needs of their future generations. Nobody taught them how to maintain the land-use practices to fit with the ever-changing social, economic and ecological dynamics (SLUF, 2006). Put differently, they have received no external input to maintain the sustainability of the system. Rather, they have done it by themselves using their own indigenous knowledge handed from generation to generation.

However, it should be noted that the land use system, which is principally based on knowledge and skills of the local people may not remain sustainable if there are notable changes in biophysical, socio-economic and cultural conditions. Any adverse changes in social and/or economic conditions will have an impact on sustainability the land use system. Obviously, any sort of changes in biophysical, socio-economic and cultural aspects of the agroforestry system are inevitable and can have positive and negative impacts on sustainability of the land use system. What matter in this regard is the nature and extent of the changes and the capacity of the system to absorb the changes or its vulnerability to the changes.

In this regard, studies conducted in recent period have clearly put their worries about the future prospects of Gedeo agroforestry system under the existing dynamics. There are some signals regarding the pressure that are threatening the agroforestry system and the livelihood of the local people. Some of these studies identified rapid population growth as a potential threat to sustainability of the land use system as well as indigenous knowledge system (SLUF, 2006; Bogale, 2007; Bekele, 2007; Zemede, 2009). For instance, the average land holding size for majority of the local people of Gedeo is reported to be below 0.5 hectares (Tadesse, 2002; Bekele, 2007). Even in some areas, it is estimated to be as low as 0.1 hectare.

The rising population density and then declining of land holding sizes are compelling the local people to revert to shortsighted production systems for meeting immediate needs, migrate to urban centers in search of off farm employment and intensively use their land. For example, there is an increasing trend with regard to utilization of indigenous trees as source of income. Consequently, the rate of felling indigenous trees has risen at a much higher rate than their replacement in recent years. For instance, SLUF (2006) indicates that valuable indigenous species, such as *Cordia africana Lam (weddeessa)* observed at a small interval (10-100 meters), are now becoming increasingly scarcer due to over-harvesting without replacement. Moreover, clearing of trees is resulting in the removal of top soils. This is also becoming a serious problem mainly in the highland parts. The fertility of soils is also declining from time to time and the system is on the verge of losing its potential of carbon sequestration (Zebene, 2009).

There is a high tendency of converting the land into a mono-cropping system. This has been widely practiced in the cold highland region, and, to some extent, in the middle and lower altitude regions. For example, farmers cold highland region are intentionally planting eucalyptus trees to earn income (SLUF, 2006; Bekele, 2007; Zebene, 2009).

Obviously, the agroforestry system of Gedeo is under increasing pressure of prevailing socio-cultural, economic and institutional transformations. The region has undergone through increasing pressure of modernization and globalization. It seems that the indigenous knowledge system that has been used for so long time is being threatened by the socio-economic, cultural and institutional changes. By its very nature IK is prone to changes when the local people who possess the knowledge and skills are exposed to a different lifestyle. Community elders are the legitimate holders of the knowledge and skills pertaining to agroforestry system of Gedeo. The knowledge and skills exists

among them and obviously, the elders will not live forever. Their death means a complete loss of the wisdom unless transferred to the successive generations.

Cognizant of its immense potential in contributing towards climate change mitigation through enhanced carbon sequestration, soil and water conservation, biodiversity conservation, livelihood security, and potential challenges threatening its sustainability, scholars from various disciplines have conducted research on the different issues of the agroforestry system of the Gedeo (Tadesse, 1994; 2002; SLUF, 2006; Mesele, 2006; 2007; Bogale, 2007; Mesele & Niguisse 2008; Mesele et al., 2011). Most of these studies focus on the biophysical, ecological and spatio-temporal aspects of the system. For instance, Bogale (2007) deals with the spatio-temporal distribution of agroforestry while Tadesse (2002) examines the land use system and its sustainability focusing on enset. However, the socio-cultural dimensions of the land use system have been completely ignored. So far, no research has been conducted on the socio-cultural sustainability of the agroforestry system and thus become necessary to conduct a study to understand the indigenous knowledge system that the Gedeo people employ since over the past many generations. It is also important to investigate its current state, dynamics, challenges and prospects since exploring the socio-cultural dimensions largely contribute to the sustainability of the system. In other words, it is very vital to understand the socio-cultural dimension of the agroforestry system and its implications to sustainability.

1.3. Objectives of the Study

The main aim of this research is to understand the dynamics of the socio-cultural aspects of traditional agroforestry system of the Gedeo with a major emphasis on IK and its implications to sustainability of the system. More specifically the study tries to:

1. identify the constituents of IK of agroforestry system
2. examine the spatio-temporal dynamics (changes and continuities) of IK of agroforestry system;
3. investigate drivers of the changes and continuities in IK pertaining to agroforestry system and ;
4. identify the implications of the changes and continuities exhibited in IK of agroforestry system for sustainability of the system.

1.4. Research Questions

In this research the following questions were used as guide. The questions are:

1. How do IK of agroforestry system of Gedeo responding to the dynamically changing biophysical, socio-cultural, economic conditions and institutional aspects?
2. Why IK of agroforestry system has been showing changes? What are the drivers behind changes and continuities of IK of agroforestry system of Gedeo?
3. In what way do the changes and continuities of IK of agroforestry system determine socio-cultural sustainability of the agroforestry system?

1.5. Significance of the Research

This research is geared towards examining the sustainability of the agroforestry system from the point view of socio-cultural variables. The research has looked at the dynamics of indigenous knowledge and practices and its implication to sustainability. So far limited researches have been carried out regarding factors that predict individual-level variation in IK (Reyes-Garcia et al., 2007a). Majority of research conducted in this field emphasis on theoretical dimension of IK and only few of these researches have looked at the practical dimension of IK. Very few researches have combined the theoretical and practical dimension of IK to determine the spatio-temporal variation of IK. Moreover, the study of IK from the perspective of normative dimension is still very much limited and very few of the researches have combined the three dimensions to study the dynamics of IK (Reyes-Garcia et al., 2007a). Thus, the current research work does have its own contribution in bringing new knowledge and methodology to the field of quantitative study of indigenous ecological knowledge as it combines the three dimensions of IK(eco-cognitive/ theoretical, practical and normative).

It is hoped that the findings and recommendations of this research is simply a step forward to evaluate the sustainability of the agroforestry system from the perspective of socio-cultural variables. So far, researches have been conducted to illustrate the ecological sustainability of the agroforestry, with two dimensions of sustainability remains to be unstudied. This research is the first of its kind to approach the agroforestry system from the unstudied perspective. Therefore, the findings of this research are expected to show the socio-cultural sustainability of the Gedeo agroforestry system. Moreover, the research output is hoped to give policy directives concerning the inclusion of IK in school curriculum and development programs.

This research account is believed to contribute towards maintaining the sustainability of the agroforestry system by providing a mechanism to revitalize indigenous belief system, cultural values, norms and indigenous institutions.

1.6. Scope and Limitations of the Study

As indicated in section 1.3, this study is geared towards examining the dynamics of IK of agroforestry system of Gedeo and its implications to sustainability of the system. The focus of this study is on the spatio-temporal dynamics. Therefore, this study has employed a cross-sectional approach to examine the dynamics instead of longitudinal approach due to time limitation.

In the course of data collection, problems were encountered. One of the challenges encountered was accessing young people. It was really challenging to get permission of the young people, particularly those engaged in off farm activities. Besides, required number of participants were not secured to conduct transect walk as majority of them were not willing to participate. In addition, because of lack of drawing skill and illiteracy among the middle adulthood limited the participation of some participants in cognitive mapping activity. However, the problems encountered were partial managed in a way it bears no significant impacts on the quality of the research.

1.7. Organization of the Dissertation

This dissertation is organized into eight chapters. Chapter one narrates the problems, objectives and research questions. Theoretical perspective and analytical frameworks of the research are discussed in chapter two. The third chapter deals with research methodology and study area description. Chapter four gives detail explanation about the agroforestry system while chapters five and six deal the changes and continuities of indigenous knowledge pertaining to agroforestry system and driving forces behind the changes respectively. The last two chapters focus on syntheses, implication and recommendations.

CHAPTER TWO

THEORETICAL PERSPECTIVES AND ANALYTICAL FRAMEWORKS

2.1. Introduction

This chapter is devoted to the description of theoretical perspectives and analytical framework of the research. The theoretical perspectives and analytical framework were discussed principally based on three broad issues. These are (1) characterization of IK pertaining to agroforestry system; (2) changes and continuities of IK in space and time and drivers behind the changes and continuities; and (3) the implications of changes and continuities of IK to sustainability of the agroforestry system.

According to Berkes (2008), IK relatedto ecology emanates from two separate approaches. These are ethnosciences and human ecology (also called cultural ecology). The ethnoscience part focuses on the study of folk taxonomies, ethnobotanical, ethnozoological and others while the human/cultural ecology gives due emphasis to the interrelationship between human and the environment including the relationship of human with animals and plants and various environmental and sometimes supernatural factors (Berkes, 2008).

The human ecology approach appears to be an interdisciplinary approach to the study of IK as it includes four main streams, (1) ethnobiology, (2) agroecology, (3) ethnosciences/anthropology and (4) environmental geography (Berkes, 2008). It deals with adaptive processes by which the nature of society and an unpredictable number of features of culture are affected by the basic adjustment through which humans utilize a given environment (Steward, 1955 as cited in Berkes, 2008).

The current study is situated in the human ecology approach and concept as it describes how the Gedeo, who are engaged in traditional agroforestry practices are able to keep the sustainability of ecosystem through adaptive processes. In other words, the research tries to relate the socio-cultural aspects of the society to the natural ecosystems. It shows the interaction between nature and human being, focusing on human-land interaction paradigm.

The three broad issues are also examined thoroughly based on Knowledge-Practice-Belief complex developed by Berkes (2008). IK acquisition and transmission processes in this study are conceptualized based on social constructivist view, which views reality as socially constructed. In

addition, different models such as cultural transmission model (Cavalli-Sfona & Feldman, 1981) modified by Hewlett & Cavalli-Sfona(1986), and the learning sequence for traditional skills and knowledge (Ruddle & Chesterfield, 1977) are among the theoretical perspectives and analytical tools used to examine the dynamics of IK pertaining to agroforestry system of the Gedeo. Considering the human-land interaction paradigm into account, analytical framework linking the different elements of IK and driving forces behind changes and continuities of IK have been developed and used.

2.2. Theoretical Perspectives

2.2.1. Conceptualizing IK

There has been a growing debate about the connotation denoted to the knowledge owned by local/ indigenous people. Some scholars use to denote such knowledge as 'indigenous', while others use 'local', 'traditional', 'folk', 'community knowledge', 'farmers knowledge' etc. In most cases, the terms are used interchangeably (Stevenson, 1996; Grenier, 1998; Davis & Wagner, 2003; Stevenson, 2005; Berkes, 2008; Davis & Ruddle, 2010; Rist et al., 2010). There is no universally agreed-up-on use of the term despite the fact that such knowledge emerged from the local practices and peoples' experiences. However, two of these terms, 'indigenous knowledge' and 'traditional knowledge', are widely used in most literature (Berkes, 2008).

Indigenous knowledge does not have a universally working definition. Different scholars conceptualize the term differently. Some attribute IK to indigenous people who occupy a certain area, exhibiting distinct culture and way of life. Some perceive it as a knowledge unique to a given culture, or society (Grenier, 1998; World Bank, 2008). While others conceptualize it from the perspective of the process, through which the knowledge is acquired and transmitted from generation to generation. For instance, according to Nakashima et al. (2012) IK is the know-how accumulated across generations, and renewed by successive generations, which guide human societies in their innumerable interactions with their surrounding environment.

Dei (1999) defines IK as a worldview that shapes the community's relationships with surrounding environments. It is the product of native people's direct experience with nature and its symbiotic relationship with the social world and, as such, is crucial for community survival. This knowledge, ancient, proven, and based on cognitive understandings and interpretations of social, physical and spiritual worlds, encompasses concepts, beliefs and perceptions of local peoples and their natural

human built environments (Dei, 1999). According to Dei (1993) IK is the product of the close and regular interaction of local people with nature. It encompasses values, belief systems, worldviews and norms, cultural traditions of the local people.

Warren, a well-known scholar in the field of IK, conceptualizes IK by signifying its importance, contrasting it with modern knowledge and ways by which it is transferred from generation to generation. According to him, IK is:

> *[K]nowledge that is unique to a given culture or society. IK contrasts with the international knowledge system generated by universities, research institutions and private firms. Such knowledge is passed down from generation to generation, in many societies by word of mouth. Indigenous knowledge has value not only for the culture in which it evolves, but also for scientists and planners striving to improve conditions in rural localities (Warren, 1991: 1).*

IK can also be conceptualized as knowledge and practices that a community accumulates over generations through the process of human-environment interaction (Atteh, 1980). Such knowledge systems are cumulative, representing generations of experiences, careful observations, and trial and error experiments (Grenier, 1998). It encompasses know-how, skills, practices and beliefs that enable the community to achieve stable livelihoods in their environment. It is embedded in community practice, institutions, relationship and rituals.

Berkes (2008) conceptualizes traditional ecological knowledge in a relatively broad manner. According to him, traditional ecological knowledge is 'a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with environment' (Berkes, 2008: 7). It is the result of dynamics mix of the past practices and the present innovation, which tested and experimented through trial and error (Berkes, 2008). IK of agroforestry system of Gedeo can be conceptualized as cumulative body of knowledge which is evolving via adaptive processes.

Another scholar who conceptualizes knowledge and practices owned by local/indigenous people is Stevenson (1996). According to him, IK has two sources: traditional knowledge and non-traditional

knowledge. Traditional knowledge encompasses specific knowledge of the environment, knowledge of ecosystem relationship, code of ethics governing ecosystem relationship and other traditional knowledge (social, cultural and spiritual). On the contrary, the non-traditional knowledge is not grounded in traditional life style. That is, it is believed to be derived from the interaction made with modern institutions, television and other modern media, formal schooling in numeracy and literacy, the adoption of Western scientific thinking, and exposure to foreign values, attitudes, and philosophies. Therefore, the contemporary knowledge and practices of the Gedeo can be viewed as having two sources: traditional and nontraditional knowledge as shown in figure 2.1 below.

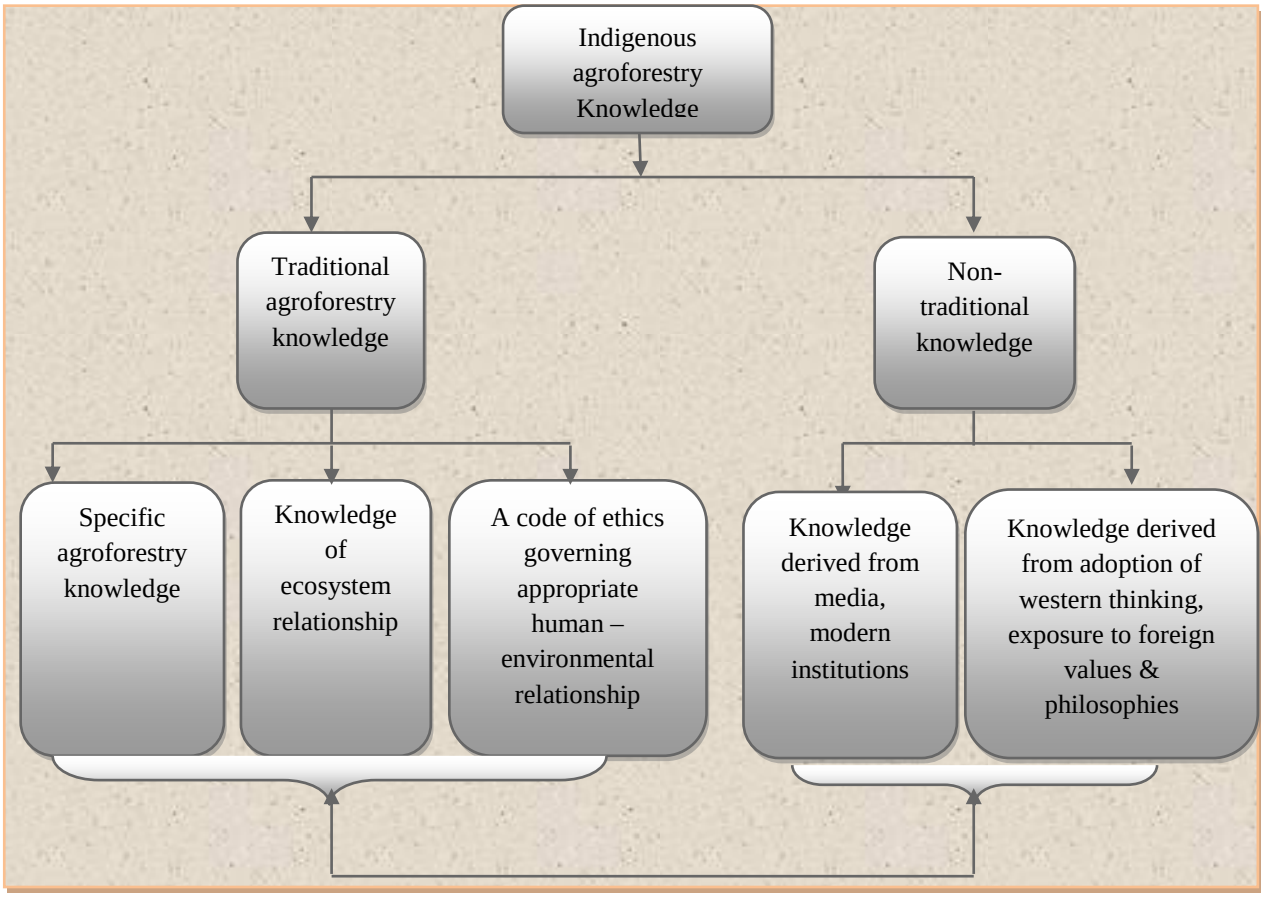


Fig 2.1: Conceptual definition of indigenous agroforestry knowledge (adapted from Stevenson, 1996).

2.2.2. What distinguishes IK from other forms of knowledge?

There has always been a debate among scholars concerning the difference between indigenous/traditional knowledge and western sciences, particularly in fields like anthropology (Antweiler, 1998). Some scholars argue that the binary opposition between the two forms of

knowledge appears to be more of artificial or institutional than naturally made (Bebbington, 1993; Leach & Fairhead, 2000; Fernando, 2003). Others argue that the divide is there naturally (Agrawal, 1995; Briggs, 2005). However, there is a consensus that IK is different from other forms of knowledge, mainly western knowledge. This binary division between IK and western knowledge has existed for longer time; however, under contemporary rapidly changing and globlaized world, it would hardly be possible to maintain the binary opposition in a practical sense. Particulary in situations that accomadate both indigenous and modern knowledge and practices, it seems unrealistic to fully maintain the binary opposition between the two forms of knowledge in practical terms. Briggs(2005) states the following regarding the division that are expected to persist:

> *The tensions created by the binary divide between western science and indigenous knowledge clearly persist, despite many well-intentioned efforts to reduce or eliminate them. It may well be that this issue will remain unresolved… However, the reality in rural areas may be much more pragmatic, in that farmers and others may, because of the demands of daily existence, develop a hybrid, mediated knowledge, which is developed and continually re-worked often in highly innovative ways (pp.15).*

Existing literature reveals distinctions between the two forms of knowledge based on the contents of the knowledge and epistemological evidences. In this regard Levi-straus (1980) pointed out that the difference between science and IK lies in which phenomena are observed and ordered. IK is viewed as 'concrete' and relies almost exclusively on intuition and evidence directly available to the senses; while the scientific mode of thought is characterized by a greater ability to break down data presented to the senses and to reassemble it in different ways. Moreover, IK is perceived as a closed system, which is characterized by a lack of awareness that there may be other ways of regarding the world. In contrast, science is an open system whose adherents are always aware of the possibility of alternative perspectives to those adopted to any particular point of time (Levi-straus, 1980).

The work of Agrawal (1998) in setting a boundary between IK and western sciences based on substantive, methodological and epistemological, and contextual dimensions seems rational. The substantive dimension addresses the difference in terms of subject matter and characteristics of both forms of knowledge. In this regard, IK deals with those activities that are intimately connected with the daily livelihoods of people rather than with abstract ideas and philosophies.

The methodological and epistemological dimensions emphasis the difference in terms of the methodology used to investigate reality and the ways the world is viewed. He pointed out that:

> *Science is open, systematic, objective, and analytical, and advances by building rigorously on previous achievements. What scientists do is supposed to be strictly separable from common sense or non-science. IK, in contrast, is no more than common sense; it is closed, non-systematic, without concepts that would conform to ideas of objectivity or rigorous analysis, and advances, if at all, it fits and starts (Agrawal, 1998;17)*

The contextual dimension focuses on the difference in terms of the fact that one is context bounded while the other is not. IK is assumed to be context bounded; it exists in close and organic harmony with the lives of the people who generated it. It cannot be separated from larger moral or normative ends. On the other hand, scientific knowledge is context free and it thrives on abstract formulation and exists divorced from the lives of people.

On the other hand, Berkes (2008) summarizes the characteristics of IK or traditional ecological knowledge by comparing and contrasting it with western knowledge (Table 2.1).

Table 2.1: Distinction between IK and western knowledge (Berkes, 2008)

IK (TEK)	**Western knowledge**
Mainly qualitative	Quantitative
Intuitive	Rational
Holistic	Reductionist
Mind and matter are considered together	Separation of mind and matter
Moral and spiritual	Value-free and mechanistic
Based on empirical observations and accumulation of facts by trial-and-error	Based on experimentation and systematic, deliberate accumulation of facts
Based on data generated by resource users	Based on data generated by specialized cadre of researchers
Based on diachronic data long time-series on information on one locality	Based on synchronic data, i.e., short time-series over a large area

2.2.3. IK transmission and acquisition: Theories and Models

Indigenous knowledge transmission and acquisition can be conceptualized as the process of social production and reproduction in which knowledge, skill, behaviors, language and beliefs are communicated and acquired (Hewlett & Cavalli-Sforaz, 1986). It is part of the socialization processes. Therefore, IK production and reproduction in the context of Gedeo can be understood from the perspectives of social constructivist approach. According to constructivist approach, reality is a social construction. Indigenous people construct reality about themselves and others, and the surrounding environment in the course of socialization processes. Their everyday life determines their knowledge, skill and behavior.

According to constructivist view, IK is often constructed from what we observe, sense, hear, touch and smell. Knowledge and skills construction is based on social perception of reality, encoded in cultural categories communicated in language shared by the group of people, and reproduced by knower's or an 'epistemic' community (Salas & Tillmann, 2004). It is transferred to succeeding generations through the annual, cyclical repetition of livelihood activities (Hunn & Selam, 1990; Freeman, 1993a; Ellen et al., 2000 cited in Berkes, 2008).

Rural children learn or acquire knowledge from their everyday life through interaction made with their parent, peer, siblings and grandparents. They also learn from the interaction made with the natural environment in which they grow (Warren & Rajasekaran, 1993). For instance, in a tradition society in which farming is their dominant livelihood, parents teach their children not about how to drive cars or how to make cars; rather they tend to teach how to cultivate crops, prepare land, sow, cultivate, weed, harvest manage the natural resources. Therefore, IK transmission and acquisition is a teaching-learning process that can be conducted between learner and apprentices and between the learner and local biophysical and socio-economic settings. The sequence of teaching and learning processes in such a traditional society may not involve chalk and talk or pencil and exercise book. It is predominantly oral, often supported by demonstration.

A number of learning theories have been formulated regarding knowledge acquisition and the elements affecting it from child to adulthood. The Bronfenbrenner ecological systems theory of human development, which was later renamed as the bio-ecological systems theory, is one among the theories formulated to address knowledge construction. The theory focuses on human development

as influenced by both internal and external environment. Furthermore, the theory concentrates on human-environment relationship, which entails dependency of human beings on nature and vice versa. The theory also focuses on socialization process through which a child becomes a matured person through exposure to various conditions. The theory is found to be holistic and hence more applicable to understanding how people acquire IK from their everyday life.

The theory defines the construct of development and the multi-system layers of the environment that influence child development. It defines the five concentric systems namely, micro-, the meso-, the exo- the macro-system and the chronosystem (Bronfenbrenner, 1979). It considers the influences on a child's development within the context of the complex system of relationships that form its environment. The theory states that a child's development is a product of context, process, time, and individual's personal attributes (Bronfenbrenner, 1979). It emphasizes that the nature of the processes within the environment has an influence on child development. The environmental and socio-cultural setting in which a child grows and the ultimate interaction of the child with the external environment determine its development.

As Bronfenbrenner´s theory dwells on human development as influenced by both internal and external environments, it seems it is applicable to the IK acquisition and transmission by children and young people of Gedeo. Acquisition and transmission of knowledge is part of human development, affected by the internal environment in which a child grows and the external environment. Therefore, IK acquisition and transmission can be seen from the perspective of Bronfenbrenner´s ecological systems theory of human development. For instance, IK acquisition and transmission is affected by the interaction of learner with home, peer, family member and adults. According to Bronfenbrenner, this is seen at the first level, the Microsystems. Then at mesosystems religious institutions, schools, neighbors are there influencing children's acquisition of IK. Beyond the mesosystems, the influence of mass media, world belief systems, world economic market, globalization and others are prominent in affecting the ability of children to acquire.

There are also models that depict how traditional/ indigenous people pass on and acquire traditional/ indigenous knowledge about their locality and the mechanisms through which IK is transmitted. The models are presented in the following three sections (section a, b and c).

a. Traditional learning sequences

Learning in traditional society may involve experiential activities through which knowledge and skills are acquired through verbalization, observation, and imitation in daily tasks. It is contextual in that every part of social life is connected to belief system and practices (O'Brien, 2008). It is tactile that involves learning while doing and relies on social and situated means of transmitting information.

Ohmagari & Berkes (1997) in their study of the transmission of IK and bush skills among the Western James Bay Cree Women of Subarctic Canada set traditional learning sequences, (originally developed by Ruddle & Chesterfield,1977), through which indigenous knowledge and skills are acquired. The model consists of eight stages of learning in which an individual is expected to pass through to acquire indigenous knowledge and skills (figure 2.2). The learning process in this case is more of traditional, embedded within the everyday life of the local people.

The learning sequence begins from familiarization to the local biophysical and socio-cultural environment. It means that a child begins acquiring knowledge about the environment when exposed to and gets familiar with it. Children, in their early childhood period, observe, try to understand their environment through the interaction made with their parents and peers. They tend to imitate what their elders do and then create their own world. This can be achieved whenever they come in contact with nature. Through time, they develop knowledge and skills that help them to work independently without assistance. The learning process in traditional societies is therefore socialization processes that involve observation, inquiring, imitation and trying by oneself.

The acquisition of IK is not something that ends at some point in time. Individuals do have the opportunity to acquire IK from their early childhood up to adult stage and even beyond as long as the learner is socially active and enthusiastic to learn. Therefore, the learning sequence is continuous in time that spans from childhood to adulthood (Reyes-Garcia et al., 2009). In most cases, children in rural areas may start familiarization with their surrounding environment at the age of five, the age at which they are given permission to fetch water from spring or collect firewood with their peers. Some researcher revealed that the majority of knowledge relatedto natural environment could be acquired during childhood (Stross, 1973; Zarger, 2002; Lozada et al., 2006; Reyes-Garcia et al., 2009). In the case of Tsimane, children above 5 years old usually spend a good portion of each day

solely carrying out daily activities, such as household chores, babysitting, playing, bathing, and looking for snack foods (Reyes-Garcia et al., 2009).

Similarly, Zarger (2002) found out that children in subsistence societies master great amount of empirical knowledge about their natural environment and subsistence related skills before they turn 12 years. When they reach stage of adolescence, their ability to name plants, describe their uses tends to increases and remain largely unchanged for the rest of their life (Zarger & Stepp, 2004; Reyes-Garcia et al., 2009).

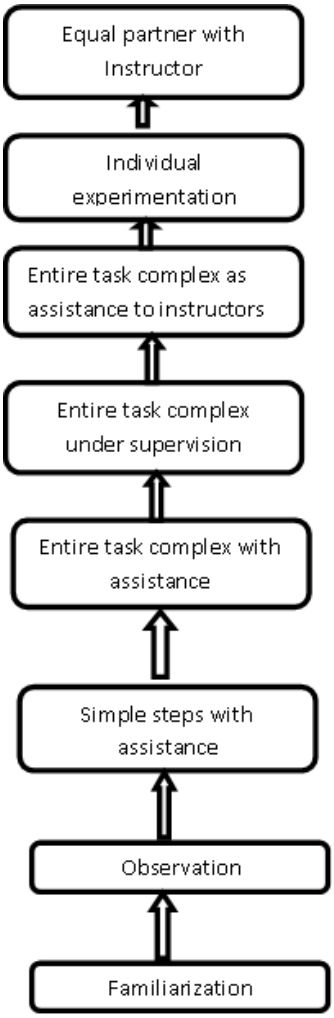


Fig 2.2: IK learning sequences

Source: Ohmagari & Berkes (1997) after Ruddle & Chesterfield (1977)

b. Modes of IK transmission

IK is oral in its nature and hence it is clearly transmitted from one individual to another in a very personal way. The most common perspective regarding IK transmission is that individual can acquire knowledge and skills about their locality through the following mechanisms:
(1) Interaction between human-nature; (2) Interpersonal interaction among peer groups; (3) Social groups, and (4) individual-society interaction (Takako, 2003). In all cases, oral communication and observation are the two modes through which IK is transmitted and acquired.

Oral transmission commonly occurs through family lines from parents and grandparents telling narratives, including stories and songs, repeatedly, formally either at social occasions or informally between family members late into the night (Alexiades, 1999; Turner et al., 2000; Singh & Singh, 2005). It can also occur through contact between non family groups (social and peer group).

Knowledge and skills gained through oral communication needs to be concretized through repeated practices overt time as IK and its practices are assimilated through experiences (Ruddle & Chesterfield, 1977; Zarger, 2002; Levesque, u.d). Therefore, children and young people must engage in practical activities to acquire knowledge and skills of their environment (Ohmagari & Berkes, 1997). IK not supported by practical experiences is unlikely to stay longer in mind. Direct experiences and contact with the natural environment provide learning opportunities and motivation to protect the environment (Miller, 2005).

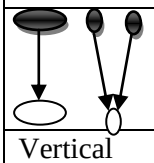
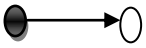
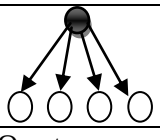
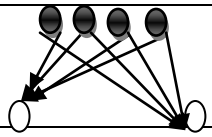
c. Model for paths of IK transmission

IK transmission occurs in three distinct but not mutually exclusive paths. These are vertical, horizontal and oblique. Vertical path involves transmission from parent to children. Parent- to-child transmission is closest to biological transmission. It is highly conservative and may maintain the status quo including all the individual variation in existence similar to biological transmission (Cavalli-Sforza & Feldmen, 1981; Hewlet & Cavalli- Sforza, 1986). In this mode of IK transmission, the learner is likely to become only receptive but innovation will be very slow to spread to others in the population unless other modes of transmission are employed along with parent to child transmission. It means that the diffusion of new knowledge and skills is likely to be lesser than the other two modes of transmission among society in which vertical transmission is predominant. Such

mode of transmission is likely to lead to greater information heterogeneity within a population (Cavalli-Sforza et al., 1982)

On the other hand, horizontal path involves knowledge transmission between two individuals of the same generation, while oblique path involves a transmission from non-parental groups to the parental generation to members of the filial generation (Cavalli- Sforza & Feldmen, 1981; Reyes-Garcia et al., 2009). The diffusion of innovation is relatively faster in horizontal and oblique transmission as the transmission occurs between any two individuals irrespective of their relationships (Hewlet & Cavalli- Sforza, 1986).

Table 2.2: Path of IK transmission

Some characteristics	**Modes of cultural Transmission**			
				
	Vertical	Horizontal	One to many	Many to one
Transmitter	Parent	Unrelated	Teacher/Media	Older members of the social group
Transmittee	Child	Unrelated	Pupils/audiences	Younger members of the social group
Acceptance of innovation	Intermediate difficulty	Easy	Easy	Very difficult
Variation b/n individuals and within population	High	Can be high	Low	Lowest
Variation b/n groups	High	Can be high	Can be high	Smallest
Cultural evolution	Slow	Can be rapid	Most rapid	Most conservative

Source: (Hewlet & Cavalli- Sforza, 1986)

2.3 Empirical review: IK in the global, Africa and Ethiopia context

Empirical evidences suggest that IK as subject of study in the academia was able to attract the attention of most researchers beginning from the early 19th century (Reyes-Garcia et al., 2007a). The interest to research IK seems to increase as of 1980's following the recognition of knowledge of local people in development rhetoric. The interest and attempt to study IK was in fact present even before the 1980's, though at its infant stage (Briggs, 2005). The work of Allan's(1965) on the *African Husbandman*, Bell(1979), Belshaw(1979), Chambers(1979), Howes(1979), and Richards(1979), all cited in Briggs(2005), are among the works contributed to the understanding IK before 1980.

The 1980's is a benchmark for indigenous people who possessed rich knowledge of biological and cultural diversity. The 1980's was a period in which IK is considered in international forum , the first time in "World Conservation Strategy" by the International Union for the Conservation of Nature and Natural Resources (IUCN). The conference believed to play a major in paving the way for the recognition of the important role played by indigenous knowledge in biodiversity and human development. Then the 1992 United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro is a breakthrough for indigenous knowledge and indigenous people in term of getting recognition among the scholars, development practitioner, policy makers, implementer, politicians and others. Agenda 21, one of the environmental agreements signed at UNCED, emphasizes that governments and intergovernmental organizations should respect, record, and work toward incorporating indigenous knowledge systems into research and development programs for the conservation of biodiversity and sustainability of agricultural and natural resource management systems.

Most of the researches conducted in the 1980's and 1990's focus on physical aspects such as environmental and natural resources and less attention was given to socio-cultural and economic aspects in which IK is used. In this regard Briggs (2005) made a critical review of the works done in the 1980's and 90's and writes the following:

> *Much indigenous knowledge research has tended to focus on the contents of indigenous knowledge systems per se, with a particular interest in indigenous soil classification and management methods (see Critchley, Reij and Wilcocks, 1994, for example), as well as on indigenous technologies, water conservation techniques and indigenous woodland management. There has been relatively less interest in knowledge about vegetation for*

> *grazing and livestock management more generally, although there are notable exceptions (for example, Bollig and Schulte, 1999; Briggs, Badri and Mekki, 1999; Dinucci and Fre, 2003; and Goodman and Hobbs, 1988, among others* (Briggs, 2005:pp.6.)

There is an increasing interest in IK research, with more diversified themes, dealing with various aspects of IK, in recent time. Many scholars from different discipline, such as from fields of anthropology, development sociology, geography, ecology, soil science, veterinary medicine, forestry, human health, aquatic science, management, botany, zoology, agronomy, agricultural economics, rural sociology, mathematics, fisheries, range management, information science, wildlife management, and water resource management are interested in the study of IK(Warren et al., 1993).

However, most of the research conducted elsewhere addresses IK from the perspective of conceptual or theoretical knowledge alone, with less emphasis to the practical skills (Kightley, 2013) and normative dimension (Reyes-Garcia et al., 2007a). In this regard Gomez- Baggethun & Reyes-Garcia (2013) reviewed the works done so far and identified three area in which TEK research is centered. These are (1) documenting the knowledge, (2) understanding the parallel changes in biological and cultural diversity, and(3) examining the processes and drivers of changes that lead to the loss of IK (Gomez- Baggethun & Reyes-Garcia, 2013).

Empirical researches have been conducted in different parts of the world (see Zent & Maffi, 2009 for detailed information) focusing on dynamics of IK (Rajasekaran et al.,1991; Byg & Balslev, 2001; Lykke et al., 2004; Zarger & Stepp, 2004; Case et al., 2005; Godoy et al., 2005; Lozada et al., 2006; Monteiro et al., 2006; Gray et al., 2008; Turner & Turner, 2008; and Godoy et al., 2009a; Gómez-Baggethun, 2009; Gomez-Baggethun et al. ,2010; Gómez-Baggethun & Reyes-Garcia, 2013; McCarter & Gavin, 2013; Reyes-García et al., 2013 and others). The study of variation of IK among and within generational group and among individuals goes back to early 1900's. However, quantitative study of individual variation of IK is started very recently (Reyes-Garcia et al., 2007a).

Many of these empirical researches have been conducted on different aspects of IK, such as cultural transmission, loss of IK and factors behind the loss of IK. Some of these research accounts reported gradual loss of IK (Leonard, 1996; Zent, 2001; Case et al., 2005; Godoy et al., 2005; Reyes-García et al., 2005; Gomez-Baggethun et al., 2010) due to factors such as change in socio-cultural values,

demography, economic condition, and institutional setup (Rajasekaran et al.,1991; Case et al., 2005; Lozada et al., 2006; Monteiro et al., 2006; Turner & Turner, 2008; and Gomez-Baggethun et al. 2010). Some of these research accounts reported contrasting result regarding the relationship between IK and drivers for its changes and continuities. For instance, in the longitudinal study conducted by Zarger & Stepp (2004), prevailing biophysical, socio-cultural and economic changes reported to have no significant impacts on IK changes. On the other the study conducted by Rajasekaran et al. (1991), Case et al.(2005), Lozada et al. (2006), Monteiro et al.(2006), Turner & Turner, (2008), Gomez-Baggethun et al. (2010) and others reported the loss of IK due to the prevailing changes in biophysical, socio-cultural and economic.

Similarly conflicting results were reported regarding the possible impacts of schooling on acquisition and transmission of IK. Some researches claim that school attendance was found to have negative impacts on acquisition of indigenous knowledge (Zent, 1999; Voeks & Leony, 2004; Rocha, 2005; Cruz Garcia, 2006; Quinlan & Quinlan, 2007; Gómez-Baggethun & Reyes-García, 2013). Education has been identified as one of the principal driving forces for assimilation and integration to western culture. On the other hand, school attendance by children and young people were found to be contributing towards acquisition of IK (Reyes-Garcia et al., 2005; Reyes Garcia et al., 2007; and Saynes-Vasquez et al. 2013).

Many scholars have tried to investigate the mechanism through which IK is acquired and transmitted and their findings suggest that oral communication and learning by doing are the two principal mechanisms through which the acquisition and transmission occurs (Cavalli-Sforza et al., 1982; Hewlett Cavalli-Sforza, 1986; Ruddle, 1993; Ohmagari & Berkes, 1997; Zobolo & Mkabela, 2006; Lozada et al., 2006; Eyssartier et al., 2008; Reyes-Garcia et al., 2009). Besides, research findings have shown that parents are among the major transmitter of knowledge and skills to the younger generation (Hawlett & Cavalli-Sforza, 1986; Lazada et al., 2006).

Thematic wise, several researches have been conducted on various domains of IK among which the emphasis on plant domain appears more prominent in most research conducted so far ((Reyes-Garcia et al., 2007a). For instance some of the researchers have studied IK of wild food resources (Ladio & Lozada, 2004; Reyes-Garcia et al., 2006; Setalaphruk & Price, 2007; Turner & Turner, 2008) traditional use of medicinal plants (Amiguet et al.,2006; Torri, 2010) traditional practices in agriculture and livestock farming(Gomez-Baggethun et al. 2010). Other scholars attempted to

address IK methodologies (Beggosi et al., 2002; Reyes-García et al., 2004; Rocha, 2005; Reyes-García et al., 2006) and others.

Africa is assumed to have a rich body of IK, which is embedded in cultural and ecological diversities of the continent. The people of Africa have long been using their local wisdom to avert challenges relatedto environmental, economic, political and social issues. In the region, IK has been playing vital roles in biodiversity conservation, sustainable use land management, and assuring sustainable livelihood. Multitude of indigenous practices exist in Africa such as practices related to midwives, construction of buildings with natural 'air conditioning'' in Sudan, settlement for land disputes between farmers and nomads in Togo, communal use of individual allocation of land by the Washmba in Tanzania, and IK of differentiating pastures and the ''wilderness among the Maasai of Kenya (Ossai, 2010). However, it is not well researched and documented (Kolawole, 2001).

This can be partly attributed to the fact that IK has been ignored, marginalized and distorted for several centuries (Wane, 2005). However, since the 1980's a growing number of African governments and international development agencies have started to recognize the role that local-level knowledge and organizations plays in laying a foundation for participatory approaches to development that are both cost-effective and sustainable(Warren, 1992).

In recent time several researches dealing with soil and water conservation (Bonsu et al., 2000; Kajembe et al., 2005), soil fertility management (Kolawole & Laogun, 2005), forestry, fisher, biodiversity conservation and management (Hens, 2006), ethno-medicinal (Abraha et al., 2013; Moa et al., 2013; Ermias et al., 2013) wetland sustainability (Dixon, 2003a; 2003b), climate knowledge (Roncoli, 2002; Orlove, 2010), Agriculture (Akullo et al., 2007), tree fodder resources (Kiptot, 2002;2005), disaster management (Mwaura, 2008), wild edible plants (Cheikhyoussef et al., 2011; Cheikhyoussef & Embashu, 2013; Maroyi, 2013) have been conducted in different parts of Africa to give solution to the prevailing societal problem, increases the awareness and hence the acceptance of importance of indigenous knowledge and practices for development, and maintain the local wisdom through documentation.

Similarly, in Ethiopia there exist rich biodiversity and cultural diversity. The indigenous knowledge and practices has been marginalized for centuries and it was not in the attention of scholars and ruling governments until 1980's. It was only in 1980's that IK is considered as an alternative options

towards sustainable resource management. Similar to other countries in Africa, the local people have been using IK and technologies for a number of purposes, the principal one being for resource conservation and management, sustaining livelihood, human and animal disease healing. Even the local people use it to treat plant's pest and disease. However, due focus has been only given to the physical aspects such as soil and water conservation, soil fertility management and so on (Alemayehu, 2003). Little is researched about the loss of such knowledge and its impacts on biodiversity as well as cultural diversity. Even the 1988 attempt by MoA was only an inventory work carried out by consultants based on short field visits to selected areas of the country with known indigenous conservation practices (Alemayehu, 2003).

The country is known for its rich IK and technologies in various aspects such as resource management (eg. Konso terracing, Agroforestry system of Gedeo), coping strategies (eg. Borena and Afar pastoralist), traditional healing system, wild food plants (eg. Konso by Ocho et al., 2012), ritual practices, resolving conflict, cultural practices, and others. Despite, the existence very rich biological and cultural resources there exist very scanty research works in this field due to lack of scientific researches. However, in recent period a number publications appears to emerge, for instance in the field of traditional use and importance of wild edible plants (Getachew et al., 2005; Haile et al., 2008; Ocho et al., 2012), ethno-botanical study of medicinal plants (Fisseha et a l., 2009; Yirga et al., 2010; Anteneh et al., 2012; Zenebe et al., 2012; Ermias et al., 2013; Hedvig et al., 2013; Moa et al., 2013; Abera et al., 2013;). Majority of these researches address the ethnobotanical aspects, focusing on plant domain and theoretical dimension of IK. None of them address the three dimensions of IK.

2.4. Analytical Frameworks

2.4.1 Knowledge- practice- belief complex: an approach to IK analysis

Knowledge-practice- belief complex is an analytical framework designed by Berkes (2008) for the purpose of analyzing indigenous ecological knowledge (IEK). According to this analytical framework, there are four levels of analysis of TEK (see figure 2.3).

The first level of analysis is primarily concerned about local and empirical knowledge of animals, plants, soils, and landscapes, which is constituted, by our direct perceptions and observations (Berkes, 2008). This level of knowledge includes information on species identification and taxonomy, life histories, distributions, and behavior. This level of analysis could also refer to the eco-

cognitive dimension of IK, addressing theoretical knowledge about ecological systems. The eco-cognitive dimension corresponds to the set of mental constructions used in a specific ecological context or environment such as soils, plants, animals, topography or climate (Boillat, 2007). From the point of view of IK in relation to agroforestry system of Gedeo, the eco-cognitive dimension encompasses the recognition and identification of plant species, local soil type, and local climate (season).

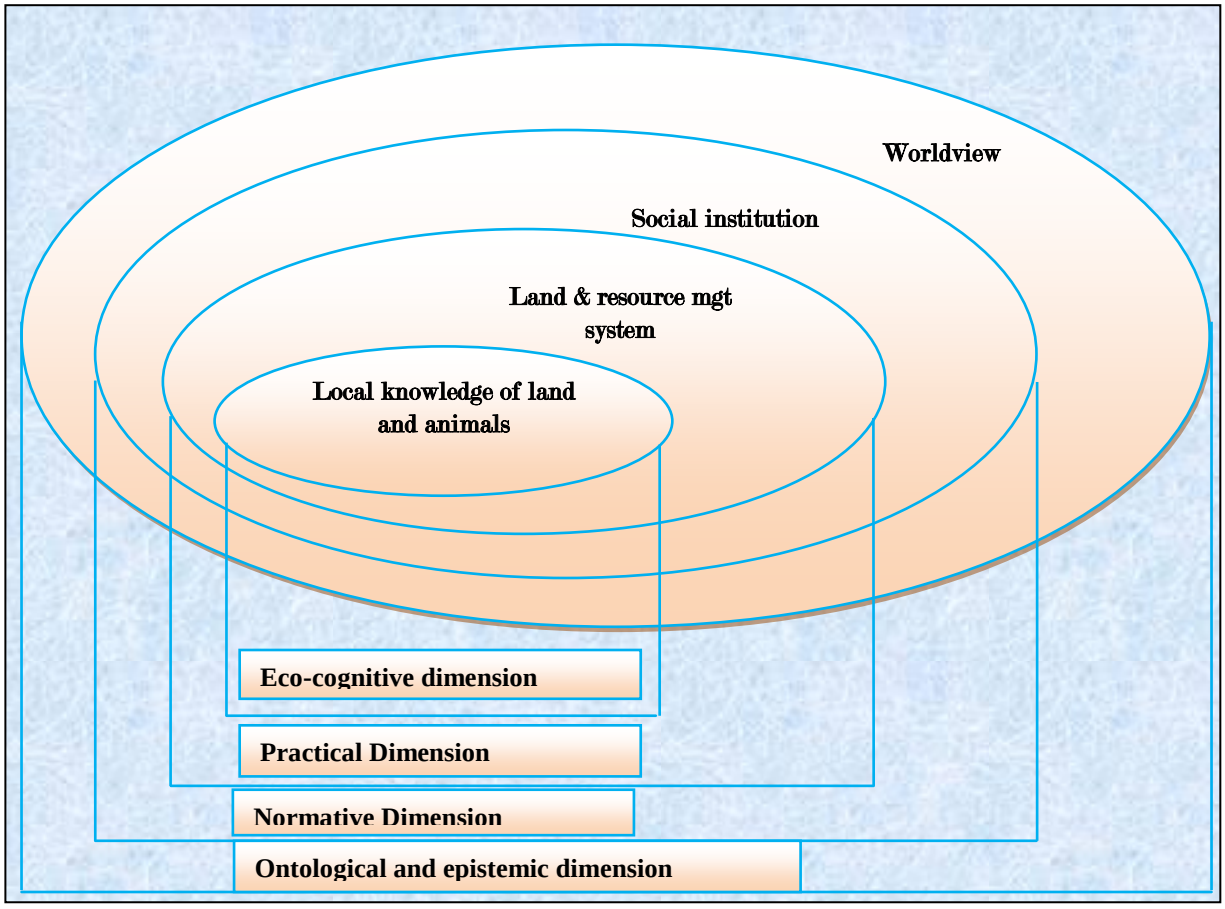


Fig 2.3: Knowledge- practice- belief complex (Source: Boillat, 2007; Berkes, 2008)

The second level of analysis is about the practical skills, techniques and tools employed for proper management of natural resources constituted by our ways of conceiving the universe. It requires understanding of ecological processes and interactions between the different components of ecology, such as the functional relationships among key species and an understanding of forest succession (Berkes, 2008). This aspect of IEK is also referred to as practical dimension, and it includes activities

of everyday life, what we do, how we use nature, how we relate to people and to spiritual entities, and how these activities are perceived (Boillat, 2007; Mathez-Stiefel et al., 2007). In the case of IK in relation to agroforestry system, the practical aspect encompasses majority of agroforestry practices and the interaction between and among the various components of the agroforestry system.

The role of social institution in the management of natural resources through designing and setting rules, and regulation and norms and value systems is set to be the third level of IK analysis. Social institutions may include institutions of knowledge that frame the processes of social memory, creativity, and learning (Davidson-Hunt & Berkes, 2003). Boillat (2007) denoted this level of analysis as normative dimension of IK. He adds that the normative dimension refers to specific forms of social organization relevant for resource management, (e.g. formal or informal rules, community-based regulation of access and distribution of resources) (Rist & Dadouh-Guebas, 2006 cited in Boillat, 2007). The various social institutions that frame rules and regulations, establish customary laws were used to examine the normative aspects of IK of traditional agroforestry system of Gedeo.

The worldview, which shapes environmental perception and gives meaning to observations of the environment, is the fourth level of analysis according to Berkes (2008) framework. This is equivalent to ontological and epistemic dimensions that form together the "philosophical dimension" (Boillat, 2007). This philosophical dimension was not explicitly used as one level of analysis. Instead, issues related to the impact of worldview on IK were examined implicitly in the third level.

2.4.2. Drivers behind changes and continuities of IK of agroforestry system

Indigenous knowledge is dynamic and evolutionary in perspective as well as being inherently conservative in the manner which it is handed down from generation to generation. It is a form of knowledge that changes through time because of creativity and innovativeness of the people who use it as well as through contact with other local and international knowledge systems (Warren, 1991). It tends to adapt to ever changing socio-economic, cultural and environmental conditions tuned to the needs of local people and quality and quantity of available resources.

Indigenous people around the world have been engaged in discovering new knowledge, reproduction and modification of the existing knowledge (Pilgrim et al., 2006). In addition, tremendous amount of knowledge is in danger of being lost because of rapid change in the life of local communities

(Nagulube, 2002). Consequently, the world has suffered, and continues to suffer, from a profound loss of IK about the natural world constructed from the intimate ties of local people to the land and place. As Cosa-Neto(2000) indicated IK is threatened with extinction as much as the biological resources.

As indicated in figure 2.4, changes and continuities of IK are determined by socio-economic, institutional and biophysical variables. The complex interaction between the socio-economic, biophysical, cultural and institutional factors may lead to the loss or retention of indigenous practices. In fact the possible changes that occur in any of the conditions may bring either retention or loss of IK depending on the extent to which the system responds to the changes.

In their review of TEK methodologies, Zent & Maffi (2009) identified formal education, parental schooling, language shift, bilingualism, market involvement, imported technology, occupational focus, wealth, land availability, public economic assistance, habitat degradation, useful species extinction, distance to farmland or town, migration, interethnic contact, availability of western medicine, religious belief and values changes as explanatory variables behind IK variation in time and space.

Population growth is believed to be one of the factors for changes and continuities of IK. It can have both positive and negative effects. In this regard, two dominant and divergent views exist. One is the Malthusian view that advocate that population growth tends to exceed the productive capacity of the land resources (Marquette, 1997). According to this view, population growth is assumed to have negative impacts on availability of food and on the environment as well. The other is the Boserupian view that addresses that population growth is regarded as an instrument to induce technological innovation that allow food production to keep pace with population growth (Marquette, 1997). The Boserupian view indicate that population growth necessitate innovativeness as a result of which production increases in relative proportion with population growth. In this sense, population growth is regarded as a resource.

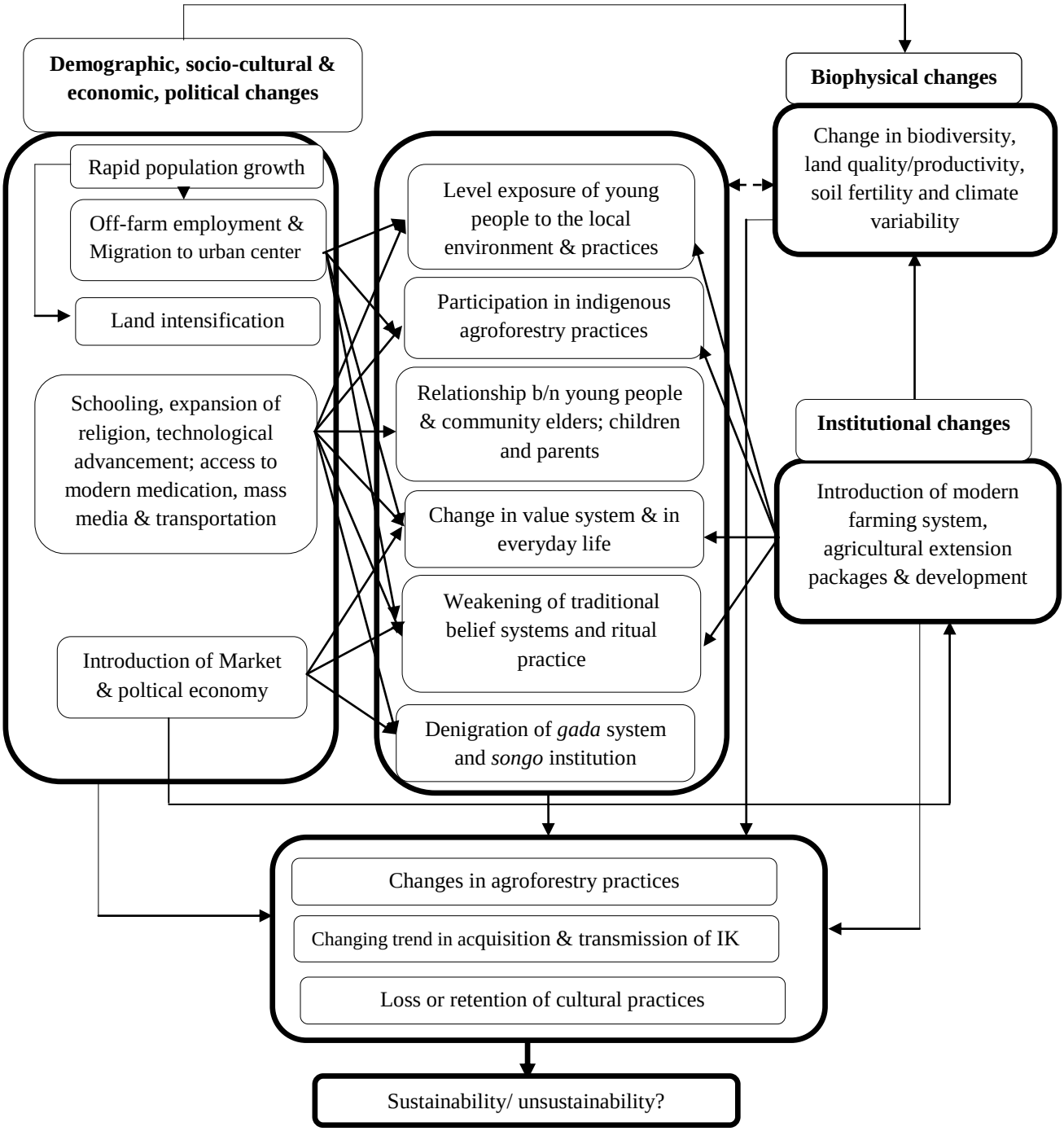
Moreover, other views had emerged as time goes, such as the multiplicative and mediating perspectives. The multiplicative perspective indicates that population growth and distribution interact in multiplicative way with level of consumption and technology to have an impact on the environment. The mediating view, on the other hand, focuses on the role of socio-cultural and institutional aspects in determining the relationship between population growth and environment.

The population- environment nexus perspectives mentioned above reveal the relationship that exist between population and environment. It appears that population growth alone cannot bring changes to the environment or livelihood of the people, given that there are multitude of complex factors that interact with the environment and with each other in determining the environmental and livelihood sustainability. Thus, the resourcefulness or the detrimental effects of the growing population is determined by how other factors interact with the environment and with each other. The adaptive capacity of the system is important in determining the role that population growth is expected to have on the environmental and livelihood.

Besides population growth, empirical evidences show that changes in the educational environment (Boster, 1984; Nabhan et al., 1993; Ohmagari & Berkes, 1997; Rocha, 2005: Reyes- Garcia et al., 2007; Saynes-Vasquez et al., 2013), diminished time of the indigenous people, changes in the value systems (Zent, 2001; Benz, et al., 2000; Hill, 2004; Reyes-Garcia et al., 2006) are reported to have an impact on sustainability of IK. Growth of international markets (Broadt, 2002), ecological change (Ross, 2002; Saynes-Vasquez et al., 2013) development processes- pressures related to rapid modernization (Ulluwishewa, 1993; Case et al., 2005; Reyes- Garcia et al., 2007), cultural homogenization (Grenier, 1998), increased access to modern medication (Alexiades, 1999; Nolan & Robbins,1999) and change in occupation (Medhin et al., 2002; Maffi, 2005; Saynes-Vasquez et al., 2013), the introduction of new technology like mobile phone, mass media and western movies (Atran et al., 2004) are also reported to have a detrimental effect on sustainability of IK system.

According to Grenier (1998), the older generations are facing tough challenges to transmit their knowledge to young people and children mainly because of changes in value systems and lack of interest to learn from elders.

The introduction of market-oriented agricultural practices focused on mono- cropping is also associated with losses in IK and IK practices through losses in biodiversity and cultural diversity (Zweifel, 1997 cited in Grenier, 1998; Benz et al.,2000; Zent, 2001; Reyes-Garcia, 2007). Above all, the disruption of traditional channels of oral communication and transmission process can be the cause of changes of IK. According to Ellen & Harris, (1996) One of the factors that lead to loss of IK is top-down development approaches.



Fi g 2.4: Analytical Framework: Changes and continuities of indigenous Knowledge (Author's construction, 2013)

CHAPTER THREE

STUDY AREA DESCRIPTION AND RESEARCH METHODOLOGY

3.1 . Description of the Study Area

3.1.1. Historical Development of Traditional Agroforestry System of Gedeo

There is no definite historical point that precisely shows the inception of the Gedeo traditional agroforestry system. The existing accounts and previous research outputs are not able to exactly trace back the origin of the Gedeo agroforestry system though Tadesse (2002) estimates that its origin would be about 5000 years of age.

The existing historical accounts reveal that the Gedeo land was covered by forests. It was among the forested lands in the country. The gradual encroachment of the area by human inhabitants led to the cutting of trees to prepare the land for cultivation of crops. The Gedeo are believed to have predominantly occupied the upland region, particularly the upper slopes of a chain of hills running southward along the rift valley escarpment east of the Lake Abaya until late 19th century (McClellan, 1988). Enset, their main staple food, was the major crop produced by the Gedeo living in the upland region. Beside enset, tuber and legume crops were produced in this region. The down slope area was a no man's zone until inhabited by non-Gedeo people, as well as the neighboring Guji and Sidama until the 19th century. As McClellan (1988) indicates, some Gedeo used to cultivate corn there seasonally, harvested a little coffee, or even grazed a few livestock, but settlement was dangerous since the area was contested by neighboring Gujji and Sidama.

Down slope expansion of settlement was made only after 1890s occupation of the land by settlers from the north. The settlers helped the Gedeo to expand their territory down slope for the purpose of growing coffee. In connection to this, Bevan & Pankhurst (1996) writes the following:

> *As new settlers entered the Gedeo land as soldiers and civil servants, the pressure on land, and the demand for incorporating forested and hitherto unoccupied lands increased. This was further reinforced by the growing interest of settlers in coffee production as a cash crop. As coffee production expanded into down slope areas (which were formerly owned by Guji as grazing lands), the traditional importance of enset was reduced, due to the allocation of more cultivable lands for coffee production(pp.3).*

Therefore, one can claim that the Gedeo agroforestry was derived from a natural forest through the domestication of natural forest landscapes and intensification of agricultural landscapes (see also Mesele & Nigusse, 2008). Farmers also deliberately retain native trees and shrubs in the landscape, and intensify the land use system to maintain the multi-strata agroforestry.

The growing market economy of coffee and the construction of the Ethio-Djibouti railway were driving motives for the expansion of coffee field to down slope area. Significant proportion of land in the down slope area was allotted for production of coffee. Then the gradual increasing number of population coupled with stagnant and declining coffee price necessitated the local people to grow enset and other crops to fulfill their subsistent demand. Then intensification of agricultural land began as a result of population growth.

3.1.2. A Brief Account of the Types of Traditional Agroforestry System of Gedeo

In this section, brief description of the types agroforestry system is made. The description is based on Tadesse's (2002), Zebene's (2009) and Mesele's (2011) broad classification; this classification is chosen instead of the one done by Bogale (2007) because it fits to the agroecological regions and manageable to compare and contrast the indigenous practices. According to their classification, three types of agroforestry system characterize Gedeo land use. These are i) Enset-based agroforestry (>2500 m asl) dominant in the highland parts; ii) Coffee-enset-based agroforestry (2500-1500 m asl) that covers the midland parts, and iii) Fruit-coffee based agroforestry (below 1500 masl) dominant in the lowland section of the zone.

i. Enset-based agroforestry system

In Gedeo, enset based agroforestry system is common in the cold highland regions located above 2500m asl. Extensive cultivation of cereal crops, vegetables with sparsely distributed indigenous trees characterize this agroforestry system. In this agroforestry system, enset is dominantly grown but limited to homesteads. Besides enset, cereal crops such as beans, wheat, and barley; vegetables such as onion and cabbage are among the dominant crops. What makes farming activities of this belt different from the others is the fact that single crop is grown on a certain piece of land without intercropping. In other words, mono-cropping practice is common in this agroecological belt (see plate 4.1).

Farming system is more or less traditional in this agroforestry system. In addition to occasional hoe plowing, animal power (oxen plow) is the usual plowing system in this belt. Farmers in this agroforestry system tend to utilize chemical fertilizers and improved seeds. This makes it quite difficult to pinpoint the indigenous part of the practice in this agroforestry system except production and harvesting of enset. The farming system and practice appears to be similar to farming practices in other parts of Ethiopia. However, it seems that there is an indigenous element in the management of soil and water. Most of the farming practices in enset based agroforestry system are hybrid of indigenous and modern methods.

Relatively speaking, plant diversity appears to be low in this system possibly due to mono-cropping culture. Similarly, vegetation diversity appears to be lower than the other agroecological regions in the zone. Only three dominant tree species, namely *Hagenia abyssinica (Bruce) J.F.Gmel, Ekebrgia capnesis (Sparrm), and Erythrina brucei S chweinf.(weleena)*are dominant (Tadesse, 2002; Bogale, 2007).

ii. Coffee –Enset based agroforestry system

The agroforestry system in this agroecological belt mainly consists of coffee, enset, trees (both woody and non-woody components) intercropped with annual crops (both cereal and root crops) (Tadesse, 2002; SLUF, 2006; and Bogale, 2007). The majority (more than 50%) of the land in this agroecological zone is occupied by coffee followed by enset. Animal husbandry is also another activity in this belt but not as extensive as the other two belts. Lack of grazing land and limited spaces inhibits the involvement of farmers in this agroforestry system in animal rearing in a wider scale. As compared to the other agro-ecosystems, this region supports a large number of population, and hosts diversified flora and fauna. According to Tadesse (2002), farm region vegetation diversity is relatively higher in this belt (see plate 4.2).

iii. Coffee-fruit based agroforestry system

Farmers in this agroecological region grow coffee and enset mixing with cereal crops (maize, wheat, teff), root crops (sweet potato, yam), and fruits (avocadao, mango, gisixa and others). Animal husbandry is also more eminent in this belt than in the coffee-enset belt because of the presence of extensive grazing land. Invasion of exotic trees particularly fruit trees is becoming a major threat to the maintenance of indigenous trees (Mesele et al., 2011). Barren and degraded land with dominant rock outcrops characterizes the landscape of this agroforestry system.

Farmers in this agroforestry system heavily relay on selected seeds and artificial fertilizers than on local seeds and compost mainly for production of cereal and root crops. Unlike coffee and enset, most cereal and root crops do not require shade trees. Most of the area in this belt is stripped off indigenous trees due to cereal and root crops production. Consequently, the possibility of enriching the soils with organic matter is negligible

3.1.3. Location of the study area

This study has been conducted in Gedeo zone situated in the southeastern escarpment of the Great East African Rift Valley (see figure 3.1). The zone is located in the Southern Nations, Nationalities and Peoples' Regional State (SNNPRS). It is located between $5^0$50'26''to $6^0$12'48''N latitude, $38^0$03'02''to $38^0$18'59''E longitude. The zone shares boundaries with the Oromia regional state in the East, West and South, and Sidama zone in the North. The total area of the zone is 134,708 hectares. According to the current government administrative division, the zone consists of six woredas and two towns as shown in figure 3.1 (see also table 3.1).

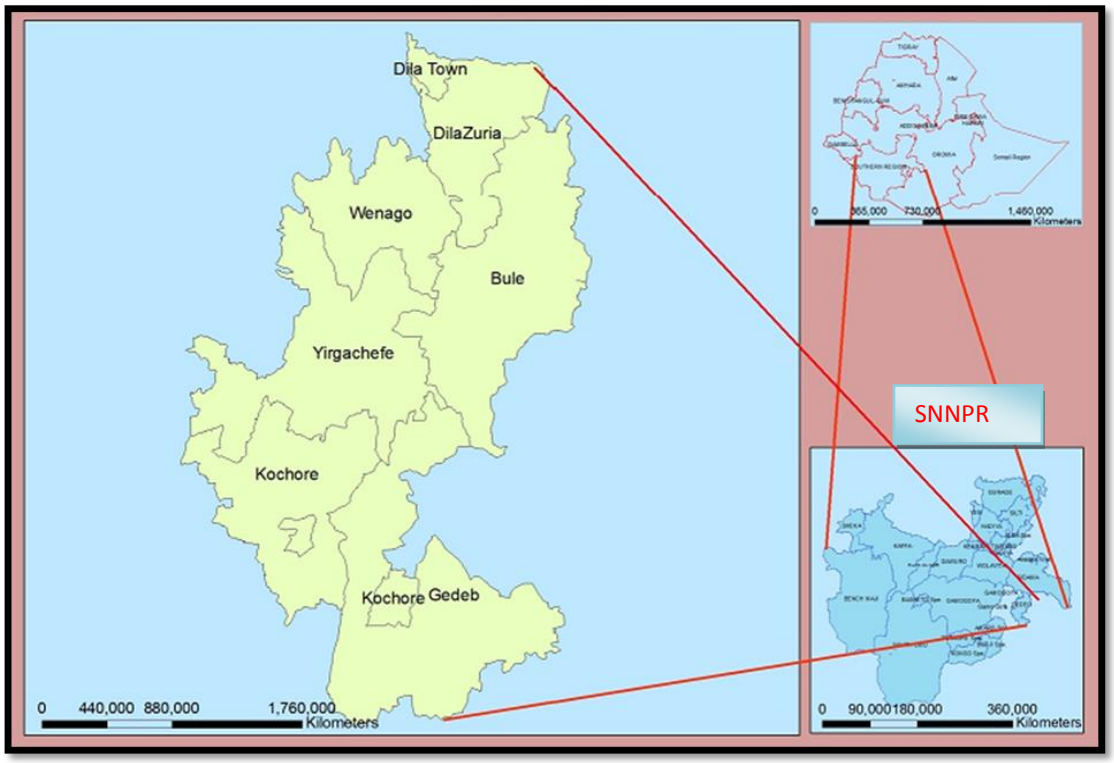
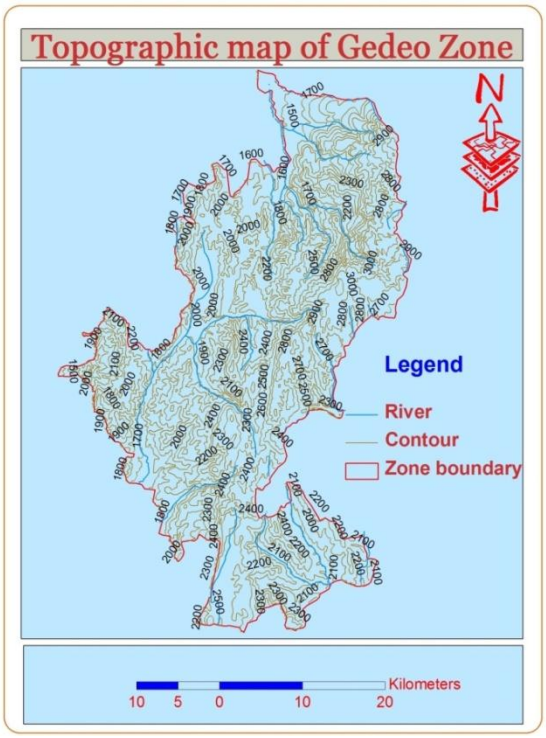


Fig. 3. 1: Location map of the study area

3.1.4. Topography and drainage of the study area

The Gedeo landscape can be characterized as one of the rugged topography in the country. It has a slope ranging from 5% to 75 % (figure 3.2). The elevation of the area ranges from 1,300–3,064 m a.s.l, of which the interval 1,500–2,700 m a.s.l. accounts for 88% of the total landscape (Mesele, 2011). The study area is drained by both intermittent and perennial rivers such as *Halo galena, Calbesa galena, Adado, Rejje, Wezida, Boce, Bantinanqa, Hawala, Sibbo, Bole, Jarso, Maladintu, Malka gulane, Gonfoma, Galena, Melka alati*, and *Qonga*. Most of these rivers originate from the eastern escarpment of the great Africa rift valley, and finally join Lake Abaya.



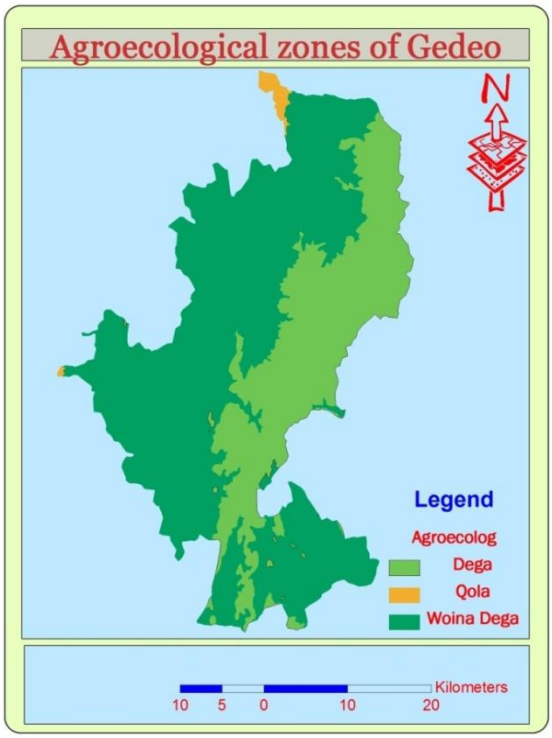


Fig 3.2: Topographic map of Gedeo zone Fig 3.3: Agroecological zones of Gedeo zone

Source: Redrawn from Ethio-GIS data base

3.1.5. Climatic condition and soil types

According to the traditional climatic classification, the majority of the study area is categorized under sub tropical climate (*woinadega*) (62%). Only 1% of the area is classified under hot tropical climate (*Kolla*) while 37% of the area categorized as high altitude climate (*Dega*) (See figure 3.3). Rainfall ranges from 800 to 1800mm while mean annual temperature varies from 12.5^{o}c to 28^{o}C (Mesele et al., 2011; annex 4, table 4-6). The area is among the bimodal rainfall regimes in Ethiopia. March to

May is the first rainy period while the second rainy season is from July to December. Common to most areas in Ethiopia, winter is a dry season in the study area.

A detailed study regarding the soil types of Gedeo zone has not been done yet. A small-scale soil classification has been conducted by FAO. According to the classification, Eutric Nitosol (48.3%), Eutric Fluvisols (20.2%), chromic and ortic Luvisols (6.4%), Luvic phaeozems (5.4%) and Dystric Nitosol (19.8%) are among the types of soils identified in the zone. Nitosols are dominant soil type covering highest proportion of the area. For example, the soil in major coffee growing areas in the zone is predominantly Nitosols. The soils are in general derived from volcanic rocks.

3.1.6. Land use and farming system

As indicated in Table 3.1 below, about 94.5% of the zone is covered with agroforestry. Urban areas cover only 1.1% of the total area of the zone (2.7%) (Bogale, 2007). The agroforestry land use comprises the production of perennial crops, annual crops, trees, fruits, beehive, and animal production.

Table 3.1: Land use types of the zone (in 2006)

Land use type	**Area in ha (in2006)**	**Percentage**
Agroforestry land	127243	94.5
Grassland	1869	1.4
Inundated land	1122	0.8
Natural forest	725	0.5
Plantation forest	121	0.1
Savanna woodland	1476	1.1
Scrubland	379	0.3
Swampy area	283	0.2
Urban land	1,468	1.1
Total	134,686	100

Source: (Bogale, 2007)

Traditional farming system is found to be common in most parts of the zone. The local people use traditional farming tools for cultivation purposes. In the midland region where enset and coffee based

agroforestry system is dominant, hoe culture is predominant. In cereal crops producing regions such as the lowland and high land regions, animal power is dominantly used.

3.1.7. Demographic characteristics of the study area

According to the 2007 Population and Housing Census result of the CSA, the total population of the zone was found to be 879,749, of which 84.7% reside in rural areas. The Gedeo zone is one of the densely populated areas in the southern region, hosting a large number of population. Population density of 1300 persons per km^2 is reported in *Mokonisa* kebele.

Table 3.2: Population distribution of Gedeo zone

Woreda	**Urban and Rural**			**Urban**			**Rural**		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Wenago	58,522	59,108	117,630	4,771	4,425	9,196	53,751	54,683	108,434
Yirgachefe	99,421	99,656	199,077	8,216	7,703	15,919	91,205	91,953	183,158
Kochire	65,235	66,183	131,418	5,929	5,602	11,531	59,306	60,581	119,887
Bule	53,289	52,632	105,921	3,184	3,058	6,242	50,105	49,574	99,679
Dila Zuria	48,835	48,492	97,327	nd	nd	nd	48,835	48,492	97,327
Gedeb	73,480	73,252	146,732	5,160	4,861	10,021	68,320	68,391	136,711
Dila /Town/	42,599	39,045	81,644	42,599	39,045	81,644	No data	No data	No data
Zone Total	**441,381**	**438,368**	**879,749**	**69,859**	**64,694**	**134,553**	**371,522**	**373,674**	**745,196**

Sources: (CSA, 2007)

As indicated in table 3.3, the total population of the zone increased from 0.4 million to 0.8 million people between 1984 and 2007. Similarly, the crude population density increased from 329 persons per km^2 in 1984 to 648 persons per km^2 in 2007 indicating the presence of rapid population growth in the area.

Table 3.3: Total population and population density (person /km^2) of the zone (1984, 1994 and 2007)

Woreda	Area in km^2	1984		1994		2007	
		Total pop.	Pop.density	Total pop.	Pop.density	Total pop.	Pop.density
Wonago	128	76381	597	85275	666	117630	919
Yirgachefe	317.05	111487	352	134163	423	199077	628
Kochore	269	61172	227	77353	288	131418	489
Bule	257	56758	221	74003	288	105921	412
Dilla Zuria	120	92773	773	109701	914	97327	811
Gedeb	256	48065	188	82393	322	146732	573
Dilla /Town/	10.2	no data		no data		81644	8004
Zone Total	**1357.25**	**446636**	**329**	**562888**	**415**	**879749**	**648**

(Source: CSA, 2007; Bogale 2007; GZFEDO, 2012)

3.1.8. Livelihood, and house hold and land holding size of the study area

The majority of the people living in the countryside depend on land and its products for their livelihoods. Coffee is their major source of income while enset is the major source of their staple food. Besides coffee and enset, cereal crops and livestock production also account for significant portion of their source of income for the people residing in the high land and lowland. Particularly the non-coffee producing region depends on the production of cereal crops for their livelihood.

Table 3.4: Average land holding size of rural household in Gedeo zone (%)

Name of woreda's	Average landholding size in hectare							
	No farmland	<0.1	0.1-0.5	0.5-1.0	1.01-2.0	2.01-5.0	5.01-10.00	>10
Gedeb	16.8	32.2	23.7	7.1	8.2	5.5	5.0	1.5
Bule	42.0	10.1	13.3	11.0	12.6	8.7	2.2	0.1
Dilla Zuria	0.5	58.5	31.0	7.4	2.6	0.0	0.0	0.0
Wonago	0.0	68.5	19.7	6.8	2.3	2.7	0.0	0.0
Yirgacheffe	0.0	23.9	30.7	26.9	15.5	3.1	0.0	0.0
Kochore	1.7	72.0	7.6	18.7	0.0	0.0	0.0	0.0
Total	9.6	44.0	19.8	15.1	7.4	3.3	0.7	0.1

Source: (GZFEDO, 2012)

The livelihood of the local people is challenged by scarcity of land due to population pressure and diminishing productivity. As indicated in table 3.4 more than 85% of the rural households have a land less than one hectare, among which 9.6% reported to have no farmland at all. The 9.6% of the household depend on off-farm activities and on farm activities by renting land from the owners. Some of them are supported by government through productive safety net program. Except in Bule and Gedeb, one cannot find farmers possessing more than five hectares land. About 44% of the rural households possess less than 0.1 hectares of land, implying a serious shortage of land in the zone.

3.1.9. Social infrastructural development: education, roads and health centres

Significant changes have been noticed in the rural parts of the Gedeo zone in terms of social infrastructure. There has been a remarkable increase in the number of schools established, road constructed, and health centers built. A brief description on each of these infrastructural developments is presented below.

One among the social infrastructure being developed in the area is school. According to the 2012 report of GZFEDO, the total number of schools functioning in 2011/12 academic year was 510, among which 96.5% were primary schools. There are only seven secondary schools (grades 9 and 10); all of them located in towns. At zonal level, there are only two preparatory public schools, one in Dilla and the other in Yirga Chaffee town. There is one private preparatory school (Donbosco comprehensive secondary and preparatory school) in Dilla town.

As a result of the establishment of primary schools in most parts of the zone, majority of children in the zone have now better access to primary education. Primary schools are located almost in all kebeles. Children may not need to travel long distance to go to school as school are now located at short distances from their locality. However, when they reach grade 9 and 10 they have to travel to towns where secondary schools are available. As indicated above, all of secondary schools are found at far distance from the countryside. Hence, young people have to either travel to schools on daily basis or have to stay around the schools by renting houses. In either case, the fact that the secondary schools are found at far distance from the rural parts claims the time of young people, who otherwise would have been used for home or farm based tasks.

Similarly, young people must go to either Dilla or Yirgachefe to attend their preparatory classes. It is very unlikely for the students to make a round trip to school on foot or using public transport. The option they have is to stay in the town through the weekdays. This has huge impacts on their

acquaintance with local practices. Even those who completed grade 10 and wish to attend technical and vocational school and health sciences, are required to go to Dilla town and somewhere else. They should move from their residences for a relatively longer time.

In addition to increasing access to primary schools, there has been a remarkable change in access to health facilities as well. According to the 2012 report of GZFEDO, 148 health stations have been providing service for the Gedeo people and other surrounding communities as well. However, there is only one hospital, which has been providing service for the people from rural and urban areas and the people coming from neighboring regions. The increasing access to health station influenced significant number of people relay on modern medication.

Besides, improvement has been seen with regard to road facility. Significant achievements have been recorded since recent time with regard to road construction in the rural parts of Gedeo zone. Obviously, road facility is the principal infrastructure for a place like Gedeo zone, which is engaged in the production of coffee. The data obtained from the GZFEDO indicate that so far 406km long all weather roads have been constructed, with density of 0.30km/km^2. On the other hand, the total length of dry weather road constructed and brought to use was found to be 365kms. This implies that majority of the people in the rural parts Gedeo zone have access to at least dry weather road.

The construction of road that connects the rural parts of Gedeo zone to the town is believed to be started in the 1940s following increase in the demand of coffee in the world market. In fact, there is no account that provides information on the types of road constructed and its extent. Most parts of Gedeo zone are now connected to the major towns of the zone through several feeder routes. The commercialization of coffee appears to be the major motive behind the construction of roads in the zone.

Since 2010/2011, in most parts of the rural the zone motorbike has been introduced. The people are using the motorbike to transport items like coffee from their residence to market center. This has paved the way for frequent visit to nearby towns.

3.1.10. Socio-cultural characteristics of the local people

The Gedeo people are one among the people in southern Ethiopia, known for cultural diversity The area is endowed with socio-cultural values and norms, which one-way or the other way has its own contribution towards sustainable use of biodiversity and livelihood of the local people. Some of these

cultural values and norms are well presented in chapter four under normative section. In this section of the dissertation, a very brief account of the socio-cultural values is presented.

It is already mentioned that the local people have their own traditional belief system. They believe in one supernatural power, which they call it, *magano*, literally means 'Sky God'. It is a common tradition among the people to praise their *magano* when they start and also finish their work. Besides their strong believe in *magano*, they have ritual practices such as *qexxela*, *cincessa*, *xeeroo* and others.

Qexxela is one among the rituals performed by all members of the society. The local people conduct the ritual practice through singing, dancing and praying; giving thanks to the divine power in order to receive blessings. They also curse their enemies and drive evil forces away. *Xeeroo* is a ceremony during which an offering is presented to *magano* for the good harvest and all other benefits received from him.

However, since recent time the local people are abandoning the traditional belief system and ritual practices because of the introduction of Christian religion in the region and other factors. According to the 2007 CSA survey, more than 90% of the rural inhabitants in the Gedeo zone were Christians. Only few of the local people were found to be traditional believers.

3.2. Research Approaches and Design

As indicated in chapter one, this study examines the socio-cultural aspects of agroforestry system of Gedeo mainly focusing on the dynamics of IK (changes and continuities), and its implication to the sustainability of the agroforestry system. Thus, it calls for an interdisciplinary approach. Geographical concepts and approaches are quite essential to depict the interaction between human and the land. According to Pattison (1990) among the four paradigms governing geographical researchers and thoughts, human- land interaction is the persistent and widely applied one. Thus, the concepts embedded in human-land interaction paradigm were used to address the socio-cultural aspects of the Gedeo agroforestry system.

Besides, geographical concepts and approaches were complemented by anthropological and developmental psychology concepts and methods. Anthropological concepts and methods are required to comprehend the communities' IK, which is in turn embedded in the cultural context of

the society; while concepts and methods from developmental psychology is needed to understand IK acquisition from the perspective of human development.

Change and continuities of IK in time and space can be studied using two approaches, namely longitudinal and cross sectional (Zent & Maffi, 2009). It is difficult to conduct this research using longitudinal approach due to time limitation as longitudinal study involves the collection and comparison of time-series data (Zent & Maffi, 2009). A Cross- sectional approach was used to examine the dynamics of IK of agroforestry system of Gedeo. As indicated by Zent & Maffi (2009) except two studies (Zager & Stepp, 2004 and Van Etten, 2006) almost all research accounts available have used a synchronic data to reveal and document changes and continuities of IK/TEK. Age is the dominant social variable used by most of these researches to measure the changes and continuities (Zent & Maffi, 2009).

A mixed research design, mainly exploratory sequential design was employed in this study. The purpose of this exploratory sequential design is primarily to explore IK of agroforestry system of Gedeo, mainly its constitutive elements and variation in space and time, which are followed by seeking explanations for its changes and continuities. The design consists of two phases (Qualitative phase of data collection followed by quantitative phase).

The first phase of the study was a qualitative exploration of the constituents, changes and continuities of IK pertaining to agroforestry system of Gedeo. In this phase, enormous amount of qualitative data were collected from key informants, development agents and agricultural supervisors selected from the three-agroecological regions. Detailed investigations were conducted in the three agroecological regions to get complete picture of the agroforestry practices in space and time. The knowledge-practice-belief systems framework of Berkes (2008) was used to guide the data gathering procedures. According to this framework, primarily the eco-cognitive dimension was dealt with in a very detailed manner. That means knowledge of plants and animals, soil, topography, climate, and others were explored through an in-depth interview with the selected key informants. Then the practical dimension was thoroughly investigated by emphasizing on only practices related to the agroforestry system. Finally, the normative aspect (traditional belief systems, local institutions, values and norms) which, are assumed to have an impact on the agroforestry system, were explored. This phase of the study is the foundation and a point of reference for second phase of data collection.

The second phase deals with quantitative data, which followed the qualitative phase for seeking explanations for the dynamics of IK pertaining to agroforestry system. In this phase, an attempt was made to quantify the eco-cognitive, practical, and normative aspects the traditional agroforestry system of Gedeo focusing on young people, adults and elderly people selected from the three-agroecological regions. Qualitative data were also collected to substantiate the data collected via quantitative methods. Moreover, household survey was conducted to seek explanation for the changes and continuities of IK of agroforestry system of Gedeo.

3.2.1. Data sources and tools of data collection

Data for this research were derived from multiple sources using multiple tools. The principal sources of data for the research were the local people above 12 years old, development agents of selected kebeles, agricultural supervisors and experts (NRM) at woreda and zone levels. Besides, important and relevant documents were also used as secondary sources.

Data collection process took almost 20 months. The first two months of data collection period was fully devoted to understanding the agro-ecosystem of the area and getting consent from officials, woreda experts, kebeles administration and development agents. Frequent visit were made to kebeles selected from the three agroecological regions. Detailed discussion and field excursions were made with development agents of the respective kebeles. Then once an understanding of the system was obtained, set of questions were prepared for the interview to be conducted with key informants. The key informant interview took more than 4 months. Assessment of local people's knowledge and skills of agroforestry practices and transmission of the IK among successive generation took nearly 12 months. Household survey was conducted within last two months of data collection period.

a. First phase of data collection

In the first phase of data collection, the components of the agroforestry system were explored by employing qualitative approach. The required data were gathered using key informant interview, focus group discussion, participatory mapping, and participant observation.

i. Key informant interview

An in-depth interview was held with 70 key informants chosen from the 11 kebeles located in the three agroecological regions (see Table 3.5). The interview was conducted to generate baseline data,

which served as benchmark and used in the design of questions to examine variation of IK among and within generational groups. The interview took on average 1-2 hrs and majority of key informants were interviewed more than once, as it was difficult to catch up the points of their argument only in one time interview.

The key informants were chosen using a combination of purposive and snowball sampling. The sample size was limited to 70 due to the fact that no new information or idea seems to emerge as we proceed more than half way. It was found to be unnecessary to go beyond 70 because of redundancy of ideas and information.

Table 3.5: Distribution of kebeles' selected for key informant interview based on agroforestry system and agroecological regions

Agroforestry system	**Agroforestry sub system**	**Altitude(m)**	**Agroecology**	**Area(ha) 2006**	**%(area)**	**Selected Kebele**
Multistory	Coffee_Enset	1500-2300	W/Dega	60583	45.0	Mokonisa, Bula, Qonga, Amba. Sugale
	Coffee_Enset_Cereal_Livestock	1500-2300	W/Dega	15905	11.8	Buno
	Coffee-Enset-Cereal	1500-2100	W/Dega	9060	6.7	Bunke busa
Agrosilvipastoral	Enset-Cereal-Livestock	2300-2500	W/Dega	7363	5.5	Gedeb Gubeta
	Cereal-Enset-coffee-Livestock	1300-1500	*Kolla*	6063	4.5	Kara Soditi
	Cereal- Enset-Livestock	2500-2900	Dega	21653	16.1	Gora Dibandibe
	Cereal-Enset	2700-3000	Dega	6616	4.9	Sika

Source: Bogale (2007)

The selection of the key informants was based on their rich experience, particular insight and special knowledge regarding the issue under study. Moreover, the informants were selected based on their ability to provide concrete information about the past and current status of IK related to agroforestry practices of the area. Priority was given to the elderly informants because they were thought to possess sufficient information about indigenous agroforestry practices as they had lived long enough to witness the changes exhibited so far concerning the agroforestry system.

The full guide of development agents and the local community council of respective kebeles made the selections of the informants relatively easier. The contribution of local community councils was significant in accessing the appropriate informants who are considered to be knowledgeable and can address the issues properly.

Similarly, the selection of the kebeles' was done based on the assumption that the Gedeo agroforestry system is characterized by three agro-ecological regions and seven types of agroforestry subsystems (see Table 3.5). As much as possible an attempt was made to include all agroforestry sub systems without disregarding the agro-ecological regions.

Table 3. 6: Distribution of key informants

S no	**Woreda's name**	**Kebele's name**	**Agroecology**	**Agroforestry sub system**	**Number of key informants**			**No of Participants in FGD**		
					M	F	Total	M	F	Total
1	Dilla Zuriya	Bula	*W/Dega* to *dega*	Coffe-Enset	3	2	5	0	0	0
		Amba	*W/Dega* to *Kolla*	Coffe-Enset	7	1	8	7	6	13
2	Wonago	Mokonnisa	*W/dega*	Coffee-Enset	3	2	5	0	0	0
		Kara Sodit	*Qolla*	Cereal-Coffee-Enset-Livestock	7	2	9	7	6	13
		Sugale	*W/Dega*	Coffee-Enset	8	5	13	8	6	14
3	Y/Chefe	Konga	*W/Dega*	Coffee-Enset	2	1	3	0	0	0
4	Kochore	Buno	*W/Dega*	Coffee_Enset_Cereal_Livestock	4	1	5	6	6	12
		Bonke Busa	*Dega*- to *w/Dega*	Coffee-Enset-Cereal	5	2	7	6	6	12
5	Gedeb	Gedeb Galcha	*W/Dega*	Enset-Cereal-Livestock	3	0	3	0	0	0
		Dibandebe	*W/Dega*	Enset-Cereal-Livestock	3	0	3	0	0	0
6	Bule	Sika	*Dega*	Cereal-Enset-Livestock	8	1	9	8	6	14
	Total				**53**	**17**	**70**	**42**	**36**	**78**

ii. Focus group discussion

Based on the information obtained from the key informant interview, issues that need further elaboration were identified for focus group discussions (FGD). The FGD were conducted in each agro-ecological region by categorizing the participants based on their sex to avoid the dominance of male during discussion. Twelve groups were taken for FGD among which six of them were women. In each group, 6 to 8 participants were included. Majority of the elders (men) were members of *songo* institution. One of the difficulties encountered while conducting FGD is the fact that women participants were not responsive.

iii. Participatory mapping

Participatory mapping was also used for the purpose of cross checking the information obtained through key informant interview and focus group discussion and map the spatial distribution traditional agroforestry system of Gedeo. As noted by Mikkelsen (2002) participatory mapping is essential to provide spatial distribution of information related to different socio-economic, physical, and cultural phenomena. It is quick and reliable as communication between the participating group members has a corrective function (Mikkelsen, 2002).

The participants were assigned into group based on their age. About six groups were formed, six to eight participants represented in each group. Then the participants were given with paper and pencil for the mapping purpose. Some participants were active and they have tried to depict the distribution pattern of the agroforestry system while some of them were not able to produce the pattern by their own. Although the participants were not able to produce the map correctly, they were able to explain the pattern of agroforestry system on the basis of the map they have produced. They were able to trace back the pattern of land use change, particularly the expansion of agroforestry system down slope. Huge amounts of data were generated through this method. Important data were collected by combining the mapping activity with oral explanation of the map drawn.

iv. Participant observation

Observation is one of the most popular forms of data collection (Creswell, 1998). Participant observation is preferred in this research as it offers possibilities for the researcher on a continuum

from being complete outsider to being a complete insider (Jorgensen, 1989 as cited in Creswell, 1998). Consequently, it helps the researcher to look at the problem not from his own perspective but from the perspective of the local people themselves.

The participant observation was conducted in the three agro-ecological zones in order to get comprehensive picture about the functioning of the system. During observation, substantial amount of information was generated particularly regarding everyday life of the local people. The day to day activities, different traditional/cultural practices were observed and noted. Moreover, an insight of the way the people live, their interaction with their environment, relationship between the neighbours, family, and relatives were clearly noted. Notes were also taken regarding how children/young people construct their own knowledge about traditional agroforestry system.

While conducting participant observation, an informal interview was held with local people. Moreover, formal and informal discussions were held with elders and young people to understand about IK acquisition and transmission and related issues.

v. Local history

Local history is one among the methods used to articulate IK related the agroforestry systems. It gives a more detailed account of how things have changed or have been changing (Grenier, 1998). The histories were developed for farming systems, cropping pattern, intercropping, traditional agroforestry practices, climate change, population changes, education changes, and biodiversity changes. An attempt was made to articulate the change exhibited with respect to farming system, management practices, climate changes, and socio-economic changes. Only key informants were involved in narrating the changes happened so far in their locality.

b. Second phase of data collection

In this phase, methods from both quantitative and qualitative research approach were employed. However, more emphasis was given to the quantitative approach as quantitative data are proved useful in assessing the mechanism of transmission of cultural traits and predicting the spatio-temporal variability, stability of cultural traits within group (Richrson & Boyd, 2005). The qualitative data were only used to substantiate the data obtained through quantitative methods.

Data collection tools regarding IK and practices may be determined by the domains of knowledge to be seen and IK dimensions, whether it is theoretical, practical or normative. The methods used may vary depending on the dimensions of IK (Reyes-Garcia et al., 2007a). For instance, free listing reported to be used to measure eco-cognitive aspect of IK (Atran et al. 2002). In this regard, Reyes-Garcia et al., (2007) reviewed about 43 empirical researches conducted on IK and investigated that 38% of the have used interview while 29% employed structured questionnaires (mainly card sorting, free listing, multiple choice) to measure theoretical/ eco-cognitive dimension of IK. On the other hand, those studies conducted to measure practical dimension have employed self reporting, observation, transect walk, and specimen identification (Reyes-Garcia et al., 2007a).

In this study, free listing combined with card sorting, was used to elicit the eco-cognitive dimension of IK of agroforestry system while for practical and normative dimensions exam type structured questionnaires were used. Besides, participatory research method, a popular method in qualitative research (Gotschi et al., 2009), was employed to substantiate the data collected via free listing and structured questionnaires. The participatory methods used include transect walk, mental/cognitive mapping, focus group discussion and participant observation. Thus, by using a combination of participant observation, structured questionnaires, transect walk, mental/cognitive mapping, focus group discussion, card/pile sorting, free listing and document review, an attempt was made to validate and cross-check the findings of the research. The tools used are presented very briefly in the subsequent sections.

i. Free listing

Among the three dimensions of IK, the eco-cognitive dimension was examined using free listing method. About 290 participants (see the details selection procedure in section ii below) were given sheets of paper containing questions that require them(the participants) to mention name of indigenous and exotic tree species, enset and coffee cultivars, wild fruits, non-woody herbs, local soil, and local climate (see Annex 4). They were asked to list as many species of plants, soil type, and local seasons known to them. They fill it independently without discussing with the one sitting besides. There was no time restriction and they were allowed to go around in order help them to remember the names of trees, herbs, and enset clones and others. Those who do not write and read were asked to mention and the researcher and field assistant were there to record their answers.

One of the challenges faced during free listing was language problem. Some participants were not able to read and write in Amharic and we need to translate it into the local language (Gedeoffa) and others were asked to give the answer in their own language. Because of this challenge, data collection period is a bit extended beyond the plan.

ii. Exam type structured questionnaires

As indicated by Berkes (2008) IK of agroforestry system can be seen as eco-cognitive, practical and normative dimensions (see section 2.4.1 for details). The eco-cognitive was examined using free listing exercises, while the practical and normative dimensions of IK were assessed using structured questionnaires.

Accordingly, questions regarding practical and normative dimensions of IK were prepared based on the information obtained from the key informants, and research outputs of Tadesse (2002); SLUF (2006); Bogale (2007) and Mesele (2008). Other relevant documents were also used to set the questions for examination. The questions include every IK based agroforestry practices beginning from seedling preparation to post harvesting activities, management practices and code of ethics, norms and values of the society, and other cultural practices which have direct and indirect relevance to the agroforestry system.

The questionnaires were administered to participants chosen from multigenerational groups (between 12 and 65 years old). The population was divided into four age category [adolescent (12-20), young adulthood (21-35), and middle adulthood ((36-45) and (45- 65))] based on the recommendation obtained from the Gedeo elders and age classification of the country. The initial year is set to be 12 due to the fact that the maximum age at which a child begins to work independently on farmland is 12 years on average. It is rare to get a child being engaged in farm before he/she turns 12. As noted by the Gedeo elders, a child may be deployed to simple tasks like fetching water and firewood collection beginning from the age of five. The upper age limit for the first group was set be 20 years based on the feedback obtained from key informant interview. The pilot survey and interview made with key informants revealed that majority of young people are expected to complete grade 10 to 12 at the age of 20. In most cases, it is after 20 years that most young people begin independent life. Thus, in this research 20 is found to be turning point for majority of young people. The other possible reason of limiting the age gap to 20 is due to the fact that young people's knowledge and skills about their locality is expected to reach its peak at the age of 20 (Stross, 1973; Hunn, 2002; Zarger & Stepp, 2004).

Multi-stage sampling was employed to choose the participants. In the first stage, representative kebeles were chosen from the agroecological zones based on the feedback obtained while exploring indigenous agroforestry practices. Accordingly, one kebele from *dega* (Sika), one from *kolla (Karasodity),* and four from *woina dega (Amba, Sugale, Qonga,* and *Bula)* were chosen depending on their coverage (areal extent) and representativeness. Then further stratification was done based on age and gender (see Table 3.7).

Table 3.7: Distribution of respondents by agroecology, sex and age category [2]

Age category	**Sex**	**Agroecology**			
		Dega	***W/Dega***	***Kolla***	**Total**
12-20	Male	**26**	**54**	**12**	**92**
	Female	8	26	6	40
	Total	34	80	18	132
21-35	Male	20	37	17	74
	Female	3	16	6	25
	Total	23	53	23	99
36-45	Male	4	8	3	15
	Female	12	5	5	22
	Total	16	13	8	37
46-65	Male	6	6	2	14
	Female	3	3	2	8
	Total	9	9	4	22
Grand Total		**82**	**155**	**53**	**290**

The sample size was determined to be 25%, considering the confidence level to be 95% and the level of precision to be ± 5% based on Cochran (1963; 75) model. It was expected that there might be no

[2] *The participants chosen for the exam type structured questionnaires were not used for the household survey (section v) as the intention in both cases is quite different. The 290 percipients grouped in age, sex, and agroecology were principally chosen to determine IK variation; while the 252 households were chosen for the purpose of examining the socio-economic, cultural, demographic and biophysical factors affecting the changes and continuities of IK. Both of them were delivered with different set of questions at different time.*

response cases or some respondents might fail to give appropriate answer. To consider such unavoidable problems, 5% of the sample was taken into account. Accordingly, 302 sampled respondents were expected to participate in the survey (Annex 5). Nevertheless, 12 of the respondents have given an invalid response as a result of which they were not included in the analysis. Therefore, only 290 respondents were considered in the analysis.

Prior to the administration of the questionnaires, an attempt was made to check the reliability of the instrument. The instrument was tested using 12 sampled respondents chosen from *Amba*, *Sika* and *Karasodity* kebeles. Based on the responses obtained and discussion held, necessary amendments were made to the questionnaires. The analysis made based on the questionnaires delivered to 10 sampled respondents also revealed that the instrument prepared could address the issue under investigation with some modification made to it.

iii. Card Sorting

Card sorting activity was used to support the free listing activities. During free listing task, some of the participants were not able to remember the name of some of the plant domains and soil types. Particularly the adults whose age is above 45 were not able to remember. As a clue to the answer, cards containing names of plant domains, soil, local seasons were prepared and given to them so that they can sort out based on the instruction given by the researcher. Fifteen species of indigenous trees which are assumed to be commonly known in the local area, and identified during an in depth interview conducted with elders were used to examine the ethno-botanical knowledge of the participants. To make it representative, the list given by the key informants were checked against the tree species identified by Tadesse (2002), Bogale (2007) and Mesele, (2008).

In addition, other elements of the agroforestry system such as enset clones (only 12 in the highland and lowland), herbaceous non-woody plant(15), local soil type(3), local seasons(4), and wild fruits(5) generated during an in-depth interview were used to measure the conceptual knowledge/eco-cognitive of the participants.

This method is effective in measuring the eco-cognitive dimension of participants as it minimizes errors that might occur because of inability of the participants to remember. It is also an interesting game for the participants, particularly for the aged people. Everyone who played the game completed without complain. However, it is not an easy task to conduct card-sorting activity with large number

of participants, as it is time taking activity. It is very practical and effective for researches particularly dealing with eco-cognitive dimension.

iv. Transect walk

The transect walk were conducted only with few selected young and adults interested as most of them are not willing to participate. The walks were conducted along the transect from the highland (3200masl) down to the lowland (1540 masl) with the purpose of evaluating the extent to which they know about their environment and understand ecological interaction between the different components of the agroforestry system. Three groups were involved in the transect walk, each group consisting of 12 to 19 participants. Female participants were only 7.

This method helped the researcher to examine the practical knowledge of the young people qualitatively as it is not possible to measure their practical knowledge while they explain about an issues during transect walk. The data obtained via this method helped only to differentiate between participants with better practical skills and less practical skills. From the walk made it is noted that the method is quite good to evaluate the real knowledge of the participants but only with limited number of participants. Through the interaction made with them, it was possible to qualitatively determine the indigenous knowledge of participants.

v. Household survey

Household survey was conducted with the intention of exploring the nature and extent of the socio-economic and demographic factors determining changes and continuities of IK. The survey consisted of the current socio-economic status of the people, the challenges that they have been encountering with respect to maintaining their indigenous practices.

Table 3.8: Distribution of household respondents based on agroecology and sex

Sex	**Agroecology**			**Total**
	Dega	**W/Dega**	***Kolla***	
Male	55	89	64	208
Female	11	29	4	44
Total	66	118	68	252

The survey was conducted with heads of household chosen from the three agroecological regions using a combination of multistage stratified sampling and systematic random sampling (see Table 3.8). The household sample size was determined to be 20%, with 95% level of significance and ±5% level of precision, based on the Cochran (1963; 75) model.

3.2.2. Methods of Data Analysis

Two phases of data analysis were employed in this research. In the first phase, data related to constituents and dynamics of IK of agroforestry system were analyzed using case summaries and thematic content analysis. In the later case, the data were coded and then categorized based on their similarities. The categorized data were then developed into themes in order to perform further analysis.

Data obtained through free listing and exam type structured interview were checked against the data obtained from key informant interview. Matching was done between the data obtained from key informants and participants selected to measure intergenerational variation of IK. This method of analysis is reported to be used by 52% among the 43 research papers reviewed by Reyes-Garcia et al.(2007).

For the questions meant to measure the practical and normative aspects of IK (Annex 4; theme 2), the participants response were coded as yes if the respondent provide correct answer for a question or set of question; on the other if the response given by the respondent is wrong, it is coded as 'no'.

Then the data were coded and captured into SPSS for further analysis. Relationships were established between independent and dependant variables. ANOVA, independent t-test and Chi-square were used to determine IK variation among different generational group, across agro-ecology, and gender wise. To elaborate more ANOVA was used to determine the variation in eco-cognitive dimension of IK among different generational groups and among participants of different agroecology. Posthoc analysis was computed to determine the extent of variation between the groups. An attempt was made to check the normality of variance and the distribution of the data as well and hence the normal assumption to use ANOVA was not violated.

An independent t-test was used to determine the geneder based variation of eco-cognitive dimension of IK. An independent t-test was chosen due to the fact that independent variables used in this research have only two categories (Male and Female). On the other hand, chi-square was employed to determine the association between independent variables (age, agroecology, and gender) and

dependent variables (practical and normative dimensions of IK). Chi-square was chosen because of categorical nature of the dependent variables.

The data obtained from household survey were organized as per the variables set to investigate the influence of biophysical, socio-economic, cultural, and institutional factors. The data were captured into SPSS for further analysis. Frequency and percentage were employed to characterize the socio-cultural and economic conditions of the respondents and establish relationship between socio-cultural and economic characteristics of the local people, and dynamics of IK of agroforestry system of the study area.

In order to determine the impacts of climate variability, analysis of rainfall and temperature data from 1988-2012 was conducted. To determine rainfall and temperature variability of the study area coefficient of variation and precipitation concentration index was used using the following formula.

$$\mathrm{SRA} = P_t - P_m / \sigma$$

Where Pt is annual (rainfall or temperature) in year t, Pm is long-term mean annual (rainfall or temperature) over the period of observation and σ is standard deviation of rainfall (Oliver,1980). Mann-Kendall test as described by Sneyers (1990) was used to detect trends. The significance level of the slope was estimated using Sen's method (Salmi *et al.,* 2002).

3.3. Reliability and Validity of the Research

An attempt was made to ensure the reliability and validity of the instruments used in this research. As indicated in previous sections, the research employed both quantitative and qualitative data collection and analysis. Ranges of qualitative and quantitative data collection tools were employed to increase the dependability of the research. The research did not merely rely on only a single source and used a single method. Data were collected from multiple sources using multiple methods.

As the research design is more of exploratory, majority of the themes used for the construction of items for interview and discussion were obtained from interview and discussion held with key informants. Frequent and season based contacts were made with key informants to get clear picture of the agroforestry and its indigenous practices. The interview and discussions were continuously conducted for more than 6 months. While visiting the area, several informal discussions were held with the informants to triangulate the data obtained through interview and focus group discussion.

In addition, development agents and supervisors who spent longer time in the area were consulted to get information about contemporary agroforestry practices and the past practices as well. Similarly, not to miss important issues (knowledge, practices and belief systems), an attempt was made to review the works of scholars who conducted research in the area (for instance Tadesse, 2002; Bekele, 2006; SLUF, 2006; Bogale, 2007; Fisseha, 2007; Mesele, 2009; Mesele & Nigusse, 2008; Mesele et al., 2011; Tamirat, 2012;).Therefore, there is no doubt regarding the validity of the research as far as qualitative data are concerned.

Regarding quantitative data, necessary measures were taken to ensure its validity and reliability. The internal reliability or consistency of the instruments was computed using Cronbach's alpha and accordingly the instruments used to measure the changes and continuities of IK among multigenerational groups was found to be reliable (see Table 3.9). Moreover, various data collection tools such as card sorting, cognitive mapping, transect walk, informal discussion, household survey and participant observations were used to make sure that the responses of the sampled respondents are genuine. The data obtained via other methods than exam type structured questionnaires were very much helpful in determining the changes that have been occurring in IK with regard to agroforestry system of Gedeo.

Moreover, prior to administration of the actual questionnaires, an attempt was made to ensure whether the questions prepared can address the intention for which it is prepared. The sample questionnaires were delivered to 12 respondents from the four age categories. Accordingly, the result of the pilot survey revealed that the instrument used was able to address almost all the points. However, there were redundant items that were removed and there were also issues which were given less emphasis. Then based on the feedback got from the analysis of the pilot survey, necessary amendments were made.

Similarly, pilot survey was made before administration of questionnaires to the households. 10 households were randomly selected from the three agroecology for the pilot test. Analysis was made based on the objective of the research and hence the necessary amendments were made based on the feedback obtained from the analysis. Moreover, an attempt was made to substantiate the household survey with informal interview and focus group discussion.

Therefore, provided that the research had employed various tools to collect data of the same type through triangulation, there is no doubt that the research is dependable and hence the result of the

research is valid. Patton (2001) claim that triangulation is important in strengthens a study by combining methods from both quantitative and qualitative approaches. Thus, through the application of triangulation and reliability tests, necessary precautions were taken to keep the dependability and reliability of the research.

Table 3. 9: Internal reliability result for exam type structured questionnaires

Dimension of IK	**Cronbach's alpha**	**Based on standardized items**	**No of items**
Eco-cognitive	0.752	0.796	8
Practical	0.912	0.913	22
Normative	0.868	0.857	9

CHAPTER FOUR

CONSTITUENTS OF IK OF GEDEO AGROFORESTRY SYSTEM

4.1. Introduction

As mentioned in Chapter one of this dissertation, agroforestry system is an intensive land management system that combines trees and shrubs with crops and livestock in time and space on a landscape level to achieve optimum benefits from biological interactions between soils, plants, and animals (Nair, 2007). It is one of the dominant ecosystems that resemble natural forests (Bhagwat et al., 2008). The system is common in the developing countries and is often practiced by indigenous farmers who usually understand land use interactions in their local ecosystems (Nair, 2007). Farmers in the Gedeo zone can be cited as principal examples as they have sustained agroforestry system for a long period keeping the mutual interactions between local human cultures and the surrounding environmental components. Some writers even claim that the Gedeo agroforestry system was reported to be one of the best exemplary land use system in the country (Tadesse, 2002; SLUF, 2006). The system harbors a large number of population. It is a self-propelled land use system that relies on indigenous knowledge of the local people (SLUF, 2006). The practices are not adopted from somewhere else; rather it is obtained through intergenerational transmission of indigenous knowledge. Its self-regenerating and regulating capacity and strong reliance on knowledge and skills of the local people had made the system relatively resilient. However, recent trend shows that the ever-increasing population, increasing demand for land coupled with climatic variability, and increasing invasion of exotic tree species are threatening the sustainability of the system (Tadesse, 2002; Zebene, 2009).

Broadly, two types of agroforestry system are practiced in Gedeo. These are multistory and agrosilvipastoral agroforestry system; the former being dominant (Bogale, 2007). The multi-storey is further classified into three, while the agrosilivipastoral categorized into four (Table 3.5). The agroforestry system can also be broadly categorized into enset based, coffee-enset based, and coffee-fruit based agroforestry system (Tadesse, 2002; Mesele et al., 2011) (For details, see Section 3.1.)

Enset and coffee are the dominant crops, accounting for more than two-third of the components in the system. Apart from coffee and enset, the system supports varied species of indigenous and exotic trees, cereal crops, root crops, fruits and domestic animals. This type of combination is very common

in the highlands of Southern Ethiopia where home garden agroforestry system is dominant (Tesfaye, 2005).

More than 75% of the agroforestry system is located on highly rugged and steep topography. The slope of the topography ranges from 5-70%, of which more than 2/3 characterized by slope ranging between 10-30% and the majority of the area has a slope range between 10 to 30% (Mesele et al., 2011). Any agricultural practices conducted in such rugged and steep topography require great precaution. In this regard, the Gedeo people are well versed with the knowledge of utilizing the resources available in their locality, overcoming such topographic limitation. They have achieved this through indigenous practices of retaining trees, shrubs and herbs on their farmland. As far as historical accounts and oral traditions are concerned the local people have been able to lead their life in such rugged topography by practicing farming system that maintains the biodiversity and reduce degradation in all aspects. The local people have not experienced significant socio-economic and environmental challenges so far despite having a highly rugged landscape and ever-increasing human population. The relative stability of the system is interesting in that it supports population beyond its carrying capacity. One possible reason behind such success stories is the utilization of indigenous knowledge. The people were diligent enough in maintaining the sustainability of the system.

The attitude of the people, their day-to-day relation with their surrounding environment, values they attribute to trees, livelihood strategies they design during the time of challenges, and credit they give to natural resources etc. make them different from the other peoples in the country. They have not received any meaningful support, for instance, from education to help them use the natural resources in a sustainable manner. They did it by themselves using their own inherited knowledge. They know what to do, when to do, how to do and where to do. They do have ample and rich knowledge about how to live harmoniously with their land without taking too much from it. .

4.2. Characterization of IK of Agroforestry System

The knowledge-practice-belief framework of Berkes (2008) is used to characterize IK of agroforestry system of Gedeo. In the framework, four levels of IK analysis are identified ((1) local knowledge of land and animals, (2) land and resource management system, (3) social institutions, and (4) worldviews) (see Section 2.4.1 for details). The four levels are regrouped into three: the eco-cognitive, practical and normative dimensions. Under eco-cognitive dimension, knowledge of dominant plants, animal species, soils, and climate have been discussed. The practical aspects

emphasize on dominant agroforestry practices and land management practices; and the normative aspects focus on norms, values, belief systems, customary land rights and social institutions.

4.2.1. Eco-cognitive dimension of IK of agroforestry system

The eco-cognitive dimension mainly focus on the major components such as plant domain (indigenous and non-indigenous trees, perennial and annual crops, non-woody herbaceous species, and fruits), local soil types, local climate and animal domain.

a. Plant domain

The Gedeo agroforestry system consists of diversified plant species. It is a reservoir of variety of plant species, with varied vertical strata extending up to five layers (Tadesse, 2002), and doing an in-depth analysis is beyond the scope of current research. What has been attempted in this work is therefore, is giving due emphasis to only dominant plant species that are identified while conducting an in-depth interview and focus group discussion with key informants.

Plant domains characterizing the agroforestry system are indigenous and exotic woody species, non-woody herbaceous weedy species, perennial (coffee and enset) and annual crops (cereal, pulses, and root, tuber), spices, fruits *(Banana (Musa x paradisiacaL.), mango (Mangifera indica L.), avocado (Persea americana Mill), anans (Ananas comsus (L.) Merr), gishixa (Annona squamosa L.), koki (Prunus persica (L.) Batsch)* and *zeitun (Psidium guajava L.)*, and vegetables (Bogale, 2007) (See Table 4.1). However, the major plant species identified by the key informants for having huge impacts on livelihood of the people are enset, coffee, indigenous tree species, exotic tree species, non-woody herbaceous plants, cereal crops and fruits.

Table 4.1: Distribution of plant domains as per agroecological regions

Agroecological	Highland	Midland	Lowland
Altitude (m)	2300-3200	1500-2300	<1500
Agroforestry system	Enset based	Coffee-enset based	Fruit-coffee based
Dominant plant species	**Crops:** enset, onion, wheat, barley, pulses, potato, bean, pea, kale **Tree species:** kosso, walena, , bahir zaf **Herbs:** hada'a, qorcisa, lede, dobe, lacee, nuxxa	**Crops:** enset, coffee, boyina, maize, sweet potato, yam, **Tree species :** dhadhatto, walena,, garbe, gorbe, qilixxa, oda'e,tala'a, ononon, mokenisa, adama, rejje,ebicha, gudubo, laafa, sisa, xibiro, birirsa, **Herbs:**hada'a, qorcisa, lede, dobe, lacee,nuxxa, gurasanjo,	**Crops:** coffee, enset, teff, sweet potato, **Fruits:** mango, banana, avocado, gishixa, papaya, **Tree species:** birbira, walena, garbe, gorbe, qilixxa, oda'e, tala'a, ononon,mokenisa, rukessa, badessa, **Herbs:** hada'a, qorcisa, lede, dobe, lacee, nuxxa,

Source: Field survey, (2011/2012; Tadesse, 2002; SLUF, 2006; Bogale, 2007; Mesele, 2008; Mesele, et al., 2011)

i. Coffee *(Coffea arabica)*

The Gedeo agroforestry system supports five major varieties of local coffee cultivars. These are *wolisho, kudhume, deegaa, badeessa* and *gallo*. In addition to the local cultivars, genetically improved coffee cultivars introduced to the area first via CIP (Coffee Improvement Program) during the Derg regime following the outbreak of coffee berry disease (CBD) and then other coffee cultivars by the succeeding regime are among the cultivars growing in the area. The local people call the local coffee cultivars *'nebar buna'*[3] while the introduced coffee cultivars *'yee project buna'*[4]. From the

[3] Amahric version of local coffee cultivars

[4] Amahric version of introduced coffee cultivars

survey, the in-depth interview and discussion held, it was noted that the newly introduced coffee cultivars are less dominant in the midland, particularly in the higher midland regions (above 1800m). On the other hand, farmers in the lowland and lower midland claim that they grow both the local cultivars and the introduced ones. The local people inhabiting the lowland region appear to be more open to new technology than the highlanders and mainlanders possibly because of easy access to infrastructures. Most development projects initiated by the CSO are found in the lower midland and lowland regions as these are closer to the main road. As a result, one can easily observe the impacts of interventions being more pronounced in these two areas than in the areas found relatively far from the main road. That is why the introduced coffee cultivars are predominantly found in the lowland.

ii. Enset (Ensete ventricosum (Welw.) Cheesman*)*

Enset has several purposes such as economic, social, cultural, and environmental. It plays a fundamental role in food security, as it is one of the major staple foods in Ethiopia. According to Brandt et al.,(1997) more than 20% of the country's population residing in the highlands of Southern Ethiopia depend on enset for human food, animal forage, construction materials and medication purposes. The Gedeo people are among these peoples depending on enset. In Gedeo, enset is grown in all agroecological belts ranging from the lowland (1300-1500) to highland (above 2300m). It can grow in moisture deficit areas (lowlands) and in areas where there is excess moisture (cold highlands). Without exaggeration, there is no household in Gedeo not growing an enset plant. The survey conducted reveals that all the sampled households grow enset on their farmlands. None of them failed to mention enset as their major livelihood. It is the only ubiquitous crop generously available for the poor and rich, child and elder, male and female, literate and illiterate though the amount and quality available varies.

The local people identified more than twenty types of local enset cultivars growing in the three-agroecological belts (*Nifo, Ganticho, Toracho, Qarase, Dambale, Harame, Dimoye, Astara, Shana, Qoshe, Qorqoo, Mundame, Galisho, Ado, Tilale, Danbalicho, Guluma, Areme, Kake, Dinke, Agana,* and *Ado).* Among the local cultivars, the most dominant and preferred enset cultivar is *ganticho*.
Shendo Udo, 80 years old local elder, explained the role of *ganticho* as follows:

> *Ganticho is a father of all enset. No enset cultivar is as strong, productive, and generous as ganticho. It is the only enset cultivar I ever seen satisfying the demand of the poor and the*

*rich, withstanding any environmental challenge. You always get ganticho appearing green, in whatsoever conditions (*Shendo Udo, 80, Amba Kebele).

Enset can also be used for soil fertility improvement and water conservation. A Gedeo elder, who turns 100 years, noted the significance of enset to their livelihood as follows:

'Enset is everything for us; it is our major food; it is our bed; our umbrella; our house, medicine, cloth, our source of wealth, food for our animals. It protects our soil from loss, increases the fertility of our soil, and conserves our water. We can't live without enset(Bali gadicho, Bula).'

Tadesse (2002, 177) writes the values of enset in the life of the people as follows:

Ensete being their means of livelihood, the Gedeo have no aspect of life, from cradle to deathbed that is not connected with ensete. The Gedeo receive the newborn on dried ensete leaves (hashupha). The placenta is also received in an ensete leaf sheath (hachcho) within the house. The birth of the new baby is announced by placing an ensete leaf (cichcha) on the door. During the first three to five months, the excreta of the infant are collected on ensete leaf sheath and fibers (haanxxa) until the time of initiation of the infant. The excreta is mulched underneath three ensete plants (bululo) that are planted to mark the initiation (cichcha fula). During marriage, the couples spend their first night in a bedding of ensete leaves. When constructing a house, the Gedeo plant ensete at the place of the future pillar (utupha). A dying person is placed on a bedding of ensete leaves and midribs. Thus, all aspects of Gedeo life are connected with ensete.

Of all parts of enset, its leaves have a lot of purposes from the point of view of environmental conservation. It protects the soil from erosion and replenishes soils with important nutrients. Above all, the leaves of the enset plant collect rainwater to be used in dry season. Farmers intentionally bend the leaves particularly in its lower part (See Plate 3, Annex 2) to protect pseudo stem from intense sun light and conserve moisture. Bending some of the leaves is also expected to minimize the suppressing effects of the leaves on the plant growing under enset plant. Moreover, the leaves of enset left on the ground after harvesting are a good source of organic matter for the soil (See Plate 4 & 5 Annex 2). They also protect the soil from runoff and keep the moisture of the soil.

ii. Annual crops

The Gedeo agroforestry system support different types of annual crops (See Table 4.2). The major crops grown are cereal crops (dominantly grown with no shade at all); root crops (grown intercropping with other perennial crops and trees), and vegetables (can be grown under the shade or in open space depending on the availability of land and the type the crop).

The local people grow annual crops for household consumption as well as a source of income. Not all farmers in the study area grow the annual crops for income generation, because of shortage of land. From the interview and survey conducted, it is noted that only farmers residing in highland and lowland areas are producing the crops mainly for sale. Farmers in the midland claim that they do not have sufficient land to produce these crops beyond home consumption.

The production of annual crops shows distinctive differences between the three-agroecological regions. The differences are attributed to altitude, availability of farmland and purposes of production. Except in the mid-land, in the lowland and highland annual crops are principally produced to generate income. The midland farmers mainly use the crops as subsidy to home consumption. There is a serious shortage of farmland in the midland due to rapid population growth. The land is dominantly occupied by coffee and enset. Only small plots of land are available for the production of these crops. Some farmers intercrop with coffee and enset while others use spare land, if any at all, around the margin of their farmland (plate 4.4). From the survey conducted, almost all of the respondents residing in the midland reported that they have no land left uncultivated and not occupied by coffee and enset. Every parcel of land is under cultivation (plate 4.5). From the transect walk conducted, it is noticed that with no exaggeration, there is no land left open except *songo* place. On the contrary, in the highland and lowland regions, there are open lands not used for cultivation. Some of these lands are used for grazing purposes while others left uncultivated owned by the kebeles (plate 4.1 and 4.2).

Table 4.2: Major Annual crops grown in Gedeo zone

Vernacular name	**Scientific name**	**Area of production**	**Uses**
Barley	*Hordeum vulgare L.*	Mainly highland	For sale
Maize	*Zea mays L.*	500-2100	For sale and home consumption
Pea	*Pisum sativum L.*	1700-2500	Mainly for sale
Horse beans	*Vicia faba L.*	1800-2300	Mainly for sale
Sweet potato	*Dioscorea abyssinicaHochst.ex.kunth*	500-2100	For sale and home consumption
Garlic	*Allium sativum L.*	Highland	For sale
Onion	*Allium cepa L.*	Mainly highland but also grown in low and midland	For sale and home consumption
Boyina	*Dioscorea alata L.*	Lowland & midland	For home consumption and sale
Potato	*Solanum tubersum L.*	Highland, midland & lowland	For home consumption and sale
Haricot bean	*Phaseoulus vulgarisL.*	Highland to lowland	For home consumption
Yam	*Colocasia esculenta (L.) Schoot*	Midland & lowland	For sale and home consumption
Teff	*Eragrostis tef (Zucc.) Trotter*	Low land & midland	For sale
Wheat	*Triticum sativum L.*	Highland	For sale
Gomen	*Brassica integrifolia (West) O.E.Scbulz*	Lowland to highland	Mainly for home consumption and sale

Source: (Bogale, 2007)

Plate 4.1 An open cropland in the lowland region with trees sparsely distributed (Source: The author, 2011)

Plate 4.2 An open land in the lowland region not used for cultivation (Source: The author, 2012)

Plate 4.3: An open grazing land in the highland regions of Gedeo zone (Source: The author, 2011))

Plate 4.4: Maize grown in small plot of land around farm boundary (Source: The author, 2011)

iv. Woody species (indigenous and exotic)

Multipurpose trees are the major component of the Gedeo agroforestry system (Plate 4.5). Most of these trees are indigenous while others are exotic. Their distribution varies across agroecology with the midland region harboring the highest woody species Mesele et al. (2011); (see table 4.1).

The woody species have multiple roles, which range from the biophysical roles such as climate change mitigation, biodiversity conservation, soil and water conservation, integrated pest management, to economic (source of income through production of timber and sale of fuel wood) and socio-cultural contributions (construction of houses, farm tools, and beehive; used in various rituals, traditional festivals, ceremonies, to cure different ailments) (SLUF, 2006; Bogale, 2007; Zebene, 2009; Fisseha, 2009; Negas et al., 2011). Above all, the role of trees in providing shade for coffee plants appears to be prominent.

Farmers in Gedeo believe that woody species play a significant role in sustainable land management and, as a result, everybody engaged in agroforestry is nurturing woody species. They know that their land does not stay productive unless covered by trees due to the nature of the topography. In addition, they know that coffee tree grown in their locality does not provide good production without shed trees. As a result, no one lets his or her coffee tree grow under no shade. One of the key informants forwarded the following concerning indigenous woody species:

> *Indigenous tree is life for Gedeo. How can we live without tree? I do not think we can live or Gedeo ethnic group live without tree. Our life is entirely attached to tree. It is the only protective layer for Gedeo people. It protects us from any sort of enemy or worrier. Be it windstorm, rainstorm, hail, intense sunshine, external enemy nothing will attack us. It is the hiding/ camouflaging place; we will not be attacked by any sort of enemy thanks to our tree. If we lose the tree, I am certain that we will lose our life too (Baqate Tekula,+100,bula).*

The woody species also serve as fodder for the domestic animals. Moreover, the farmers are well aware of the importance of producing organic coffee and therefore they depend on organic matter. Above all, the farmers are cognizant of the fact that the woody species do pump up nutrient and water from deep layer of the soil. This can be seen from the fact that some indigenous trees having the capacity to flush their surrounding with water and nutrients obtained through capillary action. Thus, the woody species are beyond everything for the farmers. That is why anyone who cuts woody

species without the goodwill of the local leaders and without having an emerging tree species (locally known as *baaboo)* is regarded as a cursed person.

An observation made and interview and discussion held with key informants reveal that multipurpose trees grown in the area have different ecological services in different agroecological zones. Tree species that benefit the annual and perennial crops in one agroecological region are reported to have a deleterious effect on the same crop type grown in the other agroecological zone. For instance, the use value of *Cordia africana Lam (weddeessa*) as coffee shade is not as significant in the lowland as it is in the midland (SLUF, 2006). Farmers in the lower and warmer parts claim that it dries up the soil and not preferred in coffee plantations. On the other hand, *Cordia africana Lam (weddeessa)* plays a significant role in increasing soil fertility, maintaining soil moisture, and providing shade for coffee and enset. Farmers in both agroecological zones are cognizant of the role it plays. Likewise, *Albizia* spp. are indicated to have a soil drying characteristic in the lowlands. Farmers in the uplands recognize well the purification of dirt and pollutants from the air by tree canopies before reaching the ground level (SLUF, 2006).

Plate 4.5: Multilayer agroforestry system of Gedeo, native woody species occupying the upper layer; enset and coffee occupying the middle layer (Source: The author, 2011)

Erythrina brucei S chweinf. (Weleena) can grow almost in all agroecological zones and mainly used as shed. However, its space selection limits its growth only to a relatively plain areas and valley bottoms. This tree species does not grow in steep slopes because it cannot withstand heavy winds or rain (Tadesse, 2002). Farmers have such an understanding about the space and ecological requirements and consequently they grow it on flatland and valley bottoms only.

Eucalyptus tree is reported to have both positive and negative effects on other plants grown around it. The majority of the farmers report that eucalyptus has detrimental effects on plants grown under it. Because of its drying effects, farmers usually avoid growing eucalyptus trees on their farmland together with annual and perennial crops. Eucalyptus tree is usually grown around farm boundary of farmland or far away from coffee and enset field. Nevertheless, in some parts of Wonago and Yirga Chaffee woreda farmers have been using eucalyptus tree as shade for coffee plant only in swampy areas where there is excess water. (plate 4.6). The farmers experientially know that coffee does not require excessive water and eucalyptus tree has the ability to consume excessive water. Accordingly, they plant it to drain some of the excess water so that the coffee tree grows properly.

Plate 4.6: Coffee trees growing under eucalyptus trees in swampy areas (Photo by the author, 2011)

In Gedeo, enset is usually planted with coffee (particularly in the middle and lower altitude) and consequently it benefits from shed intended for coffee. Enset is a light loving species but the presence of shed is useful in a way that it improves the fertility status of the soils and protects the plant from intense sunlight. Cognizant of this, farmers in the middle altitude use *Ficus sur Forssk(sholla), Cordia africana Lam (weddeessa), Millettia ferruginea (Hotchst.) Bak (Dhadhatto),*

Dracaena steudneri Engl, *Erythrina spp*. and *Albizia* spp to promote the growth and development of enset plants. On the one hand, dry deciduous trees, locally known as *qilxxa (Ficus spp),* are used as coffee shade, whereas, *ode'e (Ficus sur Forssk)*, retaining its foliage in the dry season, is used as *enset* shade. Some farmers in the higher altitude were seen growing enset alone without shade trees. However, *Erythrina brucei* Schweinf. and *Hagenia abyssinica (Bruce) J.F.Gmel* are the two dominant multipurpose tree species in higher altitude possibly having a positive effect on the development of enset plant. *Vernonia amygdalina Del* and *Vernonia auriculifera* Hiern., two fast-growing species providing small poles and mulch, are omnipresent throughout all agro-ecological zones (Tadesse, 2002).

The local people identified *Millettia ferruginea (Hotchst.) Bak (Dhadhatto), Ficus spp, Cordia africana Lam (weddeessa), Erythrina brucei* Schweinf (*Woleena), Albizia gummefera* (Gmel.) C.A.Sm.(*Gorbbe*) and *Vernonia amygdalin* Del.*(ebicha)* as the best indigenous tree species for coffee. *Millettia ferruginea (Hotchst.) Bak (Dhadhatto)* is the most favored indigenous tree species among all. The local people claim that it is a fast growing species as compared to other tree species. Its leaves and other parts can easily decompose and release important nutrients in a short period. It has relatively light crown and small leaves, which cast less shade on the lower canopy crops during active vegetative growth and fruiting stage.

Concerning the importance of *Millettia ferruginea (Hotchst.) Bak (Dhadhatto)* for coffee, a 67 years old farmer living in Kara Sodity explained the following:

> *Dhadhattois like a mother for coffee the time in which Dhadhatto shed its leaf and again bloom corresponds with the period in which coffee needs more sunlight and avoid hails and intense sunlight. Around February and March coffee tree starts to give flower and in response to this Dhadhatto begins to shed its leaf around January to let the sunlight to penetrate down to the ground so that the coffee tree gets quite enough sunlight for flowering. On the other hand, the Dhadhatto's leaf begins to bloom around March to protect coffee leaves and berries from intense sunlight. It is a major source of nutrients for coffee and other crops. Any crop grown under Dhadhatto does not suffer from lack of nutrients. You see it feeds itself and plants around. It also feed us through fuel wood. (Udesa Gebre, 67, Karasodity).*

Being aware of its special contributions almost everyone in the rural Gedeo engaged in farming has *Millettia ferruginea (Hotchst.) Bak (Dhadhatto)* at least in their home garden. My observation also confirms that everyone is well aware of the role it plays in sustaining both ecology and livelihood.

Similar to *Millettia ferruginea (Hotchst.) Bak (Dhadhatto) and Ficus vasta Forssk(Qilixxa)* shed its leaves twice a year, in September and April, when the need for shade is relatively less. Its leaves flush during dry season when the need for shade is high. Consequently, it protects the soil from adverse insolation, helps maintain soil organic matter and reduce evaporation from soil, and retain soil productivity. It also improves soil fertility through litter decomposition.

Ficus vasta Forssk(Qilixxa) covers a large area as its branches grow horizontally (see plate 4.7). As a result, it can give shade service for a large number of coffee trees. A single *Ficus vasta Forssk* can cover an area as large as $100m^2$ and even more. The local people claim that this tree is different from other indigenous tree species because of its role in regulating the local climate. One of the key informants elaborated as follows:

> *Qilixxa' is a mother tree. It has very different weather condition. If you stand under qilixxa you feel very mild temperature. The coffee grown under this tree gets mild temperature (Bali Gadicho, +100, Bula).*

Plate 4.7: *Ficus vasta Forssk (Qilixxa)* harboring coffee plants under its canopy (Source:The author,2011)

Beside ecological importance, the local people have mentioned that indigenous tree species growing in their locality have cultural and medicinal values. Different cultural events and ritual ceremonies

such as *qexxela, xeeroo, gadabo, dararo,* and others are performed using indigenous trees. Before the advent of modern medication, the Gedeo were heavily relying on the products of indigenous trees to get relief from ailments. For instance, the local people have been using *Vernonia amygdalina Del(Ebicha)* for diarrhea and stomach ache, *Cordia africana Lam(weddeessa)* to cure evil eyes, *Euphorbia Candelabrum (adaama)* for ringworm, *Millettia ferruginea (Hotchst.) Bak (Dhadhatto)* for fungal infection, *Croton Macrostachyu* Del. *(Mokennisa)* for malaria, diarrhea, epilepsy, ringworm and skin rush (Fisseha, 2007; Field survey, 2012). Of course, still now, there are some people who use medicinal trees for different ailments.

v. Non-woody herbaceous species

The Gedeo agroforestry system also consists of non-woody herbaceous weedy species, locally known as *bada'a.* These species occupy the lower canopy or the underground layer. *Bada'a'* is found commonly in coffee and enset field. Farmers have identified several species of non-woody plants growing on their farmland. Tadesse (2002) identified about 150 weedy species among which 80 are useful for soil fertility maintenance. Some of these weedy herbaceous species are used as source of food, animal fodder; while others are used for soil fertility maintenance, for house construction, ritual purposes and as medicine for human and domestic animals ailments. Some of these species are used as indicator of soil fertility status. Farmers claim that species such as *nuxxa, dobe, share, lace* and *leddee* grow only in most fertile land. Therefore, the occurrence of such species is a signal that the land is fertile and ready to use. On the contrary, species such as *agaricho, manqise, daka, hansicho, qorcisa* and *hare* indicate the infertility of the soils.

vi. Fruits

Fruit is another component of the Gedeo agroforestry system. The fruits are grown predominantly in the lower altitude. Farmers in mid and high altitude grow it but not as dominant as in the lower altitude. *Banana (Musa x paradisiacal L.), Mango (Mangifera indica L.), Avocado (Persea americana Mill), Pineappel (Ananas comsus (L.) Merr), Gishixa (Annona squamosa L.), Koki (Prunus persica L. (L.) Batsch)* and *Zeitun (Psidium guajava L.)* are some of the major fruits grown in the area. *Dokima, Hagala, Bururi, Shisha, Miqe* and *Silingo* are also some of the wild fruits consumed by cattle herders.

Farmers grow fruits mainly for the purpose of income generation. Fruit contribute to augmenting the livelihood of the local people particularly during the summer season when the people have no alternative sources of income apart from sell of firewood. To some extent, it reduces the destruction of indigenous trees through the provision of income for household livelihood. Nonetheless, the contribution of fruits in terms of enriching fertility of the soils, providing shade for coffee and enset is insignificant. From their experiential knowledge, farmers identified that *mango* and *avocado* trees have deleterious effects on other crops grown with them. Leaves of *avocado* and *mango* are reported to have deleterious effects on the plants growing underneath. Their leaves do not decompose easily and heavy shade by their canopy inhibits proper growth of the underneath plants. Therefore, farmers do not grow coffee and enset together with *avocado* and *mango*.

b. Animal domain

i. Livestock production

Generally, livestock production is not a major activity in the zone possibly because of limited grazing land. Lack of grazing land tends to affect extensive production of livestock mainly in the midland region. The highland and lowland regions are relatively better in terms of livestock production because of the presence of open land, which can serve as grazing land (plate 4.8). The majority of farmers in the midland region reported that there is no open land that can be used for grazing purpose. Consequently, stall-feeding through cut-and-carry system is the dominant feeding system in the region (plate 4.9).

Plate 4.8. Cattle grazing on an open wetland Silvopastoral agroforestry system in the highland region (Source: The author, 2011)

Plate4.9. Stall feeding system (Source: The author 2011)

ii. Beehive production

Beehive production is an activity performed for the purpose of securing livelihood. This activity is very limited despite the presence of trees and flowers to be used for making honey. Bee hiving is common in all agroecology though the extent and of quality of the products vary across agroecology.

The local people produce honey using traditional method through hanging the hive on *Polyscias fulva (Hiern) H arms spp. l*ocally known as *Tala'a.* Indigenous trees such as *Cordia africana Lam(weddeessa), Ficus* sp. (*ode.e), Croton Macrostachyus Del (mokkeenssa), Erythrina brucei* Schweinf. *(weleena), and Euphorbia abyssinica (adaamma)* are also used to hang beehive.

The hive is prepared from indigenous tree species such as *tala'a, weleena* and others. It is prepared in a drum shape. Before hanging the beehive, farmers rub it with leaves of *Fagaropsis* spp. (the smell of which is liked by the bees) to attract bees.

The local people are well aware of the time in which bees visit the hive. Winter season is the actual time for hanging the beehive as it is the period in which coffee trees and other plants begin to flower. It is the ideal time for the bees to pick up nectar for honey preparation. Harvesting of honey can be carried out either after three months of hanging or a year or more. The honey harvested after three months of hanging is locally known as *qaaxine*. On the other hand, the one harvested after a year or so is locally known as *galicho*. Culturally women are not allowed to harvest honey in any circumstance. Almost all the activities regarding traditional production of honey are conducted exclusively by men.

c. Local classification of soils of the study area

Because of their close contact and day-to-day interaction with land, the people have good knowledge about soils (locally known as *butinaa)*. They can make a distinction between fertile and infertile soil mainly using its color and the weedy species growing on the soil. Four soil types are identified based on their color. These are *xilloke (*Grayish color soil*) diimooke (*Reddish color soil, volcanic origin*), boodhadhichcha (*Black color soil*),* and *chirrachchichcaha (*Wetland/swampy soil*).* According to local rating, the best soil is *boodhadhichcha,* commonly found under coffee and enset plants. This could be due to the fact these soils consists of large amount of organic matter which partly impart the black color.

d. Local seasons

The local people have their own, a traditional means of monitoring weather conditions. The farmers identify four seasons on which various farm activities are conducted. These are *bonno*, *harssoo*, *bale'essa* and *addoleessa. Bonno* is the busiest season as it is the main harvesting season. It extends from mid August to mid January. It is a warm and moist season. *Ba'leessa* is a period from mid January to mid March. It is the driest season in which farmers prepare land for plantation of enset and other crops. *Ba'leessa* is then followed by *harsso*, a wet season. Rain usually begins at the onset of this season around beginning of April and then extends up to June. Farmers use this season to plant seedlings of trees, coffee and enset and other annual crops. Period from mid June to mid August is known as *adooleessa,* an intermittently dry and wet period (Tadesse, 2002). This season is moderately quiet season with little on farm activities. The farmers claim that this season is full of hardship as there is a limited source of income.

4.2.2. Practical dimension of IK of agroforestry system

In this section, an attempt was made to explore the production processes, resource management system, and an appropriate set of practices, tools, and techniques regarding agroforestry system, which fall under practical dimension of IK (Berkes, 2008). There are multitudes of agroforestry practices that characterize the agroforestry system of Gedeo. Presenting all the practices is not the intention of this research. It seems imperative to focus on agroforestry practices which are very unique and specific to the Gedeo people. Accordingly, an attempt was made to briefly discuss production processes and management of annual crops, perennial crops, and woody, non woody plant species. In addition, indigenous land management practices have been thoroughly examined.

a. Production, management and harvesting of perennial crops

In this section, an attempt was made to explore the agroforestry practices related to production processes, management and harvesting of perennial crops, coffee and enset. The first part is devoted to coffee followed by enset. The description under each section consists of preparation of seedlings, transplantation, management and harvesting activities.

i. Coffee arabica; seedling preparation, management and harvesting

Two methods of seedling preparation can be identified in Gedeo. These are traditional and modern methods. The traditional method is based on experiential knowledge of the local people while the

modern one is based on scientific knowledge. The traditional one is the most common among majority of the local people. This method was found to common in other regions in Ethiopia such as Sidama zone (Tesfaye, 2005).

In the traditional method, the local people obtain coffee seedlings from the existing coffee tree stand. This is evidenced by the fact that majority of coffee trees covering the land are locally produced coffee seedlings. However, a recent trend shows that using the naturally regenerated coffee seedling is becoming impossible due to overharvesting. One of the key informants living in the midland region explained what he faced in the recent past regarding coffee seedling preparation

> *What we usually perform to get the seedling is traditional and simple in my view. We deliberately left some of coffee berries fallen on to the ground for latter regeneration. In the past, no one collect coffee berries fallen on to the ground, as income earned from sale of coffee is not as such significant. Therefore, we use to obtain as much seedling as we can from the existing coffee stand. However, at present time it is becoming difficult to get the seedling because of overharvesting. There is a traditional practice known as' fishile', which gives ultimate right for our children to collect coffee berries that fall on to the ground. Once we collect from the coffee stand, we usually left the one on the ground for our children. We also inform and monitor them not to collect all the berries. We inform them to leave some. However, because of the temptation by high coffee price, our children are overharvesting it. Consequently, we are not able to get the seedling in large amount. We are forced to buy from market and also from the nursery sites (Beyene Robe, 65, Bula).*

Actual plantation of coffee seedling is not done immediately after uprooting; one has to check that the seedling is healthy or disease free. Framers use their experiential knowledge to check the health status of the seedling. Once the health status of the seedling is checked, it is transferred to another place for hardening after which it is planted.

Planting coffee seedling is preceded by preparation of pit, which is dug in between January and mid March depending on the agroecological location. Then the pit remains open for about a month or so to aerate the soil and refilling of the pit is usually performed beginning from mid of March after which the seedling plantation is carried out around May and June.

The seedlings are usually planted either on new land or in between coffee trees under the shades of *Millettia ferruginea (Hotchst.) Bak (Dhadhatto), Erythrina brucei S chweinf.(weleena)*or *Cordia africana Lam (weddeessa).* The farmers are well aware of the fact that coffee seedling planted in new land do not get proper treatment or care unless root crops like *boyina (Dioscorea alata L.)* and *yam (Colocasia esculenta(L.) Schoot)* are planted in combination with coffee. One of the key informants asserted that:

> [*T*]*hree years back, I have planted coffee seedling on new land, which is not as such covered by trees. I know that the seedlings need very intensive care for three consecutive years. Unless I cultivate the field at regular bases, I know that I will not get the yield out of it. Visiting farm only for coffee without getting yield for three consecutive years is a loss in my opinion. Therefore, what I did was I used to plant maize, haricot beans, and godare in different time together with coffee plant as a result of which proper cultivation and management is made for coffee plant. I know that the crops grown will definitely help coffee plant and at the same time, the cultivation and management made for the crops will help the coffee too (Berhanu Fayisa, 44, Buno).*

Thus, one can claim that Gedeo farmers' experiential knowledge is well expressed in their local practices of nurturing newly planted coffee seedlings. It seems that the farmers are calculative. They assume that it is a loss to nurture newly planted coffee trees for three to five years without getting benefit from it. Therefore, the attention they give to newly growing coffee tree is different from the one already begun giving production. As a strategy, they grow root crops that bear production every three or four months mixing with coffee. Growing such crops with coffee has multiple purposes as revealed by the farmers. The farmers make a regular visit to cultivate the root crops as a result of which the newly planted coffee trees benefit from the protection and management made to the root crops. That means any sort of care and management made for the root crops is likely to benefit the coffee tree as well. In other words, farmers are strategically taking care of coffee trees.

Slashing of coffee stand is usually conducted twice or three times a year. Rich and devoted farmers conduct even more to get more production. The first period of slashing begins around June following the onset of rainy season. The second period begins from November, aimed at preparing the ground for harvesting. In some cases, the second slashing is done earlier around September in lowland as the coffee berry begins to ripe a bit earlier.

The slashing is done carefully in order not to remove the emerging indigenous trees (locally known as *Baaboo*) like *Millettia ferruginea (Hotchst.) Bak (Dhadhatto)* and coffee seedlings regenerated naturally. It is time-taking as they have to selectively slash the weeds only by retaining the emerging seedlings of indigenous trees. The slashed weeds are not removed rather it is left there to replenish the soil fertility and maintain soil moisture. The local people also cultivate coffee stands twice or more in a year depending on the time they have and their economic capacity. In other words, cultivation of the field, at least twice in a year, is inevitable due to that fact there are annual crops that require regular cultivation.

Plate 4.10: Children engaged in collection of dry coffee berries (Source: The author. 2011)

Coffee harvesting is conducted at least three times per year. The first round harvesting involves only red coffee berries with no or few green berry. Then the remaining red coffee berries are harvested leaving the dry berries on the tree to be collected later. The last one is collection of the dry coffee berries from the coffee tree and the ground. According to their culture, children do not claim their share from the coffee collected from the coffee tree; they are allowed to collect dry coffee berry that fall onto the ground. The local people call this tradition *'fishile'* (see plate 4.10).

ii. Enset ventricosm; Production, management and harvesting

Enset is produced culturally and the local people make use of their own knowledge in the production, management and harvesting activities. Any practice concerning enset is tied to the culture of the local people and consequently knowledge of the local people is well expressed in this crop than any other perennial and annual crops.

Preparation of enset seedling is principally task of men. Traditionally, women are not expected to perform it unless conditions like death of husband force them to do so. Preparation of enset sucker is conducted beginning from January following the onset of dry season in the region. The selection of time is associated with the physiological state of the plants, the symptoms of which are when the plant becomes fatty (Tadesse, 2002). Farmers have got the knowledge of determining the time in which enset suckering has to be conducted.

There is no difference in the preparation of enset suckers in all agroforestry belts. In all cases, an enset tree that reaches a stage of *beeyaa*[5] is chosen for initiation of enset suckers. A 75 years old elderly person explained how the initiation of the enset sucker is done as follows:

> [*F*]*irst I select a mother enset tree that reaches a stage of beeyaaa and then I remove the leaf sheath from the pseudosteam using my hand. I then cut using traditional knife known as habile at about 10 cm from the ground. Once I remove the psedosteam, I kill off its eye, locally known as 'illicho', after which the 'simma' is marked in to four equal parts for later transfer of the seedling (Gedicho Badacha, 75, Mokonisa).* (See Plate 6, 7 & 8 annex).

Since recent times, initiation of enset sucker in one's own farmland is becoming difficult particularly among farmers of the lowland. The farmers claim that the seedling raised in their locality is not able to grow after transplantation due to climate variation and declining soil fertility. Instead, enset suckers prepared in the cold highland region are found growing with no problem. This has forced the local people residing in the lowland region to depend on enset seedling prepared in the highland.

Actual plantation of the root sucker is preceded by transplantation to the new site meant for hardening off the suckers. Transplantation of the root suckers is done after 4 or more months depending on the local environmental conditions. It is expected that the transplanted enset suckers are tended for more than 2 years depending on the performance of the seedlings.

Primarily farmers prepare the site on which the root suckers are transplanted. The plantation is done in line, by placing root sucker a bit inclined, a practice locally known as *huffe*. *Erythrina brucei*

[5] An architectural matured enset but their biomass still filling up enset that cannot be used for harvesting.

Schweinf., *Ficus spp, Millettia ferruginea (Hotchst.) Bak,* and *Cordia africana Lam* are some of tree species under which enset suckers are planted. Once planted, it requires regular management. Therefore, farmers add compost, animal manure, and household refuse to make the soil fertile so that the suckers grow vigorously.

Enset requires intensive management at an early stage, when transplanted from nursery to field (Tadesse, 2002). Cognizant of this, farmers invest much of their time in managing new enset plant. Weedy herbaceous plants are allowed to grow freely with the suckers. The weeds are usually slashed around May and June when the suckers grow too high (Tadesse, 2002).

It is common phenomena to get enset plant being grown immediate to farmers' residence. In fact this tradition is common all over the region in the country known for enset production. The local people revels that they grow enset immediate to their home for two reasons. The first is to get benefit from household refuse and animal manure. The second one is related to the belief that the smoke coming from home is quite important for its growth. In fact, the local people did not specifically single out the benefit that the enset plant obtains from being exposed to smoke. They revealed that the esnet plant grown immediate to home usually grows very vigorously than the one far from, homestead and they attribute this to the manure and the smoke.

Plate 4.11: A Gedeo woman decorticating enset and producing *qocho*(Source: the author,2012)

Harvesting of enset is conducted throughout the year. It can be harvested at any time to supplement the food demand of household. However, it is usually harvested when it is matured. Traditionally, no household dares to harvest an immature enset unless compelled by some inevitable problems like hunger. The harvesting is done right in field in a site covered by leaves of enset, locally known as *haasiwa* (See Plate 4.13). The purpose of covering the decorticating leaves of enst is to keep from eyes of their male, as there is a traditional belief that if a man sees enset decorticating, its quality would become low.

b. Land preparation, management, sowing, and harvesting of annual crops

Land preparation, seed preparation, sowing, cultivation, weeding, and harvesting practices of annual crops appear to be similar with the other highland regions cultivating annual crops (See also Tadesse, 2002). However, land management practices seem to be different from other places in the country, as there are cultural elements in the practices. That is where indigenous knowledge operates. Be it in highland, lowland or midland, the management of resources is attached to the cultural values of the local people.

c. Production and management of woody species

There is no special seedling preparation, planting and management practices made for woody species. The majority of woody species regenerate naturally through vegetative propagation or seed propagation. In other words, the local people are not expected to produce the seedling by themselves. What is expected of them is only to take care of germinating seedlings while slashing weeds. Birds and mammals play their own role in distributing the seeds of woody species. The woody species need no special management than pollarding and loping of their branches to reduce excessive shading of coffee plants and provide sufficient circulation of air for their flowering and fruiting.

d. Production and management non-woody herbaceous weedy species

Non-woody herbaceous plant species are among plant species that grow naturally. There exist varied species non-woody herbaceous weedy plants among which some of them have ecological importance while others not. The knowledge of famers in Gedeo is well expressed in their ability to select and temporarily retain species that they feel have the role of biodiversity conservation, soil and water conservation, soil fertility management, medication purpose and livelihood security.

e. Indigenous land management practices

One of the potentials of the Gedeo agroforestry system is its resources conservation potential (Tadesse, 2002; Bogale 2007; Mesele, 2007, 2008; Zebene, 2009). The Gedeo agroforestry system are home of diversified species of plants, which have huge contribution towards sustainable land management. Traditional institutions play a principal role in this regard. The customary rules and regulations set by traditional institutions are important tools in guiding the attitude and act of the local people towards resource utilization and conservation.

The Gedeo landscape is highly rugged and densely populated, and, as a result, prone to erosion and degradation. However, due to thick vegetation cover, the area is relatively kept from high rate of soil loss. The thick vegetation cover served as protective layer against the impacts of rain drop and removal of soil by the runoff. One possible reason behind thick vegetation cover, despite clearance of trees for different purposes is its naturally regenerative capacity. There is always a new-emerging tree seedling as long as the mother tree is there. Farmers are only required to maintain the emerging seedlings of the trees by protecting from clearance when slashing of weeds and herbs is done. This tradition of maintaining the emerging trees species *(locally known as baaboo)* is an old age cultural practices.

i. Traditional biodiversity conservation

The local people are cognizant of the importance of maintaining plant species on their farmland. They have been practicing farming systems, which directly or indirectly contribute to biodiversity conservation, for years. Through their traditional institutions, they protect indigenous tree species from unwise and unsustainable utilization. *Baaboo* (literally means 'progeny') is among the indigenous practices that has huge contribution towards biodiversity conservation. It is a traditional practice of maintaining the emerging seedlings of indigenous trees, enset, coffee and other plant species in one's own farmland. It is an old age and common practice. As a tradition, every one engaged in farming is expected to have a progeny of mainly indigenous and exotic trees, fruits, coffee and enset.

Baaboo needs very special care and management. Traditionally, it is strictly forbidden to use it for any purpose other than keeping for later plantation/ transplantation. It is strictly forbidden to cut, clear, or use *baaboo*. *Baaboo* is assumed to be the hope of the future. *Haxaya Serebo*, 75, and a resident of *Amba* kebele forwarded the following regarding *baaboo*:

> *We highly depend on tree, coffee, and enset for our day to day life. we often use enset as a source of food; coffee to get income; and tree as medicine, source of income, protection from enemies, soil erosion, hail, heavy rain and sunshine, source of timber, firewood etc. A single enset stays three to five years and consequently to keep its sustainability, we need to replace the harvested one with new seedling from our baaboo. We usually keep enset seedling every time with the intention of replacing the matured and ready to harvest enset plant. We also retain the seedlings of indigenous trees through selective weeding and slashing practices. Our future potential wealth is our baaboo. We feel that we have a lot of resources at our disposal, the major being baaboo(Haxaya Serebo, 75, Amba).*

Enset is the prominent staple food of the people, which is harvested every three to five years after planting. A family may harvest ten to fifteen enset plants every year on average and the equivalent number of enset is planted to replace the harvested ones. It is not an optional for the farmers to have *baaboo*; it is a must do activity if they want to keep their livelihood sustainable. In other words, maintaining *baaboo* is quite essential and mandatory for the local people. This is the only way the Gedeo people sustain their livelihood, as enset is the only staple food available with little cost. The same is true with coffee. Therefore, the presence of *baaboo* is an assurance for farmers that they will not be in danger in terms of livelihood and biodiversity degradation.

In addition to *baaboo* practices, there is a tradition of maintaining the biodiversity through cultural practices. The local people give due respect to trees planted at scared places and on graveyards. Moreover, indigenous trees and herbaceous non-woody plants are source of medicine for the majority of the people, as a result of which special protection is made to such plant species.

The Gedeo people have also a well known and an old age tradition of preserving trees on their farmland. This tradition is believed to have emanated from the significance of trees in their everyday life. The local people are well aware of the importance of trees in their life. Therefore, they do not cut the trees without replacement and without the permission of local elders. According to the elders of Gedeo, in the past, the local people used to get permission from *songo* elders or *abba gada* to cut indigenous trees for different purposes including timber production, fuel wood and others. Cutting indigenous trees *en masse* is strictly forbidden in the society. Any person who was found guilty is reported to the *songo* leaders for moral and financial punishment. The moral punishment given in the past was more painful than this day's punishment according to elders comment. A person found cutting trees without permission from the *abba gada* was alienated from any social matters. Since the

value given to *songo* elders is massive, most of the local people stand for the rule and regulation passed by *songo* elders. They do not tend to breach the words of the *songo* elders in most cases. This tradition has kept the biodiversity relatively intact as compared to the other places in the country.

ii. Mulching (locally known as Fawo) and minimum tillage(Hoffa)

Mulching and minimum tillage are the two traditional soils and water management practices. Mulching is practiced over 80% of the zone (Tadesse, 2002). The availability of diversified woody and non-woody species is one possible factor behind the predominance of mulching. Gedeo farmers intentionally leave pruned leaves of indigenous trees, enset, banana tree, crop bi-products or slashed weeds to augment soils' organic matter, protect soil from loss and conserve water (See plate_4 & 5, Annex 2). The farmers conduct this activity during winter season when there is less rain and high sunlight in order to conserve soil moisture. However, the ground is kept clean during coffee harvesting season (September- mid January).

Minimum tillage (locally known as *Hoffa*), is also a traditional practice that prohibits the farmers from ploughing each and every part of the land. The Gedeo people believe that their land requires care and protection owing to topography and hence they do not want to expose the soil to the impacts of rain by ploughing the land. Rather simple farm tools like digging fork (locally known as *habille or sholle*) are used for cultivation. To plant/ cultivate a certain tree or crop, the local people dig out only small part of the land. This practice is very common in coffee producing regions.

iv. Indigenous soil fertility management

The use of crop residue, leaves of plants, household refuse, cow dung, and residuals of harvested enset etc are common traditional methods through which fertility of the soil is maintained in Gedeo. Application of artificial fertilizer is not common among the Gedeo farmers except in cereal crops producing regions (Tadesse, 2002). Because of its impact on quality of coffee, almost in all coffee producing regions there is no record of the application of artificial fertilizers.

From the observation and discussion held with key informants, it has been found out that soil management strategies do vary among the agroecological zones. Soil fertility management strategies implemented in the mid altitude is mainly mulching by using leaf litter from multipurpose indigenous trees such as *Ficus sur Forssk(Ode'e), Cordia africana Lam (weddeessa), Vernonia amygdalina Del(ebicha), Erytherina bruci Schweinf. (weleena), Millettia ferruginea (Hotchst.) Bak (Dhadhatto)*

and *Albizia gummifera (Gmel.) C.A.Sm.(Gorbe)*. Undergrowth weedy herbaceous species are also used for soil maintenance. Farmers report that these weedy species benefit the soil by releasing organic matter up on decomposition. Farmers also recognize the impacts of weedy species in preventing soil loss and conserving moisture. They let these species to grow under coffee trees for sometimes without slashing.

Non-woody herbaceous plants play significant role in the management of soil fertility. Moreover, some of the herbaceous plants such as *nuxxa, doobbe, tunaye, gora sanjo, fechatu, ferenja, laluntie, quntuto, qisha, rejie, meracha, renshashum, sesiko, dumie, dumbella, muja, malla, qidhie* and *chekeldha* are good indicator of fertility status of soils. One of the key informants from *Buno* kebele said the following concerning the importance of *nuxxa*:

> *'Nuxxa does not grow everywhere. It grows only in an area rich in organic matter particularly in soft land. When I see nuxxa growing in my farmland I realize that my land is now fertile and I will turn my attention to the one that does not start growing nuxxa. It is a good indicator of the fertility status of our soil (Berhan Fayisa, 44, Buno).*

Farmers produce compost through traditional method mainly from remnants of plant, animal dung, urine, and household waste including ash from cooking fire. Materials utilized for the preparation of compost are collected around homestead together with household refuse and animal dung. Then the farmers mix up with leaves of trees and enset leaf sheaths after, then stored in a hole dug for this purpose. The farmers need to wait for about a month or so for the decomposition to take place. Farmers use compost mainly for enset plant (particularly the newly transplanted enset suckers). In high and low altitude farmyard manure is an ideal method because of relative dominance of livestock production. Farmers in these altitudes depend on animal manure instead of plant litter because of relatively less vegetation cover.

v. Urane

Urane (rotation of dwelling) is a traditional soil rehabilitation system. It refers to temporary shifting of dwelling/farmhouse to a land that requires more management. It is a kind of *in situ* land management systems, whereby farmers augment fertility of soils through application of animal manure and growing of trees. Farmers usually move with their livestock to a farmland they thought requires intensive care. Livestock are deliberately brought to graze and deposit dung (plate 4.12).

Plate 4.12: *Urane* house (Source: the Author, 2012)

4.2.3. Normative dimension of IK of agroforestry system

The normative dimension of IK in this context encompasses the social and cultural practices and, institutional setup and activities that guide everyday life of the society by setting customary rules and regulations on various societal matters. From the perspective of resource utilization and management, social institutions usually set normative principles that define the interaction and interrelation between nature and society. Moreover, they regulate relations between the community members and enable coordination, cooperation and the design of rules for the functioning of resource management system (Berkes, 1999). The institutions also include institutions of knowledge that frame the processes of social memory, creativity, and learning (Davidson-Hunt & Berkes, 2003).

The role of social institutions in resource management, particularly in terms of setting customary rules, norms and codes of social relationships is eminent (Berkes, 2004). Through their traditional institutions known as *baalee* (detailed below), the Gedeo people have maintained harmonious relationship between the biological and cultural diversity. The Gedeo agroforestry system in general are rooted in the social and cultural elements of the society. In other words, there exists a very close relationship between the biological and cultural diversity. A brief explanation of this link is presented in the subsequent sections.

a. Baalee institution

Baalee is a traditional social organization of the Gedeo people, an equivalent of the Oromo G*ada* system. *Baalee* provides codes of conduct for the society in social, economic, and cultural aspects. The institution usually passes rules and regulations with regard to land and its products, various

social and cultural matters, organize the people whenever mobilization is needed. According to oral tradition, the Gedeo people had been under the administration of *gada* system.

The *baalee* is assumed to have originated from the Oromo *gada* system. Historical accounts show that Gedeo ancestors learnt *gada* system from the Gujji (McClennan, 1988). He stated how the Gedeo ancestors got knowledge and skill about the *gada* system and the rituals as follows:

> *The Guji kallu named woma first gada. Gedeo admired it, believing it to be a proper way for people to elect their leaders, but the Guji were unwilling to teach the rituals to the Gedeo. Finally, two Gedeo men, disguised as women, slipped secretly into the kallu's compound and were granted asylum from the angery Guji. He then taught these men the secrets of gada.*
>
> *After a time, these men returned home, only to dispute between themselves who should be the first abba gada. A contest between the two, Fifu and Dacho, was held to resolve the conflict. First, each was asked to carry water from Ghedicchoin a sieve. Only Dacho was able to accomplish this feat. Next they slaughtered oxen, and Dacho's was found to be without a heart, a true miracle. Since that time miracles have been associated with abba gadas* (McClennan, 1988:pp28*).*

The administrative structure of *Baalee* institution also resembles the Guji *gada* administration. The head of the institution is known as *abba gada*, locally known in Gedeo as *aba gadicho. Abba gadicho* stays in power for eight consecutive years. *Aba gadicho* is chosen and assumes power after passing through different ceremonial and ritual events conducted by members of *baalee* institution. Next to *aba gadicho* is the post of *jellaba*, who succeeds the *aba gadicho* in case of death and assumes power until a new *aba gadicho* is appointed. Most of the positions in *baalee* institution are not political; rather they are ritual, ceremonial and hereditary. *Aba gadicho* and *jalleba* provide the people with the only real sense of political unity they possessed, conducting rituals for the benefits of the entire society and trying to mediate in any conflict among the clans (McClennan, 1988).

There are five major *baalee* classes into which all members of the society are grouped. These are *raabaa*[6] *lubaa*[7]*, yuubaa*[8]*, guduro*[9] and *qululloo*[10]. As the elders of Gedeo reveal it, there are three

[6] the class of those in preparation to assume power
[7] the class of those who are in power
[8] the class of those who are shortly resigned from power
[9] the class o those who resigned from power earlier than the yuubaa
[10] the class of the elderly who are exempted from social duties.

traditional administrative units, namely, the *suubbo*, the *dhibata*, and the *riqatai*. Each of them is led by *roga*. R*oga* is accountable to *abba gada (gadicho). Jalqaba* is the vice of the *roga* and is accountable to *roga.*

One of the principal roles of *baalee* institution is to keep the integrity of the culture through conducting different cultural activities, maintaining stability among the people by keeping customary rules and regulations, protecting the people from external worriers, mobilizing and conducting various ritual practices like mass prayer whenever there are natural calamities.

Elderly people conduct the majority of the activities under *baalee* institution and other indigenous institutions. In this regard, elders have a big place among the people. That is, the respect given to elders is enormous. They have extensive power through which they can pass law, code of conducts and regulation. Elders are the only ones who assume power to lead *songo* and conduct ritual ceremonies such as *ciincessa and qexxela*. In relation to this McClennan (1988) states following:

> *Although Gedeo society was in theory democratic, in reality the elders ruled. They controlled the chief resources and thus articulated the mode of production. As mediators and ritualists, they also controlled the very mechanisms that made the society functions in an orderly manner. Religious and spiritual sanctions were a large measure of their political control. The elders ensured both the production and reproduction of society. Through their efforts and resources, wives were obtained for sons and land distributed; through their ritual and mediation, the sprits were appeased (pp. 26).*

b. Songo institution

As mentioned earlier, *songo* is a traditional institution in which the Gedeo elders are locally known as *Hayicha* gathered to discuss on various societal matters. It is an institution found next to *baalee* institution (see 4.3.3.1) providing multitude of services for the people at local level. Currently, approximately, there are about more than 500 *songo* institutions in Gedeo. The biggest of all is *oda ya'a songo* led by *baalee's* higher officials.

Songo is a sacred place according to the oral tradition. The local people give value to the place. No one dares to cut the *songo* trees, allow his/her animal to graze. It is not used for cultivation purpose as well. *Songo* house is made of grass, with two open gates. The gates are intentionally left open (without door) so that anyone, a guest or local person, uses the house for a rest and even passing a night there (plate 4.13).

According to oral tradition, *songo* is a ritual place, where the local people communicate with *'Magano'*. In the past, before the introduction of missionaries to the area, the local people use to communicate with *'Magano'* through their *songo* leaders. There is a strong belief that any sort of calamities be natural, such as drought, disease or loss of production or anthropogenic, are resolved through prayer made by the traditional leaders to *Magano*. According to oral traditions, the Gedeo people have undergone through period of hardship attributed to natural and anthropogenic causes. There were times in which crop production declined because of little rainfall. There were also times in which diseases claimed the lives of the local people as well as domestic animals. Most of these natural disasters were resolved mainly through ritual practices. It was a common practice that the local people gather at *songo* place through their *songo* leaders and conduct ritual activities, in seeks of peace and security, good crop production, good rain, diseases free environment.

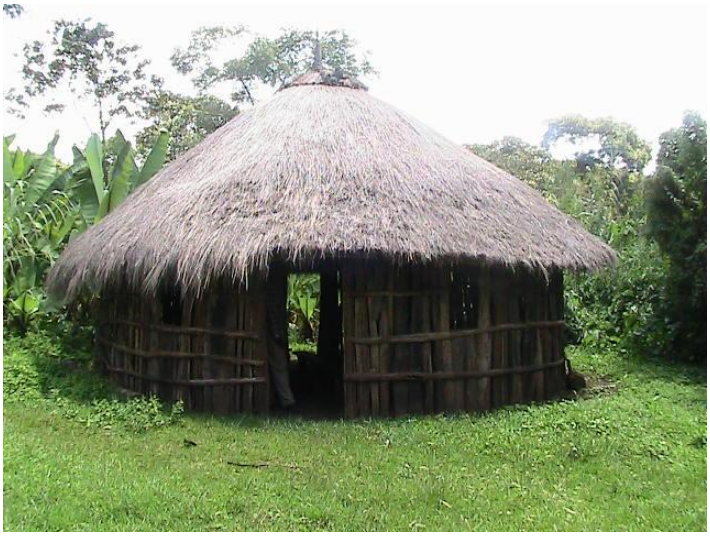


Plate 4.13: Traditional *Songo* House (Source: the author, 2012)

Whenever there is a problem, *songo* leaders make call to the people via *murra* (a messenger), to gather at *songo* place for mass prayer. Then every member of the society, irrespective of age and sex, social status isgathered at *songo* and conducts the prayer guided by elders. Such massive praying system is known as *qexxela*. Everyone who comes to conduct *qexxela* holds a leaf of an indigenous tree known as *rejje*, and sings a traditional song following their elders.

Songo is also a traditional courthouse where legal judgments are made. Before the advent of modern court system, verdicts were given by traditional court system. According to the tradition, three members of *songo* sit and hear the issues and then pass verdict. *Songo* leaders or judges are responsible to keep laws and regulation. Therefore, anyone who breaks the rule and regulation was brought to traditional court to be conducted at *songo*. The traditional court system does have the power to pass death sentence. The death sentence is conducted by the member of the *songo* using stick made of indigenous trees known as *xiibiro*.

However, the power of *songo* elders has diminished because of the introduction of modern legal judiciary system. Currently, the local people present their case to the kebele administration. The traditional court systems are no more functioning except in rare cases. In other words, any illegal acts, robbery, or dispute between or among people is taken to kebele administration.

Songo is also a playground for *songo* members. The local people play traditional games such as *saddeeqa, shelello, hokkicho, shishishiqqo, tubbaalcha, wei'laanchcho, qalle, xallo, shididdo, hokkoke, kutu kutu, dhimo daaka,* and *hiddannelexxa-geebo* in their free time. *Saddeeqa* is played as a means of entertainment. Whenever they finish their work, they play usually this game.

Songo is a place to share experiences, get information about conditions in other parts of the locality. It is a place where they use to exchange information about what is happening in their vicinity or somewhere else in the area (Gedeo). They also use to have the folktale with each other and their children.

Principally, *songo* is a common meeting place for the local people. Nowadays, local people conduct meetings at their respective kebeles. Any administrative issues are presented to kebele administration. However, before the introduction of modern administration system, the local people were under the administration of *baalee* institution at large and *songo* institution in particular. In the past any case was presented to *songo* leaders after which it was taken to *jelleqaba* and *jalleba* and then to *abba gada* if it was beyond the capacity of *songo* leaders.

Songo is also considered as an informal school where children and young people learn about their cultural, social, economic, and political systems. The local elders use to impart their knowledge, skill to their children through different events such as ritual activities, folktales, local ceremonies such as *qexxala* (discussed further in 4.3.3d.), *ciinicesa* and others. The art of preparing different traditional/cultural tools was also taught at *songo* place.

c. Customary right to land ownership and access to land

Land is one of the major resources for the people as their livelihood relays heavily on the products obtained from it. It is the most important resource as it is the base for the economy, social and political capital of the people.

Historical account attested that possession and access to land among the people was made through local leaders, mainly elders. Before the incorporation of the area into empire state in 1895, land was in the hands of traditional administrators, communally held by the seven Gedeo clans (McClennan, 1988). The clans were responsible to administer the land in their administrative regions and distribute land to the local people in their respective traditional administrative regions. The *ya'a* councils, assemblies of all adult males, were responsible, in the distribution land for the local people. The contribution to the community, the need to have the land, wealth status, power and ability to fend off enemies and wild animals were some of the criteria that the *ya'a* council consider to give land for the people in need.

This tradition of sharing land among clan and then family members has continued and currently there exist a culture of inheriting one's own land to family members, mainly son. According to culture of the people, young people (male) have ultimate right to claim land from their family.

d. The socio-cultural values and belief systems

The Gedeo people are known for their cultural diversity. Some of these cultural elements have important role in sustenance the ecological system and the livelihood of the local people. The socio-cultural systems are responsible for the wellbeing of the people through formulations of code of conducts in relation to various social, cultural and economic matters, setting different socio-cultural rules, regulation, and sustenance of the livelihood.

i. Qexxela

The Gedeo people have a cultural practice known as *qexxela* in which local elders, young people and children gather for mass prayer. Such event is conducted whenever there is a natural calamity. When the people encounter problems such as drought, epidemic diseases, loss of crop production, and others they call people through elders known as *murra*[11]. Then the people gather and sing traditional

[11] *A person who acts as a speaker of aba gada or gada institution. It can also refer to a messenger.*

song guided by elders. Everybody holds leaf or branch of a tree known as *rejje* (*Vernonia amygdalina Del*). They do not use other tree species for this purpose than *rejje*.

ii. Ciincessa

It is a traditional belief system through which elderly people in Gedeo present gifts and petition to *magano.* It is a traditional practice conducted by elders. This traditional belief system is carried out whenever newly married bridegroom is not able to conceive a baby. Whenever there are natural calamities, elders used to gather and present their request to *magano* through presenting domestic animals such as sheep to their *magano.*

iii. Cultural values attached to indigenous trees

Besides their economic, medicinal and biophysical importance, trees play great role in socio-cultural aspects of the people. Indigenous trees are used in most of the ritual practices, and social events such as marriage, death, birth, weeding and others. Among the local people, landscape (forest, mountain, valleys, rivers and plains) have different symbolic meanings. There is a common belief that maintaining a harmonious relationship with their environment would please their God who they believe would reciprocate the people with fertility, abundance, peace and health. In contrast, the local people believe that if they destroy the environment, God will inflict by holding back rain, and causing diseases and famine upon people and animals. Owing to such traditional belief, the people used to give high values to trees. Trees are used to assign name for newborn baby, places, traditional institutions such as *songo* and others. For instance, there places labeled by tree known as *dabaqa,* and *mokenisa*.

About eight indigenous trees named by local people who planted them, are identified in Amba Kebele, and are 200-250 years old. The trees are *Halgo Ganche Gudubo*[12]*, Hachana Garbe*[13]*, Adame Garbe, Mulate Birbirsa*[14]*, Taro chanqo Ode'e*[15]*, Hadame eyasa Garbe, Taro Bushe Wodessa*[16] *and Banse Wodessa.*

[12] *Aningeria adolfi-frederici Rob and Gilb.*

[13] *Prunus. africanum Hook. F*

[14] *Prunus. falcatus (Afrocurps falcatus) Pilg.*

[15] *Ficus sur Frossk*

iv. Indigenous trees in traditional burial practices

Trees have meaning in the life of the people from cradle to death. The Gedeo people often bury dead body of their family members or relatives around their residence or on their farmland. The majority are buried on their farmland. There is no mass graveyard. Tombs are marked by indigenous trees such as *Waleena, adaamaa or rejjee* selected for this purposes (see plate 4 .15). Stones are not used to mark the graveyards. The planted trees are used to assure that the soul of the dead person has gone to heaven or hell depending on their growth. That means, if the tree grows vigorously, then they assume that the person is a blessed one.

Plate 4.14: Graveyard in the middle of farmland (Source: the author, 2011)

Since recent times, trees are replaced by tombstone (made of bricks and cements), with small corrugated iron cover built around the graveyard (see plate 4.14). The cover occupies a total area of 5-6m^2. This results in the reduction of about 5 -6 m^2 of land per dead body. There is no possibility of using the land for any purpose once the tombstone is built on the graveyard. The cemented ground may act as in impervious materials for the lateral flow of water and other soil materials. It might harden the soil by blocking the flow of water. It could be also a major challenge to the systems as more people construct on their family graveyard. From ecology point of view, construction house

[16] *Cordia africana Lam*

instead of tree planting has its own impacts, as trees planted on graveyard are not used for any purposes. No one is courageous to enter into graveyard and use trees. It is strictly forbidden to cut and use those trees. Most of the old age trees found in the zone have been maintained mainly due to their association to graveyard. Those trees identified in *Amba* kebele are also assumed to be trees planted on the graveyard of Gedeo elders. Therefore, the tradition of planting trees on one's own family or relative graveyard does have a huge role in the maintenance of tree species as well other plant species grown under the trees.

Plate 4.15: Traditional graveyard (Source: the author, 2011)

One of the key informants explained the relationship between *Waleena* and graveyard as follows:

> *'Our ancestors had been planting Welana on the graveyard of their family. Building statue on once family graveyard is a recent phenomenon in Gedeo. Currently, majority of people who have the capacity to afford the cost are building statue than planting trees. Those who do not have the capacity to build the statue are still relaying on the tree.'*

v. Indigenous trees during childbirth

When a women gives birth to a baby, a branch of an indigenous tree, locally known as *garbe*, is placed on both sides of the entrance to hut/compound announcing that there is a newborn baby. The placement of the leaf is also a warning sign for the father-in-laws not to meet the mother of the newly born baby. The sanction stays for four months. This traditional practice is known as *gadabo*

vi. Belief systems attached to indigenous trees

There is a strong belief that some indigenous trees have spiritual and social values. Some indigenous trees are intentionally left unused because of the belief systems attached to them. For instance, an indigenous tree known as *deega (Celtis africana Burm.F.)* is not used for constructing houses. People avoid *deega* because of the belief that constructing one's own house with it ultimately brings poverty to the family. As a result, no one dares to cut this tree and use it for house construction. Consequently, this tree is found in large numbers in farmlands. The other indigenous tree not allowed traditionally for the construction of houses is *onoono* (*Trichilia emetica Vahl*)**.** The local people believe that constructing a house with *onoono* brings a regular conflict between a husband and a wife. Therefore, no one is courageous to use this tree for house construction. Consequently, this tree is abundantly found in more places than the other indigenous trees grown in the area. Other indigenous trees such as *xibiro (Bersama abyssinica Fresen*),and *laafaa (Brucea antidysenterica J.F.Mill)* are among unwanted for any uses than provision of shade for undergrowth plants. Local people consider these trees (locally known as *farro*) as cursed and hence no one dares to use mainly for house construction.

One of the key informants living in *Amba* kebele explained the belief attached to *laafaa* as follows:

> *There are many trees considered 'farro' meaning bad fate. We do not use laafaa for house construction and even for fuel wood as it makes people to lose their consciousness. I know people who use leaf of this tree to make people lose their consciousness and then steal their property once they lose their consciousness (Megesha Bora, 67, Amba).*

Nevertheless, now-a-days, the young generation and adults have come to breach the belief system as a result of the missionary teaching. They discredited the cultural values attached to these trees. Consequently, they are voraciously used currently for house construction, mainly to demise such belief system and in turn expand the missionary religion.

4.3. Conclusion

The Gedeo traditional agroforestry system is a kind of land management system that simultaneously combines trees and shrubs with perennial and annual crops, and livestock in time and space. The system is one of the oldest that maintain the balance between biodiversity conservation and cultural

diversity. It was the most resilient system even under the highest rural population pressure, whose carrying capacity exceeds 1000 people per square kilometer.

The agroforestry system is believed to have originated from natural forests through land intensification. Multistory system is the dominant type of agroforestry system. Generally, three types of agroforestry system are identified: enset based agroforestry system occupying the cold highland, coffee-enset based agroforestry system covering the midland region and coffee-fruit based agroforestry system occupying the lowland region.

An attempt was made to characterize the agroforestry system based on knowledge-practices-belief framework developed by Berkes (2008). Under the eco-cognitive dimension, common plant domain, animal domain, soil type, and local seasons were presented. Major emphasis was given to indigenous tree species, exotic tree species, non-woody herbaceous plants, coffee, enset, fruits and annual crops (cereal, root crops and vegetables). On the other hand, among the animal domains emphasis was given to domestic animals alone.

Regarding the practical dimension, due consideration has been given to common agroforestry practices. The production systems of plant domains beginning from seedling preparation to harvesting have been discussed. Similarly, the major activities carried out in the production of domestic animals were described briefly. Land management practices have also been discussed with due emphasis to indigenous soil fertility management and soils and water conservation practices.

This study investigated that the Gedeo agroforestry system predominantly depends on knowledge of the local people. The Gedeo people have been conducting majority of the practices based on their knowledge and skills handed down by their ancestors. However, the introduction of modern practices, and the socio-cultural and economic transformations have been compelling the local people to compromise their indigenous practices.

CHAPTER FIVE

CHANGES AND CONTINUITIES OF IK OF AGROFORESTRY SYSTEM OF GEDEO

5.1. Introduction

IK is dynamic and evolutionary in perspective. It is a form of knowledge that changes through time because of creativity and innovativeness of the people who use it and a result of interaction with other local and international knowledge systems (Warren, 1991). IK can be discovered, modified, updated or lost through time. It is often elaborated and adapted to local cultural and environmental conditions tuned to the needs of local people and quality and quantity of available resources. Change in IK inevitable, particularly in a dynamically changing environment. If the change takes place within a framework grounded in indigenous institutions and customary legal systems, it lends to cultural continuity. Otherwise, the changes may lead to cultural discontinuity.

The spatio-temporal dynamics of IK can be viewed from its transmission and acquisition among successive generations. The changes and continuities of IK is principally a function of its transmission among successive generations. The transmission among successive generations may result in IK retention; whilst any gap in the transmission of IK may entail its loss. Thus, knowing the mechanism through which IK is transmitted is important to understand the retention, erosion, and spread of cultural traits and innovations (Reyes-Garicia et al., 2011).

Since IK is mainly transmitted orally (Grenier, 1998), it is vulnerable to rapid change especially when people are displaced or when young people acquire life styles different from those of the older generation. Moreover, lack of contact and interaction between the transmitter and the learner and change in settings in which the teaching-leaning processes occur is likely to result change in IK. Any shift in the setting in which the IK transmission occurs is likely to result in change in IK.

In this chapter of the dissertation, an attempt was made to examine the dynamics of IK, focusing on mechanisms of IK acquisition and transmission and its variation among successive generation, and the settings in which IK is acquired and transmitted. Moreover, an attempt was made to examine IK variation in terms of age, gender and agroecology.

5.2. Mechanisms of IK Transmission and Acquisition among Gedeo people

In this section, an attempt was made to examine mechanisms through which the people acquire IK of agroforestry system. In addition, modes and paths of IK transmission and the settings in which the transmission of IK has been occurring are discussed thoroughly.

5.2.1. Modes of IK transmission and acquisition

Oral communication and demonstration are the two principal mechanisms through which the Gedeo transfer IK to successive generations. The local people may also acquire IK from their everyday experiences and observation. The majority of the local elders revealed that they have acquiring knowledge and skills in relation to agroforestry system from their parents through oral communication and observation. One of the informants living in the midland region has forwarded his own experience regarding IK acquisition as follows:

> *My father is a base for my present knowledge. He taught me several things. For instance, he has shown me how to prepare enset seedling from existing enset plant. I used to watch him while he cut a young enset plant for suckering. Once I felt that I could do, I tried once under his guidance. Then I was successful. Then I tried another after which I started to produce more seedlings with no support from my father. He developed confidence on me and he left me alone. Now I can produce as more seedling as I can (Gobana Dogama, 63, Sugale).*

Similarly, another informant from the same area has pointed out how his experience gave him opportunities to acquire IK. His assertion is presented as follows:

> *I have spent almost 99% of my life on farm. A person who needs me may not find me anywhere other than in my farm field. Every day I wake early morning to visit my farmland and stay there until breakfast is ready. I go back home when it is ready, have my breakfast and then I come back to farm field. You see, because of my good acquaintance with land, I came to learn a lot from my day-to-day interaction with the land. You can learn more when you interact with nature. Evidently, my father is base for my present knowledge but I can say I have acquired substantial amount of knowledge from my day-to-day interaction with nature (Waraso Dado, 82, Sugale).*

The two quotes presented above can give an implication that IK of agroforestry system can be acquired through observation, oral communication with once own parents, elders, and other member of the society. In addition, it can be acquired when one is exposed to agroforestry practices and develop what is being observed through practices. The cultural values and norms are acquired through oral communication made with knowledgeable elders and participation in cultural practices.

5.2.2. Mechanisms and paths of IK transmission and acquisition

Acquisition and transmission of IK may occur through different paths. Cavalli- Sforza & Feldmen (1981) identified three paths IK transmission, namely vertical, horizontal and oblique (Section 2.2.3). Vertical transmission occurs between parent and children and may result in slow evolution of knowledge but allows individual variation (Cavalli- Sforza & Feldmen, 1981). Oblique transmission involves the interaction beyond parent and child. In this mode of transmission, a child has the chance to acquire knowledge from other members of the community, non-family member. It may take the form of one to many or many to one (Hewlett & Cavalli-Sforza, 1986). On the other hand, horizontal, transmission involves knowledge transfer between the peer groups.

Four mechanisms of IK transmission can be identified in this study. These are (a) transmission of IK and skills from parents and grandparents to children which is equivalent to vertical transmission, (b) IK and skills transmission from non-parental social group, mainly community elders to children (oblique transmission), (c) knowledge and skills transmission among the peer groups and or (horizontal transmission) and (d) knowledge and skills acquired from once own experience, school and development agents.

The survey result revealed that parents play a principal role in the transmission of IK related to agroforestry practices (production systems of both annual and perennial crops, land management practices, animal husbandry and beehive production). More than 73% of the respondents revealed that they have acquired IK important for management of agroforestry system from their parents (fig. 5.1), indicating the dominance of vertical transmission of IK. Similar finding was reported by Hewlett & Cavalli-Sforza (1986), Ohmagari & Berkes (1997) and Lozada et al. (2006). According to their findings, parent-child transmission of indigenous environmental knowledge was found to be the dominant mechanism.

Table 5.1: Transmission of IK of agroforestry system (Percent of respondents)

Agroforestry activities	Reponses of transmitter in percentage						
	Parent	Grand parent	Peer	Community elders	Own observation	school	DA
Land preparation for coffee & enset (n=241)	89	3	0.4	0	7.5	0	0
Seedling preparation(coffee & enset)(n=196)	98	1	0	0	1	0	0
Enset suckering (n=141)	100	0	0	0	0	0	0
Transporting seedling to farm (n=261)	100	0	0	0	0	0	0
Plantation of coffee and enset (n=230)	86	6	0	0	8	0	0
Coffee & enset field management (n=232)	91	4	0	0	5	0	0
Pruning of coffee shade (n=151)	78	6	0	0	0	0	16
Coffee harvesting (n=249)	86	4	0	0	10	0	0
Enset harvesting (n=85)	100	0	0	0	0	0	0
Cultivation of annual crops (n=250)	88	5	0	0	7	0	0
Tree planting (n=199)	83	5	0	0	0	0	24
Home garden cultivation (n=215)	92	6	0	0	2	0	0
Preparation of farm tools (n=150)	79	9	0	13	0	0	0
Fetching water (n=264)	42	0	17	0	41	0	0
Preparation of traditional foods (n=92)	100	0	0	0	0	0	0
Collection of firewood (n=253)	30	0	31	0	39	0	0
Keeping cattle (n=226)	89	0	11	0	0	0	0
Animal fattening (n=197)	81	0	0	0	5	0	29
Preparation of fodder (n=181)	79	4	0	0	4	0	23
Preparation of hive (n=80)	87	13	0	0	0	0	0
Beehive production & harvesting (n=95)	88	12	0	0	0	0	0
Soil and water conservation (n=131)	18	0	0	0	0	33	65
Soil fertility management (n=136)	49	2	0	0	0	9	54
Compost preparation (n=210)	73	7	0	0	14	0	12
Coffee marketing (n=210)	6	0	42	0	52	0	0
Enset marketing (n=154)	32	0	25	0	43	0	0
Marketing of livestock (n=219)	40	0	11	0	49	0	0
Traditional dances (n=186)	12	0	0	84	0	0	0
Songo (n=63)	23	0	0	77	0	0	0
Traditional belief system (n=119)	36	0	0	64	0	0	0
Traditional conflict resolution (n=65)	14	0	0	86	0	0	0
Qeexella (n=180)	69	0	0	31	0	0	0

Source: (Field survey, 2012)

The role of community elders, particularly *songo* members, is manifested only in the transmission of cultural practices such *songo*, *qexxela*, *cinceessa*, traditional dances and others. In this regard, parents do have their role but not as significant as community elders. As indicated in fig 5.1, nearly 68% of the respondents indicated that they have acquired knowledge of the socio-cultural practices from community elders. When seen from the perspective of knowledge transmission model, the cultural practices are principally taking the form of oblique path, possibly concerted or many to one path.

Peer to peer interaction is not common as potential IK transmission mechanisms. Only 2.4% of the respondents revealed that they have acquired knowledge and skills related to off-farm activities such as collection of firewood, keeping cattle, coffee retail, and fetching water from their peer.

School and development agents are playing their own role in the transmission of knowledge and skills in relation to agroforestry practices. For instance, some respondents claim that they have got knowledge about pruning of coffee shade, tree planting, animal fattening, preparation of fodder for animals, soil and water conservation practices, soils fertility management practices, and compost preparation from either school or development agents. Development agents working in each kebele usually imparts 'modern' practices in relation to agroforestry system. They often teach and instruct the farmers how to prepare compost using modern methods, how to conserve soils and water and how to maintain the fertility of the soils.

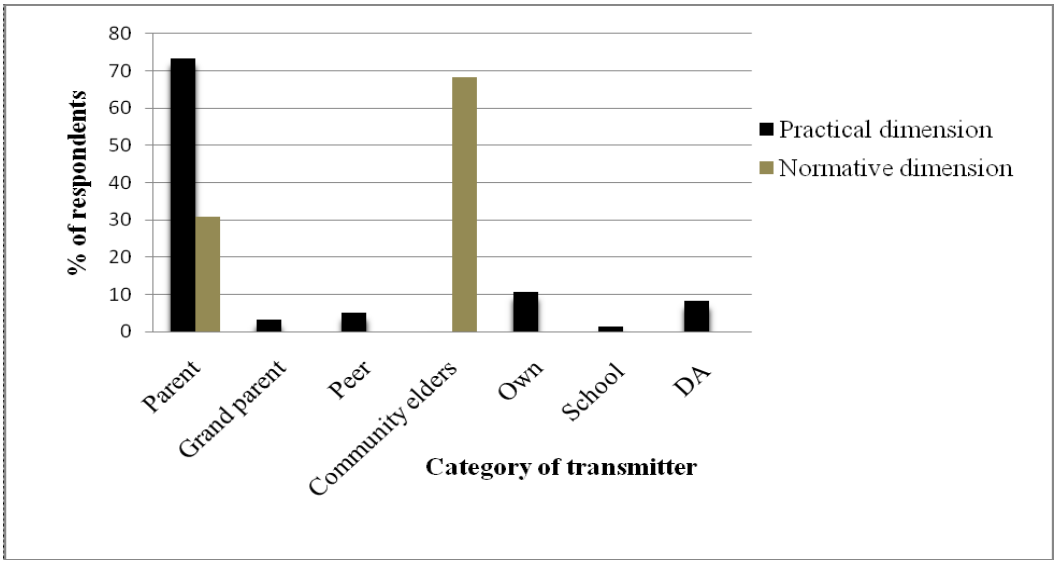


Fig. 5.1: The distribution of IK transmitter in Gedeo (2012)

In connection with IK transmission, an attempt was made to examine the sequence of IK acquisition among the people. Accordingly, the result of the survey and discussion held with the participants revealed that acquisition of IK of agroforestry begins on average at the age of 5.

As part of socialization processes, parents indeed initiate their children to participate in various activities at early age (in most cases at the age of five). In the childhood stage, parents usually take their children to farmland, send them to fetch water, collect firewood, and let them to look after cattle. They also engage them in farm tasks such as transportation of seedlings, slashing of weeds, coffee and enset harvesting but only under their supervision. In most cases, children are not allowed to work alone until they reach 12 years of age. They usually begin with observation and familiarization of tasks done by their parents after which they try to imitate what their parents do. At the age of six, seven and eight, children are only allowed to watch their parents while they are performing; around the age of 9 and 10, they will be given freedom to exercise some of the tasks but only under the full supervision of the parents. When they turn 12, they start working alone without the assistance of the parents. However, the assistance of parent does not stop until the learner begins his/ her independent life through marriage. Once they get married, parents provide their children (only son) with land, *habille*, and *qotto* to only declare that they are full person to lead their family.

This traditional learning sequence among the people seems to correspond to the learning sequence model adopted by Ohmagari & Berkes (1997) to examine the transmission of bush skills among Western James Bay Cree Women of Subarctic Canada.

5.2.3. Settings in which IK is transmitted and acquired

IK of agroforestry system of Gedeo is not taught in formal school or other setting away from its natural settings. Indigenous knowledge and skills related to Gedeo agroforestry system is acquired through the contact made with the natural environment (biophysical settings) and through socialization processes (socio-cultural settings) (See fig 5.2). The biophysical setting is a principal learning media and local laboratory for the people. Likewise, the socio-cultural settings such as *songo* institution, *baalee* institution, and various sacred places are an ideal learning environment.

a. Socio-cultural settings

Indigenous institutions (*songo* and *baallee*), sacred places, homesteads and places where cultural events such as weeding are conducted are among the principal socio-cultural setting in which IK is acquired and transmitted. Acquisition of IK, particularly, regarding cultural values and norms, belief

systems, rituals, customary laws therefore demands active participation of the learners in *songo* and *baallee* meetings, and different traditional festivals conducted at sacred places. Besides, the dialogue and conversation conducted between Gedeo elders and children at home in the late evening time is an appropriate leaning environment.

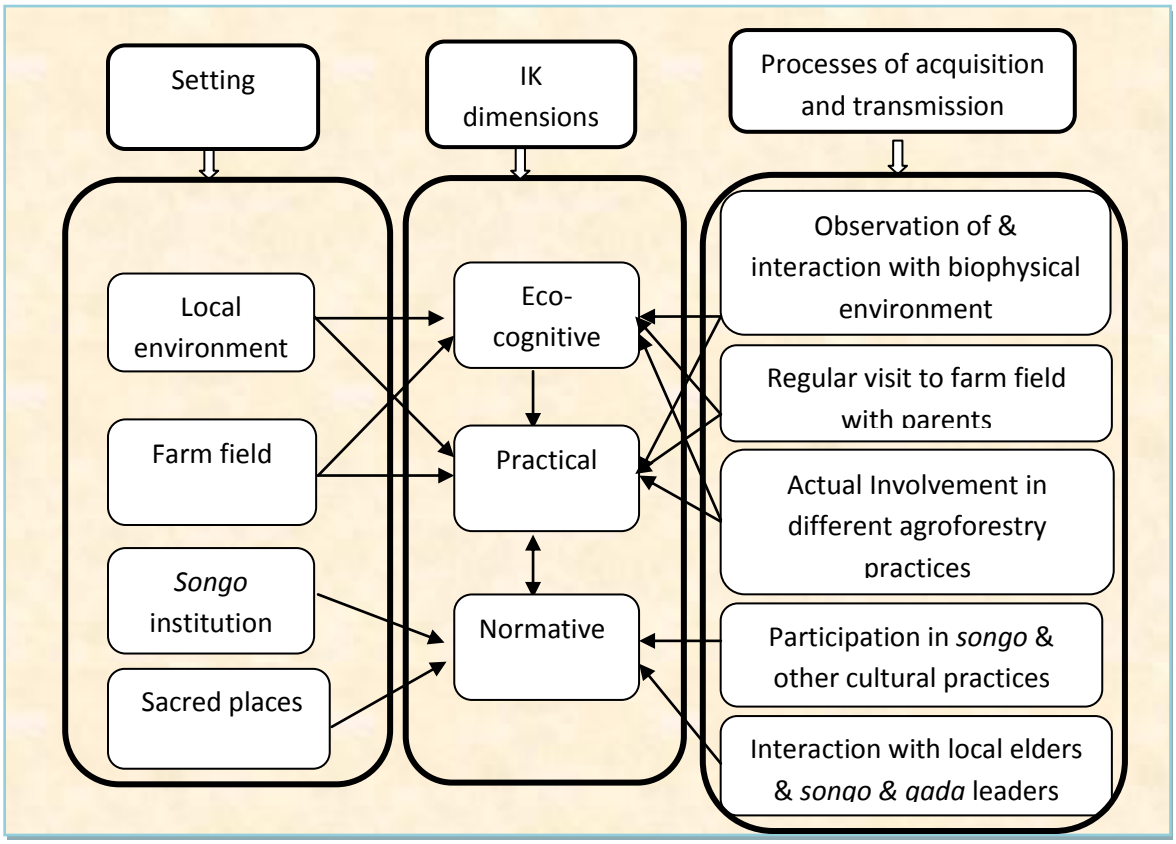


Fig 5.2: Schematic representation of acquisition and transmission of IK of agroforestry system of Gedeo as revealed by elders of Gedeo (Source: Author's construction, 2012)

Among all cultural settings, *songo* institution is the prominent learning center (details presented in section 4.3.3b). As indicated in chapter three, Gedeo elders exchange information and skills amongst each other, teach their children about their culture, values, norms and customary laws during *songo* gatherings. The majority of elders revealed that their parents used to take them to *songo* at least twice per day, and as a result of which, they came to acquire knowledge and skills regarding cultural values and norms. The elders also revealed that they acquired an enormous amount of knowledge and skills from debate and discussion held among *songo* members. The elders still believe that *songo* is an appropriate place where rich knowledge about local people's culture and other practices are obtained.

Nevertheless, despite their persistent believe in the power of *songo* in imparting IK, majority of them are not taking their children to *songo*. This might be partly attributed to modernization.

Exposure to different cultural events, such as wedding ceremony, traditional festivals (such as *qeexella* and *dararo*), traditional belief systems (such as *xeeroo,* and *ciincessa*), and mourning ceremonies are also the principal sources of cultural knowledge as revealed by the local people. The traditional festivals and belief systems provide better opportunities for the young people and even adults to know more about their culture and hence the indigenous practices.

The discussion made between elders and young people around homestead, particularly in the late evening time is another setting by which the cultural values and norms are being transferred to the successive generations. Gedeo elders used to have late evening time discussion with children and young people as a way to convey their knowledge, skills, culture and values to the younger generation. One of the informants residing in *Amba* kebele explained the interaction between children/ young people and elders as follows:

> *When I was a kid, probably 6 or 7 years old, we used to gather around the homestead to listen to the local histories, folktales and cultural songs told by elders. Until I got married, I used to have meeting with elders. Even after I got married, I use to visit my father at least three times per week just to listen to some of the folktales (Mengesha Jarso, 76, Amba).*

It appears it is very unlikely to acquire IK being detached from the socio-cultural setting. One cannot be able to acquire knowledge and skills about the cultural values, norms, customary laws, belief systems, traditional festivals and others being detached from the socio-cultural settings.

Obviously, the survey conducted and discussion held with elders, adults and young people revealed that the socio-cultural setting mentioned above are no more active in terms of serving as medium in which IK is exchanged among the local people. Majority of the cultural practices are now given less emphasis. Some of the cultural practices are already abandoned while others are rarely practiced (for instance *songo*). Some of the local people revealed that they had never practiced *qeexxella* in the last couple of years. Some reported that they have never been to traditional belief known as *ciincessa* in the last couple of years. The tradition of burying dead body of persons and marking the graveyard

with indigenous trees are now replaced by erection of monument (for detailed see section 4.3.3d). Moreover, young people are less interested to have a discussion with their elders in the late evening. Instead, most of them would like to engage in either playing games or watching movies. This situation is certainly has an impact on sustainability of the system.

b. Biophysical environment

Besides the socio-cultural settings, the biophysical environment in which the children and young people grow up determines the acquisition of IK of agroforestry system. The majority of the key informants illustrated that the biophysical environment is the major source of knowledge and skills. Rural Gedeo is almost entirely covered with vegetation; therefore, a child who is born and raised in rural Gedeo is expected to grow up sensing and feeling the natural environment. Therefore, the natural environment of Gedeo tends to shape the behavior, knowledge and sense of belongingness of its inhabitants to the environment. Indeed, it is an appropriate learning environment for children and young people of Gedeo to acquire knowledge and skills regarding the agroforestry system.

Under natural circumstance, it is unlikely to impart knowledge and skills to the learners by detaching them from the natural settings. For instance, one cannot acquire knowledge and skill about enset suckering being detached from its natural setting. One has to be in the place where the suckering is conducted, observing while it is conducted. The same is true in the case of coffee harvesting, land preparation, sowing, slashing of weeds, pruning, preparation and application of compost and others. One has to be there to learn any activities related to agroforestry system. The more time spent in biophysical environment, the higher the likelihood of acquiring knowledge and skills of agroforestry system and vice versa. The experiences of the elders are a valid testimony in this regard. They have full-fledged knowledge and skills about every aspect of the agroforestry system, despite lack of formal education and any essential training. For them the biophysical environment is the principal learning media; it is their laboratories where they can experiments and learn from their day-to-day interaction with the environment.

In this regard, recent trend shows that the majority of young people have less contact with the biophysical environment, particularly farm field. Consequently, they are not acquiring sufficient knowledge and skills regarding agroforestry system.

What is actually observed among young people of Gedeo is a reverse of what their ancestors have been doing so far by their ancestors in terms of attitude and interest. A survey conducted with young people revealed that 80% of sampled young people are school attendant and spend more than 60% of their time in school. Some of their time, from the remaining 40%, is spent being in church, playing games, watching movies, and of course assisting family. It appears that the present day young people have better opportunity to offload themselves from being engaged in farming activities, which in turn reduce their interaction with the biophysical environment.

5.3. Intergenerational difference in the transmission and acquisition of IK of agroforestry system as perceived by the local people

IK acquisition and transmission variation among successive generations is inevitable in society where there is dynamically changing environment. IK is not static; rather it is dynamic and tends to adapt to changing circumstances. The dynamics is partly attributed to changes in the rate and mechanisms of IK acquisition and transmission. Any difference in the acquisition and transmission of IK among successive generation can certainly result in change in IK itself.

An attempt was made to evaluate the perception of the local people on whether there exist differences in the transmission and acquisition of IK among successive generation. The local people perceived that the rate at which IK is being transferred to succeeding generation is relatively declining. There seems to be observable generational differences in IK acquisition and transmission.

The local people have explained that young people are not enthusiastic to acquire indigenous knowledge and skills from their ancestors. Similarly, the elders have low interest to inherit their wisdom and skills to the younger generation. Lack of interest from both parties is contributing to the low rate of IK transmission at present time.

The low rate of transmission is also partly attributed to apparent changes in the setting. For instance, *songo* institution has been replaced by modern institutions as a result of which young people are denied the chance to attend and observe events conducted at *songo*. Nowadays, the local people are not presenting their cases to the *songo* leaders; instead, they are presenting their cases to be seen by kebele administrative. Similarly majority of the socio-cultural practices such as *ciincessa, qeexella, xeeroo, gadabo, warqa, wilisha a*nd others have not been conducted on regular basis and hence

young people have only little chance to acquire the wisdom about cultural practices. The social gathering that was conducted in the late evening is dysfunctional.

5.4. Intergenerational variation of IK of agroforestry system of Gedeo

The analysis of the intergenerational variations in IK of agroforestry system of the Gedeo is conducted based on the three mutually dependent level of analysis (eco-cognitive, practical and normative dimension). The analysis begins with determining the intergenerational variation from the perspective of eco-cognitive dimension of IK and proceeds to the analysis of IK variation among successive generations from the perspective of practical dimension. It ends with determining the variation of IK from the perspective of normative dimension.

5.4.1. The nexus between age and eco-cognitive dimension of IK

According to knowledge-practices-belief framework, the first level of analysis refers to knowledge about identification of plant domains, animal domains, topography, climate and others. This category of IK is labeled as conceptual knowledge (Zent & Maffi, 2009) or empirical knowledge (Berkes, 2008), or eco-cognitive dimension (Boillat, 2007). This category of knowledge can be acquired starting from early childhood depending on the exposure of individuals to the specific environment.

The result of ANOVA test indicates that statistically significant differences were observed among adolescent(12-20), young adulthood (21-35) and middle adulthood (36-45; 46-65) in their ability of recognizing and naming exotic tree species ($F=13.13$, $P=0.000$), non-woody herbaceous weedy species ($F=23.26$, $P=0.000$), local enset cultivars ($F=53.67$, $P=0.000$), local soil types ($F=14.95$, $P=0.000$), and local seasons ($F=28.08$, $P=0.000$)

Tukey Post-hoc test shows statistically significant mean differences between adolescent (12-20) and the remaining age groups. The mean difference also persists between young adulthood (21-35) and middle adulthood (36-45; 46-65). However, no statistically significant mean difference was observed among the middle adulthood (36-45 and 46-65) (see fig 5.3a-e).

Therefore, as indicated by the ANOVA result, respondents aged between 36-65 was found to be more knowledgeable than adolescent and young adulthood in their ability to recognize and name knowledge domains categorized under eco-cognitive dimension. This is attributed to the fact that majority of the local people in middle adulthood age group have been fully engaged in farming and have spent majority of their life time in farming as a result which they become knowledgeable.

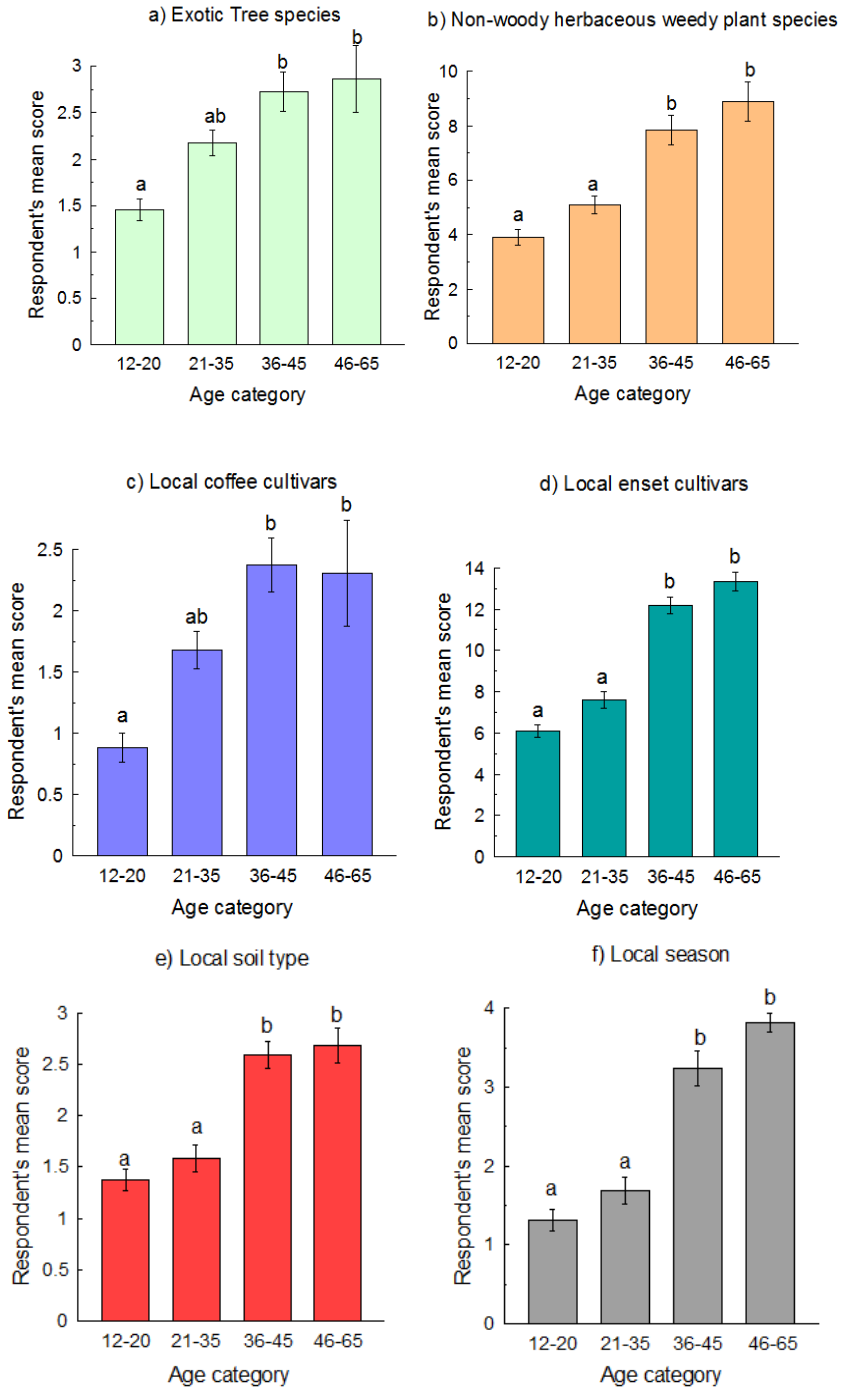


Fig 5.3 : Mean score differences between the generational groups in terms of eco-cognitive dimension of IK of agroforestry systems of Gedeo (Mean ± SE) (a) exotic tree species, (b) Non-woody herbaceous weed species, (c) local coffee cultivars, (d) local soil cultivars, (e) local soil types and (f) local season. NB: the same letter(s) on a consecutive bar show no differences while bars having different letters indicate statistically significant difference between the groups at $p < 0.05$. bar assigned with two letters show that the group is not statistically different from either of the group.

From the discussion held with key informants and interview held with head of households, it was noted that knowledge of local enset and coffee varieties cannot be simply acquired without regular contact with farm field and engagement in farm activities. The majority of young people[17] identify enset using its common name *wesse.* They were not able to identify using its specific local cultivars name like *ganticho, torabe, dine,* and *qarase.* In other words, the probability to acquire knowledge of the species of enset cultivars in everyday life, particularly being out off farms, seems to be unlikely. A person may not be able to distinguish one type of enset cultivar from the other unless he/she is exposed to it often times. The same is true in the case of coffee. Majority of the younger population replied that there are two major coffee cultivars mainly *project buna* ('high yield variety') and n*ebar buna* ('local coffee variety'). The local coffee varieties (*Wolishoo, Kudhumee, Deegaa,* and *Baddeessa*) are not commonly known among majority of the young respondents. The non-woody herbaceous plants are also quite difficult to capture and identify them in the field unless regular visit is made to farm field. Majority of the young respondents have recognized two commonly used herbs *(qorchisa* and *hada'a)* while adults and elders identified more than 10.

Statistically significant mean differences were obtained between the groups concerning their ability to recognize exotic tree species. Majority(>80%) of the adolescent have mentioned eucalyptus tree as the only exotic tree while there are other exotic trees introduced for fodder, firewood and as source of income. Majority of them do not know the newly introduced exotic trees such as *Sesbania sesban (L.) Merr, Grevillea robusta R. Br., Jacaranda mimosifolia D. Don, Moringa oleifera (Bak.f.) Cufod, Casuarina equistefolia L., Azadiraachate indica A.Juss.*and others. Instead, they have mentioned some of the indigenous trees as exotic tree species. However, the remaining was able to identify the newly introduced exotic trees.

On the other hand, statistically significant variation was not observed between the groups in their ability to recognize and name indigenous trees (F=2.309; P=0.077) and wild fruits (F=0.804; P=0.493). This can be attributed to the fact that indigenous tree species and wild fruits that can be learnt at early childhood. The young people raised in rural areas become familiar to indigenous trees and consume forest fruits in their childhood. Children in the rural parts of Gedeo usually start to fetch water, collect firewood, look after cattle and accompany parents when they go to farmland beginning

[17] In this context young people refers to those participants found between 12 and 35 years of age

from the age of five. Therefore, there is a likelihood of acquiring knowledge of indigenous trees and wild fruits in the process of fetching water, collecting firewood and looking after cattle.

The observation made and discussion held with the young people while conducting transect walk also prove that the youth have good knowledge of indigenous trees grown in their locality. Majority (more than 90% of the transect walk participants) of them were able to name and identify commonly used indigenous trees species, such as *dhadhatto (Millettia ferruginea (Hotchst.) Bak, mokkeennssa (Croton Macrostachyus Del), ode'e (Ficus sur Forssk), weleena (Erythrina brucei S chweinf.,* and *ebicha (Vernonia amygdalina Del).* These are the most frequently mentioned indigenous tree species by all age groups. There is a high probability for children of Gedeo to acquire knowledge about *dhadhatto, or mokkeennssa, or ode'e or weleena* because these tree species are often used for production of timber, as fuel wood or for house construction.

Plate 5.1: Children enjoying wild fruits while keeping cattle (Source: the author, 2012)

Wild fruits are favorite food for children of Gedeo. A child who is deployed to keep cattle is likely to consume wild fruits with his/her peer group (Plate 5.1). This practice helps the children to acquire knowledge of wild fruits.

In general, the quantitative results indicates that the knowledge gap is prominent among the generational groups in terms of recognition and naming of local enset cultivars, coffee cultivars, herbaceous non-woody plants, and exotic trees. On the other hand, the gap appears to be insignificant with regard to indigenous trees and wild fruits.

The discussion held with the participants during transect walk also revealed that majority of the young people were able to identify only some of the local enset and coffee cultivars, herbs, and exotic trees. Some of them do not know even the name of local coffee cultivars grown in their

locality, local soil types and local seasons. Majority cannot distinguish among the local enset cultivars. However, they were very good in identifying indigenous tree species.

It can be noticed from the conversation held during transect walk that the young people were not very much committed to farm tasks. Particularly those who completed grade 10 and those who are still attending school were found to be very much negligent of what is going in their locality. Therefore, lack of participation in farm related tasks could be one of the reasons for the less ability of young people to identify and name as much plant species, soil types and local seasons as their elders do.

Therefore, the result obtained from both quantitative and qualitative data revealed that there is a knowledge gap between young people (12-35) and adults (36-65). The gap appears to be prominent between adolescent (12-20) and adulthood (36-45; 46-65). Thus, it can be implied that the young people of Gedeo are less knowledgeable than that of the adults in terms of knowledge of agroforestry practices. One may question whether the gap can be attributed to level of maturity of the respondents or to other factors.

Level of maturity of the young people was not found to be the reason for the knowledge gap as there were young people of the same age group, who were able to identify almost equivalent to their elders. For instance, some young people who have still good acquaintance with their parents and support their family in farming were able to identify more than 80% of plant species. Similarly, from the quantitative data it was found that 60.1 % of younger generation was able to identify more than half of the plant species, among which 7.6% of them identified even beyond elders. Therefore, the differences cannot be attributed to the level of maturity of the respondents. The young people could have recognized at least more than half of the plant species identified by their elders, at this age level due to the fact that acquiring knowledge about plant species usually begin at early childhood, approximately at the age of 6 in Gedeo context.

Under normal circumstance, the young people are expected to perform almost equivalent to their elders, or else they could have shown only little minus from their elders. This is because the gap cannot be attributed to maturity level of the respondents. There might not be a big gap between 20 years old young boy and 40 years old adults given that at the age of 20 one can be able to acquire most of the knowledge and skills in the case of Gedeo zone.

In Gedeo, acquisition of IK begins at the age of 5 or 6 as a child begins assisting his/her parents through fetching water, keeping cattle and collecting firewood. Research findings also revealed that majority of eco-cognitive dimension of IK related to subsistence life are acquired and mastered before the age of 12, particularly in society living subsistent life (Stross, 1973; Namir, 1990; Zarger, 2002; Lozada et al., 2006; Reyes-Garcia et al., 2009). For instance, in research conducted by Ohmagari & Berkes (1997) the Cree people in Moose factory and the Peawanuck in the Western James Bay in Canada learn how to get the wood from the forest at the mean age of eight. That is because of close interaction they have with their parents in their childhood period. Children spend most of their time around homestead collecting wild food resources, playing, or working alongside family members. They learn much of what they know about their biophysical environment from their siblings, their parents, and their grandparents.

Then through observation and practices the acquired knowledge and skills will gradually develop and it remains unchanged for the rest of their life once the young people turn 20 (Stross, 1973; Hunn, 2002; Zarger & Stepp, 2004). Once this knowledge is obtained, it may or may not stay longer with the children depending on their exposure to external environment. There might be a tendency whereby children and young people are likely to lose knowledge they acquired through time because of different factors. There might be also a likelihood of retaining knowledge and skills acquired despite prevailing internal and external factors. When viewed from these perspectives, the young people might have lost some of the agroforestry knowledge through time may be because of lack of interest, limited participation in farming and weak contact with parents and community elders.

5.4.2. The relationship between age and practical dimension of IK

Two approaches were employed to examine age-based variation of IK with respect to practical dimension. In the first approach an attempts was made to examine the variations that exist between and among the respondents in terms of practical knowledge; while in the second approach an attempt was made to investigate an intergenerational variation in terms the participation of the respondents in agroforestry practices.

In the context of the Gedeo agroforestry system, practical knowledge refers to knowledge of land preparation, seedling preparation, sowing and planting of seedlings, management (cultivating, weeding, addition of manure and compost), harvesting and post harvesting tasks, preparation of fodder, beehive production and land management practices.

The computed chi-square results have shown statistically significant association between age and practical knowledge for majority of the agroforestry practices (Table 5.2). As chi-square result does not indicate the extent of relationship between the generational groups, it was not possible to determine the extent of the variation among the age groups. However, one can imply relationships among the group from the percentage of correct and wrong responses though it is not sound to claim statistically significant differences.

The chi-square result indicated that the young people were not able to articulate as much knowledge of agroforestry practices as their elders do. Among the adolescent, on average 52% were able to articulate the agroforestry practices while the remaining 48% found to have no or little knowledge about agroforestry practices. On the other hand, more than 80% of the middle adulthood have got better knowledge agroforestry practices (Table 5.2). For instance, if we take production of enset, more than half of adolescent were found lacking the knowledge to carry out enset suckering, plantation and management of *huffee*, application of locally prepared compost, and control of pest and diseases. The same is true in the case of production of beehive, cattle feeding and indigenous land management practices.

The discussion, interviews and informal conversation held with the local people and observation made have also shown that the young people's knowledge of agroforestry practices is relatively lower than that of the adults. This implies a knowledge gap between young people and adults in terms of essential indigenous agroforestry practices.

Nonetheless, no association was found between age of respondents and ecological interaction between indigenous trees and perennial crops such as coffee and enset (x^2=6.515; P=0.089). In other words, it means that no significant variation was observed between the groups in terms of identifying indigenous trees, which have ecological importance for plants growing beneath. The majority (61%) of the adolescent mentioned dhaadhatto *(Millettia ferruginea (Hotchst.) Bak), weleena (Erythrina brucei* S chweinf.*),* and *wodessa (Cordia africana Lam)* as the dominant indigenous trees having ecological importance. This could be attributed to the widespread use of the indigenous trees as shade, fuel wood and timber production. The discussions and interviews held with young people while conducting a group walk along the transect also confirmed that the majority of the respondents have knowledge about ecological importance of indigenous trees.

Table 5.2: Intergenerational variation of practical knowledge of agroforestry system (n=290)

Indigenous agroforestry practices	Age category[18]								Pearson Chi-Square		
	12-20		21-35		36-45		46-65				
	Y (%)	N (%)	Y (%)	N (%)	Y (%)	N (%)	Y (%)	N (%)	Value	Df	Asymp. Sig. (2-sided)
Propagation of indigenous trees using local methods	73	27	84	16	97	3	96	4	15.979[a]	3	0.001*
Indigenous trees not useful for the growth of coffee and enset	52	48	61	39	76	24	86	14	14.161[a]	3	0.003*
Indigenous trees useful for the growth of coffee and enset	61	39	71	29	76	24	82	18	6.515[a]	3	0.089
Enset suckering	43	57	65	35	92	8	96	4	43.854[a]	3	0.000*
Plantation & management of *huffee*	46	54	68	32	92	8	96	4	40.732[a]	3	0.000*
Application of compost(local)	48	52	54	46	97	3	100	0	46.121[a]	3	0.000*
Protection of enset plant from diseases and pests	37	63	49	51	68	32	73	27	17.362[a]	3	0.001*
Preparation of coffee seedling(n=208)	65	35	82	18	95	5	100	0	15.988[a]	3	0.001*
Plantation and management of coffee seedlings(n=208)	75	25	67	33	71	29	77	23	1.340[a]	3	0.720
Protection of coffee from diseases and pests(n=208)	45	55	62	38	62	38	62	38	5.971[a]	3	0.113
Production & management of annual crops	57	43	64	36	97	3	96	4	30.219[a]	3	0.000*
Ecological interaction b/n annual crops & other components of the system	56	44	60	40	87	13	91	19	19.425[a]	3	0.000*
Ecological importance of non woody herbaceous plants	47	53	59	41	70	30	77	23	11.743[a]	3	0.008*
Cattle feeding systems	57	43	78	22	100	0	100	0	40.060[a]	3	0.000*
Contribution animal dung to soil fertility	56	44	74	26	100	0	100	0	38.794[a]	3	0.000*
Preparation of beehive	61	39	64	36	92	8	91	9	18.626[a]	3	0.000*
Beehive production & harvesting	52	48	63	37	84	16	82	18	17.238[a]	3	0.001*
Soil & water conservation	53	47	55	45	46	54	32	68	4.491[a]	3	0.213
Traditional soil fertility management	43	57	51	49	92	8	91	9	40.122[a]	3	0.000*
Preparation of compost	47	53	67	33	97	3	96	4	44.059[a]	3	0.000*
Urane and its importance	38	62	48	52	97	3	100	0	61.642[a]	3	0.000*
Role of leaf litter in the management of soils	36	64	49	51	27	73	18.2	81.8	11.439[a]	3	0.010*
Mean of Percentage	52	48	63	37	82	18	84	16			

* the association is significant at p<0.050

[18] The total number of respondents of each age category (12-20=**132**; 21-35=**99**; 36-45=**37** and 46-65=**22**).

Lack of participation by 41% of the adolescent is partly attributed to change in life style, which in turn is attributed to modernization. From the discussion and interview held with young people and key informants, it was noted that majority of the young people have less participation in agroforestry practices in recent time.

In addition, soil and water conservation was not found to have an association with age of respondents as chi square result revealed (x^2=4491; P=0.213). It means that there is no difference between the respondents in terms of identifying traditional soil and water conservation practices. Majority of the respondents were not able to distinguish the traditional soil conservation from the modern one. This is due to two factors. The first one is related to the recently introduced watershed development project and the second is related to the influence of formal education.

Currently, all over the country massive works have been going on with regard to resource conservation through watershed development projects. Majority of the farmers have been taking part in watershed development as a result of which they came to know modern methods of soil and water conservation. That is why some farmers were found mentioning soil bund, cut off drain, fanaya juu instead of the traditional soil and water conservation measures.

The other possible factor is the impact of modern education, which is found to be the major source of knowledge of soil and water conservation measures. The young people claim that they have learnt about soil and water conservation practices from lessons to be taught in school. However, nearly half of them were not able to single out the traditional soil and water conservation that the Gedeo people have been using.

In addition to examining their practical knowledge, an attempt was made to investigate the variation that exists between the respondents in terms of their participation in agroforestry practices. Accordingly, the chi-square result revealed strong association between age of the respondents and participation in most of the agroforestry practices. The computed mean percentages for all agroforestry practices have shown variation between young people and adults (Table 5.3). Among the adolescent 41% were found having no participation in agroforestry practices while it is only 27% for middle adulthood. The 27% for middle adulthood is not because of lack of participation; rather it is mainly due to gender-oriented tasks. For instance, enset suckering is mainly the tasks of men while harvesting is solely the duty of women. Likewise, beehive is seldom prepared and hanged by women.

Table 5.3: Intergenerational variation regarding participation in indigenous agroforestry practices (n=290)

Agroforestry practices	Age category								Pearson Chi-Square		
	12-20		21-35		36-45		46-65				
	Y (%)	N (%)	Y (%)	N (%)	Y (%)	N (%)	Y (%)	N (%)	Value	Df	Asymp. Sig. (2-sided)
Land preparation for coffee & enset	74	26	85	15	100	0	100	0	19.592[a]	3	0.000*
Coffee seedling preparation (n=208)	61	39	58	42	100	0	100	0	35.760[a]	3	0.000*
Enset suckering	58	42	44	56	30	70	45	55	11.425[a]	3	0.010*
Transportation of seedlings to farm	84	16	92	8	100	0	100	0	12.082[a]	3	0.007*
Planting coffee and enset	67	33	84	16	100	0	100	0	24.250[a]	6	0.000*
Management coffee & enset field	67	33	92	8	86	13	100	0	24.447[a]	3	0.000*
Cultivation of annual crops	77	23	91	9	100	0	100	0	21.708[a]	3	0.000*
Pruning of shade trees	48	52	67	33	30	70	45	55	15.614[a]	3	0.001*
Preparation of fodder	55	45	50	50	100	0	100	0	45.419[a]	3	0.000*
Coffee harvesting(n=208)	73	27	94	6	100	0	100	0	17.702[a]	6	0.007*
Enset harvesting	22	78	21	79	68	32	50	50	38.079[a]	3	0.000*
Preparation of farm tools	46	54	69	31	30	70	100	0	8.527[a]	6	0.202
Preparation of traditional foods	27	73	21	79	68	0	50	50	32.614[a]	3	0.000*
Animal production	48	52	70	30	100	0	100	0	47.859[a]	3	0.000*
Cattle fattening	55	45	67	33	100	0	100	0	38.782[a]	3	0.000*
Preparation of hive	31	69	19	81	30	70	45	55	8.782[a]	3	0.032
Beehive production	33	67	31	69	30	70	45	55	2.055[a]	3	0.561
Soil & water conservation	47	53	49	51	30	70	45	55	4.174[a]	3	0.243
Soil fertility management	48	52	44	56	43	57	55	45	1.483[a]	3	0.686
Compost preparation	55	45	79	21	100	0	100	0	43.836[a]	3	0.000*
Home garden cultivation	79	21	53	47	100	0	100	0	46.188[a]	3	0.000*
Tree planting	72	28	77	23	30	70	55	45	16.830[a]	3	0.001*
Keeping cattle	63	37	85	15	100	0	100	0	36.852[a]	3	0.000*
Mean percentage	**56**	**44**	**63**	**37**	**73**	**27**	**80**	**20**			

*the association is significant at $p<0.050$

On the other hand, no association was obtained between age of the respondents and agroforestry practices like, soil and water conservation, soil fertility management and beehive production. This could be attributed to gender based practices. These practices are often considered as task of men than women.

5.4.3. The relationship between age and normative dimension of IK

Beside the biophysical component, the socio-cultural elements of the agroforestry system of Gedeo play significant role in determining its sustainability. Socio-cultural values, norms, customary laws, code of conduct, belief systems and rituals are at the center of the agroforestry system. Social institutions that are important for the implementation of IK play a major role in shaping the behavior and attitude of the local people towards natural resources management.

Similar to practical dimension, an intergenerational variation in normative dimension of IK of agroforestry system were assessed using two sets of questions, one examines respondents' knowledge of the socio-culture attributes while the other set of question investigate participation of the respondents in socio-cultural activities. The result is presented in table 5.4 and 5.5.

As indicated in table 5.5, strong associations were observed between age of the respondents and knowledge of the socio-cultural practices. However, no association was obtained between the groups in terms of knowledge of Gedeo clans (x^2=5.782; p=0.123). As indicated in the result, 91% of the adolescent have known clans of Gedeo. The young people have this knowledge from formal school.

Gedeo people have their own traditional ruling systems almost identical to their neighboring Guji *gada* system. Though modern ruling systems prevail in almost all over the zone, *gada* system is still functioning but not as powerful as it used to be.

Although the chi-square result revealed statistically significant association (x^2=22.8; p=0.00) between age of the respondents and knowledge of *gada* system, relatively significant percentage (76%) of the adolescents were able to articulate *gada* system of Gedeo alike their elders. However, majority, including elders themselves, do not know a person who is currently in charge of *baalee* institution. The majority have no idea about the current status of *baalee* institutions and claim that they only know that the institution is active. This implies that the institution is no more playing role in the life of the local people. More than 95% of the respondents claim that the kebele administration is in charge of societal matters and beyond kebele, the woreda and zonal offices act upon the social,

economic and political matters. Nowadays, *gada* institution seems to have less impact on the life of the society because of the prevalence of modern administrative systems.

Table 5.4: Intergeneration variation regarding knowledge of normative dimension of the agroforestry system (n=290)

	Age category								Pearson Chi-Square		
	12-20		**21-35**		**36-45**		**46-65**				
Socio cultural activity	**Y (%)**	**N (%)**	**Y (%)**	**N (%)**	**Y (%)**	**N (%)**	**Y (%)**	**N (%)**	**Value**	**Df**	**Asymp. Sig. (2-sided)**
Baallee institution	74	26	89	11	100	0	100	0	22.862[a]	3	0.000*
Current *abagada*	1.5	98.5	2	98	29.7	70.3	22.7	77	48.249[a]	3	0.000*
Clans in Gedeo	91	9	91	9	100	0	100	0	5.782[a]	3	0.123
Cultural practices related to graveyard	14	86	30	70	76	24	77	23	73.661[a]	3	0.000*
Cultural practice	24	76	53	47	87	13	82	18	64.441[a]	3	0.000*
Worqo	8	92	18	82	92	8	100	0	1.601E2[a]	3	0.000*
Gadabo	12	88	26	74	97	3	96	4	1.336E2[a]	3	0.000*
Haafa	8	92	27	72	97	3	100	0	1.514E2[a]	3	0.000*
Xeeroo	30	70	61	39	97	3	100	0	80.217[a]	3	0.000*
Wilisha	31	69	36	64	92	8	100	0	72.788[a]	3	0.000*
Mean Percentage	**29.4**	**70.6**	**43.3**	**56.7**	**86.8**	**13.2**	**87.8**	**12.2**			

*the association is significant at $p<0.050$

The survey result also revealed that majority of the adolescent (>75%) were not well aware of the socio-cultural practices such as *ciincessa, xeeroo, haafa, gadabo, wilisha* and others. Some replied that they have not heard of them. The majority (84%) were not able to explain why the people mark the graveyard of their family or relative with indigenous trees such as *Waaleena(rythrina brucei S chweinf.)* and *adaamaa(Euphorbia abyssinica Gmel).* Only 14% of them were able articulate the tradition of planting indigenous trees on graveyard. This indicates a knowledge gap between the young generation and the older one.

In addition to generational differences in knowledge of the socio-cultural practices, significant variation was observed between the generational groups in terms of participation in socio-cultural practices. The chi square result indicated very strong associations between age of the respondents and their participation in socio-cultural practices (Table 5.5). Similarly, the discussion and interview held with key informants and other participants have shown that young people's participation in socio-

cultural practices is relatively lower than that of their elders. The young people are not as such interested to attend and participate in most of the cultural practices. The recent trend shows that the elders themselves are not conducting some of the cultural practices.

Table 5.5: Intergenerational variation regarding participation in socio-cultural activities(n=290)

	Age category								Pearson Chi-Square		
	12-20		21-35		36-45		46-65				
Socio cultural activities	Y (%)	N (%)	Y (%)	N (%)	Y (%)	N (%)	Y (%)	N (%)	Value	Df	Asymp. Sig. (2-sided)
Traditional dances	39	61	76	24	100	0	100	0	73.937[a]	3	0.000*
Participation in *Songo*	21	79	15	85	30	70	45	55	11.320[a]	3	0.010*
Traditional belief system (*Cincessa* and others)	27	73	32	68	87	13	91	9	68.813[a]	3	0.000*
Traditional conflict resoultion	21	79	17	82	27	73	46	54	8.843[a]	3	0.031*
Qeexella	37	63	74	26	97	3	100	0	73.569[a]	3	0.000*
Mean score	**29**	**71**	**42.8**	**57.2**	**68.2**	**31.8**	**76.4**	**23.6**			

*the association is significant at p<0.050

In conclusion, among the three dimensions of IK, normative dimension was found to be more prone to change than the other two dimensions. Relatively high rate of erosion is observed in normative dimension. Some of the cultural practices are completely abandoned while others are less practiced. Because of less participation and interest by the young people, there is likelihood of disappearance of the practices in the future.

5.5. Agroecology based variation of IK of agroforestry system

The agroforestry system of Gedeo varies across agroecology. As described in chapter four, enset based agroforestry system is dominant in the cold highland region (Dega) while coffee-enset and fruit-coffee based agroforestry systems are common in midland (*Woinadega*) and lowland (*Kolla*) regions respectively.

The cold highland region is known for its production of annual crops and enset, with no or limited production of coffee. On the other hand, the midland region (*Woinadega*) is known for its production of both perennial and annual crops, well integrated with indigenous trees, herbs and fruits. The land use system in lowland region (*Kolla*) partly reflects the land use of midland region and partly the cold highland region. The transitional zone between midland and lowland consists of multistory land use system; while in areas near to neighboring Guji Oromo, cereal crop production is common.

An attempt was made to examine the variation of eco-cognitive, practical and normative dimensions of IK of agroforestry system across agroecology. The result is presented below in section 5.5.1, 5.5.2 and 5.5.3.

5.5.1. The relationship between agroecology and eco-cognitive dimension of IK

According to the survey conducted, eco-cognitive dimension of IK was found to be varying across agroecology. The computed ANOVA results (F=18.05, P=0.000) have shown statistically significant mean difference between respondents of the three agroecological regions in terms their ability to recognize and name indigenous trees. Residents of*dega* (Mean=6.13; SD= 4.17) were found responding less than that of *Kolla* (Mean=9.17; SD=3.55) and W/Dega (Mean=9.16; SD=3.8) agroecological regions (see fig 5.4a). Post Hoc analysis also indicated statistically significant mean difference between *dega* and the other two-agroecological regions (W/Dega and *Kolla*). However, no mean difference was observed between the local people residing in *Kolla* and W/Dega agroecological regions (see fig 5.4). This can be attributed to land use system and climate related factors.

Because of extensive production of cereal crops and other vegetables, which do not require shade, substantial parts of the cold highland region are sparsely covered by indigenous trees. The farmlands are open with trees occupying farm boundary or roadside. Consequently, tree species are less abundant in the cold highland region than the *Woinadega* and *Kolla* agroecological regions.

On the contrary, the midland region is composed of multilayered type of land use system, in which indigenous tree species occupying the upper layer, while coffee and enset occupying the middle layer. Diversity of tree species of trees are found in this agroecological region. The lowland is also partly covered by diversity of tree species. Therefore, the presence of vast cover of indigenous trees is an opportunity for the inhabitants of these agroecological regions to acquire knowledge about its production and management as well.

The second factor is related to climatic variation among the agroecological region and this has a profound effect on distribution of tress and hence on IK related to recognition of indigenous tree species. Obviously, tree species do have their own specific requirements for climate. Some trees may grow in cold climate while others may not. For instance, indigenous trees such as *Hagenia abyssinica (Bruce) J.F.Gmel* and *Arundiaria alpina K.Schum* are only found in cold region. On the other hand, indigenous trees such as *Millettia ferruginea (Hotchst.) Bak , Ficus vasta Forssk* and *Croton Macrostachyus Del* are rare in the cold highland regions. The *Woina dega* agroecological region support variety of tree species than *dega* and *Kolla*. Some of the indigenous trees found in other two agroecological region were not present in *dega* partly because of climate. The findings of Mesele et al. (2011) also revealed that the mid land region covering an altitudinal range between 1500 to 2400 m asl consists of high proportion of native woody species. Therefore, one can claim that *dega* agroecological region supports less tree species than *Woina dega* as a result of which limited indigenous trees were identified by the key informants inhabiting the cold highland region.

Statistically significant mean differences were also observed in the ability of respondents of different agroecology to recognize and name wild fruits. Respondents residing in *Kolla* agroecological region identified relatively large number of wild fruits (Mean=3.02; SD= 177) than respondents from *Woina dega* (Mean=1.97; SD=1.767) and *dega* (Mean=2.07; SD=1.66)(see fig 5.4e). Despite thick vegetation cover, the inhabitants of *Woina dega* identified less number of wild fruits. This can be attributed to the differences in cattle feeding systems. Because of lack of grazing land, majority of the Gedeo people inhabiting the densely populated and intensively cultivated midland region feed their cattle through stall-feeding and cut carry system. In some cases, the people may let their cattle to graze around roadside. Therefore, children in the midland region might have little chance of consuming wild fruits found in their locality, as there is no way to keep cattle *en mass* in an open grazing land.

On the other hand, cattle graze in an open grazing land in *Kolla* and *dega* agroecological regions as a result of which children and young people have a better chance of consuming wild fruits (plate 5.1). This could be one of the reasons for the better identification of wild fruits.

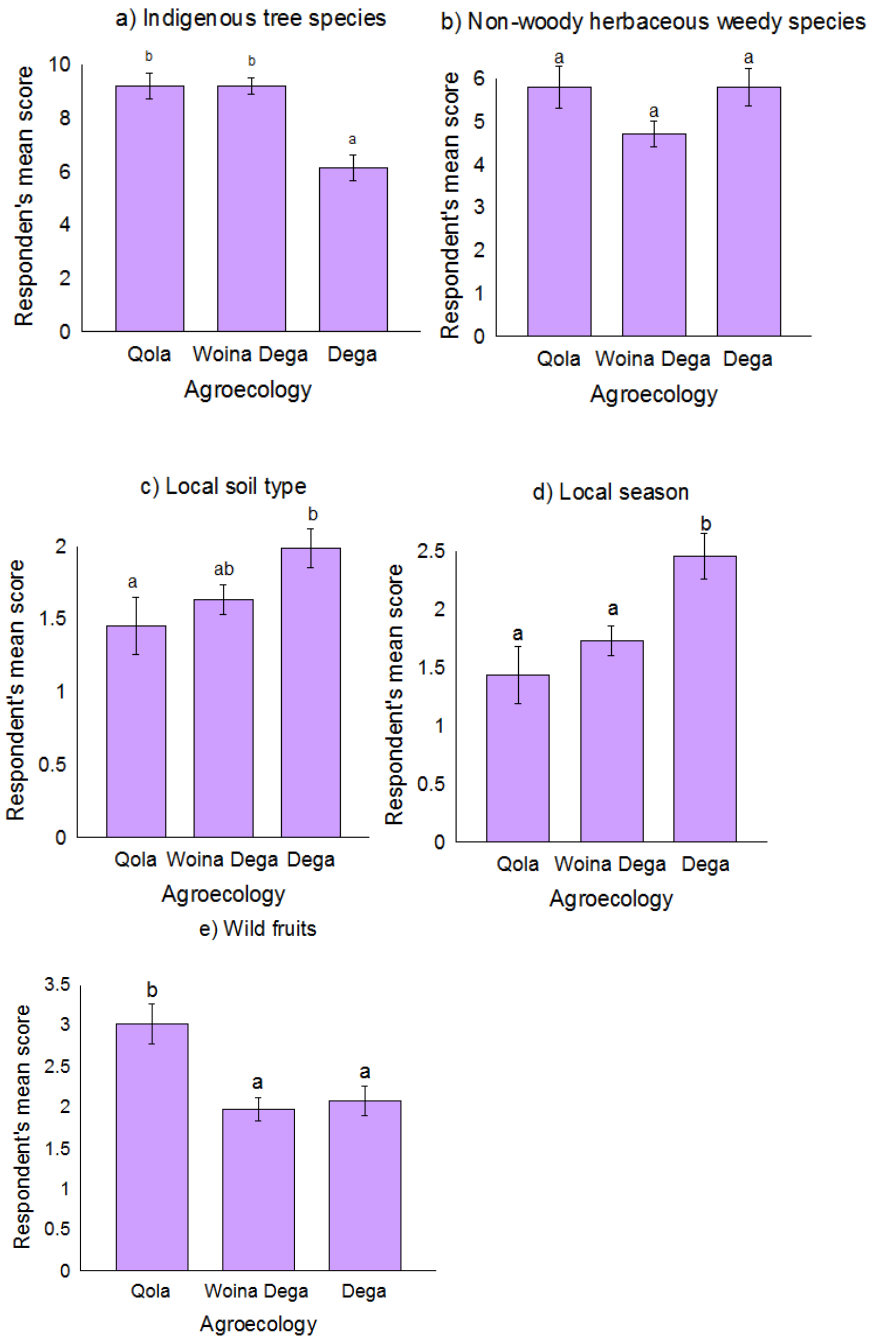


Fig 5.4 : Mean score differences between respondents of the three agroecological regions in terms of eco-cognitive dimension of IK of agroforestry systems (Mean ± SE) (a) indigenous tree species, (b) Non-woody herbaceous weed species, (c) local soil type, (d) local season and (e) wild fruits. (NB: the same letter(s) on a consecutive bar show no differences while bars having different letters indicate statistically significant difference between the groups at $p < 0.05$. bar assigned with two letters show that the group is not statistically different from either of the group.

There is no significant mean differences between respondents of the three agroecological regions in terms of their ability to recognize exotic trees (F=2.586; P=0.077), enset cultivars (F=2.195; P=0.113), coffee cultivars (F=1.664; P=0.199) and local soil types (F=3.035; P=0.050). The wider distribution of *Eucalyptus spp*. and *Juniperus procera Hotchst ex.Engl* in all agroecology is one possible reason behind similarity in respondents' ability to identify exotic tree species in the three agroecological regions. Majority of the respondents in all agroecological regions responded that *Eucalyptus spp.* and *Juniperus procera Hotchst ex.Engl* are the two common exotic tree species found in Gedeo.

The widespread occurrence of enset in all agroecology is also the principal reason behind absence of statistically significant difference between the respondents of the three agroecology. Enset is the only major staple food of the community irrespective of agroecological location. Therefore, one may not expect differences in identification of enset cultivars mainly because of agroecological differences.

Plate 5.2: Mass of cattle grazing on an open land (Source: The author, 2012)

Except in the cold highland region, coffee grows almost in most parts Gedeo. Coffee is the major cash crop of the area. It might be difficult to get a person who does not have coffee field in coffee producing region of Gedeo zone. Therefore, one may not expect significant variation in knowledge

of coffee cultivars because of only agroecological variation. There could be variation in other aspects such as age or gender. However, agroecologically, no difference was noticed in terms of the ability of respondents in identifying coffee cultivars.

In general, it can be implied from the analysis made that the eco-cognitive aspects of IK of agroforestry system of Gedeo have exhibited difference in some elements while showing no variations in other elements. The difference is significant between *dega* and other two agroecological regions. This is mainly due to the presence of distinctive land use system and local climate.

On the other hand, the variation between *Kolla* and *Woina dega* was found to be less significant due to the fact that majority of the region categorized as *Kolla* exhibit more or less the same type of local climate. The land use system is also more or less the same except the introduction of cereal crops production in the lower parts of *Kolla* region. Even in the lower part, there are pockets of land occupied by coffee and indigenous trees (Plate 5.3).

Plate 5.3: Parts of the lower region of *Kolla* agroecological region hosting coffee under the canopy of *Ficus* species (Source: The author, 2012)

5.5.2. The relationship between agroecology and practical knowledge

The Chi-square test results have shown no association between respondents of the three agroecology in their knowledge of the majority of agroforestry practices. Relatively strong association (X_2=8.45; df=3; P=0.015) was obtained between agroecology and respondents knowledge of ecologically important tree species. The difference seems to be high between *dega* (55%) and, the other two agroecological regions (*Woina dega* (73%) and *Kolla* (71%)). The difference can be attributed to the value given to indigenous trees. For the people of *dega*, the economic importance of trees is much greater than their ecological importance.

It seems that there is an association between agroecology and methods of propagation of indigenous trees, and methods used to control enset pest and diseases. The association seems to be not strong enough to claim that the practices vary across agroecology. The computed percentage indicated that there are no as such significant differences between respondents of the different agroecology.

In addition to assessing the practical knowledge of the respondents, an attempt was made to assess the difference between the respondents of the three agroecology based on their actual engagement in selected practical activities. The Chi-square test revealed that there is no association between agroecology and respondents' participation in majority of practical activities. Association was found only for activities such as soil fertility management, compost preparation, tree planting, and looking after cattle. Percentage of respondent who reported that they have been participating in soil fertility management varies between *Kolla* (74%) and *Woina dega* (41%) and *dega* (41%).

As the chi square result revealed (X_2=9.95; df=2; P=0.007), there is an association between tree planting practices and agroecology. The inhabitants of *Kolla* (87%) are more engaged in tree planting than inhabitants in *Woina dega* (64%) and *dega* (65%) agroecological regions. This might be due to introduction of watershed management practices in Qoal region. In fact, watershed is also introduced in the middle and highland region, but the presence of highly degraded land in the lowland region might have necessitated the plantation of trees. The respondents have been organized by the development agents to plant trees on severely degraded lands. This might be one potential reason why high response rate is given by respondents from *Kolla* agroecological region.

Table 5.6: Agroecology based variation in respondent's knowledge of practical skills

Activities	Agroecology						Pearson Chi-Square		
	Kolla		W/Dega		Dega				
	Y (%)	N (%)	Y (%)	N (%)	Y (%)	N (%)	Value	df	Asymp. Sig. (2-sided)
Propagation of indigenous trees	68	32	88	12	77	23	12.45	2	0.002*
Indigenous trees not useful for the growth of coffee and enset	62	38	62	38	56	44	0.864	2	0.649
Indigenous trees useful for the growth of coffee and enset	71	28	73	27	55	45	8.454	2	0.015*
Enset suckering	60	40	58	42	66	34	1.366	2	0.505
Plantation and management of huffee	64	36	61	39	67	33	0.866	2	0.649
Application of locally prepared compost	70	30	58	42	58	42	2.614	2	0.271
Protection from diseases and pests	60	40	50	50	35	65	8.386	2	0.015*
Preparation of coffee seedling	79	21	75	27			0.31	1	0.577
Plantation and management of coffee seedlings	74	26	71	29			0.133	1	0.715
Protection of coffee from diseases & pests	52	42	52	48			617	1	0.432
Production of annual crops	60	40	58	42	89	11	24.72	2	0.000*
Ecological interaction between annual crops and other components of the system	62	38	65	35	62	38	0.27	2	0.874
Ecological interaction of non woody herbaceous plants	62	38	54	46	56	44	1.046	2	0.593
Cattle feeding systems	83	17	73	27	66	34	4.776	2	0.092
Contribution animal rearing for soil fertility	72	28	73	27	66	34	1.557	2	0.459
Preparation of beehive	74	26	70	30	60	40	4.315	2	0.116
Bee hive production	75	25	60	40	56	44	5.534	2	0.063
Soil and water conservation	38	62	53	47	56	44	4.803	2	0.091
Traditional soil fertility management	49	51	54	46	62	38	2.486	2	0.288
Preparation of compost	66	34	64	36	62	38	0.207	2	0.902
Urane	55	45	52	48	56	44	0.34	2	0.844
Role of leaf litter in the management of soils	45	55	41	59	28	72	5.103	2	0.078

*the association is significant at $p<0.050$

Relationship was also found between participation in cattle keeping and agroecology(X_2=11.88; df=2; P=0.030). Local people in *dega* and *Kolla* agroecological regions are found more engaged in cattle keeping than local people in the W/Dega region. This is mainly due to the possibility of keeping cattle *en masse* because of availability of grazing land in the *dega* and *Kolla* agroecology.

Despite the variation in land use systems between and among the agroecological regions, it appears that substantial variations were not observed between the residents of the three agroecological regions in terms of their knowledge of agroforestry system and participation in agroforestry practices. This could be due to the presence of shared knowledge and practices among the communities living in the area. Some farmers reported to have farmlands in more than one agroecology. The possession of farmlands in two or more agroecological regions could be also the reason behind lack of significant difference among the communities.

Table 5.7: Agroecology based variation in respondent's participation in agroforestry practices (n=290 except non coffee producing region)

Agroforestry practices	Agroecology						Pearson Chi-Square		
	Kolla		*Woina dega*		Dega				
	Y (%)	N (%)	Y (%)	N (%)	Y (%)	N (%)	Value	df	Asymp. Sig. (2-sided)
Land preparation for coffee & enset	91	9	84	16	77	23	4.466	2	0.107
Seedling preparation(coffee)	70	30	68	32	nd	Nd	0.234	2	0.890
Enset suckering	43	57	51	49	48	52	0.958	2	0.619
Transporting seedling to farmland	89	11	88	12	94	6	1.938	2	0.379
Plantation of coffee and enset	87	13	76	24	nd	nd	2.693	1	0.101
Weeding & slashing of coffee & enset field	77	23	79	21	83	17	0.71	2	0.710
Cultivation of farmland	87	13	84	16	90	10	1.85	2	0.396
Pruning of coffee shade	62	38	54	46	17	83	37.486	2	0.000*
Preparation of fodder	64	36	57	43	71	29	4.135	2	0.127
Coffee harvesting	98	2	91	9	nd	Nd	3.014	1	0.083
Enset harvesting	28	72	30	70	28	72	0.166	2	0.921
Preparation of farm tools	41	59	32	67	50	50	7.946	4	0.940
Fetching water	89	11	90	10	95	5	2.389	2	0.303
Preparation of traditional foods	28	72	34	66	30	70	0.583	2	0.747
Collection of firewood	87	13	86	14	89	11	0.331	2	0.848
Animal production	70	30	61	39	74	26	4.444	2	0.108
Cattle fattening	68	32	64	36	76	24	3.392	2	0.183
Preparation of hive	26	74	30	70	24	76	0.795	2	0.672
Beehive production & harvesting	32	68	34	66	30	70	0.348	2	0.840
Soil and water conservation	55	45	43	57	44	56	2.423	2	0.298
Soil fertility mgt practices	74	26	41	59	41	59	18.563	2	0.000*
Compost preparation	83	17	66	34	78	22	7.675	2	0.022*
Home garden cultivation	68	32	74	26	78	22	1.722	2	0.423
Tree planting	87	13	64	36	65	35	9.946	2	0.007*
Keeping cattle	83	17	70	30	89	11	11.882	2	0.003*

*the association is significant at $p<0.050$

5.5.3. The relationship between agroecology and normative dimension of IK

The chi-square test results have shown strong association only between agroecology and the ability of the respondents to identify the current *abba gada*, leading the *baalee* institution and cultural practices known as *ciincessa and wi'lisha*. The strong association that exists between agroecology and current *aba gada* might lead to the inference that knowledge gap exist between the residents of the three agroecology. When percentage of respondents of each agroecology is observed, the difference seems not as such significant (Table 5.8). From the discussions and interview held with local people of all agroecology, it can be noted that majority (>80%) have no idea about who is leading the *baalee* institution.

Table 5.8: Agroecology based variation in respondent's knowledge of socio cultural practices (n=290)

	Agroecology						Pearson Chi-Square		
	Kolla		*Woina dega*		Dega				
Socio-cultural elements	Y (%)	N (%)	Y (%)	N (%)	Y (%)	N (%)	Value	df	Asymp. Sig. (2-sided)
Baallee institution or Gada system	83	17	82	18	90	10	2.93	2	0.231
Current *abagada*	15	85	1	99	12	88	16.72	2	0.000*
Clans in Gedeo and owns clan	94	6	93	7	90	10	1.113	2	0.573
Cultural practices related to graveyard	45	55	28	72	30	70	5.307	2	0.700
Cultural practice locally known as *Ciincessa*	68	32	34	66	54	46	20.898	2	0.000*
Worqo	32	68	26	74	33	67	1.626	2	0.443*
Gadebo	34	66	30	70	41	59	2.961	2	0.227*
Haafa	38	62	29	71	38	62	2.492	2	0.288*
Xeeroo	62	38	50	50	56	44	2.445	2	0.294*
Wi'lisha	41	59	54	46	33	67	10.264	2	0.006*

*the association is significant at $p<0.050$

Similarly, the chi-square results have shown strong association between the participants of the three agroecogical regions in terms of cultural practices known as *ciincessa* (X_2=20.898;df=2; P=0.000) and *wi'lisha* (X_2=10.264;df=2; P=0.006). The computed percentage indicated that only 34% of

respondents selected from *woina dega* have given correct answer about *ciincessa.* As far as data obtained via discussion and key informant interview is concerned, no significant difference were observed between respondents of the three agroecology.

In general, it can be implied that the knowledge about socio-cultural practices seems to be not varying across agroecology. The chi square test revealed strong relationship between some cultural practices and agroecology. The information obtained via discussion and interview were not in support of the quantitative results. Therefore, one can infer from the data obtained from both qualitative and quantitative analysis that significant variation does not exist across agroecology, however, there is a trend that majority of the respondents have little knowledge about socio-cultural practices.

Table 5.9: Agroecology based variation in respondent's participation in socio-cultural practices (n=290)

	Agroecology						Pearson Chi-Square		
	Kolla		*Woina dega*		Dega				
Socio-cultural practices	Y (%)	N (%)	Y (%)	N (%)	Y (%)	N (%)	Value	Df	Asymp. Sig. (2-sided)
Traditional dance	74	26	59	41	67	33	3.905	2	0.142
Participation in *Songo*	21	79	21	79	23	77	0.147	2	0.929
Traditional belief system (*Ciincessa* and others)	17	83	43	57	54	46	18.23	2	0.000*
Traditional conflict resolution	19	81	18	82	33	67	7.281	2	0.026*
Participation in *Qeexella* practices	70	30	55	45	71	29	7.405	2	0.025*

*the association is significant at p<0.050

Regarding the relationship between agroecology and participation of respondents in cultural practices, some differences were noticed. For instance, very strong relationship was obtained between participants of different agroecology in their participation in traditional belief system. The difference can be attributed to level of exposure to modernity. As compared to inhabitants of *dega* and *Woina dega* agroecological regions, the inhabitants of *Kolla* seem to be exposed to the influence of modernity because of its accessibility to main road and urban centers. That is why the number of respondents who participated was relatively less than the other two agroecologicla regions.

5.6. Gender based differences of IK of agroforestry system

Broadly speaking, gender based division of labor is reflected among the people. In tradition, women are usually responsible for household chores while male shoulder the responsibility of managing the land and the resources in general. This tradition of gender based labor division persisted for longer time but nowadays it seems that the division is becoming narrow.

5.6.1. The relationship between gender and eco-cognitive dimension of IK

An independent sample t-test was computed to examine the gender based variation of eco-cognitive dimension IK. The result of the test indicated statistically significant means score difference between male and female in their ability to recognize and identify indigenous trees (t: 4.79; df: 254; p: 0.000). The mean score of male respondents for indigenous trees (Mean=9.06; SD=4.29) was found to be higher than their counter part, female (Mean= 6.9; SD= 3.26), implying that the number of indigenous tree species identified by male respondents was found to be greater than female. This could be not attributed to fact that female respondents are less knowledgeable as compared to male respondents. The difference could be attributed to the fact that they do not feel comfort to sit and speak in public.

On the other hand, no statistically significant mean differences were obtained between male and female respondent in terms of their ability of identifying exotic tree species(t:1.502; df:239;p:0.134), wild fruits(t:1.091; df:227;p:0.277), non-woody herbaceous plants(t:1.575; df:234;p:0.117), enset cultivars(t:-0.149; df:288;p:0.882), coffee cultivars(t:1.055; df:206;p:0.292), local soil type(t:-2.022; df:223;p:0.044), and local season(t:-1.64; df:217;p:0.103). Even in some cases, female respondents were found performing much better than their male counterpart.

5.6.2. The relationship between gender and practical dimension of IK

Gender based variation of practical dimension of IK was examined by measuring knowledge of agroforestry practices of both male and female and their participation in agroforestry practices. Accordingly, the survey conducted indicated that there is no as such significant variation between men and women in terms of their knowledge of agroforestry practices except some practices which are conducted by male or female alone. Though women involvement in the majority of agroforestry practices seems to be limited, they were found to have better knowledge about what is being practiced in their locality.

Table 5.10: Gender based variation in respondent's knowledge of agroforestry practices(n=290 except non coffee producing regions)

Indigenous agroforestry practices	Gender				Pearson Chi-Square		
	Male		Female				
	Y (%)	N (%)	Y (%)	N (%)	Value	Df	Asymp. Sig. (2-sided)
Propagation of indigenous trees through traditional methods	81	19	82.2	17.8	0.65	1	0.798
Indigenous trees not useful for the growth of coffee and enset	67	33	48	52	10.64	1	0.001*
Indigenous trees useful for the growth of coffee and enset	74	25	55	45	12.2	1	0.000*
Enset suckering	61	39	59	41	0.107	1	0.744
Plantation and management of *huffee*	64	36	62	38	0.256	1	0.613
Application of compost(local)	59	41	62	38	0.365	1	0.317
Protection from diseases and pests	50	50	44	56	1.091	1	0.296
Preparation of coffee seedling(n=208)	81	19	69	31	0.133	1	0.715
Plantation and management of coffee seedlings(n=208)	77	23	61	39	6.126	1	0.013*
Protection from diseases and pests(coffee)(n=208)	62	38	40	60	9.048	1	0.003*
Annual crops production	71	29	60	40	3.297	1	0.069
Ecological interaction b/n annual crops and other components of the system	68	32	56	44	3.632	1	0.057
Ecological interaction of non woody herbaceous plants	58	42	52	48	0.877	1	0.349
Cattle feeding systems	73	27	71	29	0.148	1	0.700
Contribution of livestock production for soil fertility	73	27	68	32	0.556	1	0.456
Preparation of beehive	69	31	67	33	0.064	1	0.800
Bee hive production and harvesting	68	32	50	50	9.794	1	0.002*
Soil and water conservation	55	45	45	55	2.753	1	0.097
Traditional soil fertility management	57	43	54	46	0.264	1	0.607
Preparation of compost	65	35	61	39	0.389	1	0.533
Urane	50	50	61	39	3.595	1	0.058
Role of leaf litter in the management of soils	43	57	29	71	5.593	1	0.018*

*the association is significant at $p<0.050$

The chi-square test has shown strong association between gender and ecological role of indigenous trees (X_2=10.64;df=1; P=0.001), role of exotic trees (X_2=12.2;df=1; P=0.000), plantation and management of coffee seedlings (X_2=6.13;df=1; P=0.013), protection of coffee plants from pests and diseases (X_2=9.05;df=1; P=0.003), production of honey (X_2=9.79;df=1; P=0.002) and ecological role of leaf litter (X_2=5.59;df=1; P=0.018). Though the chi-square test revealed strong association between gender and some agroforestry practices, it does not mean that female respondents were less knowledgeable than that of male respondents. The difference is partly due to the fact that the majority rural women do not feel comfort to respond to questions that are forwarded to them as the tradition to speak out in public is not usual.

However, there are specific agroforestry practices, which are exclusively conducted by male or female and a result of which knowledge difference exist between male and female. For instance, the responsibility of preparing beehives, hanging the hive and harvesting honey is solely the task of men. It is very unusual to come across women conducting such activities. Similarly, crop cultivation and related activities is traditionally assumed to be the duty of men though women have also the right to engage in crop and land management practices. Of course, there is no legal ground that prohibits women from being involved in crop and land management practices.

With regard to participation in the agroforestry practices, differences were obtained between male and female respondents. The participation of women is very much limited in agroforestry practices such as enset suckering, pruning of shade, preparation of farm tools, preparation of beehives, production of honey, and soil and water conservation. There is a tradition that such activities are conducted by male alone. On the other hand, activities such as enset harvesting and preparation of traditional food are exclusively the task of women. Traditionally, women are more responsible for household chores while male take the responsibility of handling farm related tasks. The role to harvest enset and prepare any traditional food is vested on women alone; while the duties related to land is entirely vested on men. However, women often conduct some of farm activities too, but only as assistant to their husband. The right to use the land for production of both annual and perennial crops is decided by male.

The chi-square tests have shown strong association between participation of the respondents in agroforestry practices such as coffee shade pruning, preparation of farm tools, traditional foods, enset suckering and others (Table 5.11). The difference is principally attributed to gender based labor division.

Table 5.11: Gender based variation in respondent's participation in agroforestry practices (n=290 except non coffee producing region)

Agroforestry practices	Gender				Pearson Chi-Square		
	Male		Female				
	Y (%)	N (%)	Y (%)	N (%)	Value	df	Asymp. Sig. (2-sided)
Land preparation for coffee & enset	88	12	74	26	8.636	1	0.003*
Seedling preparation(coffee)(n=208)	69	31	64	36	0.738	1	0.390
Enset suckering	66	34	16	84	66.656	1	0.000*
Transporting seedling to farmland	90	10	90	10	0.002	1	0.967
Plantation of coffee and enset	87	13	65	35	12.841	2	0.000*
Weeding & slashing (coffee & enset)	86	14	68	32	13.221	1	0.000*
Cultivation of farmland	91	9	78	22	8.319	1	0.004*
Pruning of coffee shade(n=208)	65	35	8	92	86.831	1	0.000*
Preparation of fodder for animals	59	41	69	31	3.139	1	0.076
Coffee harvesting(n=208)	93	7	92	8	0.601	2	0.740
Enset harvesting	0	100	84	16	2.25E+02	1	0.000*
Preparation of farm tools	52	48	14	86	42.12	2	0.000*
Fetching water	88	12	97	3	6.825	1	0.009*
Preparation of traditional foods	0	100	91	9	2.52E+02	1	0.000*
Collection of firewood	83	17	95	5	8.488	1	0.004*
Animal production	68	32	64	36	336	1	0.562
Cattle fattening	68	32	67	33	0.026	1	0.872
Preparation of hive	41	59	2	98	50.866	1	0.000*
Beehive production and harvesting	48	52	5	95	54.405	1	0.000*
Soil and water conservation	63	37	12	88	69.35	1	0.000*
Soil fertility mgt practices	60	40	23	77	36.216	1	0.000*
Compost preparation	75	25	67	33	2.008	1	0.157
Home garden cultivation	67	33	87	13	13.64	1	0.000*
Tree planting	85	15	39	61	64.804	1	0.000*
Keeping cattle	77	23	80	20	463	1	0.496

*the association is significant at $p<0.050$

5.6.3. The relationship between gender and normative dimension of IK

Result of chi square indicates no relationship between gender and respondents' knowledge of cultural practices except *worqo, gadabo* and *haafa*. Two of these cultural practices (*gadabo, haafa*) are related to women's maternity as a result of which the total percentage of females who have known is greater than male. Women respondents got better knowledge about practices related to customary mourning ceremony mainly *worqo* and *wi'lisha.*

Table 5.12: Gender based variation in respondent's knowledge of socio-cultural activities (n=290)

Cultural elements and practices	Gender				Pearson Chi-Square		
	Male		Female				
	Y (%)	N (%)	Y (%)	N (%)	Value	Df	Asymp. Sig. (2-sided)
Baallee institution or *Gada* system	86	14	81	19	1.283	1	0.257
Current *abagada*	7	93	7	93	0.000	1	0.987
Clans in Gedeo and owns clan	91	9	96	4	2.484	1	0.115
Cultural practices related to graveyard	30	70	36	64	0.909	1	0.340
Cultural practice locally known as *Ciincessa*	48	52	42	58	0.675	1	0.411
Worqo	19	81	48	52	25.943	1	0.000*
Gadabo	23	77	55	45	31.249	1	0.000*
Haafa	23	77	53	47	26.262	1	0.000*
Xeeroo	52	48	57	43	0.675	1	0.411
Wi'lisha	40	60	57	43	8.346	1	0.004*

*the association is significant at p<0.050

Gender was not found to be a determinant factor in the participation in cultural practice such as traditional dance, traditional belief systems and participation in *qeexxella*. The computed chi-square result for traditional dance (X_2=3.44; df=1; P=0.063), *ciincessa* (X_2=2.698; df=1; P=0.10) and *qeexella* (X_2=1.82; df=1; P=0.177) have shown no relation with gender. This implies that traditional dance can be conducted irrespective of gender. In addition, there is no any barrier, which inhibits women to take part in any traditional belief systems. However, according to the oral tradition women are not entitled to lead the traditional belief system, as they are not legitimate to assume any position

in *baalee i*nstitution. Participation in *qeexxella* is also possible for both male and female. The only gender based cultural activities are *songo* and arbitration through traditional methods. In these two cultural practices, women seldom assume responsibility. The full responsibility to conduct *songo* meetings and traditional conflict resolution is vested on men than women.

Table 5.13: Gender based variation in participation in socio-cultural practices (n=290)

	Gender				Pearson Chi-Square		
	Male		Female				
Cultural activities	Y (%)	N (%)	Y (%)	N (%)	Value	Df	Asymp. Sig. (2-sided)
Traditional dance	60	40	71	30	3.444	1	0.063
Participation in *Songo*	31	69	4	96	28.76	1	0.000*
Traditional belief system practices	38	62	47	53	2.698	1	0.100*
Traditional conflict resolution	31	69	6	94	24.18	1	0.000*
Participation in *Qeexella* practices	59	41	67	33	1.82	1	0.177

*the association is significant at $p<0.050$

5.7. Discussion

The changes and continuities of IK are determined by different factors, among which its transmission and acquisition across and within generations is the principal one. As IK is oral in its nature, its continuity is ensured when there is an intergenerational transmission and when it remains functional.

In this regard, this study identified that the rate at which IK is transmitted among successive generations is declining. Like indigenous people in other parts of the world, the Gedeo people communicate their local wisdom among each other through oral communication and demonstration methods. Parents are playing a major role in the transmission of knowledge and skills related to indigenous agroforestry practices (see section 5.3 for detail). On the other hand, community elders were found transmitting knowledge and practices related to cultural values and norms.

Therefore, given that parents are the major transmitter of IK of agroforestry practices, decline in IK transmission can occur when communication between parents and their children, and between and among community elders is relatively slow. Undoubtedly, there is loose contact between parent and children, and between young people and community elders. Young people of Gedeo are not eager to acquire knowledge and skills related to agroforestry system principally due to change in value

system. Likewise, parents and elderly people are also not courageous to impart their local wisdom to the younger generation due to the expectation that their knowledge and skills are inferior to the knowledge and skills that their children get from formal schooling. The loose contact between and among elderly people is in turn attributed to modernization. The Cree people of Canada are also experiencing the same challenges regarding the transmission of IK (Ohmagari & Berkes, 1997).

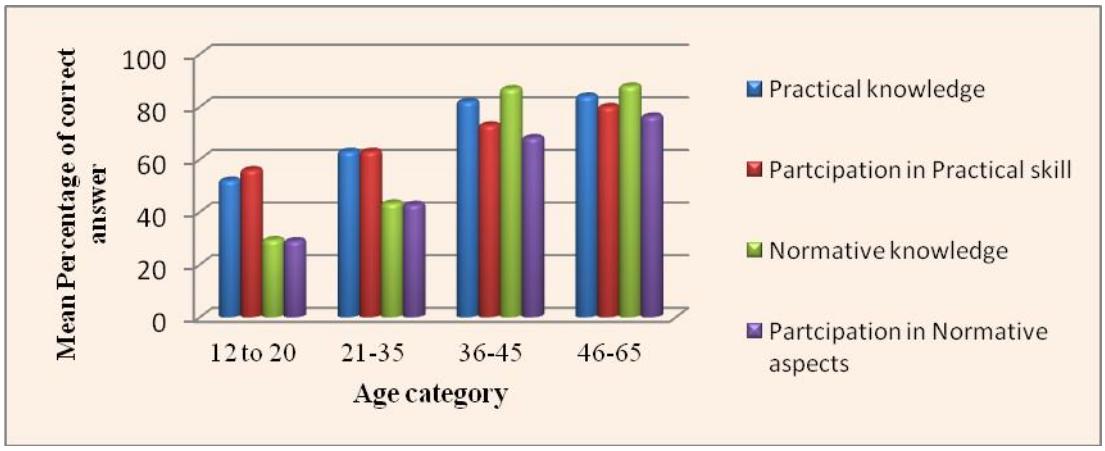


Fig. 5.5: Age based distribution of practical and normative dimension of IK of agroforestry system.

Decline in the transmission of IK among successive generations is manifested in ability of the young people to articulate IK related to agroforestry system of Gedeo. According to the analysis conducted, the majority of young people of Gedeo were not able to articulate as much knowledge and skills as their elders. For instance, among the sampled adolescent (12-20), only 48% of them have relatively better knowledge about agroforestry system (fig.5.5) while the rest 52% were less equipped with knowledge with regard to agroforestry system. The same is true in the case of young adulthood (21-35). If we look at also socio-cultural practices, significant differences were observed between young people and their elders. Only 29.5% of the sampled adolescent was able to articulate the socio-cultural practices. The extent of young people participation in socio-cultural practices has also shown a declining trend. About 71% of sampled adolescent (12-20) reported to have no participation in the socio-cultural practices.

Two important questions can be raised regarding the observed knowledge differences between young people and their elders. The first question is whether the difference observed between young people and adults can lead to the inferences that there is a knowledge and skill gap among the groups.

Evidently, the comparison made between young people, adults and elders have shown clear knowledge gap in terms of eco-cognitive, practical and normative dimension. The observations made and discussions held with members of the community, development agents, and woreda supervisors, for more than two years indicate that the knowledge gap does exist. There is no question about it as far as statistical data and qualitative information are concerned.

The second and the most important question is the implications from the perspective of IK changes and continuities. Could it be possible to claim that IK pertaining to agroforestry system is gradually disappearing as a result knowledge gap between young people and their elders?

In this regard Zent & Maffi (2009) indicated that the differences in IK between older and younger people may imply the degree of loss or retention of IK. It means that a knowledge gap among generational groups may imply loss; while the absences of such gap implying an ongoing retention. From this perspective, it is evident that IK with regard to agroforestry system of Gedeo is undergoing changes, leading to gradually loss, which in turn is likely to have an impact on its sustainability.

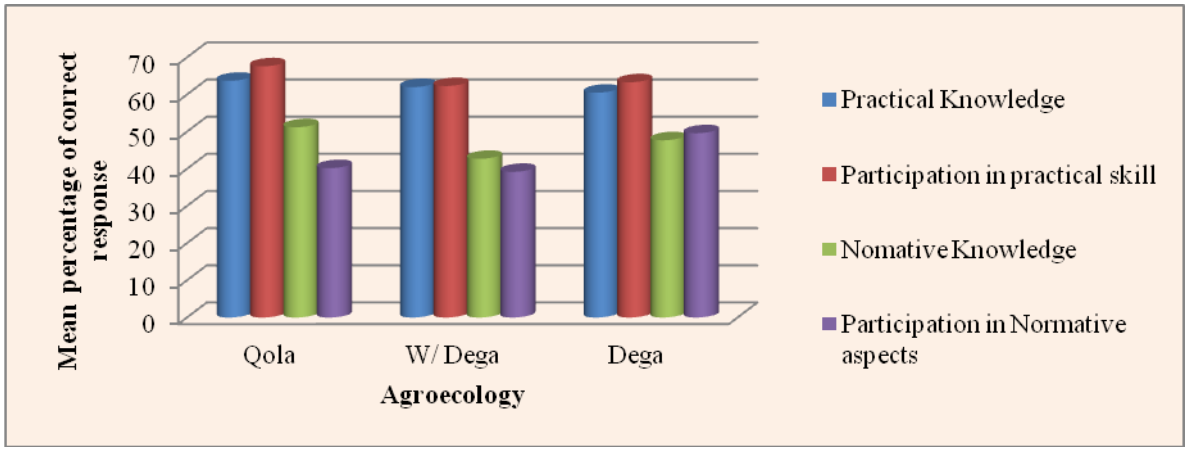


Fig. 5.6: Agroecology based distribution of practical and normative dimension of IK pertaining to agroforestry system

Therefore, the existing knowledge gap between the younger generation and adults implies the gradual loss of IK, which is not related to maturity level differences, rather to some internal and external pressure. Obviously, the area is undergoing remarkable social and economic transformations. The issue is whether the system remains resilient under such remarkable changes in

biophysical, economic and socio-cultural aspects. Does the system maintain its sustainability in the face of remarkably changing demographics, biophysical, socio-cultural and economic aspects of the society? These are the issues that must be addressed and given emphasis in order to bring solution to the changing IK. There is no doubt that the agroforestry system would lose its sustainability if the trend of IK acquisition and transmission, and its gradual loss persist.

Although the land use system varies agro-ecologically, the difference observed in terms of local people's knowledge and skills regarding the agroforestry system were not as such significant. Of course as depicted in fig 5.6 there is slight variation between the three agro-ecological regions in terms of practical dimension and the difference seen cannot justify the gap. However, the socio-cultural values and norms, belief systems, and traditional practices related to agroforestry system appear to vary agro-ecologically.

Gender wise differences were observed in practical and normative dimensions of IK (fig 5.6). However, the differences were not very much significant to claim knowledge and skill gap between male and female. The differences are primarily attributed to gender specific tasks, gender biased roles in the society, level of exposure of both parties to prevailing socio-economic and cultural challenges. In the past, there was a tradition of granting greater public space and recognition to men than women. For instance, women were not entitled to assume position in *gada* and *songo* institution. In addition, they were not entitled to take the leading role in indigenous conflict resolution, traditional belief systems, and various cultural events. Even in crop and land management practices, women's role was found to be less than their counterpart male. Women in Gedeo were restricted to home based activities and home garden cultivation. In fact, nowadays, women are getting more chance to participate in any activities that involve them. However, some of this tradition of depriving the right to involve as leader still persists among the people. Therefore, the difference that observed between male and female in terms of practical and eco-cognitive dimensions is attributed to presence of gender specific tasks in Gedeo and personality of women respondents, particularly in feeling shy to respond to questions.

The finding of this research with regard to gender based variation of IK appears to conform with research findings conducted elsewhere. For instance, women were identified to have better knowledge of herbal medicine than men (Begossi et al., 2002; Voeks & Leony, 2004). However, the study conducted among the, do not support the findings of this research. Which in the case of the

Tzotztil Maya of Mexico women were found to perform better than male in terms of listing more utilitarian plant taxa (Ross & Medin, 2005).

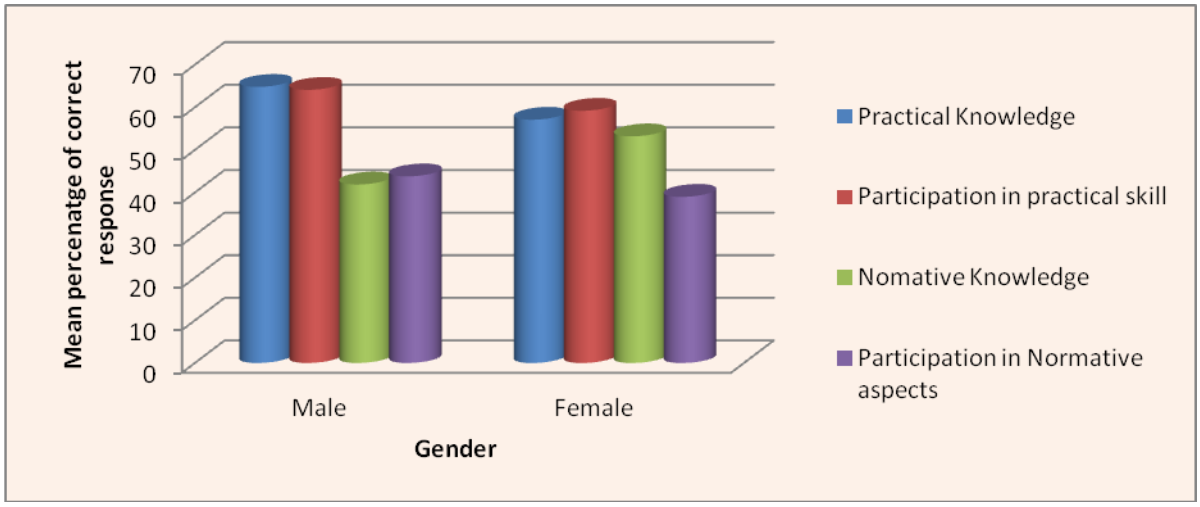


Fig. 5.7: Gender based distribution of practical and normative dimension of IK pertaining to agroforestry system of Gedeo

5.8. Conclusion

In this chapter, a detailed presentation and discussion of spatio-temporal dynamics of IK was made focusing on four important aspects of IK. These are (1) IK acquisition and transmission (mechanism, path and settings), (2) Intergeneration variation in IK acquisition and transmission, (3) change and continuities of IK, and (4) agroecology and gender based variation of IK.

The finding of this research indicated that IK of agroforestry system of Gedeo has been transmitted among successive generations mainly through oral communication. Three path of IK transmission were identified, namely vertical, oblique and horizontal. Vertical transmission of IK was found to be the dominant in the transmission of knowledge and skills related to indigenous agroforestry practices. Whilst knowledge and practices related to normative aspects of IK of agroforestry system is transferred among successive generations through oblique transmission.

This study also identified that the rate of knowledge transmission among successive generations has shown a declining trend. Parents have not been encouraging their children to learn from themselves. Similarly, young people are not interested to learn from their parents. Young people of Gedeo have been spending significant proportion of their time away from their locality. Consequently, they are getting accustomed to a lifestyle which is different from their locality. This has resulted in slow rate

of transmission of IK. The declining transmission rate of IK and lack of interest of younger generation to acquire IK from their ancestors is in turn affecting the continuity of IK.

The comparison made between young people and adults also indicated knowledge and skill gap in terms of eco-cognitive, practical and normative dimensions of IK. The gap seems to be more prominent in normative aspects of IK, implying that cultural values and norms, belief systems are at high risk of being lost. Such changes in IK would inevitably bring damage to the ecological system as well as cultural system.

It is evident that the future prospect of agroforestry system is in the hands of the young generation. Their interest, their commitment to their culture, their farsighted thinking is really demanding when we think of sustainability of the agroforestry system. Therefore, persistent effort is needed to acquaint the young people of Gedeo with the required indigenous knowledge and skills so that they will be able to keep the sustainability of the agroforestry system.

CHAPTER SIX

DRIVERS OF IK CHANGES AND CONTINUITIES

6.1. Introduction

IK is dynamic in its nature, and hence its change in time and space is inevitable. Evidently, the changes may lead to retention or loss of the knowledge system. Thus, two cases are evident with regard to IK changes. The first is the adaptive nature of IK and its regenerative capacity to ever changing environmental and socioeconomic conditions; and the second case is the loss of IK due the internal and external factors (Benz et al., 2000; Godoy et al., 2005; Stone 2007).

According to the analysis conducted, IK of agroforestry system has exhibited changes in time and space (see chapter four and five for details). It is revealed that changes were noticed in all aspects of IK (eco-cognitive, practical and normative), of which the changes observed regarding normative dimension of IK is remarkable. Relatively moderate changes were seen with regard to eco-cognitive dimension. Majority of the indigenous agroforestry practices categorized under practical dimension are still functional except some modifications made to some practices. The changes noticed in IK of agroforestry system of Gedeo entail a gradual loss.

Besides, knowledge and skill gap were observed between different generational groups in terms of eco-cognitive, practical and normative dimension of IK, which indicate the gradual loss of IK. The gap appears to be significant with regard to normative dimension of IK

.

The loss of IK can be attributed to multifaceted and complex factors such as modernization, technology, schooling, integration into the market economy, and acculturation (Zent & Maffi, 2007; Gómez-Baggethun & Reyes-Garcia, 2013). The loss could also be attributed to the inability of the system to adapt to the changes that occurs in ecological, economic and socio-cultural factors.

An attempt was made to investigate the drivers behind changes and continuities of IK of agroforestry system of Gedeo. The drivers are broadly categorized into biophysical, demographic, socio-cultural, and economic aspects. It is beyond the scope of this research to determine the magnitude of the association between IK changes and driving factors behind the changes. Therefore, what is presented

below is only the mere association between the IK changes and driving factors behind the changes and continuities.

6.2. Biophysical Changes and their Impacts on IK Changes and Continuities

Some writers claim that Gedeo agroforestry system is resilient, resource conserving and productive (Tadesse, 2002). However, in recent time it seems that the agroforestry system of Gedeo is gradually losing its ecological sustainability as perceived by the local people. This can be manifested in different ways such as decline in quality of the soil, decline in biodiversity and climate variability.

Loss of biodiversity through destruction for timber, fuel wood, house construction, and preparation of farm tools is becoming common phenomena in most parts of the zone. The indigenous trees are now endangered. Indigenous trees such as *Acacaia abyssinica Hochst.ex.Benth, Acacia albida Del, Ekebrgia capnesis (Sparrm) Euphorbia abyssinica Gmel, Juniperus procera Hotchst ex.Engl, Olea europaea subsp.cuspidata (Wall.ex G.Don) Cif, Ploysica fulva* (Hiern) Harms, *Termminalia brownie, Aningeria adolfifriederecii* Rob and Gilb, and *Shefflera abysisinca(Hochst.ex A.Rich)Harms* are among the rare indigenous tree species (Bogale, 2007). In some areas, indigenous tree species are replaced by exotic trees. For instance, driven by its income generating capacity, farmers in the highland region have been replacing the indigenous tree species with exotic one, mainly eucalyptus tree. The increasing demand of household utensils and fuel wood by the urban dwellers is increasing the rate of deforestation in recent time. The study conducted by SLUF (2006) indicates that the rate at which indigenous trees are cleared is becoming higher than its replacement rate. The survey conducted revealed that old indigenous trees are disappearing rapidly. According to the survey result, the age of indigenous trees identified in farmer's farmland ranges from 1 year to more than 250 years, with majority of them indicating that most of the indigenous trees grown on their farmland are 15 to 20 years old on average.

The problem of biodiversity loss is more significant in the cold highland region. Unlike the midland region where there are varied species of indigenous trees, the cold highland region is covered with few indigenous tree species. The only dominant indigenous tree species found in the cold highland of Gedeo are *Hagenia abyssinica (Bruce) J.F.Gmel, Erythrina brucei S chweinf.(weleena)* and *Arundiaria alpina K.Schum.*

Despite the evergreen nature of the landscape, the local people claim that the soils are not as productive as it used to be. There is an increasing perception among the local people that the fertility

of their soil is declining from time to time. One of the informants residing in the cold highland region said the following regarding the nature of the land:

> *Our land is getting older and older. It is demanding much from us. In order to get production from the land, we have to invest much. We have to use fertilizer to get better production. This was not the case in the past. I do not know what has happened to the land (Shunde Udo, 82, Sika).*

Soil acidity is one of the big problem challenging farmers in the cold highland region. Despite the recent efforts made by the government to reduce the problem of acidity, the problem still persist in most of the highland region, particularly in the cereal crop producing cold highland region. The local people revealed that because of acidity, the productivity of the land is declining.

Asked to give their view about the changes observed in biophysical aspects in the last three successive regimes (Haile Silase I, Derge and EPRDF), the respondents indicated that it is easy for them to remember what has happened in their locality in the last half century. Accordingly, more than 90% of the respondents perceived that the biophysical aspects have shown significant changes in the last five decades. Most of them perceived that above all climatic condition is becoming variable and unpredictable. They claim that they are not able to predict rainfall pattern due to the fact that sometimes rain comes late while in other times early. There has been an increasing variability of rainfall pattern, sometimes deviating from its normal period, even resulting in prolonged dry season. Farmers residing in the lowland region reported that rain is accompanied by hailstorm and strong wind. Mr. *Bekele* is an inhabitant of *Amba* kebele. He explained the situation of rain as follows:

> *We expect the rain to come in the mid of March as April and May are the time of seedling plantation. Often times the rain delay up to late April. If we do not get the rain in the right time, then we may not be able to plant the seedlings of enset and coffee (Bekele Gadicho,47, Amba kebele).*

It is obvious that climate variability is expected to have impacts on the production of both annual and perennial crops. Any change in the amount of rain or deviation from its actual raining time is likely to have an impact on growth of plants and their productivity. Indeed the variability of climatic elements (rainfall and temperature) is being prevalent as depicted in fig 6.1-6.5(see also annex 3, table 4 to 5). As depicted in fig.6.1, there is an increasing trend in rainfall, and the computed coefficient of variation is calculated to be 33.3% implying that annual rainfall distribution in the area

is relatively variable. This is also clearly indicated in fig. 6.2. As it can be noted from fig. 6.2 there were rainfall deficit for about 16 years while the surplus rainfall occurred only for about 9 years (fig. 6.2). .

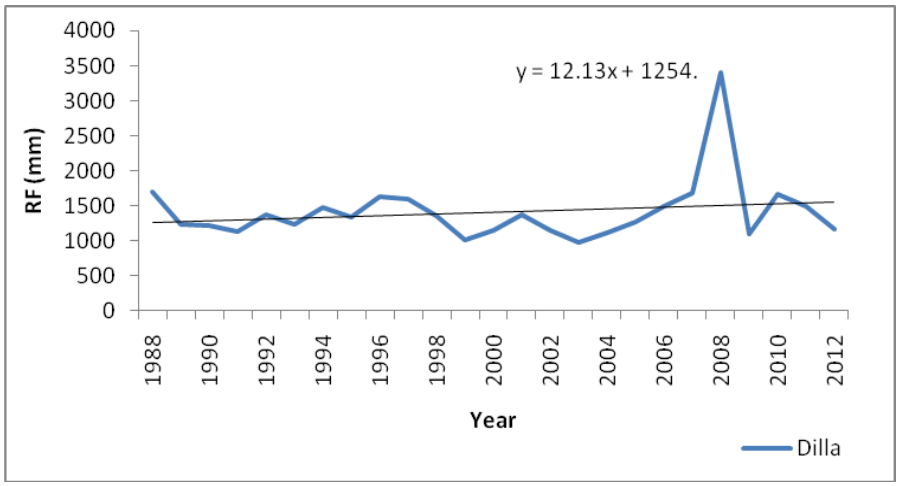


Fig.6.1: Annual rainfall trend (1988-2012)

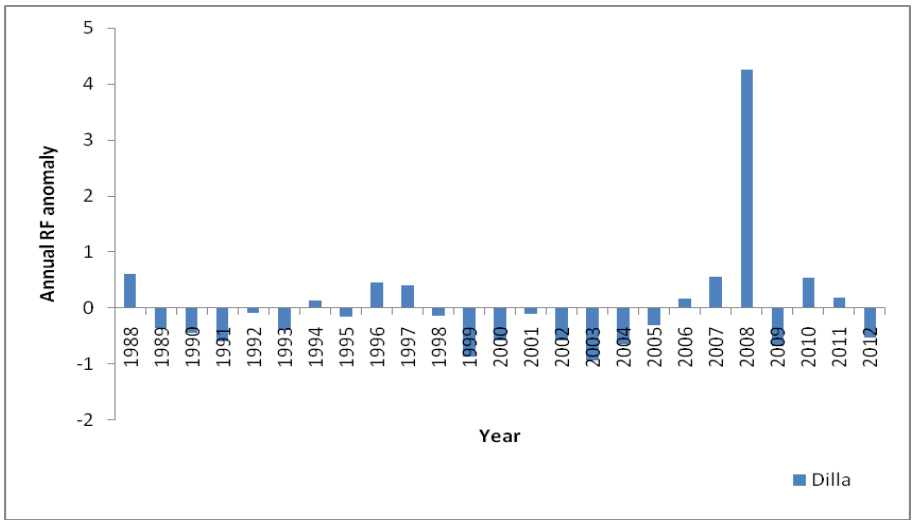


Fig.6.2: Annual rainfall anomaly (1988-2012)

Regarding temperature variability, it is indicated that the average monthly maximum, minimum and mean annual temperate increase by 0.43, 0.25 and 0.35 degree Celsius per decade respectively. The variation is found to be statistically significant at 0.1 significant level. This may imply that temperature is relatively variable and would have its own impacts on growth of plants and hence on the livelihood of the local people.

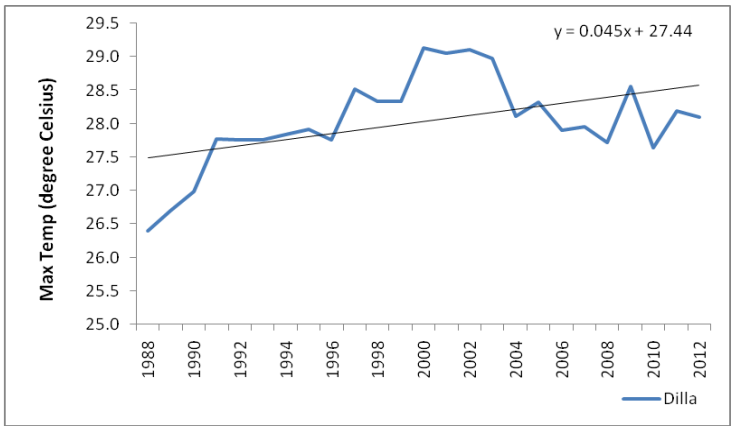


Fig. 6.3 Annual maximum temperature trend (1988-2012)

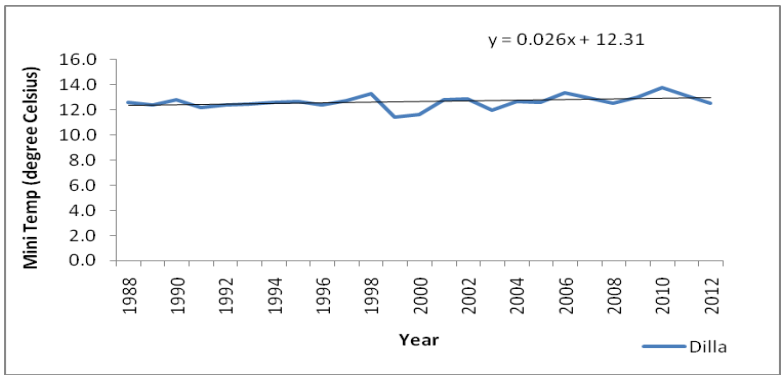


Fig.6.4 Annual minimum temperature trend (1988-2012)

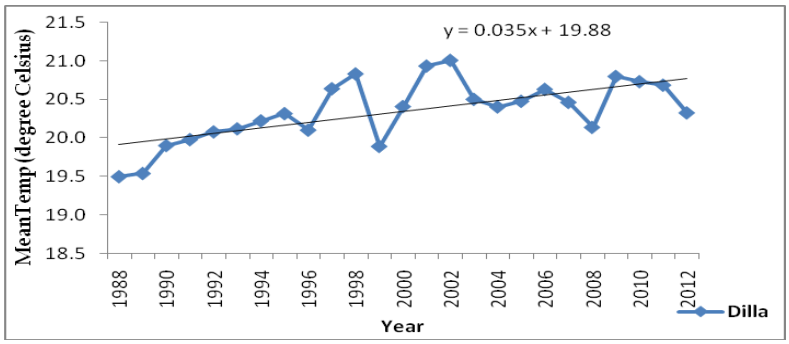


Fig.6. 5. Annual mean temperature trend (1988-2012)

Apart from the empirical data presented in fig 6.1-6.5, farmers' perception conducted with regard to climate variability reveals that rainfall variability (its deviation from its actual time, variation in amount and duration) is one amongst the factors affecting productivity in the area. The local people

also perceived that temperate is showing some increment from year to year. In the survey made, about 96.7% of the respondents reported that the production obtained from both annual and perennial crops is declining from time to time because of climate variability.

Enset is one among the perennial crops being affected by a combined effect of climate change and decline in soil fertility as perceived by the local people. The following quote taken from the explanation of Mr. *Kassu Fondqa,* is a good testimony for the claim that production of enset is declining. He begins his assertion stating his fear that the successive generations are endanger:

> *We are not in good condition. I do not know where we are heading. Every day you see changes. In the past, it was very difficult for a woman to finish harvesting of a single enset tree within one day. It may take more than one day if done alone. However, nowadays, one can finish it within few hours. In the past, women use to ask help from their husband or son to chop down the enset trees because of its size. However, nowadays she can do it by herself. In the past, one cannot embrace the enset plant in full arms because of its thickness. However, these days one can hold it even with a single arm.*

The assertion of Mr. *Kassu* indicates that the productivity of enset is declining from time to time mainly because of biophysical changes. As enset is the only staple food available all the time for majority of the people, a decline in its production presumably have an immediate impact on the livelihood of the people. More than 80% of the household respondents reported that because of decline in the production of enset, they are not able to feed their family, particularly during summer season. Robbery cases are becoming common since recent time. Some reported that processed enset is being stolen from where it is stored (*Hasewwa).* As a result, there is a tendency to conduct part of the harvesting processes away from its natural setting (*Hasewwa)* in fear of being stolen.

As indicated above, changes have been noticed with regard to biodiversity, soil fertility and climate. The changes were found to have both direct and indirect impacts on IK changes and continuities. Changes in biophysical conditions have threatening the livelihood of the local people by affecting the productivity of the land. On the other hand, the change occurring have been limiting the participation of young people in some agroforestry practices abandoned as a result of decline in soil quality and climate variability (eg. enset suckering in the lowland region).

6.3. Demographic and Socio-Economic Changes and their Impacts on IK Changes and Continuities

In Gedeo, particularly in the rural areas, remarkable changes have been noticed in demographic and socio-economic conditions. Human population is increasing at alarming rate, exerting pressure on the existing land and other natural resources and thereby on IK of agroforestry system of Gedeo.

6.3.1. The impacts of rapid population growth

Researchers (Tadesse, 2002; Bekele, 2006; SULF, 2006) claim that Gedeo agroforestry is unique because of its capacity to host large number of population in relatively rugged topography. Extensive part of the rural parts of Gedeo appears to be green throughout the year. The evergreen nature of the landscape might give an impression that there is no a major threat to the biodiversity despite rapid population growth. However, recent trend shows that biodiversity is being threatened by various factors among which rapid population growth is the principal one. Human population is growing in unprecedented manner, with population density increasing from 329 in 1984 to 648 person per km^2 (see section3.1.7 and Table 3.3 for details). The maximum population density is found to be recorded in wonago woreda (919 person/km^2). The change in population density have shown that the existence of rapid population growth exerting pressure on livelihood of the local people.

In addition, household survey indicated that on average a Gedeo women living in the countryside is bearing a child every two to three years. There are only two to three years gap between successive children as indicated in table 6.1. For instance, the household respondent presented in case-1 got 12 children and the gap between successive children is less than 3 years. On the other hand, the average land holding size of individual farmer is declining from time to time. One can simply guess what would happen to the land holding size of individual household if the fertility rate increases in such pattern.

One of the impacts of rapid population growth identified in this study is increasing pressure on land and other natural resources of the area. There has been an increasing demand for land, food and shelter following growth of human population. The demand for land is increasing from time to time as the local people revealed it. Land is being shared among family members, as it is a tradition to share land for one's own son. As a result, the household land holding size is declining from time to time. The average land holding size is below 0.5 hectare for majority of the local people. The situation in the coffee producing midland region is typical example in this regard. The data obtained from the GZFED office revealed that almost all the land in the midland region is utilized for

production of both annual and perennial crops (GZFEDO, 2012). There is no land left unoccupied except sacred places. Then if there is no uncultivated/unutilized land, where does the succeeding generation is expected to live and lead their life? Obviously, the problem of shortage of farmland is a big challenge for the current as well as forthcoming generations, given that human population continues to increase at alarming rate.

Table 6.1: Evidence of rapid population growth as reported by household respondents

	Age of children of selected households				
	Case-1*	Case-2**	Case-3***	Case-4****	Case-5****
1st child	23	29	30	12	40
2nd child	21	27	25	7	38
3rd child	19	26	23	5	37
4th child	18	25	20	3	34
5th child	18	14	18	8 months	22
6th child	15	12	17	-	20
7th	9	11	15	-	18
8th	8	10	13	-	14
9th	7	9	10	-	-
10th	5	8	5	-	-
11th	3	7	-	-	-
12th	1&6 months	5	-	-	-
13th	-	4	-	-	-
14th	-	3	-	-	-

Source: Household survey, 2012

** Age of the household: 49; Total number of children: 12, **Age of the household: 52; Total number of children: 14; ***Age of the household: 67; Total number of children: 10; ****Age of the household; 24; Total number of children: 5; ***** Age of the household:,68; Total number of children: 8*

Mr. *Gazagn Gedo* lives in the lowland agroecological region. He has 17 children, among which seven of them are male while the others are female. The livelihood of Mr. Gezagn's family depends on 2 hectares of land he inherited from his parent. As it is a tradition to share land to one's own children, Mr. *Gazahgn* is expected to share some of the two hectares of land to his sons when they get married. In the same manner, children of Mr. *Gezagn* are expected to share a portion of the land inherited from their family. One can imagine what would happen to the land when the two hectares of land is shared among successive generations.

Mr *Madash's* family live in the midland region, where there is serious shortage of land. Mr.*Madsha* has got five children among which two are male while the others are female (see fig 6.6). Mr.*Madsha* inherited a parcel of land from his family, from which he shared some to his first son *Daye Madash* and others. *Daye* has got nine children among which 6 are male, the rest female. Daye has already given a piece of the land he inherited and got through purchase to his sons. It continues and *Tessema Daye*, one among the children o*f Daye* is expected to share some of the land he got from his father to his three sons. The other five brothers of *Tessema* are also required to do the same things. This tradition will continue in the family so long as the land to be shared is available.

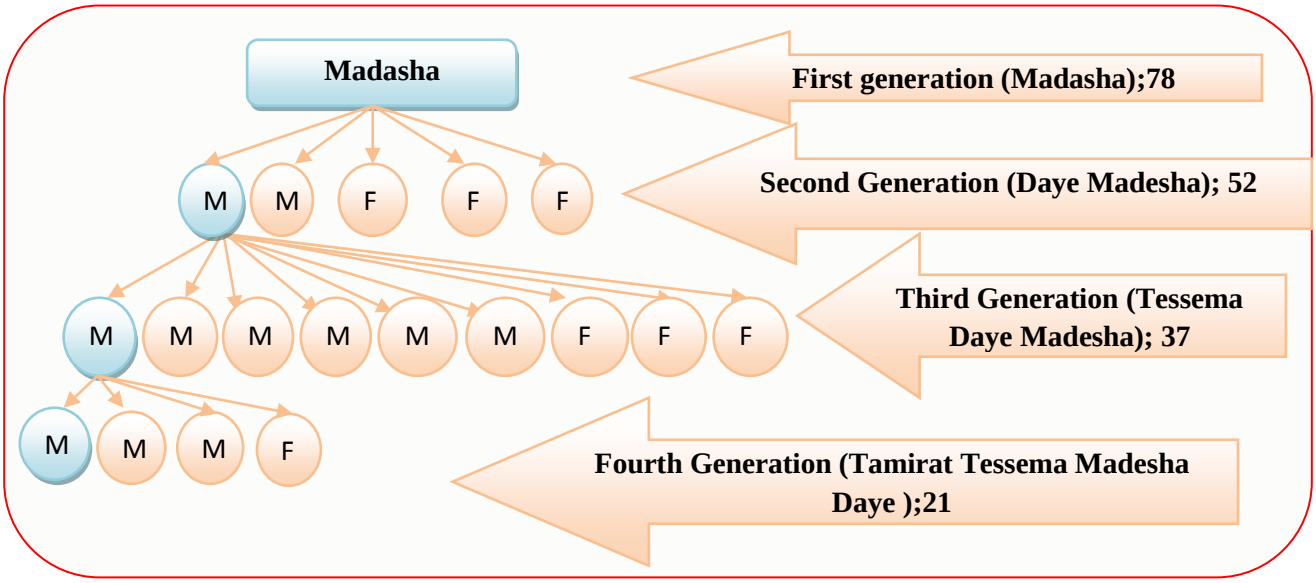


Fig 6.6: Land inheritance among the *Madash's* family

Apart from the manifestation of impacts of rapid population growth through high population density, the above two cases are good indicators of the extent to which household land holding size is diminishing due to rapid population growth. As the land is shared among successive family members, the size of the land gets diminished and very much fragmented, leading to poverty. This is not the problem of one or two people. It is common among the majority. Complain about shortage of farmland is everywhere in the zone.

Cognizant of the impacts of rapid population growth, the local people have designed different coping strategies among which (1) income generation through sale of indigenous tree (2) land use intensification, (3) deploying children to school so that they can get off farm employment and (4) migration to nearby towns in search of job, are the dominant one (See fig 6.7). From the perspective

of environmental and socio-cultural sustainability, some of these strategies are likely to have deleterious effects on the biological and cultural diversity.

As a means to subsidize their livelihood, the local people are using indigenous and exotic trees as a source of income. In the survey conducted, more than 65% of household respondents replied that indigenous and exotic trees are the principal source of income, particularly during summer season (May to September), for majority of the local people. Consequently, indigenous trees such as *Acacaia abyssinica Hochst.ex.Benth, Acacia albida Del, Shefflera abysisinca(Hochst.ex A.Rich)Harms, Ekebrgia capnesis (Sparrm), Euhorbia abyssinica Gmel, Juniperus procera Hotchst ex.Engl, Olea europaea subsp.cuspidata (Wall.ex G.Don)Cif, Ploysica fulva* (Hiern) H arms, and *Termminalia brownie* are among the rare and endangered tree species (Bogale, 2007). The clearance of these trees for the purpose of income generation is leading to loss of biodiversity.

In addition, as a coping strategy, the local people have been persistently encouraging their children to pursue in their formal education, as majority of the local people own small plots of land which is not quite enough to feed their family, let alone sharing to their sons. The intention of the local people is to deploy some of the young people in off farm jobs so that the burden on land would be reduced. However, this attempt of the local people has been jeopardized by the fact that majority of the young people failed to pass entrance examination and as a result returning back home.

From the perspective of reducing burden on land, the attempt of the local people to offload some of the young people through education is crucial. However, in their attempt to mitigate the impacts of rapid population growth through schooling, the local people failed to encourage their children to acquire knowledge and skills with regard to agroforestry practices, cultural values, and norms that are pertinent to their livelihood. As indicated earlier, majority are not encouraging their children because they do not want their children to be a farmer. Therefore, most of the young people have only little exposure to farm practices while having better exposure and acquaintance to urban life style. With limited exposure to indigenous farm practices, no/limited elements of cultural values and norms, and having low interest to be a farmer, one may not expect the young people of Gedeo to step up in the shoes of their ancestors.

In addition to an off-farm employment through schooling, temporary movement to nearby urban centres is common among young people and adults of Gedeo as means to subsidize their livelihood. Young people and adults have been migrating to urban centres on daily basis in search of labour

work. Majority of the respondents claim that they possess small pieces of land, which is not be able to feed the family. Therefore, to subsidize their livelihood they move to nearby urban centres in search of labour work or other off farm tasks.

Majority have small land holding size. Hence, it would not take them much time to manage. They can finish everything within 2 to 3 hrs as revealed by the respondents and they tend to use the remaining time for other off farm job. Limited land holding size because of population growth is therefore, exposing young people and adults to urban lifestyle, which in turn is expected to have an impact on local knowledge and culture.

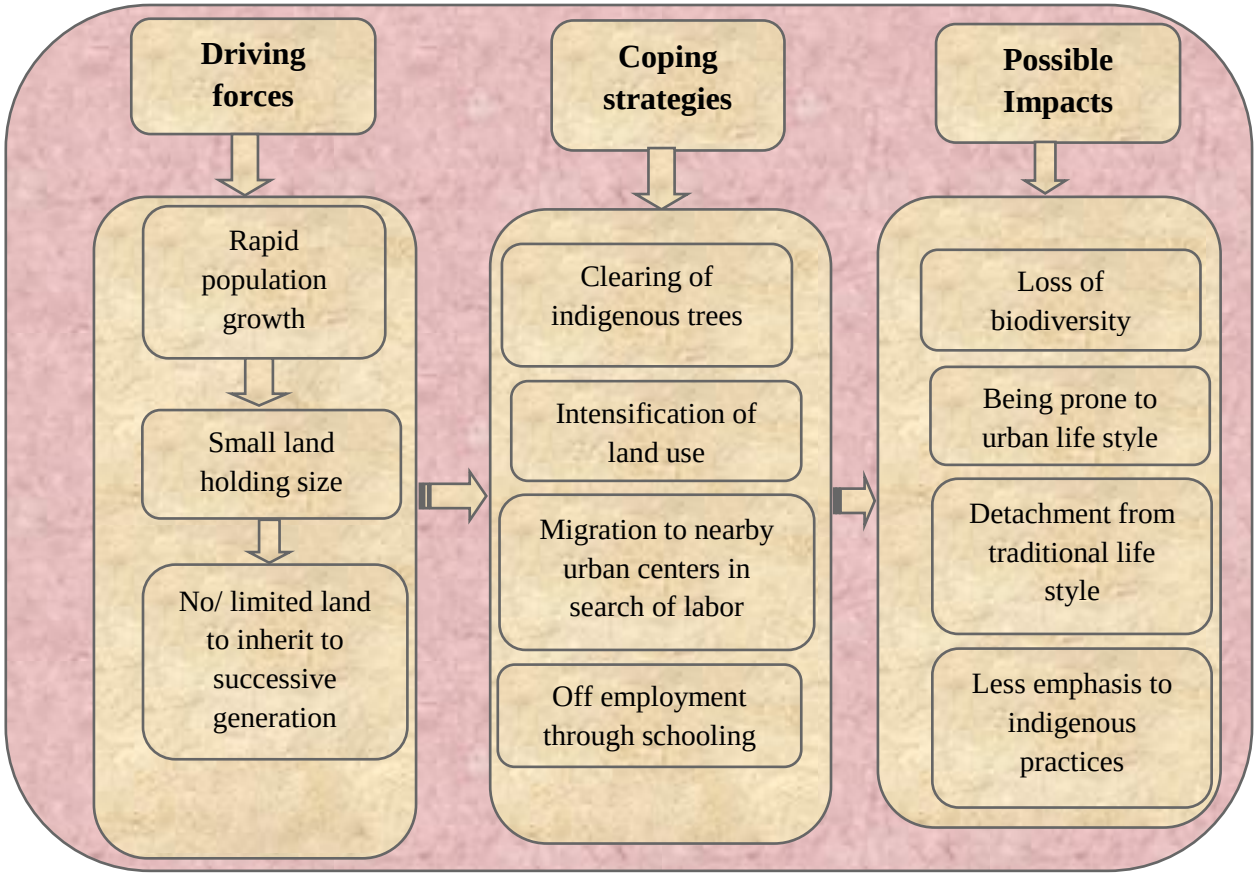


Fig 6.7: Schematic representation of the impacts of population growth on indigenous agroforestry practices (Sources: The author's construction, 2013)

6.3.2. Social and infrastructural development (access to health facility, road, and transport)

As revealed by the household respondents, there have been remarkable changes in infrastructural development in most parts of Gedeo. Currently, majority of the rural Gedeo have access to power supply, health facilities, transportation, mass media, telecommunication, and market centers.

One of the changes observed since recent time is in terms of the expansion of modern medical centers and health extension services in every corner of Gedeo. According to the 2011/12 annual report of the zone, there is at least one health center in one kebele and each kebele has its own health extension workers that provide services. The expansion of health facility in the rural parts of Gedeo is expected to have huge contribution in improving the health conditions of the local people. However, from the point of view of sustaining socio-cultural elements, the introduction of modern medication has a negative impact.

The utilization of locally available medicinal plants to cure various human and domestic animals ailment is an old age practices among the Gedeo's. The area is rich in plant species, which have medicinal values. For instance, in the study conducted by Fisseha (2007) about 58 medicinal plant species, useful for treatment of human health problems were identified from wonago woreda alone. In the discussion held with key informants, it is revealed that most human and animal diseases have been treated through traditional methods using the existing medicinal plants. One of the key informants residing in the cold highland region revealed the following regarding the importance medicinal plants for human and animal alignment and the change occurred since recent time.

> *I never went to health station in my life. Whenever I feel discomfort, like headache or stomachache, I usually take a piece of leaf of plants. We have local medicine for all kind of diseases. There are plants that cure malaria, diarrhea, influenza, skin related diseases, toothache, headache, stomachache, persistent cough and others. In the past, nobody go to health center, as it was inaccessible. We usually took local medicine prepared from plants. However, today we are very much lucky to get medical center at small distance from our residences. Nowadays we have health center in our locality. Health extension workers are also available to give us treatment when people are sick (Woresa Tiba, 75, Sika).*

The expansion of health centers and health extension services almost in all rural parts of the Gedeo seem to influence the perception of the people on the use of local medicinal plants. Nowadays, the local people prefer to visit health extension workers, even for simple pain like headache, instead of

utilizing the local medicine available at their disposal. Therefore, the tendency to use local medicinal plants for different human and animal disease seems to be declining because of the expansion of health facilities. Consequently, the possibility to communicate knowledge and skills about the use of locally available medicinal plants to the successive generation seems to be diminishing because of heavy dependence on modern medication. This is evidenced by the fact that majority of the young people of Gedeo were not able to identify those plants which have medicinal values.

The availability of road infrastructure is another factor, which is contributing towards the gradual loss of IK. Access to transportation facility has contributed a lot for the frequent visit of the local people to nearby urban centers. According to the 2011/12 annual report of the zone, almost all the woredas are connected to each other through dry weather road. Efforts have been made to connect all the kebeles through dry weather road as well. People living in the remotest place have access to transport facility. Nowadays, it is becoming easy to get access to transportation services because of introduction of motorcycle. The following quote is a testimony concerning the changes noticed with regard to transportation services:

> *Five years ago, there was no any means of transportation, except along all weather road connecting woreda towns to dilla town. We have to travel four to five hours by foot to go to wonago town. There is no means to take farm products to town other than human and animal back. Transportation is available only along the main road. Now, thanks to bajaj, it only takes 20-30 minutes to go to wonago town. We can take our farm products using motorbike. Anybody can have access to transportation service up to home (Kassaye Dayu, 68, Karasodity).*

The construction of road and availability transportation facility have paved the way for the young, adults, and elders to have easy access to urban centers as a result of which they get accustomed to urban lifestyle. In recent time, it is very common to see most of the local people travelling to nearby towns on daily basis. The discussion held with local elders and DA have shown that majority of the local people spend their time out of farm, principally being in towns.

Beside transportation facility, majority of the rural population have access to power supply, mass media, and telephone services. Small-scale shops are available in all corners of the rural parts of Gedeo. During data collection period, we did not face any challenges with regard to logistics. Packed water, soft drink, bread, stationary materials, and mobile cards etc are all available even in the

remotest areas. The majority of the local people have access to urban based products, which is likely to have impacts on local people perception about the use of local products and their lifestyle as well.

There is no village, which have at least a mini shop. It is very common to see young people playing games, hearing spiritual songs, music and FM radio broadcasted from local and national broadcasting centers. All these have impacts on acquisition of IK. The young people are more attracted to the lifestyle different from their own. They usually spend their time after schooling watching movies, playing mobile games, watching television and chatting with their friends. It appears that the introduced technology have changed them largely and have made them to give less credit to the local wisdom. This issue was presented as big challenges in the focus group discussion conducted with local elders and key informants. The discussant reflected that the young generation is showing quite different lifestyle as they are very much affected by what they call 'modernization'.

Generally, remarkable changes have been observed in terms of health and transport facilities as indicated above. The changes were found to have an impact on the IK acquisition and transmission. Nonetheless, it has to be noted that access by itself cannot be considered as a threat to IK system. Availability of road is vital for economic development of a certain area. The problem lays on the change that comes because of exposure of the local people to urban life style as a result of access to transportation. It is evident that the frequent visit of local people to urban center has an impact on their traditional life. They might get accustomed to a different life style when they are exposed to urban life style. Apparently, most of the young people were seen attempting to reflect completely a different life style. Majority of them were seen worrying much about their hairstyle. For instance, it is becoming usual to see group of young people living in the rural areas, wearing very neat cloth, wondering here and there throughout the day in working time. All these changes are certainly because of their exposure to urban life style.

The same is true in the case of the introduction technology such as mobile phone and mass media. Since recent time there has been a wide spread use of mobile phone among the young generation. In the discussion held with key informants and other participants, it is noted that majority young people have been engaged in manipulating mobile phone, playing games, and watching movies. This has its own contribution in discouraging the young people from appreciating and practicing the traditional belief systems and other local practices through changing the behavior and lifestyle the younger

generation. Young people's act style of dressing and hairstyle seems to be influenced by what they see through TV broadcasting and western movies loaded on mobile phone. It is believed that the introduction of technology such as mobile phone and TV have made a great contributions in creating the awareness of the local people regarding the world in which they are living as well as the market condition regarding their principal cash crop, coffee. The problem lays on the way the technologies are utilized. If we use the technology only for the purpose it is intended for, then it may not inflict damage. However, if we let the technology to shape our behavior and lifestyle, then it may bring significant damage to our own life. What are noticed among the young people of Gedeo is the introduced technology affecting their everyday life.

6.3.3. The impacts of newly introduced religion

Gedeo people have their own traditional belief systems. They believe in *magano* literally means 'Sky God'. When the local people are in need of help from God, they often turn their face upward to the sky saying '*ko Magano'* meaning you God. They usually give words of thanks to *magano* via traditional leaders. Whenever disasters like intense sunshine, heavy rainfall, drought, or epidemic diseases prevail, the people used to come together summoned by community elders to conduct mass prayer. One of the informant, who is member of *Bashu songo,* said the following regarding the belief system in Gedeo:

> *The Gedeo believe in magano. Our ancestors were powerful in bringing peace and productivity to the people. I remember once up on a time, rain was delayed from its actual time. The rain would have come in March but it remained until end of May. The elders came out and conducted mass pray. Immediately a day after the mass prayer, it has rained. You can see how powerful the elders of Gedeo are in this regard (Woraso Dado, 82, Sugale).*

There is a belief among the Gedeo that ancestral sprits are the intermediaries between *magano* and the people. This sprit serves as a bridge between *magano* and the people. There are also people who are regarded as saints locally known as *wabeeko*. The *wabeeko* can predict the future events and provide an advice for those people who are in trouble with *magano* (Tadesse, 2002).

The Gedeo have also traditional belief system known as *xeeroo,* in which the people present petition to *magano* together with gifts. Tadesse (2002) states the following regarding the belief system regarding *xeeroo:*

> *There are certain places, such as riversides, hillsides, or large trees, where individuals present their petitions to Mageno. The Gedeo people often present their petitions together with xeeroo, offerings presented to Mageno. A piece of food and/or a mouthful of honey sprayed over the area comprise the xeero. In doing so, the Gedeo people always refer to the Mageno who created these beings (rivers, hills or trees). Most outsiders misunderstand this as a pagan approach (pp.27).*

There are also other traditional practices such as *wi'lisha, haafa* and *gadabo. Wi'lisha* is also a traditional belief system conducted whenever human being die. It is a customary mourning ceremony, by which the mourner's dirge is conducted, two days after the death of a person. H*aafa* and *gadabo* are traditional practices carried out for a woman who gave birth.

As revealed by elders of Gedeo, traditional belief systems were the base for everyday life of the society. The socio-cultural system in general is strongly tied to the traditional belief systems. Until the late 19th c, traditional belief system was the dominant that governs everyday life of the people. Though there is no archive data on the number of traditional believers in the past, the elders pointed out that majority of the population in Gedeo were found to be follower of 'original Gedeo religion'.

In the late 19th c a new religion was introduced to the area by the settler and later on by Sudan Interior missionaries. Following the introduction of missionaries, most of the followers of traditional belief system were converted into Christian. According to the report of CSA (1996a) cited in Tadesse (2002) among the total population, only 24.6% were found to be followers of traditional belief systems, while the rest were followers of other religions; 43.2% protestant Christian; 21% orthodox; 2.8% catholic; and 2.8% Muslim.

From the survey conducted, only 5.8% households were adherent to the traditional belief system. Among the sampled household respondents 43.8 %(majority being adult, 20 to 40) replied that they had never been participated in *qeexella*. Even among the elderly respondents, some claim that they had participated in their childhood and adolescence time but not now. More than 90% of the respondents were followers of Christian religion among which 83.3% are protestant, 9.6% orthodox, and 0.8% catholic. The young people and adults who believe in Christianity criticize elders who believe in traditional belief system.

Thus, it can be implied that the introduction of new religion since 1940's has been largely contributing to the dwindling of traditional belief system and indigenous institutions. For instance, the mass prayer, which has been conducted at *songo* place, has now been shifted to modern religious institutions. The local people are not in support of *songo* institution. Instead the local people are more interested in newly introduced religious institutions According to the household survey, 67.1% household respondents replied that the acceptance of *songo* among the people is gradually declining since recent time. Only 19.6% of the respondents revealed that *songo* has still strong acceptance among the society. Moreover, the survey conducted with young people, adults and elders revealed that nearly 85% claim that they do not believe in *songo* institution. Adults themselves are very much biased towards modern religion. Consequently, instead of sending their children to *songo*, they prefer to send them to church.

In addition, some of the traditional practices such as *wilisha, haafa,* and *gadabo* are viewed as against the teaching of the bible. These traditional practices were common in the past. However, nowadays, majority of them are not practices because of mainly religion.

The emergence of new religion in Gedeo is also found affecting one of the cultural practices, which have a profound impact on biodiversity conservation. Prior to the coming into being of missionaries and orthodox religion, the Gedeo people bury the body of their family or relative on their own farmland and mark the graveyard by planting selected indigenous trees (eg. *Weleenna (Erytherina abyssinica Lam. ex DC)* and *adaamma (Euphorbia abyssinica Gmel*)) in two sides of the graveyard. According to tradition in Gedeo, it is forbidden to cut and use the trees planted on graveyard. No one is courageous to cut and use the trees for any purposes as cutting such trees is considered as demolishing the reputation of the person buried. People fear to cut it. Significant number of old trees now found in different parts of Gedeo is assumed to be representing the graveyard of Gedeo elders. For instance, there are about eight old indigenous trees identified in *Amba* kebele, each of them having specific names. It seems that the name refers to an elderly or heroic person buried under the trees. This tradition persisted for longer time, however, since recent time it is getting lost because of the influence of religion.

The recent trend shows that most of the people are constructing monuments/tombstone on the graveyard. The tradition is now shifted from planting of trees to construction of tombstone. The building constructed on the individual graveyard take small plots of land (section 4.3.3.*d iv*.). One can imagine what would happen to Gedeo land after half a century if the building if tombstone

continues. Perhaps significant proportion of land might be occupied by building meant for graveyard after some decades if the tradition of constructing monuments continued.

One of the informants revealed that some of the local people who have better wealth status notify their children that they must construct nice appearing tombstone on their graveyard to indicate that the person is from well to do family. Here one can understand that the parents are teaching their children such tradition, which is not useful for the Gedeo land.

As indicated in previous sections, the Gedeo land is very much fragmented, hosting large of population, in some area even beyond its holding capacity. Majority of the farmers have land-holding size less than 0.5 hectare. The farmers are using such a small plots of land for their livelihood. In the absence of open land used as graveyard, the only area to use as graveyard is once own farmland. What would be the fate of the people if portion of their land is used as graveyard, having monuments constructed on it? Once it is occupied by graveyard, particularly with iron-corrugated houses like in Plate 4.14, it is difficult to reuse it again by demising the tombstone. Primarily, the presence of such corrugated iron houses in the middle farmland is expected to have impacts on the biodiversity. The graveyard would have been occupied by indigenous trees, which have multiple purposes. The tree serve as shade for the undergrowth, it can serve as sources of nutrients through leaf decomposition. It regulates the local climate. On the other the tombstone, may inhibit the free movement of water laterally, and movement of micro-organisms as well. Undoubtedly, planting tree on the graveyard is ecologically sound, economically viable, and socially acceptable than constructing houses on the graveyard in the middle of farmland.

In general, such shift of tradition and value is likely to have an impact on sustainability of the agroforestry system. Indigenous trees, which are rather maintained through such traditional practices, are likely to be lost because of the impacts of modernization, mainly religion.

The other impact of religion is manifested in the utilization of indigenous trees, which were thought to have bad fate upon utilization. The local people believe that indigenous trees such as *onoonoo (Trichilia emetica Vahl.), deegaa (Celtis africana Burm.F.), xiibiro (Bersama abyssinica Fresen),* and *laafa (Brucea antidysenterica J.F.Mill)* are not to be used for purpose of construction of house and fuel wood. There is a belief that *onoonoo* is a source of conflict, while *deegaa* is a source of poverty. That means if the local people construct their house using *onoonoo*, they are likely to

quarrel with their wife, if with *deegaa* they are likely to be thrown into world of poor. However, since recent time, the people have started to use these trees because of the impacts of religion.

Thus, it can be implied from the preceding discussion that the introduction of religion in the area has detached the people from their social value, and cultural elements. It hinders children and young people from admiring and developing interest to know about their culture. In fact, one cannot deny the importance of religion for the society. However, from the perspective of culture, it appears that religion is contributing negatively, resulting in denigration of cultural values and norms.

6.3.4. The impacts of formal education on IK changes and continuities

Formal education is reported to have positive and negative impacts in the everyday life of the rural children from the perspective of socio-cultural system. On one side, it tends to heighten children's cultural awareness and increases their aspiration to be better person. On the other hand, formal education may lead children and young people to disregard traditional life style and then appreciate cosmopolitan life styles associated with urban living (Rao et al., 2003).

This study identified that schooling has both positive and negative effects on IK changes and continuities. The negative effect of the school is manifested in discouraging children and young people not to stay in their locality for relatively longer time and partly by infusing western based knowledge which in most case does not corresponds to the local wisdom. Obviously, what is being taught in school and what the family and community member are teaching seem different in most cases. On the other hand, the positive impact of education is from the perspective of increasing the awareness of children and young people about environmental protection and conservation.

Table 6.2: Age based distribution of students' enrollment in 2011/12

Age	Projected total population (2009/2010)			Student Enrollment 2011/12 & their grade level	% of students enrollment
	Male	Female	Total	Total	
7 to 10	54,629	51,780	106,409	75,998(Grade 1 to 4)	71
11 to 14	47,629	44,407	92,036	37,648(Grade 5 to 8)	41
15 -16	25,576	24,279	49,855	6,213(Grade 9 to 10)	12
17-18	22,039	22,433	44,472	976(Grade 11 to 12)	2

Source: (GZEFDO, 2012)

The majority of Gedeo children have access to formal education as compared to their parents. Nowadays primary schools are located almost in all kebeles of the zone. Consequently, almost more than 75% of children in the rural parts of Gedeo have access to primary education (Table 6.2). As indicated in table 6.2, about 71% of children were registered to attend from grade one to four in 2011/12 academic year. This implies that the people are aware of the importance of education.

Table 6.3: Distribution of school by grade level(2012)

Sno.	Woreda name	Grade level					Total
		1-4	5-8	1-8	9-10	11-12	
1	Wonago	19	7	26	1	-	27
2	Yirgachefe	36	12	48	-	-	48
3	Kochere	26	9	35	1	-	36
4	Bule	31	10	41	1	-	42
5	Dilla Zuria	20	7	27	-	-	27
6	Gedeb	24	9	33	1	-	34
7	Dilla Town Admin.	21	13	34	2	1	37
8	Yirgachefe town	4	3	7	1	1	9
Total		181	70	251	7	2	260

Source: (GZEFDO, 2012)

The expansion of formal school in Gedeo is identified to have an effect on socio-cultural elements of the Gedeo agroforestry system. The effect seems to get manifested in terms of (1) discouraging young people of Gedeo from appreciating and exercising the indigenous knowledge, (2) influencing the attitude of the local people towards their local wisdom and (3) partially detaching the young people from the local settings for a relatively longer time and minimize the contacts the young people assumed to have with the local environment and settings.

It is obvious that what is being taught in formal schools will not be exactly the same with what the local people and local environment provide to the inhabitants of rural Gedeo. There is a difference between what the school provides and what the traditional lifestyle and settings provide. Consequently, the knowledge and skills that the young people obtain from formal schooling will not be the same with the one obtained from informal communication. This was witnessed in the discussion held with the younger generation during transect walk and their result of exam type

questions. According to the view of the younger generation, being in schools will give them better chance of acquiring knowledge and skills than being in farm throughout the day. It seems that the young generations are biased towards formal education and as a result they tend to give less attention to the knowledge of their parents as well as local elders. This has affected young people's courage to acquire and practices local wisdom.

Apart from this, the local people have developed the feeling that local wisdom and practices are not as such useful as knowledge and skills obtained from formal schooling. The local people seem to be ignorant of the fact that informal education (knowledge and skills obtained through contact made with local elders) is as equally important as formal education for people like Gedeo who exclusively depend on natural resources for their livelihood. Consequently, the local people appear to be unenthusiastic to encourage their children to acquire indigenous knowledge and skills principally due to the expectation that it is only formal education that provides their children with off farm employment.

The survey conducted revealed that, participation of young people in agroforestry practices is found to be low due to lack of interest, which in turn is attributed to the influence of formal education. This is expected to have an impact on acquisition of IK. When it comes to IK acquisition, learning becomes effective through repeated practices, instead of simple observation of adult's performance (Ruddle & Chesterfield, 1977). Young people have only little time to spend with their parents, grandparents, or local elders. They spend half of the day in school and in most cases, they spend their time after schooling either playing with their peer group, going back to school for tutorial, doing homework and assignment, or involving in income generating activities. Some of the young people whose residence is near urban center invest their time after schooling in watching movies and television broadcasting. Therefore, they have little opportunity to get exposed to local practices. This would mean that the children and young people are not getting the opportunity to know the local wisdom either being in their locality or whenever they are in school. Thus, schooling is a principal factor that play role in discouraging the young people from acquiring and exercising their culture and indigenous agroforestry practices as well.

The household survey result indicated that about 99% of the households are very much keen to see their children being employed in government institutions after completing their education. Only two, out of 272 respondents have the feeling that being a farmer is equally important as being an employee of government institutions. However, contrary to the expectation of the local people,

majority of the young people have been left jobless after completing their education. These young people have returned back to their locality with different mind setup, life style and thinking.

An attempt was made to assess the work habit of young people of Gedeo who completed grade 10 but failed to get pass mark to join preparatory school. The majority (>95%) of them have shown very little interest to continue as a farmer. Some of them are interested to join vocational training college or teacher training college while others are interested to engage in off farm activities such as trading. They are very much accustomed to urban life style. Their hairstyle, dressing style and behavior is quite different from the local people. The majority of the younger people are already accustomed to urban lifestyle and they might not have the tolerance to work on farmland consistently. This entails that the young people are not as such productive from the perspective of sustaining the socio-cultural system of Gedeo.

Here, I am not disregarding the contribution and importance of education. I completely agree that every Gedeo children should get access to quality education, which can make them competent at national and international level. My point is that the children should be able exposed to both school based education and local setting based education as well. The majority of farmers were seen disvaluing their own knowledge and giving higher value to the knowledge obtained from formal schooling. They are insisting their children to advance in their formal education alone. Little has been done to let children and young people to acquire knowledge and skills of local agroforestry practices, culture, norms, and different traditional practices. This should not be the case.

Gedeo agroforestry system is not like any other agricultural systems that are managed being at distance. It is not type of farming systems, which are managed by deploying labor force every time. It needs a great care and management as the landscape is rugged. Moreover, majority of the practices depend on the socio cultural values of the people. The social values and norms, the different sanctions passed by *songo* members and *baalee* institutions, traditional practices, and rituals are base for the agroforestry system of Gedeo. One cannot disentangle the socio cultural values from the ecological values in the case of Gedeo agroforestry system. The moral values attached to nature govern people to nurture nature than the economic and ecological importance. Therefore, it seems that it is not easy to manage the agroforestry system being at distance, even closer to it without possessing the socio-cultural elements important for its management.

6.3.5. The role of political economy on IK changes and continuities

With the commencement of colonialism, African subsistence economy was largely transformed to cash economy in accordance with the colonial mode of production. Although Ethiopia was under feudal system until 1974, commercial agriculture was introduced particularly to the Southern part of the country in late 19th century. In this context, historical account revealed that Gedeo people came under incorporation of state government in 1895. The conquest brought new forms of political economy in which military and administrative officials of the state changed customary land rights into private ownership whereas the local people were reduced to the status of servitude and tenancy (McClellan, 1988).

From the time of conquest, Gedeo people had experienced a policy of long-term land and labor expropriation. The people struggled much to adapt to the new political and economic systems introduced under *neftenya-gabbar,* landlord- tenants and socialist systems. The newly introduced political and economic systems in each regime have brought significant changes in the socio-cultural, economic, and political conditions of the area (McClellan, 1988) as a result of which the local practices, belief systems, rituals and indigenous institutions were denigrated. The economic burden of the systems was so heavy as revealed by historical and oral accounts.

One of the changes brought as a result of the introduction of new administrative and political system during *neftenya-gabba* and landlord- tenants was the ultimate transfer of customary land rights to private ownership. During this time, the local people were deprived of ownership right to land and its produces. They had no legal claim to their land. They were reduced to status of *gabbar* as a result of which they were required to provide parts or the entire surplus (ensete, coffee, maize, teff, honey, sheep and cattle) to the settlers. Moreover, they were required to provide fuel wood to the settlers' compound, grind grain, construct houses and fences, herd livestock and cultivating *qudad*[19] (McClellan, 1988). They were also required to contribute to feast days on each of the four-Christian holidays, Easter, finding of true cross, Christmas, and epiphany and on occasion like weeding and birth. *Abba gada* and his subordinates were also reduced to the status of *gabbar*. The political and ritual power of *aba gada* was diminished as well.

[19] *Private state*

The changes were believed to affect the socio-cultural, economic and political systems of the Gedeo people. Apparently, land and its products are the only principal source of livelihood for the Gedeo people. The economic and socio-cultural aspects of the people entirely depend on the products obtained from land. The Gedeo people are not an industrial society; rather they are merely an agrarian society. Therefore, given that land is a principal base for their livelihood, one can imagine what would happen to this people when they are alienated from the right to land ownership for nearly a century. The existing historical accounts and oral traditional revealed that there were problems of land insecurity; their economy was dwindled. As a result, majority of the local people become economically destitute and culturally weak (McClellan, 1988). As noted by McClellan (1988) poor economic performance of the local people during this time, was the principal cause for gradual decline of *gada* system and indigenous institutions. It also brought about the denigration of the socio-cultural values of the people due to the discrimination, forceful adoption of the dominant Christian Orthodox religion and culture to the detriment of traditional practices, values and norms of the Gedeo people.

To elaborate more, the fact that their products were channelled to the settlers affected the relation the ordinary people of Gedeo had with their traditional social and political leaders. According to their tradition, the *abba gada* and his subordinates were required to conduct ritual practices through which they bring peace and prosperity to the people. They also conduct different cultural practices that determine the very existence and survival of the society. In turn, the ordinary people channel some from their surplus into traditional social services as reciprocity. Such mutual relationship between the *gada* elders and ordinary people of Gedeo were inexistence until the incorporation of the area into the state. However, the introduction of *neftegna-gabar* system brought about an end to the channelling of parts of surplus produced to the traditional leaders. Consequently, the socio-cultural services provided by the Gedeo elders had declined and resulted in loose contact between local people and their traditional leaders. Thus, it can be claimed that the gradual decline of Gedeo *gada* system during this period is partly attributed to the channelling of the produces to the settlers instead of the traditional leaders.

Although written evidence was not obtained concerning the possible specific impacts of the political economic system on IK production, reproduction, and transfer, it is possible to entail something from the changes noted in the socio- cultural values of the society. In fact, some of the elderly people of Gedeo with whom I have discussed revealed some impacts of the political economic system

introduced in different regimes. The elders pointed out that it was not an easy time for the people of Gedeo to lead their life in away it maintains their socio-cultural and economic integrity. They were not only deprived from using the products of the land but also from conducting the ritual practices. It was not an easy time for the local people to advance their indigenous practices, as they have to cope up with the prevailing circumstances. One among the elderly people illustrated the situation as follows:

> *In fact, I do not remember most of the events happened at that time, as I was a small boy. My father was one among the tenants. We were not considered as human being. We were completely deprived of our right. No appeal, no questions other than doing what the settlers ordered you. I knew that my father was expelled from his own land, as he was not able to provide what was required of him. I heard from my father that the settlers weakened the local institutions by disallowing the traditional leaders the right to have access to farm produces. They reduced the leaders to the status of tenants (Bali Gadicho, 100+, Amba).*

The introduction of *qalad* in 1920's by *Balcha* (see section 3.1 for details) was another challenge that exacerbated the weakening of the economic, socio-cultural and political aspects of the local people. Due to land measurement policy, significant portion unoccupied lands in the down slope areas were brought into the hands of the settlers. Formerly forested areas, which were under the control of the traditional authorities came under the disposal of the settlers. As the settlers claimed *rist* and *maderia* rights over measured lands, the ordinary Gedeo were forced to abandon their traditionally inhabited areas of *enset* and eventually migrated toward the periphery in search of unoccupied lands (Bevan & Pankhurst, 1996).

Then following the 1920's land measurement policy, the interest on coffee dramatically increased. Coffee became one of the commercial crops and major export item of the then state. Consequently, commercialization of coffee attracted more settlers. As revealed in historical accounts, new settlers came into the area in 1920's following the increasing demand of coffee. Initially the settlers were not cognizant of coffee's contribution to the national economy. The major export commodities were mainly animal products. However, the decline in animal products had paved the way for coffee to be considered as major export item of the state. Moreover, the re-assignment of the then governor of Harar, Balcha, for the second time as governor of Sidamo, paved the way for the settlers to develop more interest on Gedeo land that hosted wild coffee. Balcha was interested to use coffee as export

items for the purpose of providing sufficient tribute and build his political base (McClellan, 1988). Gedeo was found to be the appropriate place for him to produce coffee and fulfil his desire.

The people were then encouraged to give emphasis to coffee production as the changing needs and priorities of the Ethiopian state dictated a shift in the economic organization of the area (McClellan, 1988). Particularly, the opening of Ethio- Djibouti railway paved the way for the export of coffee to world market and hence to the expansion of coffee land in the down slope regions.

Then through time, coffee got a good reception in the world market and brought greater economic and social opportunity to the settlers and to the Gedeo as well. Coffee become the prime commodity of local and middle distance trade, and foreign firms, often in alliance with Ethiopian entrepreneurs, came to dominate processing and exportation (Tadesse, 2009).

Following the increasing demand of coffee in the world market, the local people were required to plant as much coffee tree as possible, which restricted other types of crops and livestock (McClellan, 1988). The local people inhabiting coffee producing region were restricted to produce coffee alone, leaving aside the other produces. They have had only little chance of producing enset and other crops, which were used for subsistence. Coffee could not be eaten, and virtually monoculture meant that in case of crop disaster the people were in life threatening situation. Coffee meant little unless it could be gotten to national and international markets, access to which was controlled by settlers and expatriate merchants. The local people thus became more dependent on the settlers for subsistence. This situation had debilitated the survival of the local people (McClellan, 1988). As illustrated in the writing of McClellan (1988) the situation happened after 1920's was more painful for the local people as compared to pre 1920's.

From ecological and social sustainability point of view, mono cropping or dependency on only a single cash crop is not viable option for the Gedeo people, who have the tradition of diversifying livelihood through multiple cropping to overcome the challenges rugged topography and population pressure. Settlers' motive to expropriate the resource (coffee) by limiting the production of subsistence crops is against the tradition of the local people. The Gedeo people have chosen multiple cropping not because their ignorance of the monetary value of coffee. From their experiential knowledge, they know that the presences of subsistence crops are vital for coffee and vice versa. They have understood the mutual benefit between coffee and other crops. That is why they tend to grow different crops in a certain plot of land.

Moreover, the very existence of Gedeo people is determined by enset, the major staple food of the people, coffee, the major cash crop, and other annual crops. The local people are very much cognizant of the very volatile nature of coffee price. In time of low coffee price, or low production, they often depend on enset and other annual crops for their livelihood. Therefore, the tradition of multiple cropping is means to lead sustainable livelihood.

The settlers and the state were unaware of local people's intention of keeping more than two crops in farm. They did not give attention to local tradition. The only motives were the immediate cash obtained from sale of coffee. This was damaging to the system and to the livelihood of the local people and indeed the dependency on mono-cropping has contributed to the disturbance of the socio-cultural elements of the local people.

Beside expansion of coffee field at the expense of subsistence crops, commercialization of coffee necessitated the settlers to shift their residence from towns to countryside. The settlers moved to countryside and stationed there to supervise and purvey coffee. Churches were established to provide spiritual service for the settlers stationed in the countryside. Roads that link coffee producing rural areas to towns were constructed for easy access to the area and then marketing of coffee.

In this regard McClellan(1988) wrote the following:

> *... while still responsible for military security, its prime purpose increasingly would be to supervise and purvey a commodity fast becoming Ethiopia's chief export crop. This role required more settlers and expanded facilities in terms of churches, roads, and markets. Since coffee areas were isolated from garrison sites, new towns began to develop to channel that commodity more efficiently to the capital. Settlers also felt the need to supervise their estates more effectively, and they begun to establish residences in the countryside away from the ketemas (towns). This led to the social contact between settlers and the client (pp.86-87).*

Prior to recognition of commercial importance of coffee, there were no frequent contact between the settlers and local people, as the settlers live in garrison site. The local people meet the settlers whenever they went to provide the farm produce. However, after 1920's the settler begun to have day to day contact with the local people as a result of which more social contact was established.

The day to day contact paved the way for the settler to infuse their culture into the local people and to get accustomed to the traditional life of the society as well. As indicated by McClellan (1988) the social contact between the settlers and the local people resulted in acculturation of both groups (the local people and settlers). The resultant effect was, however, more damaging to the local people, as they have to adapt to the prevailing circumstance.

About 14 orthodox churches were established to provide religious service for the settlers dispersed in various parts of the coffee producing regions of Gedeo. As the number of settlers were small to conduct the prayer, local people were forced to get baptized to accompany the settlers in church by abandoning their traditional belief systems (McClellan, 1988). This was one among the factors that contributed for the denigration of traditional belief system in Gedeo.

In general, as noted in historical accounts, the people had benefited little from the then administrative system. The settlers confiscated their land. They abandoned their traditional belief systems; they disempowered their traditional leaders; they prevented them from conducting the ritual practices. Moreover, the local people have limited power to utilize the resources found in their locality. In connection with this, McClellan (1988) states the following:

> *While the Abyssinians were not necessarily predisposed to destroy existing social structure, that was often the effective result; by changing the distribution of a society's or household's resources and rechanneling its surplus, the settlers altered the indigenous' ability to maintain pre-conquest social services and political and ritual offices(pp.131)*

Furthermore, he states the following regarding the demising role of *abba gada* by the settlers:

> *Ethiopian rule slowly diminished the status of and respect for the abba gada by making him a gabar like virtually every other Gedeo and by reducing the traditional rewards allocated him through draining that surplus as a way for support of northerners. The balabat was one of the few Gedeo who did not have to work his own land, his importance soon become apparent. As their land was alienated, Gedeo came to see that the abba gada was totally ineffective in dealing with this situation, and there were a tendency to reduce the resources they channeled into the traditional structure.*

From the above quotes, it can be implied that the role of *abba gada* was diminished, as the settlers had to build strong hold on coffee. They knew that the *abba gada's* has strong political power among the society. Therefore, it was only through oppression of the *abba gada* that they can be able to get stronghold on the coffee land. The settlers had an ultimate right to decide on the fate of the local people. The people did not have much to invest on social and ritual matters or events as they direct their earning to the settlers. Above all, they did not get chance to channel even the limited resource they have to support the socio-cultural systems. The participation in ritual practices was very much limited.

The consequent administrative system, which took power from Haile Silase I in 1974 also recognized coffee as the major export item of the nation. During this time, the land was given to the tenants as a result of which Gedeo farmers got their coffee land back. However, introduction of new agricultural policies such as the quota system and controlled pricing mechanisms, which discouraged coffee growers from freely marketing their agricultural produce on local markets, emerged as another bottleneck. Other government measures, such as villagisation, cooperativization and recruitment of Gedeo for local militia and military services, became a disincentive to most of the development endeavor of the Gedeo people (Bevan & Pankhurst, 1996).

Moreover, the introduction of coffee improvement project (CIP) to approach coffee farmers was found to inflict significant damage to the indigenous practices (Tadesse, 2009). Following the outbreak of Coffee berry disease (CBD), CIP introduced a new coffee variety, which was not friendly to the system in Gedeo. From the discussion held with the elderly people of Gedeo, it was noted that the CIP workers insisted the local people to replace the old coffee species with the newly introduced coffee variety. In this regard, Tadesse (2009) writes the following:

> *Unlike the indigenous varieties, the new varieties were not to be intercropped with enset and shade trees. Farmers were thus to learn how to grow coffee without its traditional associate, enset and multi-purpose trees. The CIP recommended instead of indigenous shade trees such as exotic species as Sesbanian Sesban. However, Sesbanian Sesban was soon found harboring the notorious Xete, the pest responsible for the mass death of coffee trees (pp.8).*

The attempt of CIP to replace the local with the improved coffee varieties resulted in loss of production. To compensate the decline in the productivity of coffee, large areas of land was converted to coffee field. Some of the local elders revealed that the then CIP workers blamed the

farmers for not managing the new coffee varieties properly. They claimed that they were told to abandon the old local coffee varieties and replace it with the new coffee cultivars.

The discussion held with key informants revealed that the major problem with the Derge regime was the fact that the CIP workers were not able to take into account the local situation. They did not listen to the farmers' point of view.

Driven by the income obtained from coffee and its importance in world market, the military junta, insisted the people to give more emphasis to the production of coffee at the expense of other crops including ensete. Farmers were told to specialize in coffee production (Tadesse, 2009). What so ever may be the amount of production, the income obtained from coffee was not significant for the farmers, as the coffee prices remain stagnant for about 40 years.

Similar to the landlords who insisted to expand coffee farm at the expense of enset and other crops, the advice and recommendation of CIP workers were against the indigenous practices. The recommendation of CIP workers was not viable both ecologically and socially. Therefore, though there is scanty data that inform the impacts on IK production, and reproduction, it can be noted that the recommendation made by CIP workers were not compatible with the indigenous practices.

The period of EPRDF has seen the increasing important of coffee for the country's economy. Coffee remains the major export item of the national economy. Since recent time, coffee prices have been increased. An increase in the price of coffee would undoubtedly bring changes in the lives of the Gedeo people, and consequently improve their living conditions (Bevan & Pankhurst, 1996). However, coffee price is still determined by the world market, putting the life of the local people at mercy of world market price.

Free market economy is supposed to have an impact on the livelihood of the coffee producers. From the survey made, it was found that majority of the households were not leading better life though they possess one of the dominant export items of the nation. The coffee producing farmers were exposed to shortage of food than the non-coffee producing region. For instance, among the woredas in the zone only two of them, namely *Bule* and *Gedeb*, are self sufficient in terms of food. These two woredas are known for cereal crops production. The rest are beneficiaries of productive safety net program. One may question why the coffee producing region is prone to hunger while the non coffee-producing region remains safe. Is it because of rapid population growth? Or Is it because of

the fact that the coffee producers are not the prime beneficiaries of the income obtained for sale of coffee? It may be also attributed to the fluctuation of coffee price in the world market. What is obviously occurring in the area is that only few individuals who have the monetary power to control the local coffee market are benefiting much from coffee. Majority the ordinary farmers are living at the mercy of the few individuals. This situation has been bearing its own impacts on the livelihood of the local. Majority of the local people get starved in time of no coffee harvest as a result they were migrating to urban centers, engaged themselves in sale of fuel and fire wood. This in turn is bearing an impact on the system in general and IK in particular

6.4. The Impacts of Agricultural Extension Programs and Development Packages

Various rural development policies, agrarian reforms and land polices have been implemented in Ethiopia. Farmers in every corner of the country have experienced the different reform policies with regard to land and economic system as well. However, as most of development policies and strategies follow top-down approach, the likelihood of considering the local knowledge and practices seems to be insignificant. Most of the development policies and strategies designed and implemented in different level have rarely considered the local context.

Similarly, development programs and strategies so far implemented in rural Gedeo failed to take into account the ecological, socio-economic, and historical context of the area. The Gedeo land use systems appear to be distinctive, as it existed without significant loss to the biodiversity, despite very rugged topography and high population pressure. This is mainly due to fact that the systems depend on indigenous practices. What is important for the Gedeo land use system is to capitalize on the well established indigenous practices through integration of emerging modern knowledge and practices than fully imposing new strategies and programs that do not fit to the existing systems.

Analysis of existing secondary data indicated that different development programs and packages have been launched in the zone among which PSNP, Household Asset Building (HAB), natural resource management strategies (watershed development, water harvesting, and propagation of seedlings), development of irrigation schemes, improving agricultural productivity through use of improved seeds and artificial fertilizers are the principal one. Different CSO are also operating in the zone to improve the livelihood of the people and contribute to sustainable natural resource management. Currently concerted efforts have been made to improve the yield obtained from cereal crops through application of modern farming systems. Attempts have been made to maintain the productivity of the land and rehabilitate the degraded land through mass mobilization of the farmers

in watershed management programs. The watershed activities being going are encouraging. However, most of the programs did not emanate from the local people themselves. The programs were designed at national level and then reach the farmers level passing through different hierarchies.

Construction of water ponds or water harvesting package is a typical example in this regard. With the intention of harvesting of rainwater, project was design and implemented in all parts of the zone. Different views were reflected from the local people. Some of the local people are happy with the programs and packages while others are not convinced with the importance of the packages. For instance, local people residing in the lowland region where there is deficiency of water has welcomed water-harvesting program though the program failed. According to the findings of Tamirat (2012) among the water pond constructed (38 in number) in one kebele none them are functional mainly because of top-down planning approach.

On the other hand, those local people in the midland region who are suffering from shortage of land firmly resisted the implementation of water-harvesting program. Although they resisted they were forced to construct farm ponds. The development agents were insisting the people to construct the water pond disregard of the local environmental conditions in the area.

The same is true in the case of soils and water conservation programs. The mid land region relatively have better vegetation cover than the lowland region. Therefore, biological conservation/*circa situm* conservation is the best option for this region. However, in cereal crops producing region the land is usually left open to avoid the impacts of shade. Therefore, the soils in lowland region are relatively prone to erosion because of less vegetation cover and thereby physical structure might be needed to mitigate the problem of soil erosion.

However, despite considerable variation in land use type, agroecology and socio-economic status, almost similar type of soil and water conservation programs have been introduced in the zone in the last decades. Everywhere in the zone, the same documents (implementation and training manual) have been given to the experts and development agents; same training and same activities have been conducted. The report prepared and sent to the woreda and zonal level by respective development agents was also found bearing the same format. It is a kind of blanket recommendation.

This is a manifestation of top-down approach, which gives little or no recognition to the local practices. It did not take into account the indigenous practices that the local people developed

through time. For instance, most of the local people residing in the midland region have small land holding size. They tend to cultivate more than two to three crops in such small plots of land. Introducing physical structure in such very intensively cultivated land would mean aggravating the problem of land shortage. Even those local people residing in the lowland region claim that they did not construct physical structures even if they are convinced that the structure is important to reduce soil erosion and conserve water as well, principally due to shortage of land.

Gedeo people exclusively rely on local resources and local capacity to manage the land use system. The biophysical and social cultural phenomena prevailing in each agroforestry system dictate the type of farming systems employed, management practices, and production systems as well(Tadesse, 2002). Therefore, the development projects or packages introduced in the area need to consider the specific biophysical and socio-cultural characteristics.

The local people are well aware of the fact that the indigenous trees, enset and coffee covering the upper and the middle layer, annual crops and herbs occupying the lower layer protects the soils from erosion. They deliberately left the byproducts of harvested enset, pruned leaves of indigenous trees, and slashed weeds to protect the soils from removal, to reduce moisture loss from the soils and to increases the fertility status of the soils. This is the most compatible methods of soils and water conservation for the local people engaged in production of coffee and enset. Therefore, any programs dealing with conservation of soil and water must buildup on the existing practices. As indicated above, the Gedeo agricultural and rural development office, however, have been implementing the same programs in all agroforestry system despite the variation in local situation. Physical structures have been introduced in a very intensively cultivated region. The local people are forced to construct physical structure on their small plots of land. The well established indigenous practices were not given priority. Instead, emphasis is given to the introduced soils and water conservation practices. Majority of the local people have been engaged in construction of physical structure. This has influenced their perception about soils and water conservation practices.

From the above discussion, it is noted that different development strategies have been introduced into the area. It is obvious that if the programs are not in the interest of the beneficiaries, it will not be sustainable. As most revealed, development programs need to emerge from the bottom or otherwise it must consider the local situation into account. The fact that most of the development programs

implemented in the region are not considerate of local people's knowledge and local situation is hampering the indigenous practices.

6.5. Discussion

In the preceding sections of this chapter, a detailed assessment of factors affecting the changes and continuities of IK related to agroforestry system of Gedeo is made. In the analysis made, it is identified that multitude of factors are responsible for the gradual loss of IK. In fact, the analysis conducted does not establish a quantitative relationship/ association between the different domains of IK and factors contributing to the loss of IK. Rather it attempts to decipher how the changes in biophysical, socio-economic, and cultural elements are affecting the capacity of the indigenous knowledge system to regenerate and maintain by adapting to the changing situations.

As indicated earlier, IK is evolutionary and dynamic, and is capable of adapting to the ever-changing ecological, economic, socio-cultural, and political conditions. Thus, the sustainability of the IK system is principally determined by the extent to which it adapts to ecological, economic, socio-cultural, and political conditions. What is essential is the capacity of the IK system to regenerate new knowledge and maintain the existing knowledge through adaptation to the changing circumstances (Gómez-Baggethun & Reyes-Garcia, 2013).

Empirical research conducted elsewhere justifies the claim that IK system can adapt to the changing environment, while others pinpointed that it may get lost in response to the changing conditions. For instance, in the study conducted among Tzeltal Mayan children, no significant loss of IK is reported despite changes in socio-political, economic and environmental conditions (Zarger & Stepp, 2004). Similarly, no direct evidence of loss of knowledge of medicinal and other useful woody plants found among the Gourounsi group of the Sahel region of Burkina Faso despite the fact that the region is marked by increasing demographic pressure, socioeconomic changes and habitat degradation (Kristensen & Lykke, 2003). On the other hand, empirical research conducted among the Tsimane' of Bolivia (Gómez-Baggethun & Reyes-Garcia, 2013), farmers of Doñana, in Spain (Gómez-Baggethun & Reyes-Garcia, 2013) and communities from Malekula Island in Vanuatu (McCarter & Gavin, 2013) indicated that IK is being lost due to various internal and external factors. The empirical research findings of Ohmagari & Berkes (1997); Atran (2001); Brodt (2001); Sternberg et al. (2001); Zent (2001); Ross (2002a, 2002b); Atran et al. (2004); Hill (2004); Voeks & Leony (2004);Rocha(2005); Case et al. (2005); Reyes-Garcia (2007); Chistancho & Vining (2009) also have

shown the gradual loss of IK in response to changing biophysical, socio-economic and cultural conditions.

When IK pertaining to agroforestry system of Gedeo evaluated from the adaptive and regenerative capacity perspective, one may arrive at conclusion that the system's capacity to withstand the contemporary changes is relatively weak. The recent trend shows that the system is under continuous transformation with regard to ecology, economy, and socio-cultural conditions. It appears that the existing indigenous practices and system is not able to cope up with the ongoing ecological, social and economic transformations.

Previous research indicated that the system was resilient in the past despite demographic pressure and rugged topography (Tadesse, 2002; SLUF, 2006). This claim entails the assumption that population growth in Gedeo is considered to have a positive impact on the system, supporting the view that population growth is not a threat rather it is a resources (Tadesse, 2002). This view might have worked in the past, when the impacts of modernization/globalization are relatively lesser. This is not the case in recent time. The area is under the effects of multiple and complex factors. Human population is growing at alarming rate, exerting an intense pressure on land; household land holding size is shrinking from time to time, the ecological systems is changing; modernization is already expanding in every corner of Gedeo, and the area is becoming hotspot in terms of cash economy(coffee and very recently fruits), attracting local investors. With all these changes acting against the socio-cultural dimension, it may not be logical to assume that population growth is a resource at this time. What is being observed in the area in recent period, does not support the claim that the growing population is a resources. Instead, it is indeed becoming a menace to the sustainability of agroforestry system.

This is evidenced by the fact that less capacity of the indigenous knowledge systems to adapt to the changing circumstances. The recent trend shows that the socio-cultural aspect appears to be weakening support the claim that the prevailing biophysical, socio-cultural, economic and institutional factors leading to the gradual loss of IK.

The coupling effects of demographic pressure and modernization/globalization is the possible factors behind the changes. In the past, the system's stability is challenged by demographic and topographic factors alone. The local people were only required to adapt to the rugged topography and rapid population growth. Nonetheless, nowadays the factors are multiple and complex and it seems that it

is beyond the capacity of the local people to withstand and adapt to the ongoing changes. Some of these factors are not in the local people's ability to control.

Schooling is found to be affecting the attitude and perception of the people regarding socio-cultural values and norms both positively and negatively. On the one hand, it detach the younger generation from the local practices, resulting in gradual loss of IK. What is being taught in school does not exactly fit the local practices. The school teaching does not equip the children and younger generation with local practices, cultural norms and values of the society. On the other hand, school is found to be source of knowledge for natural resource management. Younger generation is aware of the importance of resource management from their environmental studies and geography lessons.

Conflicting results were reported regarding the possible impacts of schooling on acquisition and transmission of IK. Some researches claim that school attendance was found to have negative impacts on acquisition of indigenous knowledge (Zent, 1999; Voeks & Leony, 2004; Rocha, 2005; Cruz Garcia, 2006; Quinlan & Quinlan, 2007; Gómez-Baggethun & Reyes-García, 2013). Education has been identified as one of the principal driving forces for assimilation and integration to western culture. On the other hand, school attendance by children and young people were found to be contributing towards acquisition of IK (Reyes-Garcia et al., 2005; Reyes Garcia et al., 2007 and Saynes-Vasquez et al., 2013). Such conflicting result may arise from the differences in local circumstances, or difference in approaches and methodologies of the research or the knowledge domains considered (Zent & Maffi, 2009) or due to the difference in the level adaptive capacity of the system (Reyes- Garica et al., 2013). Thus, the existing relationship between formal schooling and IK can be attributed the existing socio-economic and demographic situation in Gedeo

Similarly, introduction of new religion, access to technology, mass media and transportation services are among the factors affecting the capacity of the IK systems to regenerate and become resilient. These factors paved the way for children and young people to get accustomed to urban life style. The change in social service has paved the way for acculturation. Change in preference of young people is a clear indication for being accustomed to urban life style. Young people are no more interested in being a farmer. They all wish to get employment in urban centers. This is certainly the result of access to the aforementioned social facilities.

The expansion of religion for instance, significantly changed the perception of people about belief systems and hence contributed to the loss of traditional belief systems. The gradual decline of *songo*

institutions, *gada* system, traditional practices such as *qexxela*, *ciincessa* and others is principally the result of expansion of religion.

The introduction of health clinics and health extension workers in every corner of the rural parts of Gedeo was found having detrimental effects on the retention of IK. There is heavy dependence on modern medication while there are multitudes of medicinal plants that can be used to heal various ailments. The majority of the young people do not know the medicinal plants and it seems that it is also getting lost from the memory of the adults due to heavy reliance on modern medication. Previous research findings also revealed that the introduction of modern medicines among the traditional people resulted in loss of IK about identification and uses of medicinal plants species (Ghimire et al., 2004; Voeks & Leony, 2004; Case et al., 2005; Lozada et al., 2006 and Monteiro et al., 2006).

Exposure to market economy and top-down development approaches are among the factors contributing to the gradual loss of IK. The findings of Gómez-Baggethun & Reyes-Garcia (2013) support the claim that exposure to market economy, top-down conservation policies that exclude local farmers are among the factors contributing to the loss of IK.

6.6. Conclusion

In this chapter of the dissertation, an attempt was made to examine the drivers of IK changes and continuities. Emphasis was given to impacts of changes in biophysical, economic, and socio-cultural on IK in relation to agroforestry system of Gedeo An attempt is made to associate the IK dimensions with drivers behind the changes and continuities of IK. Accordingly, among the three dimensions of IK, the normative aspect is in danger of being lost principally due to modernization (introduction of new religion, market economy, schooling, and access to technology and urban centers).

The loss of IK in the study area is attributed to the combined effects of ecological, demographic, socio-cultural, and economic factors. Biodiversity loss, rapid population growth, schooling, introduction of new religion, development of road infrastructure, access to technology and mass media, introduction of market economy, top-down development approaches are altogether contributing towards the gradual loss of IK.

Among the factors identified, schooling and religion was found to be the newly emerging factors, substantially influencing both knowledgeable elders as well as younger generation with respect to disregarding their own socio-cultural values and norms. Concerted efforts are required in this regard,

principally to aware, the local people regarding the contribution both school based knowledge and local setting based knowledge as well as traditional belief system and practices and, modern belief systems and practices.

Lastly, it is quite important to critically look at how the different factors are affecting the sustainability of indigenous knowledge system, and quantitatively determine the magnitude of each factor on loss and retention of IK. The factors appear to be multitude and complex. Therefore, further research, which specifically measures the extent, are required to single out the factors that are more contributing to the loss of IK. Moreover, it is essential to establish relationship between the different domains of IK and individual factors affecting its changes and continuities.

CHAPTER SEVEN

SYNTHESES AND IMPLICATIONS TO SUSTAINABILITY

7.1. Introduction

Previous research accounts reveal that the Gedeo agroforestry system was relatively sustainable and exemplary land use system principally due to extensive use knowledge of the local people. There had never been any significant records of significant draught and famine in Gedeo zone. However, the recent trend shows that the system in general is suffering from loss of biological and cultural diversity.

In this study, a detailed investigation of dynamics of IK of agroforestry system of Gedeo is made. From the analysis conducted, it is found that the agroforestry system exhibits both indigenous and modern aspects. It appears that the recently introduced modern practices are influencing the decision of the local people in their management of the agroforestry system. Thus, it can be claimed from the findings that the system is on the verge of being engulfed by the modern practices. However, majority of the indigenous practices related to production, management and harvesting are relatively intact in coffee producing regions. In addition, the study investigated that the rate of IK acquisition and transmission among successive generation has shown a declining trend. Gap was observed between young people and elders in terms of eco-cognitive, practical and normative dimensions, which implies a gradual loss of IK.

Though the area is experiencing gradual loss of biological and cultural diversity, it seems that the loss in cultural diversity is more prominent. This is principally due to the disruption of cultural norms and values, customary laws, rituals, and belief systems, which in turn is attributed to ever changing biophysical, socio-economic, demographic and institutional factors. Thus, it can be implied that the agroforestry system of Gedeo is in state where its capacity to adapt to the prevailing circumstance is weak. This imposes a big threat to its sustainability.

7.2. Changes and Continuities of IK pertaining to Agroforestry System

Gedeo agroforestry system is a form of sustainable land use system that simultaneously or sequentially combines trees with crop or animal production. The system was proved to be self-sustaining and self-regulating, hosting large number of population in small plots of land. This is mainly due to diligent efforts of the local people who harness the resource in sustainable manner,

keeping the system relatively sustainable. However, recent trend indicates that the system is gradually losing its resilience. Evidently, majority of IK related to practical aspects (production, management and harvesting of crops) are still practiced with some changes made to them. Significant loss is observed with regard to IK related to normative aspect (Cultural values and norms).

Acquisition of IK and its transmission among successive generation is a key to continuity of the system. Not only acquisition and transmission, but also the retention of the acquired knowledge through hand on practices is a vital to its continuity. Thus, the likelihood of continuity of IK system depends on individual's ability, interest and commitment in acquiring the knowledge and scaling it up through regular practices. The capacity of the system to absorb the perturbation that occurs with respect to biophysical, socio-economic and institutional factors is also a determinant factor in the continuity of IK.

Recent trend in IK transmission among the people indicates that the rate of transmission among successive generations is found to be relatively low. Moreover, the comparison made to investigate the knowledge differences between different generational groups reveals a clear knowledge gap. One may question why the knowledge gap exists between young people and their elders. Is it because of maturity level between the younger and the elders or due to lack of IK transmission and interest to acquire IK? Can we attribute to apparent shift in everyday life of the younger generation or to the disruption of some of indigenous practices? What causes the gap?

Apparently, maturity level is not found to be the potential causes of the knowledge gap, as there are young people who are in the same age category, and whose performance is almost comparable to their elders. There is a tradition among the people that young people above 12 years old are considered to be fit to conduct any farm activities without assistance from the family or peer. Therefore, young people above 12 years old are not said to be illiterate about their locality.

The knowledge gap is rather attributed to slow rate of IK acquisition and transmission, which in turn is attributed to shift in everyday life of the younger generation. This in turn is principally attributed to modernization. Significant proportion of the younger population has been moving to urban centers on daily basis for schooling, labor work, and other purposes. Given that the participation of young people in any local activities is limited, the likelihood of acquiring indigenous knowledge and practices, and valuing their culture is certainly low. Undoubtedly, such disparity between elders and

young people is likely to create a knowledge gap. Similar findings reported that lack of transmission between and among successive generation is resulting in loss of IK (Reyes-Garcia, et al., 2005).

Parents take the first blame, as they are responsible to impart their knowledge and skills to their children and also encourage them to give value to their culture. As revealed in previous chapter, majority of the agroforestry practices (above 80%) are transmitted via parent to child interaction (vertical transmission). Obviously, vertical transmission of IK will not be effective in the absence of one partner or if one partner shows less interest. Both parties must have interest and be willing to participate in the process of knowledge transmission. What is actually observed in recent time is lack of interest and commitment from the side of the younger generation to acquire IK from their parent and lack of courage from the elders as well. The elders claim that their acceptance among the younger generation is becoming low and therefore, they are not committed to teach them.

Not only parents, but also community elders take the blame of not transferring cultural norms and values to the successive generations. Young people can only learn about their culture if they come in contact with elders and attend cultural practices. This is not happening in Gedeo. If this is the reality, how could the young people of Gedeo be able to acquire knowledge about their culture having only very limited contact with elders who are the legitimate holders of the knowledge? Do we expect them to acquire the knowledge without participation in some of the cultural practices? Perhaps not.

The decline in interest is not only from the side of the youngsters; the elders are also lacking the courage to orient and teach the younger population about the cultural values and norms. For instance, there used to be an indigenous forum held by community elders and the younger population in the evening time. The forum is a kind of entertainment forum whereby the community elders tell folktales, local proverbs, and local histories. Since recent time this forum is non-functional mainly because of modernization The younger population have now several options to spend time after school like playing games, watching movies, or chatting among themselves.

Moreover, the discontinuity and dysfunctional nature of some of the socio-cultural practices is one potential factor for the gap. In fact, the majority of indigenous knowledge related to practical aspects is retained. The majority of the younger generation did not get the opportunity to observe and attend some of the socio-cultural practices, because some of the practices are already abandoned while others are less often practiced.

To put is concisely, IK of agroforestry system of Gedeo is gradually eroding due to lack of transmission of the knowledge and practices and disruption in cultural system. This is further exacerbated by the changes in biophysical, socio-economic, demographic and institutional aspects. Contrasting results have been reported by scholars regarding the changes and continuities of IK among different societies (see Lozada et al., 2006).

7.3. Driving Forces behind IK Changes and Continuities

As IK is dynamic and evolutionary in its nature, changes are inevitable. It is normal to expect IK being reproduced, modified, produced and lost. What is important is the capacity of the system to absorb the changing circumstances. This depends on the extent to which the system becomes resilient to the prevailing demographic, socio-economic and institutional dynamics.

Remarkable transformations have been exhibited in Gedeo since recent time. Human population has been growing at alarming rate; primary schools and medical centers have been established all over the zone at kebele level; road that links rural kebeles and woredas have been constructed; majority the rural kebeles are connected to each other and to the world through telecommunication and mass media; and various agricultural development policies and strategies have been introduced to the area to improve production and hence livelihood of the people. Then do we expect the system to remain unchanged under such transformations? Perhaps not. Let alone in such very dynamically changing circumstances, even in society living in remote areas, far from the impacts of modernization, changes are inevitable. There is no question regarding the changes. What matters is the resultant effect of the changes on sustainability of the system.

Apparently, Gedeo zone is one among the densely populated areas in the country, with population density extending beyond 500 persons per square kilometer. The current average land holding size of majority (90%) of the local people is less than one hectare. The size is expected to go down as succeeding generation claim their share from their parents

There is an ongoing debate among scholars that the growing size of population in Gedeo is considered as bless than a curse (Tadesse, 2002). There is a claim that population is a resource by itself and therefore, the role it plays in maintaining the environment is positive. This claim is emanates from the view that if there are more people, then there will be more trees. One can get convinced with this kind of argument by looking at only the greenness of the Gedeo agroforestry system. Undeniably, the area appears to be green throughout the year. However, the greenness does

not necessarily entail that the area is stable economically, socially, ecologically and culturally. What is actually being observed in the area in recent time is the deterioration of livelihood of the local people and perturbation in biological and cultural diversity. Therefore, at this point in time, it seems not viable to argue that rapid population has positive effect on the agroforestry system. Instead, population growth is leading to gradual loss of biological and cultural diversity and, food insecurity as well.

The decline in the abundance and diversity of tree species and prevalence of poverty in some parts of Gedeo, significantly diminishing landholding size, and increasing number of landless and jobless people are among indicators of the inapplicability of the view that increasing population is a resource. Rapid population growth is compelling the local people to migrate to nearby urban centers or towns in search of off-farm employment. Moreover, it is compelling the local people to use the land intensively as a result of diminishing land holding size. Majority of the local people are not encouraging their children to follow their ancestor's footsteps partly due to limited land to share to their children.

The current research account shows that rapid population growth is negatively affecting the system and the livelihood of the local people as well. This implies that rapid population growth for the contemporary Gedeo zone is not a blessing, rather it is a challenge. The same findings were reported by Rajasekaran et al (1991) and Grenier (1998) in which rapid population growth is among the major factors for the loss of IK related to natural resource management.

On the other hand, there have been remarkable changes in social infrastructures. Roads connecting the zonal town to different woredas have been constructed. There has been remarkable achievement with regard to providing the rural population with power supply. Primary schools have been established in all over the zone, each kebele having at least one primary school. Small-scale health stations were also established all over the zone. Majority of the rural population have now access to mass media (ERTA, and local media), telecommunication through mobile telephone, and transportation service (Motorbike). In every corner of the zone, there is small-scale shop that provides service for the local people. All these infrastructural development indicate that the rural Gedeo have been transformed since recent time.

The current study investigated that although the social infrastructures being introduced in the rural parts of Gedeo have brought changes, their contribution in terms maintaining IK pertaining to

agroforestry system of Gedeo are limited. Rather some of the changes have been affecting the sustainability of the indigenous practices. For instance, construction of road is good for the people as it helps them to channel their produces to the market. Nevertheless, the construction of road and the consequent introduction of motorbike paved the way for the people to have frequent visit to urban centers and thereby being accustomed to urban lifestyle. This problem is most prevalent among the young people who are very much prone to the impacts of modernization. This finding seems contrast with the finding of Godoy et al. (2009a) which indicates that access to transportation make it easier to move over wider area, as a result of which the Tsimane's get access to learn ethnobotanical knowledge. In fact, this is not the case in Gedeo, as majority of the local people travel to urban centers, where there is a different a lifestyle from their locality. This implies that some of these factors are bearing positive effects while in other areas bearing detrimental effects. This can be partly attributed to the resilience and adaptive capacity of the systems. The context in which the research is conducted, the time and the nature of the society (economic, social, cultural set up) is a key in this regard. Therefore, what is happening with regard to infrastructural development vis *a vis* indigenous knowledge system can be seen from context of the area.

If we take the establishment of health centers, their contribution with regard to supporting women during prenatal and postnatal period and creating awareness among the people with regard to keeping their surrounding clean is so immense. However, the heavy reliance on modern medication is resulting in disregard of the traditional medication. Research conducted in different parts of the world reported similar results regarding the impacts of modern medication on IK loss (Ghimire et al., 2004; Voeks & Leony, 2004; Case et al., 2005; Lozada et al., 2006 and Monteiro et al., 2006).

The same is true in the case of education. Significant number of children and young people got access to education. However, only few individual have been getting access to off farm employment after completing their education. Thus, majority of the young people of Gedeo have been returning home. This has multiple effects on the sustainability indigenous practices. One of the effects is expressed in terms of increasing pressure on land as the young people who return to home demand their share of land from their parents. One can imagine the extent of the problem related to small land holding size, when already highly fragmented piece land is further shared among successive generations

The problem regarding school is further complicated as young people who are coming back home are relatively accustomed to urban life style. Although they can have access to land through inheritance,

it seems that they might not have the commitment and courage to lead their life in sustainable manner. Their knowledge and feeling about the socio-cultural values and norms, which are the base for management of Gedeo agroforestry system, seems to be not strong. Their commitment to invest much of their time in managing the farm in uncomfortable environment like in time of drought, low productivity and other natural disaster seems to be not strong. It seems that most of the present young generation aspires to live an easy life, free of hardship. Certainly speaking, young people of Gedeo will not be able to manage the agroforestry system lacking appropriate knowledge, interest and commitment.

Obviously, the indigenous land use system of Gedeo demands regular management as well as diligent efforts. It is not a kind of land use system that can easily be managed with minimum efforts. This is due to the undulating nature topography, which is very much prone to soil erosion in the absence of multistory land use system. Whatsoever may be the socio-economic challenges, the indigenous trees, which are providing protective and regulative services for the system, should be kept from massive clearance. Although the local people are using indigenous trees for different purposes, it is not without ensuring the presence of emerging seedlings that replaces the utilized tree species. Elders of Gedeo have a tradition of keeping emerging seedlings *(baaboo)* of indigenous trees as well as other plant species useful for the system. Great care is taken not to damage the emerging seedlings while slashing weeds and herbs. One of the big questions is whether the young people of Gedeo will have the courage and commitment to compromise their socio-economic demands at the expense of the biophysical environment.

Therefore, though increasing access to school in rural Gedeo have brought majority of children to schooling, its role in terms of maintaining IK with regard to agroforestry system is seen as having negative effects. Detachment of children and young people from their cultural values and norms are among the impacts of schooling.

Contrasting findings were reported by scholars regarding the impacts of formal schooling on IK. The findings of Zent (1999), Voeks & Leony (2004), Rocha, (2005), Cruz Garcia (2006), Quinlan & Quinlan (2007), and Gómez-Baggethun & Reyes-García (2013) have shown the detrimental effects of formal schooling while the research findings of Reyes-Garcia et al. (2005); Reyes Garcia et al. (2007) and Saynes-Vasquez et al. (2013) reported the contribution of school attendance towards IK acquisition. Such disparity between the findings of the researchers is attributed to difference in methodology and the context in which the study was conducted.

Expansion of religion is also one among the social changes, which significantly debilitated the socio-cultural norms and values of the Gedeo. The traditional belief systems, ritual practices and other cultural practices were not functional due to religion. The current study revealed that more than 90% of the sampled households are the followers of protestant religion while only two of the sampled household respondents still believe in Gedeo's original religion. This means the present day children and younger generation have only little chance of acquiring their customary laws and belief system.

Nowadays, elders are not encouraged to conduct *songo, qexeela* and other cultural practices as they are more influenced by religion. As a result, the successive generation is not able to acquire knowledge and skills regarding the cultural values and norms of the people.

The disruption of some of the cultural practices by settler since1890's, and expansion of missionaries since 1940 played a vital role for the gradual loss of IK with regard to agroforestry system of Gedeo. Prior to incorporation of Gedeo into the empire state, land was in the hands of traditional leaders or clan leaders and every member of the society has customary right to land ownership. However, the coming of the feudal system in late 19th century had changed the system and gradually debilitated the intact relationship between and among the community. The customary right to land ownership was replaced by private ownership. The right to allocate and control land its produces was transferred to the settlers. This has resulted in land tenure insecurity and sense of distrust among the local people.

The surplus of their produces, which was channeled to *gada* institution, was diverted to the settlers. The *abba gada,* the spiritual and political leader of the people, was made to serve the settler as being one among the *gabbar*. As a result, the economic power of the *gada* institution and the community has declined because of the channeling of all or part of their produces to the settlers. Eventually this resulted in breakdown of the indigenous institutions and destabilisation of the subsistence economy of the people. This process of weakening indigenous institutions and cultural practices has been continued and is of course the principal driving forces behind the denigration of cultural values and norms of the society.

It is worthwhile to mention that the introduction of market economy, particularly commercialization of coffee was also a principal force behind the gradual decline of indigenous agroforestry practices. It has brought change in indigenous land management practices. The land use system in Gedeo is a kind of land use system that integrates crops, trees, and animals. This tradition of integrating more than one crops and trees is an old age practices, which has been transferred from generation to

generation. The local people have developed such knowledge and skills of growing perennial and annual crops, trees and rearing animals in sustainable manner over decades. They were not tempted by the economic benefit of coffee and rush to abandon other components to expand coffee field alone. Yet now the people are very much wise in terms of integrating more than one produces in a plot of land. Even under such high economic return from coffee, they have not been tempted to expand the coffee land at the expense of other crops. This attitude of the local people emanated from the experiences they had developed over a long period. However, the settlers, who were very much tempted to expand coffee plant for the sake of earning more income, were not in favor of the indigenous practices of the local people. Rather they demanded the local people to produce coffee alone, by abandoning other crops such as enset. Consequently, by putting pressure on the local people, the settlers were able to bring significant portion of land in coffee producing region under coffee production alone. This policy of massive expansion of coffee land at the expense of other subsistence crops has brought two significant changes. One is the destabilization of the livelihood of the local people, as they have to wait for the settlers to provide them with subsistence crops such as enset. The other is change in indigenous land management practices.

The top-down development approach is also another potential driving forces behind the gradual loss of indigenous practices in Gedeo. The local people were under the persistence influence the country's policy of modernization of agriculture. A number of development policies and strategies have been introduced to the area, majority not compatible with the indigenous land use system. The fact that less recognition is given to the indigenous land use system is affecting the indigenous land management practices. The local setting and condition should be the starting point for any development programs. As much as possible the development programs should build up the already existing indigenous practices.

It can be implied from the preceding paragraphs that the local people have been trapped between two compelling circumstances from point of view of sustaining IK regarding agroforestry system. One of the circumstances is that increasing pressure of rapid population growth and diminishing size of land among majority of the local people, which eventually leading to poverty. The other is remarkable transformation in social facilities and introduction of market economy, which have huge impacts in everyday life of young people and children and even elders themselves.

In general, this study identified that IK of agroforestry system of Gedeo is showing a gradual decline in response to dynamically changing ecological, socio-economic and cultural factors. The combined

effects of changes in ecological, socio-economic, cultural and institutional factors are contributing towards to the gradual loss of IK. The findings of this study seem to dovetail with the research findings of Ohmagari & Berkes (1997), Zent (2001), Case et al. (2005), Lozada et al. (2006), Turner & Turner (2008), and Gomez-Baggethun et al. (2010). On the other hand, the findings of Byg & Balslev (2001), Lykke et al. (2004), Zarger & Stepp (2004), and Godoy et al. (2009a) suggest that IK remains to be resilient despite changes in cultural, economic, ecological, institutional and political conditions. This implies that the changes that occur regarding IK and the drivers behind the changes is not universal and hence it differs from region to region depending on the existing local circumstance, the adaptability of the system to the prevailing conditions and the methodologies and domains of knowledge used to depict the changes and the causes. Therefore, what is investigated in Gedeo reflect that the system's local adaptation mechanism is determinant for its sustainability. This can also reiterate the concept that IK is culture specific that adapt to the prevailing situation through local adaptation mechanisms.

7.4. Implications to Sustainability

Sustainability of the traditional agroforestry system of Gedeo is viewed from the perspectives of ecology, economy and socio-cultural. In line with the concept of sustainability, the agroforestry system of Gedeo is said to be sustainable when it satisfies the three dimensions of sustainability.

Researchers have already reached at conclusion that indigenous agroforestry type of land use system is one of the best options to overcome problem of land degradation and biodiversity loss. It is one of the socially and ecologically acceptable land use systems (Teklehimanot, 2004; Jama et al., 2006; Miller & Nair, 2006; Peyre et al., 2006; Nair, 2007.).

Most researchers, theorists and development practitioners also came to realize the role that IK plays in sustainable development. There has been a growing concern that the western development paradigm and approaches are not able to bring desired outcome keeping environmental sustainability. Since the last three or four decades greater emphasis has been given to endogenous development (; Slikkerveer & Brokensha, 1991; Warren, 1991; Agrawal, 1995). The fact that many areas of highest biodiversity on earth is being inhabited by indigenous or traditional people (Posey, 1999) attest that development programs that depend on local/indigenous knowledge and practices are often harmonious with the natural environment. This is due to the fact that indigenous people use their own knowledge to maintain the biodiversity (Posey, 1999).

The Gedeo agroforestry system was considered as an exemplary in this regard. The systems remained sustainable for more than centuries despite topographic limitation and socio-economic pressures. Scholars attribute the enduring nature of the agroforestry system to its indigenousness (Tadesse, 2002; Robe, 2006; SULF, 2006; Bogale, 2007; Mesele et al., 2008; Mesele et al., 2011). The fact that the land use system is built on the IK, which in turn is embedded on cultural values and norms, made it to remain resilient despite persistent demographic, socio-economic and institutional pressures. Then if this is the actual scenario, it is easy to guess what would happen to Gedeo agroforestry system when the very foundation of the system, IK, is being eroded. Undoubtedly, the sustainability of the system would be under big challenge if IK is eroded.

The current study concluded that the indigenous knowledge systems, which is a function of cultural values and norms, customary laws, rituals and traditional belief systems, is gradually eroding, posing a major threat to the sustainability of the agroforestry system. The continuity of IK is ensured whenever the transmission process continued among successive generation. Moreover, the functionality of the indigenous practices among the society is a key to its continuity. In this regard, it can be implied that there is a gradual decline in the transmission of knowledge among successive generation and some of the indigenous practices are not functional. These two principal changes are threatening indigenous land use systems of Gedeo.

Literally speaking IK is embedded in the culture of the society. IK cannot be seen disentangled from the spiritual and social practices of the society. Therefore, any changes in either spiritual or social practices tend to change IK. For instance, disruption in traditional belief systems, customary laws, communal way of life, social networks and ritual practices has huge impacts on IK. Certainly, this can result in change in value system and hence to the loss of IK. The current study founded that the cultural values and norms of the society is being eroded from time to time. The prominent indigenous institutions such *songo* has been disempowered by the modern administration systems. *Gada* system seems to be not active in terms of passing decision that determines the socio-cultural, economic and political aspects of the society. Its autonomous is overtaken by the modern administrative systems. Traditional belief systems are more or less denigrated. There exist symptoms of replacement of communal relationship by individualistic way of life. Secularism is becoming common among the society. Therefore, the cumulative effects of observed changes in social and cultural values of the people, is expected to weaken the indigenous agroforestry practices. People may start to give less value to their culture and hence it may lead to destruction of biodiversity. The loss in cultural

diversity eventually resulted in loss of biodiversity due to the inextricable link between cultural diversity and biodiversity. Therefore, given that the indigenous practices are declining and the ability of the system to absorb the shocks is weakening, it is definite that the indigenous land use systems will not remain sustainable.

Finally, one can imply from the prevailing situations that the traditional agroforestry system of Gedeo is trapped between the dwindling indigenous practices and the newly emerging modern mode of production, practices and economy. Unable to cope with the prevailing ecological, socio-economic and institutional transformations, indigenous knowledge of agroforestry system of Gedeo is gradually eroding. On the other hand, there exists an emergence of new mode of production supported by modern methods, modern mode of economy, and influence of modernization. This situation seems to have its own impacts on the sustainability of the social dimensions of the agroforestry system in Gedeo.

CHAPTER EIGHT

CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion

This research aims at assessing the dynamics of IK with regard to agroforestry system and its implications to sustainability. The research was conducted in Gedeo zone, located in the Eastern escarpment of the Great East African Rift valley. The local people have distinct culture, language and way of life. They belong to Cushitic family. The people are believed to be agrarian and well known for their exemplary indigenous land management system.

The Gedeo agroforestry system comprises of three sub-systems, namely enset based, coffee-enset based (multistory system) and coffee-fruit based agroforestry system. The multistory agroforestry system is the dominant type of land use system. The system integrates trees, shrubs, herbs, crops, fruits, and animals in systematic manner. It is self-regulating and self-sustaining type of land use system. The system remained to be undisturbed for several decades, adapting to the prevailing environmental, socio-economic and demographic conditions. This is mainly due to the meticulous efforts of the local people in harnessing the natural resources in sustainable manner. Therefore, the secret behind the sustainability of the system for several decades, despite rugged topography and demographic pressure is its heavy reliance on indigenous knowledge system of resource management. Loss of the indigenous knowledge and practices would mean loss of biodiversity, cultural diversity and threat to livelihood of the local people.

An attempt was made to explore the changes occurring from the perspective of socio-cultural dimension of the agroforestry system, focusing particularly on changes and continuities of IK. To address the problem, the study employed an interdisciplinary approach, whereby concepts and approaches from environmental geography, anthropology, and developmental psychology were combined. An exploratory sequential research design was employed. Data were collected on three principal issues. These are (1) IK acquisition and transmission and its changes in time, (2) an intergeneration variation in IK among the local people and (3) drivers of IK changes and continuities.

Obviously, change in ecological and social systems is inevitable in society where there are dynamically changing circumstances. What matters is the capacity of a system to respond to the changes, recover after disturbance, absorb stress, internalize and transcend it (Berkes et al., 2000).

When the traditional agroforestry system of Gedeo is evaluated from the perspective of its socio-cultural dimension, it appears that the system is gradually losing its resilience because of its inability to cope up with the existing dynamics. This can be manifested in loss and modification of some elements of indigenous agroforestry practices, biodiversity loss, prevalence of food insecurity, denigration of socio-cultural systems, and non-functional nature of the indigenous institutions.

The findings of this study suggest that some elements of the indigenous agroforestry practices remain active, whilst others found to be non-functional, being replaced by the modern one. More than 50% of the agroforestry practices, particularly practices referring to production, management and processing of components of the system remain resilient despite the prevailing circumstances. However, the socio-cultural aspects of IK, such as customary laws, norms, values, rituals and belief systems are significantly dwindled. Majority of the cultural practices are abandoned while other are less often practiced.

One of the big challenges with regard to the resilience of the system is the changes observed in terms of what Berkes et al. (2000) call **'social mechanism behind management practices'**, which include generation, accumulation and transmission of indigenous ecological knowledge. Disturbance in the social mechanism is likely to challenge the resilience of an ecosystem, particularly in a society that depends on natural resources. When the status of the Gedeo agroforestry system is evaluated from the social mechanism perspective, it implies that it is losing its sustainability.

For the sake of analysis, IK is categorized into three dimensions (eco-cognitive, practical, and normative). The mechanism of its transmission among successive generation, difference in the transmission among the generation and IK gap among the intergeneration were analyzed and implications were drawn based on the result obtained.

The findings of this research reveals that oral communication, observation and practices by doing remain to be the dominant mode of IK acquisition and transmission. Regarding paths of IK transmission, the local people have been transferring their local wisdom through vertical, horizontal and oblique paths. Vertical transmission is predominantly used for intergenerational transfer of IK related production, management and processing of components of agroforestry system. On the other hand, indigenous practices related to cultural values and norms, ritual ceremonies, indigenous institutions, and tradition belief systems are often transmitted through oblique transmission. Thus, parents are the most responsible for the transmission of practical dimension of IK, while community

elders are responsible for the transmission of normative aspects IK. Horizontal transmission of IK was found to be less dominant.

Gender plays a role in the transmission of gender based indigenous practices. Both male and female conduct majority of the indigenous agroforestry practices in common. However, some of the indigenous practices are exclusively conducted by female alone; while others by male. In such practices, the transmission is predominantly along the gender line.

Regarding the difference in the rate of IK transmission among successive generation, a gap is observed. Although, the extent of the difference is not quantitatively determined, it can be concluded from the observation and analysis conducted that the rate of knowledge generation and transmission has shown a declining trend. Besides, there is less opportunity of IK storage or accumulation among the younger generation, whom are expected to be the hope of the future.

Loose contact between younger generation and elderly people, between parents and children, younger generation less contact with and exposure to the socio-ecological systems, are some among the manifestation of declining rate of IK transmission among successive generation.

From the perspective IK variation among generational group, the findings of this study suggest that knowledge differences were noticed between the generational groups in all dimensions IK. There exist a knowledge gap between younger generation and elderly people. The gap is seen in all dimensions of IK. However, the differences observed in normative dimension of IK were much greater than the other two. This indicates that most of the cultural values and norms, customary rights, indigenous institutions were disrupted. This again entails a break in cultural continuity.

The gap seems to emanate from multitude and interwoven factors. The inability of younger generation to acquire knowledge from their ancestors, lack of courage and commitment from the older generation and parents to impart their knowledge coupled with the ever-changing ecological, socio-cultural, economic and institutional conditions paved the way for the gradual erosion of IK.

There exists a decline in relationship between parents and young people, community elders and young people and among the local people themselves. More of individualism type of life than communal, secular than spiritual type of life is becoming common among the society.

Young people of Gedeo have neglected their ancestral norms and values. Instead, they are reflecting urban life style. The young people are relying on formal education, media and technology. One can

unquestionably speak off the deteriorating relationship between parents and young people, and young people and knowledgeable community elders. IK transmission among the successive generation is weak implying the likelihood of its erosion in the end. This is mainly attributed to the impacts of schooling, religion, mass media, and technology, cultural contact with dominant culture (mainly during the imperial and feudal period), labor mobility and lack of coordination between traditional and governmental institutions. Young people of Gedeo have been alienated from their culture through the impacts of schooling, religion spread by missionaries, modern technology, mass media and commercialization of coffee.

Thus, we can conclude from the recent trend that IK with regard to agroforestry system of Gedeo has been dwindling. The systems' capacity to withstand the prevailing circumstances and hence become sustainable is getting weaker and weaker. It seems that the culturally embedded indigenous land use system of Gedeo is being overwhelmed by the prevailing socio-cultural, economic and institutional dynamics.

On the other hand, there has been an increasing impact of emerging modern methods of production. Recently introduced development programs and strategies influence the decision of local people regarding land management practices. The development programs and strategies did not consider indigenous practices. There has been negligence to indigenous knowledge on the part of the state whenever development programs and strategies are designed and implemented.

Moreover, there has been an overwhelming transformation in terms of infrastructures as compared to the past. The local people are quite happy with the ongoing transformation and indeed it has brought an observable changes in many circumstances as majority of the reported. However, their effect on sustainability of the indigenous knowledge is incontestably negative. .

Thus, the land use system of Gedeo is apparently trapped between dwindling indigenous practices and recently emerging new mode of production, way of thinking, life style, and modern modes of economy. IK of resources conservation, people-environment relation, production and livelihood that has been embedded in the culture, norms, values and beliefs of the communities has been deteriorating from time to time. Instead, new mode of production supported by technology and improved seeds, and new dynamics of modern modes of economy are becoming common in the region. This is found to have an effect on continuity of the indigenous practices hence to

sustainability of the agroforestry system. It is impossible to ensure the sustainability of the agroforestry system given that the current trend of IK erosion continues.

Management of the intergenerational transmission through cultural revitalization processes is required to ensure the continuity of IK of agroforestry system. Moreover, managing the principal driving forces behind change in indigenous practices is crucial to maintain the sustainability of IK pertaining to agroforestry system.

8.2. Recommendations

The findings of this research reveal that IK of agroforestry system of Gedeo is gradually eroding because of multifaceted and complex factors. The rate of transmission of IK among successive generations has been gradually declining. Customary laws, norms, values, traditional belief systems and rituals have been denigrated. Indigenous institutions such as *gada* and *songo* are also disempowered. Consequently, the socio-cultural sustainability of traditional agroforestry system of Gedeo is under challenges.

Decline in the transmission of IK among successive generations and disruption of indigenous practices, which in turn are attributed to ever changing socio-cultural, economic and institutional conditions are among factors for the gradual erosion of IK. The emergence of new production system and new mode of economy are also weakening IK.

Such complex problems cannot be mitigated if concerted efforts are not in place. What is important in this regard is to look for possible strategies to retain the existing indigenous practices and to revitalize the denigrated but important indigenous knowledge and practices. Thus, cognizant of the multifaceted nature and complexity of the problem, it is hoped that the following recommendations will be a means to the problems prevailing in the study area.

i. Ensuring and increasing the adaptive capacity of social-ecological systems to the ever changing biophysical, socio economic, cultural and institutional factors.

The very existence of IK depends on its adaptive capacity to the changes in socio-cultural, economic and biophysical conditions. Its continuity is ensured based on its resilience to the prevailing local and international conditions due to the fact that indigenous knowledge and practices are closely interwoven with people's everyday life. Any internal or external factors that affect the local people's everyday life are also expected to have an impact on the systems. Therefore, it is imperative to

increase the adaptive capacity of the systems, through managing the factors prevailing in the area. These can be achieved by regulating rapid population growth through strengthening family planning programs and increasing local people's awareness about the possible impacts of uncontrolled population growth. Moreover, challenges related to socio- economic conditions can be addressed via improving saving culture the local people, diversification livelihood through provision of financial and technical support eg. Microfinance, strengthening some of the local strategies such as household asset building, and promoting beehive production as it does not require large space and much investment. In addition, concerted efforts must be made to increase the awareness of the local people regarding the role of the socio-cultural values of the local people towards sustainability of the agroforestry system.

ii. Revitalizing and sustaining an intergenerational transmission of IK of agroforestry system and strengthening rituals, traditional belief systems and important cultural practices. In this regard, the following points will address the revitalization of IK transmission and strengthening of the socio-cultural practices. The points are:

- As the dominant mechanism of IK transmission among the Gedeo is vertical, the role of parents in equipping their children with the necessary knowledge and skills is immense. Parents are not only required to encourage their children to become strong in their formal education. It is their responsibility to let their children to acquire the local wisdom as well. Therefore, much is expected from the parents in terms of directing their children towards acquisition of IK of agroforestry system of Gedeo. This can be done through awareness creation forum with the local people on the importance of transmitting local wisdom to successive generations.
- The second point is motivating the holders of IK so that they can be initiated to teach the young people and children in their spare time.
- Maintaining indigenous institutions such as *gada* and *songo* institution so that the institutions will have their own contributions in strengthening the tradition of taking one's own child to farmland, ritual practices, local meetings (such as *songo*), and telling folktales, history and culture of the people. .
- Revitalizing the socio cultural practices through (1) Promoting the recognition of the value of customary laws, ritual practices and traditional belief systems for the preservation of indigenous cultures and indigenous knowledge and practices, (2) Inclusion of IKS in school curriculum (lower grade) or expansion of multicultural

education or at least establishing demonstration sites that can depicts the agroforestry systems of Gedeo in primary schools and (3) working towards documentation of the existing local wisdom. In this regard, further research is required as to how to include IK into school curriculum. Thus, interested research can pursue in this line of enquiry, investigating the mechanism through which IK can be incorporated in school curriculum.

- It is inevitable that if IK is not transferred across different generational groups, it is subject to loss. The current trend has shown that because of less transmission of IK, there is likelihood that some aspects of IK are on the verge of disappearance. If the transmission rate continues this way, then we may not get the knowledge as the holders of the knowledge passed away. Therefore, beside the attempt made to regain the transmission process, it is imperative to document the indigenous practices as well as the socio-cultural practices. In this regard, extensive research is required with regard to the how of the documentation processes.

iii. Consideration and incorporation of IK in the development agenda, policy and strategies and local community based program of environmental education

Lack of consideration by policy makers, and disregard of IK in formulation of development programs and strategies are among the institutional factors responsible for erosion of IK. Therefore, it is vital to take into account IK into development programs. This may require understanding of IK by policy makers, development partners, and practitioners so that it can increase their responsiveness to the land users by building on local experiences and practices.

iv. Working towards the integration of existing indigenous practices and emerging modern practices

One of the challenges in this regard is the dominance of recently emerging modern production systems and resource conservation practices. The existing indigenous practices are engulfed by the modern practices. Local people are encouraged to increases the productivity of the land through application of modern production systems at the expense of indigenous practices. In fact, it is unlikely to abandon the non-indigenous practices while the world is being under the continuous pressure of globalization. It seems impractical to isolate Gedeo from the other world. Therefore, the introduction modern mode of production based on technology is inevitable under such globalized

world. What is important is to continue to utilize both indigenous and modern methods of production without bringing significant damage to the existing indigenous practices. It appears that both forms of knowledge are complementary in some aspects. Undeniably, some of the improved practices are boosting the production as the local people, particularly the local people inhabiting the highland and lowland regions, reported. Because of small land holding size, local people have not been able to produce quite enough to satisfy their demand. Besides, there is no open land to expand cultivation. Therefore, the only option is to intensify production using modern practices. This attempt of land intensification must not lead to loss of the indigenous practices. It must be conducted without bringing significant damage to the indigenous practices. Integrating both indigenous and modern practices is vital to bring sustainable livelihood. In this regard, extensive research is required for the possible integration of indigenous practices and modern practices.

References

Abera, T., Balcha , A. & Mirutse, G., 2013. An Ethnobotanical Study of Medicinal Plants used in Kilte Awulaelo District, Tigray region of Ethiopia. Journal of Ethnobiology and Ethnomedicine, 9(65).

Agrawal, A., 1995. Dismantling the Divide between Indigenous and Scientific Knowledge. Development. Development and change, pp. 339-413.

Alexiades, M. N., 1999. Ethnobotany of the Ese Eja: Plants, health and change in an Amazonian society. Ph.D thesis: City University of New York.

Amiguet, V. T. et al., 2006. A Regression Analysis of Q'eqchi' Maya Medicinal Plants from Southern Belize. Economic Botany, 60(1), pp. 24-38.

Anteneh, B., Zemede, A., Sebsebe, D. & Negussie, F., 2012. Medicinal Plants Potential and Use by Pastoral and Agro-pastoral Communities in Erer Valley of Babile Wereda, Eastern Ethiopia. Journal of Ethnobiology and Ethnomedicine, 8(42).

Antweiler, C., 1998. Local Knowledge and Local Knowing: An Anthropological Analysis of Contested 'Cultural Products' in the Context of Development. Anthropos, 93(4-6), pp. 469-494.

Arnold, J., 1987. Economic Consideration in Agroforestry. In: A. Steppler H & P. R. Nair, eds. Agroforestry, A decade of Development. pp. 173-190.

Asseged, B., 1996. The Potentials of Homestead Trees in Solving the Shortage of Fuel wood, A Case Study of Two Villages in Tigray. Sweden: Msc Thesis, SLU.

Atakilt, B., 1996. Indigenous Knowledge on Farmland Tree Management as a Basis for Forestry, A Case Study from Central Zone of Tigray, Ethiopia. Sweden: Msc. Thesis, SLU.

Atran, S., 2001. The Vanishing Landscape of the Petén Maya Lowlands. In: In: Maffi L, editor. On Biocultural Diversity. Linking Language, Knowledge, and the Environment. Washington: D.C.: Smithsonian Institution Press, pp. 157-174.

Atran, S., Medin, D. & Ross, N., 2004. Evolution and Devolution of Knowledge: A Tale of Two Biologies. Journal of the Royal Anthropological Institute, Volume 10, pp. 395-420.

Atteh, O. D., 1980. Resources and Decisions. Peasant Farmer Agriculture Management and its relevance for Rural Development Planning, in Kwata, state, Nigeria.

Barrett, B., 1995. Herbal knowledge on Nicaragua's Atlantic coast: Consensus within diversity.. Journal of community Health, Volume 20, pp. 403-421.

Begossi, A., Hanazaki, N. & Tamashiro, J., 2002. Medicinal Plants in the Atlantic Forest (Brazil): Knowledge, Use, and Conservation. Human Ecology, Volume 30, pp. 281-299.

Bekele, R., 2007. In Population Dynamics: the Practice f Indigenous Knowledge for Soil Conservation, a Case Study of Wonago Woreda, Gedeo Zone, Southern Ethiopia. Addis Ababa: Msc. Thesis, Unpublished, Addis Ababa University.

Ben, O., Carla, R., Merit, K. & Abushen, M., 2009. Indigenous Climate Knowledge in Southern Uganda: the Multiple Components of a Dynamic Regional System. Climate Change, Volume 100, pp. 243-265.

Benz, B. F. et al., 2000. Losing Knowledge about Plant Use in the Sierra De Manantan Biosphere Reserve, Mexico. Economic Botany , Volume 54, pp. 183-191.

Berkes, F., 1993. Traditional Ecological Knowledge in Perspective. In: J. T. Inglis, ed. Traditional Ecological Knowledge: Concepts and Cases. Ottawa, Canada: International Development Research Centre and the Canadian Museum of Nature, pp. 1-9.

Berkes, F., 1999. Sacred ecology: Traditional Ecological Knowledge and Resource Management. Philadelphia: Taylor and Francis.

Berkes, F., 2004. Rethinking Community-Based Conservation. Conservation Biology , Volume 18, pp. 621-630.

Berkes, F., 2008. Sacred Ecology. Second ed. New York: Rout ledge, Taylor and Francis.

Berkes, F. Coldings. J. &. Folke. C., 2000. Rediscovery of Traditional Ecological Knowledge as Adaptive Management. Ecological Applications, Volume 10, pp. 1251-1262.

Bevan, P. & Pankhurst, A. eds., 1996. Ethiopian Village Studies, Adado, Gedeo.

Bhagwat, S. A., Willis, K. J., Birks, H. J. & Whittaker, R. J., 2008. Agroforestry: A Refuge for Tropical Biodiversity?. Trends Ecol Evo, 23(5), pp. 261-265.

Blomely, N., 1998. Landscape Property. Law and society Review, pp. 567-612.

Bogale, T., 2007. Agroforestry Practice in Gedeo Zone, Ethiopia: A geographical Analysis. 188. India: Ph.D dissertation, Panjab University.

Boillat, S., 2007. Traditional Ecological Knowledge, Land Use and Ecosystem Diversity in the Tunari National Park (Bolivia) An Ethnoecological Approach to Dialogue between Traditional and Scientific Ecological Knowledge: Centre for Development and Environment (CDE), Geographisches Institut, Universitat Bern.

Bonsu, M., Apori, S. O., Quaye, E. C. & Anderson, T., 2000. Indigenous Soil, Water and Forest Resource Conservation in Ghana: A Case Study of Brong- Ahafo and Western Regions. Accra, Ghana: Friends of the Earth.

Boster, J., 1986. Exchange of Varieties and Information between Aguarun Manioc Cultivators. American Anthropologist, Volume 88, pp. 429-436.

Brandt, A. S. et al., 1997. The ‘‘Tree Against Hunger’’ Enset-Based Agricultural Systems in Ethiopia. Washington: American Association for the Advancement of Science.

Briggs, J., 2005. The Use of Indigenous Knowledge in Development: Problems and Challenges. Progress in Development Studies, 5(2), pp. 99-114.

Brodt, S., 2001. A Systems Perspective on the Conservation and Erosion of Indigenous Agricultural Knowledge in Central India. Hum Ecology, 29(1), pp. 99-120.

Bronfenbrenner, U., 1977. Towards an Experimental Ecology of Human Development. American Psychologist, pp. 513-531.

Byg, A. & Balslev, H., 2001. Traditional Knowledge of Dypsis fibrosa (Aracaceae) in Eastern Madagascar. Economic Botany, Volume 55, pp. 263-275.

Carne, R. J., 1993. Agroforestry Land Use: The Concept and Practice. Australian Geographical Studies, 31(1), pp. 79-90.

Casey, J. F., 2004. Agroforestry Adoption in Mexico: Using Keynes to Better Understand Farmer Decision-Making. Journal of Post Keynesian Economics, 26(3), pp. 505-521.

Cavalli-Sforza, L. L. & FELDMAN, M., 1981. Cultural transmission and Evolution: A Quantitative Approach. Princeton: Princeton University Press.

Cheikhyoussef, A. & Embashu, W., 2013. Ethnobotanical Knowledge on Indigenous Fruits in Ohangwena and Oshikoto Regions in Northern Namibia. Journal of Ethnobiology and Ethnomedicine, 9(34).

Cheikhyoussef, A., Shapi, M., Matengu, K. & Mu Ashekele, H., 2010. Ethnobotanical Study of Indigenous Knowledge on Medicinal Plant Use by Traditional Healersin Oshikoto region, Nambia. Journal of Ethnobiology and Ethnomedicine, 7(10).

Cochran, W. G., 1963. Sampling Techniques. 2nd Ed. ed. New York: JohnWiley and Sons, INC.

Cosata-Neto, E. M., 2000. Sustainable Development and traditional Knowledge: A Case Study in A Brazilian Artisanal Fishermen's Community. Journal of Sustainable Development, Volume 8, pp. 89-95.

Creswell, J. W., 1998. Qualitative Inquiry and Research Design Choosing among Five Traditions. New Delhi, London: Sage.

Cristancho, S. Vining. J., 2009. Perceived Intergenerational Difference in the Transmission of Traditional Ecological Knowledge in Two Indigenous Group from Colombia and Guatemala. Culture and Psychology, 15(2), pp. 229-254.

Cruz Garcia, G., 2006. The Mother-Child Nexus. Knowledge and Valuation of Wild Food Plants in Wayanad, Western Ghat, India. Journal of Ethnobiology and Ethnomedicine, 3(39).

CSA, 2007. Population and Housing Census, Analytical Report on Southern Nations Nationalities Peoples Region, Addis Ababa, Ethiopia: Central Statistical Authority.

Davidson-Hunt, I. J. & Berkes, F., 2003b. Nature and Society through the Lens of Resilience: Towards a Human-in- Ecosystem Perspective. In: F. Berkes, J. Colding & C. Folke, eds. Navigating Social-Ecological Systems: Building Resilience for Complexity and Change. Cambridge: Cambridge University Press, pp. 53-82.

Davis, A. & K, R., 2010. Constructing Confidence: Rational Skepticism and Systematic Enquiry in Local Ecological Knowledge Research. Ecological Application, Volume 20, pp. 880-894.

Davis, A. & Wagner, J. R., 2003. Who Knows? On the Importance of Identifying " Experts" When Researching Local Ecological Knowledge. Human Ecology, 31(3), pp. 463-489.

Dei, G., 1993. Sustainable Development in the African Context: Revisiting Some Theoretical and Methodological Issues. African Development, 18(2), pp. 97-110.

Dei, G., 2000. Rethinking the role of indigenous knowledge in the academy. International Journal of Inclusive Education, 4(2), pp. 111-132.

Demel, T. & Assefa, T., 1991. Traditional Tree Crop Based Agroforestry in Coffee Producing Areas of Hararghe, Eastern Ethiopia. Agroforestry System, Volume 16, pp. 257-267.

Dixon, A. B., 2003a. Indigenous Management of Wetlands: Experiences in Ethiopia.

Dixon, A. B., 2003b. The Indigenous Evaluation of Wetlands Research in Ethiopia. Development in Practice, Volume 13, pp. 394-398.

Ellen, R. & Harris, H., 1996. " Concepts of Indigenous Environmental Knowledge in Scientific and Development Studies Literature- A Critical Assessment"; Draft Paper East-West Environmental Linkages Network Workshop 3, Cantebury.

Ellen, R. & Harris, H., 2000. Introduction. In: R. Ellen, P. Parkes & A. Bicker, eds. Indigenous Environmental Knowledge and its Transformations. Amsterdam: Hardwood Academic Publishers..

Eric, P. R., A, G. & Michael, 1999. Indigenous Knowledge System and Agroforestry Projects in theCentral Hills of Nepal. In: L. S. Warren & M. D, eds. The Cultural Dimension of Development: Indigenous Knowledge Systems. pp. 88-112.

Ermias, L., Zemede, A., Ensermu, K. & Van Damme, P., 2013. Ethnomedicinal Study of Plants used for Human Ailments in Ankober District, North Shewa Zone, Amhara Region, Ethiopia. Journal of Ethnobiology and Ethnomedicine, 9(63).

Ernest, L. M., 2005. The Economics of Tropical Agroforestry System: The Case of Agroforestry Farms in Cameroon. Forest Policy and Economics, pp. 199-211.

Eyasu, E., 2002. Farmer's Perceptions of Soil Fertility Change and Management. SOS Sahel and ISD.

Eyssartier, C., Ladio, A. H. & Lozada, M., 2008. Cultural Transmission of Traditional Knowledge in Two Populations of North-Western Patagonia. Journal of Ethnobiology and Ethnomedicine, 4(25).

FAO, 2010. Global Forest ResourceAssessment 2010, Country Report of Ethiopia. [Online] Available at: www.fao.org/forestry/fra/fra2010

[Accessed 04 May 2014].
Fisseha, M., 2007. An Ethnobotanical Study of Medicinal Plants in Wonago Woreda, SNNPR, Ethiopia.. Addis Ababa, Ethiopia: Msc. Thesis, Unpublished.
Fisseha , M., Sebsibe, D. & Teklehaymanot, T., 2009. An Ethnobotanical Study of Medicinal Plants in Wonago Woreda, Southern Nations, Nationalities and Peoples Regional State, Ethiopia. Journal of Ethnobiology and Ethnomedicine, 5(28).
Getachew, A., Kelbessa, U. & Dawit, D., 2005. Ethnobotanical Study of Edible Wild Plants in Some Selected Districts of Ethiopia. Human Ecology, 33(1), pp. 83-117.
Ghimire, S. K., McKey, D. & Aumeeruddy Thomas, Y., 2004. Heterogeneity in Ethnoecological Knowledge and Management of Medicinal Plants in the Himalayas of Nepal: Implications for Conservation. Ecology and Society, 9(3).
Godoy, R. et al., 2009a. Long-term(Secular) Change of Ethnobotanical Knowledge of Useful Plants Separating Cohort and Age Effects. Journal of Anthropological Research, Volume 65, pp. 51-67.
Godoy, R. et al., 2005. The Effects of Market Economies on the Well-being of Indigenous Peoples and on their Use of Renewable Natural Resources. Annual Review of Anthropology, Volume 34, pp. 121-138.
Godoy, R. et al., n.d. Does Modernization Erode the Secular Trend of Indigenous Knowledge? New Evidence from Native Amazonians Born 1920-1985, Bolivia. Waltham,Ma,: Heller School for Social Policy and Managment, Brandeis University: Tsimane' Amazonian Panel Study Working Paper#29.
Gomez- Baggethun, E. & Reyes-Garcia, V., 2013. Reinterpreting Change in Traditional Ecological Knowledge. Human Ecology, Volume 41, pp. 643-647.
Gomez-Baggethun, E. et al., 2010. Traditional Ecological Knowledge Trends in the Transition to Market Economy: Empirical Study in the Donana Natural Areas. Conservation Biology, Volume 24, pp. 721-729.
Gotschi, E., Robert, D. & Bernhard, F., 2009. Participatory Photography as a Qualitative Approach to Obtain Insights into Farmer Groups. Field Methods, pp. 290-308.
Gray, C. L., Bilsborrow, R. E., Bremner, J. L. & Lu, F., 2008. Indigenous Land Use in the Ecuadorian Amazon: A Cross-Cultural and Multilevel Analysis. Human Ecology, Volume 36, pp. 97-109.
Grenier, L., 1998. Working with Indigenous Knowledge; A guide for researchers. Canada: International development research center.
GZEFDO, 2012. The Socio-Economic Report of Gedeo Zone, Gedeo, Dilla, Ethiopia.
Haile, Y., Yewhalaw, D. & Teketay, D., 2008. Ethnomedicinal Plant Knowledge and Practice of the Oromo Ethnic Group in South Western Ethiopia. Journal of Ethnobiology and Ethnomedicine, 4(11).
Hens, L., 2006. Indigenous Knowledge and Biodiversity Conservation and Management in Ghana. Journal of Human Ecology, 21(1), pp. 21-30.
Hewlett, B. S. & Cavalli-Sforza, L. L., 1986. Cultural Transmission among Aka Pygmies. American Anthropologist, Volume 88, pp. 922-934.
Hill, J. H., 2004. What is Lost When Names are forgotten? In: O. G. Sanga G, ed. Nature Knowledge, Ethnoscience, Cognition, and Utility. New York: Berhahm Books, pp. 161-184.
Hunn, E., 2002. Evidence for the Precocious Acquisition of Plant Knowledge by Zapotec Children. In: Z. R.K, J. Stepp, F. Wyndham & R. Zarger, eds. Ethnobiology and Biocultural Diversity:

Proceedings of the Seventh International Congress of Ethnobiology. Athens: University of Georgia Press: International Society of Ethnobiology, p. 604.

Jama, B., Elias, E. & Mogotsi, K., 2006. Role of Agroforestry in Improving Food Security and Natural Resource Management in the Dry lands: A Regional Overview. Journal of the Dry lands, 1(2), pp. 206-211.

Jones, M., n.d. Landscape as resource and the problem of landscape values.

Kajembe, G. C. et al., 2005. Impacts of Indigenous Based Intervention on Land Conservation: A Case Study of a Soil Conservation and Agroforestry Project, Arumeru District, Tanzaina. Land Degradation and Development, Volume 16, pp. 311-325.

Kajembe, G. C. et al., 2005. Impact of Indigenous - Based Interventions on Land Conservation: A Case Study of A Soil Conservation and Agroforestry Project, Arumeru District, Tanzania. Land Degradationa and Development, Volume 16, pp. 311-325.

Kightley, E. P. et al., 2013. An Empirical Comparison of Knowledge and Skill in the Context of Traditional Ecological Knowledge. Journal of Ethnobiology and Ethnomedicine , Volume 971.

King, K., 1984. The History of Agroforestry. In: H. &. Nair, ed. Agroforestry a Decade of Development. pp. 3-12.

Kiptot, E. C., 2002. A Study of an Indigenous Knowledge System Underlying the Use and Management of Tree Fodder Resources by the Maasai Community of Kajiado District, Kenya, Third Progress Report, Nairobi, Kenya: Kenya Forestry Research Institute.

Kiptot, E. C., 2007. Eliciting Indigenous Knowledge on Tree Fodder among Maasai Pastoralists via a Multi-method Sequencing Approach. Agriculture and Human Value, Volume 24, pp. 231-243.

Kitchin, R. M. & Fotheringham, A. S., 1997. Aggregation Issues in Cognitive Mapping. The Professional Geographer, Volume 49, pp. 269-280.

Kolawole, O. D., 2001. Local Knowledge Utilization and Sustainable Rural Development in the 21st Century. s.l.: Indigenous Knowledge and Development Monitor.

Kolawole, O. D. & Laogun, E. A., 2005. Between Man and His Environment: Indigenous Knowledge Approaches to Soil Fertility Conservation amongst Farmers in Ekiti State, Nigeria. Journal of Human Ecology, 17(2), pp. 109-115.

Ladio, A. & Lozada, M., 2004. Patterns of Use and Knowledge of Wild Edible Plants in Distinct Ecological Environments: A case Study of a Mapuche Community from North Western Patagonia. Biodiversity Conservation, Volume 13, pp. 1153-1173.

Leonard, J. S., 1996. Loss of Cree Traditional Ecological Knowledge in the Western James Bay Region of Northern Ontario, Canada: A Case Study of the Sharp-Tailed Grouse, Tympanuchus phasianellus. The Canadian Journal of Native Studies, 16(2), pp. 282-292.

Levesque, C., n.d. Indigenous Knowledge: Questions, Issues and Challenges. In: The Handing Down of Culture, Smaller Societies and Globalization. pp. 161-170.

Lozada, M., Ladio, H. A. & Weigandt, M., 2006. Cultural Transmission of Ethnobotanical Knowledge in Rural Community of North Western Patagonia. Economic Botany, 60(4), pp. 374-385.

Lundgren, B., 1982. Introduction. Agroforestry Systems. Volume 1, pp. 3-6.

Lykke, A. M., Kristensen, M. K. & Ganaba, S., 2004. Valuation of Local Use and Dynamics of 56 Woody Species in the Sahel. Biodiversity and Conservation, Volume 13, pp. 1961-1990.

Maffi, L., 2005. Linguistic, Cultural, and Biological Diversity. Annual Review of Anthropology, Volume 34, pp. 599-618.

Maroyi, A., 2013. Traditional Use of Medicinal Plants in Southern Central Zimbabwe: Review and Perspectives. Journal of Ethnobiology and Ethnomedicine, 9(31).

Marquette, C., 1997. Turning but not Toppling Malthus: Boserupian Theory on Population and the Environment Relations. Bergen, Norway: Working Paper, Chr. Mechelsen Institute, Development Studies and Human Rights.

Mathez-Stiefel, S. L., Boillat, S. & Rist, S., 2007. Promoting the Diversity of Worldviews: An Ontological Approach to Biocultural Diversity. Leusden, ETC/COMPAS, pp. 67-81.

McCarter, J. & Gavin, M. C., 2013. Local Perceptions of Changes in Traditional Ecological in Traditional Ecological Knowledge: A Case Study from Malekula Island, Vanuatu.

McClellan, C. W., 1988. State Transformation and National Integration: Gedeo and the Ethiopian Empire, 1895-1935. Monograph No.19 ed. Michigan: African Studies Center, Michigan State University.

Medin, D., Ross, N. & Atran, S., 2002. Categorization and Reasoning in Relation to Culture and Expertise. The Psychology of Learning and Motivation, Volume 41, pp. 1-41.

Melchias, G., 2001. Biodiversity and Conservation. Enfield: Science Publishers, Inc.

Mesele, N., 2006. Indigenous agroforestry Practices and their implications on Sustainable land use and Natural Resource Management, the case of Wonago District, Proceeding on policy making workshop on Land Tenure and Land Management, pp. 4-20.

Mesele, N., 2007. Tree's Management and Livelihoods in Gedeo's Agroforests, Ethiopia. Forest, Trees and Livelihood, 17(2), pp. 158-167.

Mesele, N., & Niguisse, A., 2008. History of Indigenous Agroforestry in Gedeo, Southern Ethiopia, based on Local Community Interviews: vegetation diversity and structure in the land use systems. Ethiopian Journal of Natural Resource, 10(1), pp. 32-52.

Mesele, N., Yirdaw, E. & Luukkanen, O., 2011. Potential of Indigenous Multistrata Agroforests for Maintaining Native Floristic Diversity in the South-eastern Rift Valley Escarpment, Ethiopia. Agroforest System.

Mikkelsen, B., 2002. Methods for development work and research a guide for practitioners. New Delhi, London: Sage.

Miller, J., 2005. Biodiversity Conservation and the Extinction of Experience. Trends in Ecology and Evolution, 20(8), pp. 430-434.

Miller, R. P. & Nair, P. K. R., 2006. Indigenous Agroforestry Systems in Amazonia: From Prehistory to Today. Agroforest System, Volume 66, pp. 151-164.

Million, A., 2003. Characterization of Indigenous Stone Bunding and its Effect on Crop Yield and Soil Productivity, at Mesobit, Gedeba, North shoa Zone, Ethiopia: Unpublished Msc. Thesis.

Mitiku, H. & Abdu, A., 1994. Potentials and Limitations of Alley Farming in Sorghum- Chat based Cropping System in Haraegh Highlands, Eastern Ethiopia. Proceeding 6th CSSE, pp. 80-86.

Moa, M. et al., 2013. An Ethnobotanical Study of Medicinal Plants in Wayu Tuka District, East Welega Zone of Oromia Regional State, West Ethiopia. Journal of Ethnobiology and Ethnomedicine, 9(68).

Monteiro, J. M. et al., 2006. Use Pattern and Knowledge of Medicinal Species among Two Rural Communities in Brazil's Semi-arid Northeastern Region. Journal of Ethnopharmacology, Volume 105, pp. 173-186.

Mwaura, P., ed., 2008. Indigenous Knowledge in Disaster Management in Africa. Nairobi, Kenya: UNEP.

Myers, N., 1990. The world's forests and human populations: The environmental interconnections, Population and Development Review 16 (special supplement).

Nabhan, G. P. & St Antoine, S., 1993. The loss of floral and faunal story: The extinction of experience. Washington DC, Island Press, pp. 229-250.

Nair, P. K. R., 2007. Perspective The coming of age of agroforestry. Journal of the Science of Food and Agriculture, Volume 87, pp. 1613-1619.

Ngulube, P., 2002. Managing and Preserving Indigenous Knowledge in the Knowledge Management Era: Challenges and Opportunities for Information Professionals. Information Development, 18(2), pp. 95-101.

Niamir, M., 1990. Community Forestry: Herders' Decision-Making in Natural Resources Management in Arid and Semi-arid Africa, Rome: FAO.

Nolan, J. M. & Robbins, M. C., 1999. Cultural Conservation of Medicinal Plant Use in the Ozarks. Human Organization, Volume 58, pp. 67-72.

Ocho, D. L. et al., 2012. Assessing the Levels of Food Shortage using the Traffic Light Metaphor by Analyzing the Gathering and consumption of Wild Food Plants, Crop Parts and Crop Residues in Konso, Ethiopia. Journal of Ethnobiology and Ethnomedicine, 8(30).

Ohmagari, K. & Berkes, F., 1997. Transmission of indigenous knowledge and bush skills among the western James Bay Cree women of Subarctic Canada. Human Ecology, 25(2), pp. 197-222.

Oijen, M. et al., 2010. Coffee Agroforestry Systems in Central America: A Review of Quantitative Information on Physiological. Agroforest syst.

Oliver, J., 1980. Monthly Precipitation Distribution: A Comparative Index. Professional Geographer, Volume 32, pp. 300-309.

Orlove, B., Roncoli, C., Kabugo, M. & Majugu, A., 2010. Indigenous Climate Knowledge in Southern Uganda: The multiple Components of a Dynamic Regional System. Climatic Change, Volume 100, pp. 243-265.

Ossai, N. B., 2010. African Indigenous Knowledge Systems. Simbiosis, 7(2), pp. 1-13.

Pattison, W. D., 1990. The Four Tradition of Geography. Reprinted from Journal of Geography. The National Council for Geographic Education.

Patton, M. Q., 2002. Qualitative Research and Evaluation Methods. Third ed. Thousand Oak, CA: Sage Publications.

Peyre, A., Guidal, A., Wiersum, K. F. & F, B., 2006. Dynamics of Home garden Structure and Function in Kerala, India. Agroforestry System, Volume 66, pp. 101-115.

Pfeiffer, J. M. & Ramona, J. B., 2005. Assessing Cultural and Ecological Variation in Ethnobioloical Research: The Importance of Gender. Journal of Ethnobiology, 25(2), pp. 240-278.

Pilgrim, S. E., 2006. A Cross-Cultural Study into Local Ecological Knowledge. :Ph.D. Dissertation, University of Essex.

Polkinghorne, D. E., 2005. Language and Meaning: Data Collection in Qualitative Research. Journal of Counseling Psychology, 52(2), pp. 137-145.

Poschen, P., 1986. An Evaluation of the Acacia albida-Based Agroforestry Practices in the Hararghe Highlands of Eastern Ethiopia. In: P. K. R. Nair, ed. Agroforestry systems in the. Dordrecht, the Netherlands: Kluwer Academic Publishers, pp. 385-400.

Posey, D. A., 1999. Cultural and Spiritual Value of Biodiversity: A Complementary Contribution to the Global Biodiversity Assessment. London: Intermediate Technology Publications.

Posey, D. A., Frenchione, J., Eddins, J. & Silva, L. F., 1984. Ethnoecology as Applied Anthropopolgy in Amazonian Development. Human Organization, 43(2), pp. 95-107.

Quinlan, M., 2005. Considerations for Collecting Free lists in the Field: Examples from Ethnobotany. Field Methods, Volume 17, pp. 219-237.

Quinlan, M. & R, Q., 2007. Modernization and Medicinal Plant Knowledge in a Caribbean Horticultural Village. Medicinal Anthropology Quarterly, Volume 21, pp. 169-192.

Rajasekaran, B., Warren, D. M. & Babu, S. C., 1991. Indigenous Natural Resource Management Systems for Sustainable Agricultural Development- A Global Perspectives. Journal of International Development, 3(4), pp. 387-401.

Rao, K. S., Nautiyal, S., Maikhuri, R. K. & Saxena, K. G., 2003. Local Peoples' Knowledge, Aptitude and Perceptions of Planning and Management Issues in Nanda Devi Biosphere Reserve, India. Environmental Management, 31(2), pp. 168-181.

Reyes-Garcia, V. et al., 2013. Secular Trends on Traditional Ecological Knowledge: An Analysis of Changes in different Domains of Knowledge among the Tsimane' Men. Leaning and Individual Differences, Article in Press.

Reyes-Garcia, V. et al., 2008. Do the Aged and Knowledgeable Men Enjoy More Prestige? A Test of Prediction from the Prestige-Bias Model of Cultural Transmission. Evolution and Human Behavior, Volume 29, pp. 275-281.

Reyes-Garcia, V. et al., 2005. Market Economy and the Loss of Folk Knowledge of Plant Uses: Estimates from the Tsimane' of the Bolivian Amazon. Current Anthropology, Volume 46, pp. 651-656.

Reyes-Garcia, V. et al., 2007a. Economic Development and Local Ecological Knowledge: A Deadlock? Quantitative Research from Native Amazonian Society. Human Ecology, 35(3), pp. 371-377.

Reyes-Garcia, V. et al., 2006. Evaluating Indices of Traditional Ecological Knowledge: A Methodological Contribution. Journal of Ethnobiology and Ethnomedicine, 21(2).

Reyes-Garcia, V. et al., 2006. Cultural, practical and economic value of wild plants: A quantitative study in the Bolivian Amazon. Economic Botany, Volume 60, pp. 62-74.

Richerson, P. & Boyd, R., 2005. Not by Genes Alone: How Culture Transformed Human Evolution. Chicago: University of Chicago Press.

Rist, L., Shaanker R.U, Milner.-Gulland. E, J. & Jaboury G., 2010. The Use of Traditional Ecological Knowledge in Forest Management: An Example From India. Ecology and Society, 15(1).

Rocha, M. J., 2005. Measuring Traditional Agro-Ecological Knowledge: An Example from Peasants in the Peruvian Andes. Field Methods, 17(356).

Roncol, C., Ingram & Kirshen, P., 2002. Reading the Rains: Local Knowledge and Rainfall Forecasting. Social Natural Resource, Volume 15, pp. 411-430.

Ross, N., 2002a. Cognitive Aspects of Intergenerational Change: Mental Models, Cultural Change and Environmental Behavior among the Lacandon Maya of Southern Mexico. Human Organization, 61(2), pp. 125-138.

Ross, N., 2002b. Lacandon Maya Intergenerational Change and the Erosion of Folk biological Knowledge. Athens, International Society of Ethnobiology. University of Georgia Press, pp. 585-592.

Ross, N. & Medin, D. L., 2005. Ethnography and Experiments: Cultural Models and Expertise Effects Elicited with Experimental Research Techniques. Field Methods, 17(2).

Ruddle, K., 1993. The Transmission of Traditional Ecological Knowledge. In: J. T. Inglis, ed. Traditional Ecological Knowledge: Concepts and Cases. Ottawa: International Program on Traditional Ecological Knowledge and International Development Research Center, pp. 17-33.

Rusten, E. P., Gold, A. & Michael, 1999. Indigenous Knowledge System and Agroforestry Projects in the Central Hills of Nepal. The Cultural Dimension of Development: Indigenous Knowledge Systems, pp. 88-112.

Salas, M. A. & Tillmann, H. J., 2004. Indigenous Knowledge and Peoples. Network on Capacity Building in MMSEA. Chiang Mai.

Salmi, T., Määttä, A., Anttila, P., Ruoho-Airola, T. & Amnell, T., 2002. Detecting trends of annual values of atmospheric pollutants by the Mann-Kendall test and Sen's slope estimates –the Excel template application MAKESENS. Finnish Meteorological Institute, 456-789X Publications on Air Quality.

Saynes-Vasquez, A., Caballero, J., Meave, J. A. & Chiang, F., 2013. Cultural Change and Loss of Ethnoecological Knowledge among the Isthmus Zapotecs of Mexico. Journal of Ethnobiology and Ethnomedicine , 9(40).

Setalaphruk, C. & Price, L. L., 2007. Children's Traditional Ecological Knowledge of Wild Food Resources: A Case Study in Rural Village in Northeast Thailand. Journal of Ethnobiology and Ethnomedicine, 3(33).

Sillito, P. & Marzano, M., 2009. Future of Indigenous Knowledge Research in Development. Futures, Volume 41, pp. 13-23.

Singh, R. K. & Singh, P. K., 2005. Fertility Management Dynamics of Soil: Exploration of Farmers' Hidden Wisdom. Asian Agri-History, Volume 9, pp. 291-303.

SLUF, 2006. Indigenous Agro-forestry Practices and their Implications on Sustainable Land Use and Natural Resources Management, the Case of Wonago Woreda: SIDA and Oxfam Novib.

Sneyers, R., 1990. On the Statistical Analysis of Series of Observation, Geneva, Switherland: Technical Note No. 143.WMO.

Stepp, J. R., 2005. Advances in Ethnobiological Field Methods. Field Methods, Volume 17, pp. 211-218.

Sternberg, R. et al., 2001. The relationship between Academic and Practical Intelligence: A Case Study in Kenya. Intelligence, Volume 29, pp. 401-418.

Stevenson, G. M., 2005. Traditional Knowledge and Sustainable Forest Managment. Sustainable Forest Management Network.

Stevenson, M. G., 1996. Indigenous Knowledge in Environmental Assessment. Arctic, 93(3), pp. 278-291.

Stone, G. D., 2007. Agricultural Deskilling and the Spread of Genetically Modified Cotton in Warangal. Current Anthropology, Volume 48, pp. 67-103.

Swaminathan, M. S., 1987. The Promise of Agroforestry for Ecological and Nutritional Security. Agroforestry a decade of Development. pp. 25-42.

Tadesse, K., 1994. The Gedeo Agroforests and Biodiversity: Architecture and Floristic. MSc. thesis, 89. Wageningen.

Tadesse, K., 2002. Five Thousand Years of Sustainability? A Case Study on Gedeo Land use, Southern Ethiopia. 295. Wageningen.

Tadesse, K., 2009. Historical Premises and Social Value of Gedeo Agroforestry System, a paper Presented on Regional Workshop on Gedeo Agroforestry System-Its' Conservation and Sustainable Use, Addis Ababa, Ethiopia: Lem Ethiopia,pp.1-16.

Takako, H., 2003. Transmission Mechanism of Traditional Ecological Knowledge.

Tamirat, A., 2012. An Assessment of the Role of Charity Service Organization on Soil conservation and livelihood diversification: The Case of Wonago Woreda, Gedeo zone, Ethiopia, Dilla: Unpublished Msc. Thesis, Dilla University.

Teklehaimanot, Z., 2004. Exploiting the Potential of Indigenous Agroforestry Trees: Parkia Biglobosa and Vitellaria Paradoxa in Sub-Saharan Africa. Agroforestry System, Volume 61, pp. 207-220.

Tesfaye, A., 2005. Diversity in Home Garden Agroforestry System of Southern Ethiopia. Wageningen University, Wageningen.

Torquebiaua, E. F., 2000. A renewed perspective on agroforestry concepts and classification. Agronomy, pp. 1009-1017.

Torri, M. A., 2010. Community-Based Entrepreneurship Initiative in Tamil Nadu: Promoting Self-Reliance at the Grassroots Level Through an Increasing Knowledge and Traditional Use of Medicinal Plants by Local Communities. Complementary Health Practice Review, 15(40).

Turner, N. J., Ignace, M. B. & Ignace, R., 2000. Traditional Ecological Knowledge and Wisdom of Aboriginal Peoples in British Columbia.. Ecological Applications, Volume 10, pp. 1275-1287.

Turner, N. J. & Turner, K., 2008. " Where our Women Used to Get the Food" : Cumulative Effects and Loss of Ethnobotanical Knowledge and Practice; Case Study from Coastal British Columbia. Botany, Volume 86, pp. 103-115.

Ulluwishewa, R., 1993. Indigenous Knowledge, National Resource Centers and Sustainable Development. Indigenous Knowledge and Development Monitor, 1(3), pp. 11-13.

UNCED, 1992. Report of the United Nations Conference on Environment and Development, Rio de Janeiro.

UNESCO, 1978. Tropical forest ecosystems, Natural Resources Research 14,, s.l.: UNESCO0-UNEP.

Usman, I. A., 2003. Population, Poverty and Environment: NASSD Background Paper. Pakistan.

Valentina, M. & David, N., 2002. Population Growth and the Environment in Africa: Local Informal Institutins, the Missing Link.

Voeks, R. A. & Leony, A., 2004. Forgetting the Forest: Assessing Medicinal Plant Erosion in Eastern Brazil. Economic Botany, Volume 58 Supplement, pp. S294-S306.

Wane, N. N., 2005. " African Indigenous Knowledge: Claiming, Writing, Storing, and Sharing the Discourse. Journal of Thought, Volume 40, pp. 27-46.

Warren, D. M., 1991. Using Indigenous Knowledge in Agricultural Development. World Bank Discussion Paper No.127.

Warren, D. M., 1992. Indigenous Knowledge, Biodiversity Conservation and Development. Key Note Address at the International Conference on Conservation of Biodiversity in Africa: Local Initiative and Institutional Roles. [Online]

Available at: www.ciesin.org/docs/004_173/004_173.html

[Accessed 23 July 2012].

Warren, D. M. & Rajasekaran, B., 1993. Putting Local Knowledge to Good Use. International Agricultural Development, Volume 13, pp. 8-10.

Warren, M. D., 1993. Using Indigenous Knowledge for Agriculture and Rural Development: Indigenous Knowledge and Development Monitor, 1(1), pp. 7-10.

Yirga, G., 2010. Ethnobotanical Study of Medicinal Plants in and around Alamata, Southern Tigray, Northern Ethiopia. Current Research Journal Biological Science , Volume 5, pp. 338-344.

Zarger, R. K., 2002. Children's Ethnoecological Knowledge: Situated Learning and the Cultural Transmission of Subsistence Knowledge and Skills among Q'eqchi' Maya.:Ph.D. Dissertation, Department of Anthropology, University of Georgia.

Zarger, R. K. & Stepp, J. R., 2004. Persistence of Botanical Knowledge among Tzeltal Maya Children. Current Anthropology, 45(3), pp. 413-418.

Zemede, A., 2003. Tree Species Diversity, Topsoil Condition and Arbuscular Mycorrhizal Association in the Sidama Traditional Agroforestry Land use, Southern Ethiopia. Uppsala.: Ph. D Dissertation, Swedish University of Agricultural Sciences.

Zemede, A., 2009. Threats and Opportunities of Gedeo Agroforestry Land Use Systems, A Paper Presented on Regional Workshop on Gedeo Agroforestry System-Its' Conservation and Sustainable Use, Addis Ababa, Ethiopia: Lem Ethiopia, pp.17-25.

Zemede, A.& Nigatu, A., 1995. Home-garden in Ethiopia: Characteristics of Plant Diversity. SINET: Ethiopian Journal of science, 18(2), pp. 235-266.

Zenebe, G., Zerihun, M. & Solomon, Z., 2012. An Ethnobotanical Study of Medicinal Plants in Asgede Tsimbila District, North Western Tigray, Northern Ethiopia. Ethnobotany Research and Applications, Volume 10, pp. 305-320.

Zent, S., 2001. Acculturation and ethnobotanical knowledge loss among the Piaroa of Venezuela: Demonstration of a quantitative method for the empirical study of traditional ecological knowledge change.In: Maffi L, editor. On Biocultural Diversity: Linking Language, Knowledge. Washington D.C., Smithsonian Institution press, pp. 190-211.

Zent, S. & Maffi, L., 2009. Final Report on Indicators No.2: Methodology for Developing Vitality Index for Traditional Environmental Knowledge (VITEK) for the Project "Global Indicators of the Status and Trends of Linguistic Diversity and Traditional Knowledge" : Terralingua.

Zobolo, A. M. & Mkabela, Q. N., 2006. Traditional Knowledge Transfer of Activities Practiced by Zulu Woman to Manage Medicinal and Food Plant Gardens. African Journal of Range and Forage Science, Volume 23, pp. 77-80.

Appendices

Annex 1: Distribution of plant species in the zone

Table 1. Distribution of trees in all agroforestry subsystems (Source, Bogale, 2007)

Agroforestry sub system	Indigenous Trees	Indigenous trees rare	Exotic	Exotic rare
Coffee-enset	*Millettia ferruginea (Hotchst.) Bak (Dhadhaato)*	*Acacaia abyssinica(Basara girar)*	*Luenaena leucocephala*	*Eucalyptus camaldulensis*
	Cordia africana Lam(weddeessa)	*Acacia albida Del (Girar)*	*Sesbania sesban (L.) Merr*	*Eucalyptus globlus*
	Erythrina brucei S chweinf.(weleena)	*Shefflera abysisinca(Hochst.ex A.Rich)Harms (Geteme/kokora)*	*Chamaecytisus palmensis*	*Eucalyptus citriodora*
	Croton Macrostachyus Del(Mokennesa)	*Ekebrgia caensis(Lol/sombo)*	*Casuarina equistefolia L.*	*Cupressus lustianica*
	Albizia gummifera (J.F. Gmel.) (Gorbe)	*Euhorbia abyssinica (Kulkual)*	*Azadiraachate indica A.Juss*	*Delonix regia*
	Ficus sur Forssk.(Sholla)	*Juniperus procera Hotchst ex.Engl (Tid)*	*Jacaranda mimosifolia D. Don*	*Moringa oleifera (Bak.f.) Cufod*
	Ficus vasta(Warka)	*Olea europaea subsp.cuspidata (Wall.ex G.Don)Cif (Wiyra)*	*Grevillea robusta R. Br.*	
	Vernonia amygdalina Del (Ebicha)	*Polyscias fulva (Hiern) H arms (Tela'a)*	*Cajanus cajanL.*	
	Syzygium guineese (willd.) DC. (Dokima)	*Termminalia brownie(Abalo)*		
	Aningeria adolfi-frederici Rob and			

	Gilb(Gudubo)			
	Prunus africana (Hook.f.)(Tikur inchet)			
	Podocarpus falcatus Thunb. (Zigba)			
Coffee-enset-cereal-livestock	*Hagenia abyssinica (Bruce) J.F.Gmel(Kosso/heto)*			
	Ricinus communis L.			
	Millettia ferruginea (Hotchst.) Bak (Dhadhatto)		*Luenaena leucocephala*	*Eucalyptus camaldulensis* Dehnh.(B/Zaf key)
	Cordia africana Lam(wodessa)		*Sesbania sesban (L.) Merr*	*Eucalyptus globulus* Labill.(B/Zaf nech)
	Erytherina abyssinica Lam. ex DC,		*Chamaecytisus palmensis*	*Eucalyptus citriodora*
	Croton Macrostachyus Del		*Casuarina equistefolia L.*	*Cupressus lustianica*
	Albizia gummifera (Gmel.) C.A.Sm.,		*Azadiraachate indica A.Juss*	*Delonix regia* (Boj. ex Hook.) Ref.
	Ficus sur Forssk.		*Jacaranda mimosifolia D. Don*	*Moringa oleifera (Bak.f.) Cufod*
	Ficus vasta Forssk		*Grevillea robusta R. Br.*	
	Vernonia amygdalina Del			
	Syzygium guineense (wild) Del			
	Aningeria adolfi-			

	frederici Rob and Gilb.,			
	Prunus africana (Hook.f.),			
	Podocarpus falcatus Thunb.			
coffee- enset - cereal	*Millettia ferruginea (Hotchst.) Bak (Dhadhatto)*		*Luenaena leucocephala*	*Eucalyptus camaldulensis*
	Cordia africana Lam(weddeessa)		*Sesbania sesban (L.) Merr*	*Eucalyptus globlus*
	Erytherina abyssinica Lam. ex DC,		*Chamaecytisus palmensis*	*Eucalyptus citriodora*
			Casuarina equistefolia L.	*Cupressus lustianica*
	Albizia gummifera (Gmel.) C.A.Sm.,		*Azadiraachate indica A.Juss*	*Delonix regia* (Boj. ex Hook.) Ref.
	Ficus sur Forssk.		*Jacaranda mimosifolia D. Don*	*Moringa oleifera (Bak.f.) Cufod*
	Ficus vasta Forssk.		*Grevillea robusta R. Br.*	
	Vernonia amygdalina Del			
	Syzygium guineense (wild) Del,			
	Aningeria adolfi-frederici Rob and Gilb.,			
	Prunus africana (Hook.f.),			
Cereal-enset-	*Hagenia abyssinica*	*Juniperus procera Hotchst*	*Chamaecytisus*	*Euclyptus*

livestock	*(Bruce) J.F.Gmel*	*ex.Engl*	*palmensis*	*globlus*
	Erytherina abyssinica Lam. ex DC,	*Olea europaea subsp.cuspidata (Wall.ex G.Don)Cif*	*Cajanus cajan L.*	*Cupressus lusitanica*
	Croton Macrostachyus Del	*Ploysica fulva* (Hiern) Harms	*Grevillea robusta R. Br.*	`
	Millettia ferruginea (Hotchst.) Bak (Dhadhatto)	*Maytenus undata*		
	Podocarpus falcatus Thunb.	*Maytenus senegalensis* (Lam.) Excell		
	Ficus sp	*Arundiaria alpina K.Schum*		
	Shefflera abysisinca(Hochst.ex A.Rich)Harms	*Polyscias fulva (Hiern) H arms*		
	Ekebrgia capnesis (Sparrm)			
	Albizia gummifera (Gmel.) C.A.Sm.,			
	Acacaia abyssinica Hochst.ex.Benth			
Cereal –enset	*Hagenia abyssinica (Bruce) J.F.Gmel*	*Arundiaria alpina K.Schum*	*Chamaecytisus palmensis*	*Euclyptus globlus*
	Erytherina abyssinica Lam. ex DC,	*Olea europaea subsp.cuspidata (Wall.ex G.Don)Cif*	*Cajanus cajan L.*	*Cupressus lusitanica*
	Ekebrgia capnesis (Sparrm),	*Juniperus procera Hotchst ex.Engl*		
Enset cereal livestock	*Croton Macrostachyus Del*	*Juniperus procera Hotchst ex.Engl*	*Sesbania sesban (L.) Merr*	
	Millettia ferruginea	*Olea europaea*		

	(Hotchst.) Bak (Dhadhatto)	*subsp.cuspidata (Wall.ex G.Don)Cif*		
	Syzygium guineense (wild) Del	*Podocarpus falcatus Thunb.*		
	Hagenia abyssinica (Bruce) J.F.Gmel	*Ficus sp*		
	Aningeria adolfi-frederici Rob and Gilb.,	*Acacaia abyssinica Hochst.ex.Benth*		
	Ricinus communis L.	*Shefflera abyissinica*		
		Ekebrgia capnesis (Sparrm),		
		Erytherina abyssinica Lam. ex DC,		
		Albizia gummifera (Gmel.) C.A.Sm.,		
		Polyscias fulva (Hiern) H arms		
Cereal coffee enset livestock	*Millettia ferruginea (Hotchst.) Bak (Dhadhatto)*	*Acacia spp.*	*Sesbania sesban (L.) Merr*	
	Erytherina abyssinica Lam. ex DC,	*Dodonaea angustifolia* L.		
	Croton Macrostachyus Del			
	Vernonia amygdalina Del			
	Prunus africana (Hook.f.),			
	Cordia africana Lam(weddeessa)			
	Podocarpus falcatus Thunb.			

	Ficus sur Forssk			
	Ficus vasta Forssk			

Table 2.Common uses of some selected woody species (Sources: Field survey, 2011; Mesele et al., 2011; Mesele, 2007; Tadesse, 2002; Bogale,2007 & SLUF,2006)

Scientific name	***Local name***	***their uses***	***Remark***
Albizia grandibracteata Taub.	*Denbele Kuche*	*2,4,9*	
Albizia gummifera (Gmel.) C.A.Sm.,	*Gorbe*	*1, 2, 9*	
Aningeria adolfi-frederici Rob and Gilb	*Gudubo*	*1,2*	
Annona chrysophylla Boj.	*Geshita*	*12*	
Bersama abyssinica Fresen	*Tibero/Sessa*	*2,12*	
Brucea antidysenterica J.F.Mill	*Lafa*	*9*	
Casimiora edulis Lal lave & Lex	*Abukere*	*12*	
Cordia. africana Burm.F.	*Motokomo*	*2,5,6*	
Celtis gomphophylla Bak.	*Wolaba*	*6*	
Citrus sinensis Osb.	*Birtukan*	*15*	
Cordia africana Lam	*Weddeessa*	*1, 2, 4, 7, 10*	
Croton Macrostachyus Del	*Mokonisa*	*2, 7, 9, 10*	
Dracaena steudneri Schweinf. ex Engl.	*Cho'e*	*3,10*	
Trichilia emetica Vahl	*Onono*	*1,2,7,*	
Erytherina abyssinica Lam. ex DC	*Welena*	*1,3,4,5,7*	
Euphorbia candelabrum Trem and Kotschy	*Adame*	*1,2*	
Ficus elastica Roxb.	*Kilto*	*4*	
Ficus gnaphalocarpa (Mig.) steud. ex A. Rich	*Odh'e*	*2,4,7,10*	
Ficus vasta Forssk	*Kilto*	*4,6,9,12*	

Galiniera coffeoides Del.	*Abaye*	*1,2*	
Mangifera indica L.	*Mango*	*12,13*	
Millettia ferruginea (Hotchst.) Bak (Dhadhatto)	*Dharato*	*1,2,3,4,7,8,10*	
O. welwitschii (Knobl.) Gilg & Schellenb.	*Dega/Setamo*	*1,3,9,*	
Persea americana Mill	*Avocato*	*12,113*	
Polyscias fulva (Hiern) H arms	*Tele'a*	*5,6*	
Prunus persica (L.) Batsch	*Koke*	*12,13*	
Psidium guajava L.	*Sholla*	*12,13*	
Prunus africanum Hook. F	*Gerebe*	*1,2,5,6,8,9*	
Solanecio gigas (Vatke) C. Jeffrey	*Dimbola*	*9*	
Trema orientalis (L.) Bl.	*Walo*	*9*	
Vernonia amygdalina Del	*Eebicha*	*2,3,9,10*	
Vernonia auriculifera Hiern	*Reji*	*2,11*	
Discopodium penninervium Hochst.	*Chosika*	*2*	
Podocarpus falcatus (Thunb.) Mirb.	*Birbirsa*	*1,2,4,7,10*	
Senna sp.	*Cheketa*		
S. guineense (Willd.) DC.	*Badessa*	*1, 3, 7, 9*	

1.Timber 6.Beehive hanging 11. Live fences
2.Fuelwood 7.Household utensils 12. Fruit
3.Fodder 8. Farm tools 13. cash
4.Shade 9.Medicine
5.Beehive construction 10.Soil fertility

Table 3. **List of perennial and annual crops grown in Gedeo (Source: Bogale, 2007)**

Type	**Vernacular name**	**Scientific name**
Root crops	*Boyna*	*Dioscorea alata L.*
	Carot	*Daucus carota* L.

	Cassava	*Manihot esculenta* Granz
	Dinch	*Solanum Tuberosum L.*
	Enset	*Ensete ventricosum* (Welw.) Cheesman
	Godere	*Colocasia esculenta(L.) Schoot*
	Qey sir	*Beta vulgaris L.*
	Sikur dinch	*Ipomoea batatasL.*
Cereals	*Beqolo*	*Zea mays L.*
	Gebs	*Hoedeum vulgare L.*
	Mashila	*Sorghum bicolor L.*
	Sinde	*Triticum sativum L.*
	Teff	*Eragrostis tef(Zucc.) Trotter*
Pulses	*Adenguare*	*Phaseolus vulgaris*
	Ater	*Pisum sativum L.*
	Baqela	*Vicia faba L.*
	Yewof ater	*Cajanus cajanL.*
Oil seeds	*Gomenzer*	*Brassica carinata A. Br.*
	Gullo	*Ricinus communis L.*
	Nug	*Guizotia abyssinica* (L.f.) Cass.
	Telba	*Linum unisatissimum*
Vegetables	*Baro*	*Allium porrum L.*
	Duba	*Cucurbita pepo* L.
	Gomen	*Brassica integrifolia (West) O.E.Scbulz*
	Mimita	*Capsicum frutescens L.*
	Nech shinkuri	*Allium cepa L.*
	Qaria	*Latuca saliva L.*
	Qey shinkurti	*Allium cepa L.*
	Selata	*Latuca saliva*
	Tiqil Gomen	*Brassica oleraea L.*
	Yegurage gomen	*Brassica oleracea*
	Timtim	*Lycopersicon esculentum Mill*
Fruits	*Abokado*	*Persea americana Mill*
	Ananas	*Ananas comsus (L.) Merr*

	Birtukan	*Citrus sinensis Osb.*
	Gishixa	*Annona squamosa L.*
	Hopi	*Pass flora edulis*
	Kazmir	*Casimiora edulis Lal lave & Lex*
	Kok	*Prunus persica (L.) Batsch*
	Lomi	*Citrus lemon* (L.) Burm.f.
	Mango	*Mangifera indica L.*
	Muz	*Musa x paradisiacal L.*
	Papaya	*Carica papaya L.*
	Zeitun	*Psidium guajava L.*
Stimulants	*Buna*	*Coffee arabica L.*
	Chat	*Catha edulis (Vahl) Forsk., ex Endl*
	Tembaho	*Nicotiana tobaccum L.*
Spices	*Korerima*	*Afromomum korarima* (*Braun) Jansen.*
	Mimita	*Capsicum annum* L.
	Tenadam	*Ruta chaepensis L.*
	Tiqur azimud	*Nigella sativa*
	Zingible	*Zingiber officinale* Roscoe
Others	*Gesho*	*Rhamnus prinoides* L'Herit.
	Shenkora ageda	*Saccharum officinarum*

Annex 2: Rainfall and temperature data of Gedeo Zone(1983-2012)

Table 4: Monthly minimum and mean minimum temperature(^{o}c) of Gedeo zone(1983-2012)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MEAN
1988	9.6	11.6	12.9	14.8	13.5	13.7	14.8	14.1	14.0	14.1	10.0	8.2	12.6
1989	9.3	9.3	12.8	14.0	12.6	12.7	14.2	13.1	13.0	13.0	11.5	13.1	12.4
1990	9.8	13.8	13.0	14.4	13.7	12.8	14.4	14.5	13.0	11.9	11.6	10.8	12.8
1991	9.3	12.8	12.8	13.9	13.3	13.1	14.0	14.6	13.0	11.0	10.0	8.5	12.2
1992	8.8	11.8	12.7	13.4	12.9	13.3	13.5	14.6	13.3	13.8	11.0	9.7	12.4
1993	9.4	11.4	12.7	13.4	13.4	13.5	13.7	14.6	13.5	13.5	11.0	9.7	12.5
1994	9.9	11.1	12.5	13.5	13.8	13.8	13.9	14.6	13.7	13.2	11.0	10.2	12.6
1995	9.9	11.1	12.5	13.5	14.3	14.0	14.1	14.6	13.9	12.9	11.0	10.8	12.7
1996	11.0	10.3	12.3	13.5	13.4	14.5	14.1	14.3	13.8	12.6	10.5	9.0	12.4
1997	11.3	7.0	12.9	13.9	12.4	13.2	14.2	13.9	12.7	14.3	14.4	12.9	12.8
1998	13.9	14.0	13.5	14.9	13.6	13.3	15.4	15.3	14.3	14.5	10.0	7.1	13.3
1999	8.4	8.1	12.8	12.2	12.3	12.4	13.8	12.2	12.7	13.6	10.0	8.8	11.4
2000	6.9	7.2	10.4	13.2	13.2	12.7	13.6	13.9	13.3	14.5	11.6	9.6	11.7
2001	11.2	10.2	13.3	13.6	13.5	13.7	14.3	14.9	13.4	13.8	11.3	10.4	12.8
2002	10.7	9.5	13.8	13.5	14.0	14.0	13.5	14.0	13.1	13.0	12.3	13.4	12.9
2003	10.7	9.7	11.1	13.7	13.2	13.1	13.5	13.2	12.8	12.4	11.4	9.4	12.0
2004	11.3	11.3	11.3	14.4	12.9	13.1	13.6	14.5	13.3	12.3	12.7	11.6	12.7
2005	10.1	10.5	13.8	14.1	14.9	13.8	13.9	14.2	14.0	13.6	11.4	7.2	12.6
2006	9.9	12.3	13.3	14.1	13.6	13.9	14.9	14.1	14.0	14.4	13.1	12.7	13.4
2007	12.3	12.3	12.1	14.0	14.3	15.1	15.0	14.1	14.6	12.2	11.9	7.7	13.0

2008	9.3	10.2	11.1	13.7	14.1	13.9	15.0	14.4	14.4	13.8	11.5	9.2	12.6
2009	10.4	11.2	12.5	14.3	14.2	13.2	13.6	13.8	14.2	14.1	11.3	13.5	13.0
2010	11.3	14.8	14.4	15.0	15.7	14.7	15.1	15.4	14.7	13.9	11.1	9.6	13.8
2011	10.0	9.7	12.9	13.8	15.4	15.2	14.7	14.8	14.7	13.0	13.8	10.0	13.2
2012	8.2	8.3	10.8	14.2	13.9	14.5	14.5	14.7	14.4	13.3	12.8	11.0	12.6

Table 5 : Monthly max and mean max temperature of Gedeo zone(1983-2012)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MEAN
1988	28.3	28.3	28.0	28.0	26.3	25.1	23.2	24.1	24.5	25.4	27.3	28.4	26.4
1989	28.2	29.0	29.0	26.2	26.7	25.4	23.9	25.8	25.4	26.7	27.1	27.0	26.7
1990	28.4	27.7	27.8	26.8	26.6	25.9	25.2	25.1	26.4	27.4	28.4	28.3	27.0
1991	29.2	28.7	28.2	28.2	27.1	26.2	25.5	25.2	27.2	28.8	29.6	29.5	27.8
1992	30.0	29.7	28.6	29.5	27.6	26.5	25.8	25.3	26.3	26.1	28.1	29.8	27.8
1993	30.0	29.7	28.6	29.2	27.4	26.8	25.6	25.3	26.2	26.3	28.3	29.8	27.8
1994	29.9	30.4	28.8	29.0	27.3	27.1	25.5	25.4	26.2	26.4	28.4	29.9	27.8
1995	29.9	30.7	28.9	29.1	27.1	27.4	25.3	25.4	26.1	26.6	28.6	30.0	27.9
1996	29.8	31.7	29.3	28.6	27.2	27.4	24.4	24.8	25.3	26.5	28.6	29.5	27.8
1997	30.9	32.9	33.3	28.2	27.3	27.4	26.0	27.0	27.6	26.9	27.0	27.7	28.5
1998	28.1	29.8	30.8	30.3	28.3	27.6	26.9	27.0	27.2	26.0	28.3	29.9	28.3
1999	30.9	33.0	29.3	28.8	27.1	26.8	25.3	26.9	26.7	26.2	29.0	30.1	28.3
2000	31.7	33.0	34.1	29.2	27.5	26.9	26.4	27.0	27.0	28.1	29.0	29.9	29.1
2001	31.1	33.3	32.2	29.3	27.6	26.9	26.7	27.1	27.0	28.7	29.0	29.8	29.1
2002	30.8	33.4	30.3	29.5	27.9	27.0	27.4	27.2	27.2	30.0	29.0	29.6	29.1
2003	29.9	33.8	34.7	30.1	28.9	26.8	25.7	26.4	26.8	27.9	28.5	28.3	29.0
2004	30.4	30.0	31.4	27.0	28.2	25.9	26.2	26.8	26.7	27.4	28.2	29.2	28.1

2005	30.8	32.8	31.1	30.1	26.0	26.2	25.5	26.5	26.5	26.5	28.0	29.9	28.3
2006	31.2	30.8	29.6	27.4	27.6	27.3	25.4	26.0	26.7	27.2	27.5	28.1	27.9
2007	29.5	31.0	30.4	28.3	28.3	27.1	25.0	25.7	25.6	27.3	28.2	29.1	28.0
2008	30.7	30.9	31.7	28.5	26.1	25.9	24.6	25.2	26.3	26.3	27.3	29.2	27.7
2009	29.6	30.9	32.3	28.1	27.8	27.3	26.9	27.6	27.2	27.4	29.5	28.2	28.6
2010	29.2	29.5	28.5	27.9	26.8	26.4	25.1	25.6	25.9	27.5	29.5	29.9	27.7
2011	31.0	31.9	32.0	31.7	27.0	26.0	25.9	25.5	25.5	27.3	26.5	28.1	28.2
2012	30.7	31.9	32.4	28.3	27.5	24.8	25.5	26.0	25.4	27.3	28.0	29.0	28.1

Table 6: Monthly and total Annual rainfall of Gedeo zone(1983-2012)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total anual
1988	30.2	112.5	136	167.2	247.9	95.9	262.8	229.7	153.3	194.6	60	6.6	1696.7
1989	47.2	26.2	112.4	108.9	93.3	135.4	99.1	59	150.2	175.7	90.8	143.3	1241.5
1990	13.2	198.8	159.6	161.4	158.9	53.7	42.1	108.9	132.8	94.1	59.3	25.3	1208.1
1991	13.65	51.9	123.6	195	169.4	105.3	71.5	103.15	143.6	101.8	9	45.3	1133.2
1992	14.1	37.8	44.9	207.5	179.9	156.9	100.9	97.4	186.1	250	54.2	46.4	1376.1
1993	7.7	24	88.8	153.6	340.8	158.1	34.5	78.7	114.8	163.2	50.5	17.6	1232.3
1994	1.3	10.2	132.7	384.3	147.6	105.5	257.4	164	142.6	92.1	38.4	0.4	1476.5
1995	0.5	55.4	73.9	262.9	190.3	67	151.8	105.4	200	174	42.4	18.4	1342
1996	87.6	33.2	165.8	280.1	252.9	232.8	123.8	151.6	174.5	86.1	27.9	12.4	1628.7
1997	17.5	5.3	25.5	256.8	272.3	161.3	111.5	93.1	149	220.3	203.5	85.5	1601.6
1998	58.4	45.6	108.4	232.9	210.6	67.9	124.7	146.2	107.5	155.2	82.3	7.2	1346.9
1999	20.7	15.1	64.4	148	261.75	75.5	46.6	44.2	126.05	159	35.1	13.8	1010.2
2000	0	0	20.4	190.1	312.9	19.7	98.7	113.3	144.6	162.8	69.8	13.1	1145.4
2001	15.7	25.2	105.6	226.7	194.8	144.4	72.4	145.3	157.4	197.4	52.4	28.8	1366.1
2002	35.6	18.7	208	86.6	137.9	104.8	63.95	132	112.35	57.4	69.9	115.7	1142.9
2003	56.7	4	76.1	146.9	100.3	102.9	55.5	118.7	67.3	128	95.4	22.2	974

2004	87.3	32.1	63.3	275.5	113	40.2	73.7	63.4	136	70	112.2	45.4	1112.1
2005	44.6	9.3	77	273.2	246.2	63.7	76.9	95.9	133.15	183.4	58.6	4	1265.95
2006	15.5	51.4	151.1	206.2	158.4	151.4	53.7	159.5	130.3	292.1	82	39.4	1491
2007	81.3	10.5	95.2	149.8	340.2	164.5	98.75	276	212.2	193.3	54.5	0	1676.25
2008	10.5	4.5	983.2	198.5	213.9	85.1	143.8	89	789	815.7	74.6	0.6	3408.4
2009	52.6	40.8	39.5	207.2	134.6	72	25.9	46	177.3	156.5	15.9	127.1	1095.4
2010	45.4	141.1	203.9	217	313.7	139.8	80.5	147.5	126.6	238.7	7.3	8.2	1669.7
2011	11	23.3	39.5	135.6	276.4	110.5	99.2	180.3	190	223.6	198.7	11.5	1499.6
2012	14.8	12.6	29.2	136.4	198.9	113.7	89.85	163.9	158.3	181.2	54.1	9.2	1162.15

Annex 3: Plates depicting the traditional agroforestry practices

Plate 1: Coffee seedling naturally grown under mother coffee tree (Source: The author, 2011)

Plate 2: Children being engaged in collection of dry coffee berries that fall on to the ground (a practice locally known as *Fishile*

Plate 3: Leaf of enset plant being bent to collect rainwater and protect the psedostem from sunlight (Source: The author, 2011)

Plate 4: Mulching using herbaceous weedy plants

Plate 5: **Plate 5**: Enset being used for purpose of mulching (Farmers intentional left leaves of enset on the ground to maintain the moisture of the soils protect the soils from loss and augment soil fertility (Source: The author, 2011))

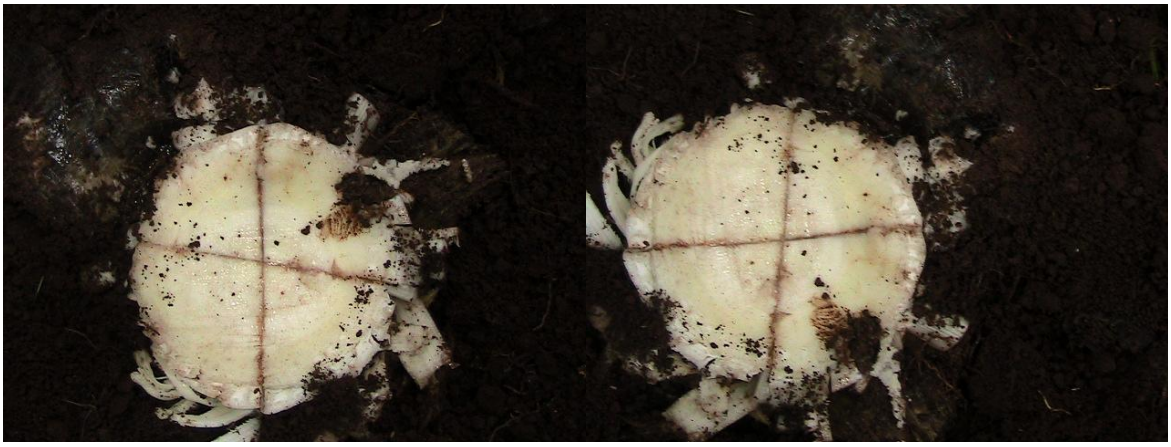


Plate 6: 'Simma' equally divided in to four parts (Source: The author, 2011)

Plate 7: Simma covered by leaf of enset (Source: The author, 2011)

Plate 8: Enset seedling being transplanted for hardening off (Source: The author, 2011)

Plate 9: Eucalyptus trees serving as shade for coffee in waterlogged areas (Here you can see how wise the farmers are. Scientifically it is not advisable to plant such trees with annual or perennial crops as it highly compete for water and nutrients. Nevertheless, the local farmers use it as shed for coffee in water logged areas to reduce excess water in the area. It is reported that the coffee plant grown under Eucalyptus trees is as productive as coffee plant grown in other indigenous multipurpose trees. (Source: The author, 2011))

Plate 10: Stall feeding(Photo by the author, 2011)

Plate12: Multilayered Traditional Agroforestry System of Gedeo at glance (Source: The author, 2011)

Plate 13: Enset based agroforestry system in midland regions (Source: The author, 2011)

Annex 4: Instruments used in the research

Instrument 1: Semi-structured interview

Interview Protocol

Research title: The Dynamics of **Indigenous knowledge of agroforestry system of Gedeo: implications to sustainability**

Writer: Abiyot Legesse

Position: Ph.D Student at UNISA

Brief Description of the research:

Purpose of the interview: The principal purpose of this interview is to explore the constituents of indigenous knowledge with regard to agroforestry system of Gedeo. The interview focuses on the exploring indigenous agroforestry practices, and its changes and continuities in time and spaces.

Time: Date:

Interviewer: Interviewee: Position of the interviewee:

Some of the Interview questions used(for key informants) :

1. Can you tell us the kind of agroforestry system being practiced in your locality?
2. Can you tell us the major components of Gedeo agroforestry system?
3. Can you please name any indigenous trees known to you? For what purpose do the local people use them?
4. What can you tell us about the history of traditional agroforestry sytem of Gedeo?
5. Do you have farmland? What can you tell us about your own farmland?
6. Do you practice intercropping? What do you mix up with coffee and indigenous trees? Why?
7. Which crops do you think is often planted with trees?
8. Any crops that can mutually grown with coffee or Enset?
9. How many coffee varieties grow in your locality? Can you please name some of them?
10. How long will it take to give production? Which of the coffee variety gives better production? Why? Which of them is locally grown one?
11. How do you evaluate its annual production? Is there any variation and why?
12. Do all group of community participate in coffee weeding and harvesting?

13. What kind of management do you practices to increase the productivity of coffee?
14. What do you use in order to increase the fertility of soils and then productivity of coffee and other crops?
15. Is coffee grown in your locality organic?
16. Can you please name variety of enset being grown in your locality?
17. Any value attached to enset?
18. For what purpose do the people use enset?
19. How long will young enset tree takes to give production?
20. What kind of management system/ strategies does it requires?
21. Is there any division of labor between male and female in terms of managing, weeding and harvesting enset? What is the role of male? What will be the role of female as well?
22. How do you see the production of enset? Is it increasing or decreasing? Why is the change?
23. What are the common edible fruits and root crops grown with other crops? Which are grown?
24. Which indigenous trees are suitable for coffee and why? Which indigenous trees are not suitable for coffee and why? How did you know?
25. What do you think is the major livelihood of the Gedeo ?
26. What kind of farming system is suitable for this area? What kind of farming system is being practiced in your locality?
27. How do the Gedeo conserve the biodiversity?
28. What kind of conservation mechanism do the people use so far?
29. What do the people do in order to conserve the biodiversity?
30. Is the conservation methods depend on indigenous knowledge of the society?
31. From where do the people get seedlings of coffee, Enset and other crops?
32. In your time, have you seen/ encounter any change in climate and biodiversity?
33. How do people manage the natural resources?
34. Can you give us a brief account of the historical development of the Gedeo?
35. What can you tell us about the *ballee* system? Its role in socio-economic, cultural and political conditions of the people?

36. What do you know about the traditional belief systems, traditional festivals and traditional events that the local people have been using?

Interview Questions for Development agents

1. When did you start working as DA in the present Kebele?
2. What is your role as development agent of the area? What kind of support do you give to the local people? What is your responsibility?
3. How do you describe the traditional agroforestry system of Gedeo?
4. What special characteristics can you tell about Gedeo agroforestry system? Is it different from other traditional agroforestry system in the other parts of the country or the regions?
5. What are the major components of traditional agroforestry system of Gedeo?
6. How do the local people see you? What is the perception of the local community about you?
7. Any new technology introduced to the area in order to enhance productivity.
8. Do you advice the local people to use modern technologies and practices in lieu of the local/ traditional one?
9. Which one do the local people prefer and which one is your preference and government preference and why?
10. How do you describe the participation of young people and children in traditional agroforestry practices?
11. Where do the young people spend most of their spare time?
12. Do they participate in different activities with regard agroforestry?
13. In your opinion, are they keen to follow the footstep of their ancestors?
14. Have you observed any change in the system? Any considerable change in vegetation distribution? Are the number of indigenous trees increasing or decreasing?
15. Which group of people is better in terms of maintenance of the indigenous trees? Is it the haves or have not? The young or old? The one residing near urban center or remote rural place?
16. What are the factors that influence the sustainability of the agroforestry system**?**
17. How do the local people maintain the sustainability of the agroforestry system?
18. How do you evaluate the sustainability of Gedeo agroforestry system?

19. Do you think that it will stay without/overcome any perturbation?
20. What do you do to foster the productivity of the system?
21. From the local knowledge and modern knowledgeable, which one do you think is preferred by the local people? Which one is effective and why?
22. How often do you go to farm field?
23. Do you have schedule to follow up the activity of the local farmer?
24. Did you give them training? On what topic? How often?

Interview Questions for zonal agricultural experts

1. What is your responsibility?
2. How do you describe the traditional agroforestry system of Gedeo?
3. How do you relate the Gedeo agroforestry system to the livelihood of the community?
4. How do you describe the role of young and children in maintaining the sustainable use of the system?
5. Do you think that the traditional agroforestry system come out of the IK of the community?
6. Do you provide them with modern inputs to enhance productivity?
7. What is the role of the zonal government concerning the traditional agroforestry system of the zone?
8. How do you see the sustainability of the system?
9. Does the system encounter challenges so far? If so what are the challenges? How did you overcome?

Interview Question for Nongovernmental organization

1. What is the name of your organization?
2. What is your responsibility?
3. What is the role of the organization in Gedeo agroforestry system?
4. What kind of support do you give for the locality?
5. Is it depending on the demand of the people or solely based on your plan?
6. What is the reaction of the local people?
7. Do you give them training? How often do you give training for the local people?
8. On what topic do you give them?

Instrument 2: Focus group discussion

FGD protocol

Procedures
• Welcoming participants to the discussion; • Introducing the facilitator; • Presenting the topic; • Brief explanation about selection of participants; • Clarifying that differing viewpoints as well as positive and negative comments are of interest; informing participants that the session would be tape recorded so that none of the comments would be missed; • Requesting that only one person talk at a time; • Explaining that first names is to be used for the discussion and that no names would be attached to comments in the report as measures of confidentiality; and • Informing participants about the approximate length of the session

Issues to be discussed	**Possible Questions to be raised**
Constituents of IK/ Current status **Its dynamism(production, reproduction, loss, modification, transfer)**	1. Could you please tell us your name, from where you come and your responsibility? 2. How do you describe the traditional agroforestry of Gedeo? 3. What goes to traditional agroforestry system of Gedeo? 4. What are the unique features of traditional agroforestry system of Gedeo? 5. How do you perceive current states of the traditional agroforestry system of Gedeo? 6. What types of agricultural activities are suitable in your locality? Do other activities suit to the local conditions other than agroforestry? 7. Do you think that Eucalyptus trees are parts of the Gedeo agroforestry system? Why do the local people plant the tree on their farmland? Does it affect the system? Can it be grown without affecting the system?

Its future prospects	8. For what purpose do the Gedeo use indigenous trees? Do they use for income generating purpose? Do the local people cut it and sell it to generate income? 9. How do you see the availability of indigenous trees at present and in the past? Is there any variation? Are old indigenous trees available everywhere? If not, where do we get them? Is it in farmland owned by young or elders; rich or poor'; urban or rural dwellers? 10. Did you notice any problem with regard to the system? Any problem related to soils, water, and biodiversity. How do you conserve the soil, water and other resources? How do you protect the soil, water and other natural resources in your locality? 11. What is the role of women in traditional agroforestry system of Gedeo? 12. What is the role of young people in traditional agroforestry system of Gedeo? 13. What are the indigenous practices that the local community uses? 14. Is coffee and enset harvesting gender based? Which one is gender based and why? 15. Do you think that agroforestry is the only means of livelihood for Gedeo people? What would happen to the Gedeo people in the absence of agroforestry? Do the people survive without it? 16. Is there any observable change in agroforestry systems/ practices of Gedeo? Any adverse situation so far happened in the locality. How did the people overcome? 17. Any fluctuation in coffee production? Is the production constant or changing? 18. How do you see/compare the forest coverage of present and past time? Is there any difference? Why is the difference?

	19. Are the young people willing to engage in farming activity? How do you see the participation of young in agroforestry practices? 20. Is there any local meeting that involves young people and children? Any ritual gathering? How often do you conduct? 21. Is there any means through which the elders teaches their children about the traditional agroforestry system of Gedeo? 22. Do Gedeo elders transfer their knowledge to their children? 23. How did you learn about the traditional agroforestry system of Gedeo? Who taught you? Where? 24. Is the agroforestry system sustainable? 25. How do you see the sustainability/the future prospects of indigenous knowledge of the community? 26. How many of your children are interested to inherit your profession? 27. How do you evaluate the relationship between this day's children and young people, and community elders? Do you think there is a relationship? How strong the relation is? 28. How do you evaluate the attitude of young people towards their ancestors' wisdom? Do the young people give credit to the local wisdom? How about elders? Do they encourage the young people to acquire knowledge about their locality? 29. Do you believe that the local practices are gradually declining due to both internal and external factors? What is your opinion regarding the gradual loss of IK? What are the factors contributing for the loss of IK?

Instrument 3: Participant Observation

Observation Protocol

Observation notes	**Reflection notes**
Sketch:	

Instrument 4: Card-Sorting activities

The purpose of this instrument is to determine the level of knowledge of the participants in identifying plant domains, animal domain, soil types and climatic characteristics of the study area categorized as eco-cognitive aspects of IK

Instrument 5: Transect walk

Purpose:

The walk will be conducted with youth and children whose age is above 15. Children below 15 are intentionally omitted because of the potential risk of being tired during the walk. The assumption is that children at age of 15 and below may not be able to travel for longer hours like 7 to 8 hrs. Sometimes the group may cross-river and dense forests in which case the children may face challenges. The omissions of these children do not have an impact of the result of the research.

Observation toolkit

Objects or items observed	Elevation	Comments made by the participants

Instrument 6: Cognitive mapping/Mental mapping

Purpose:

Drawing sheet Name: Locality:
Brief description of the drawing :

Instrument 7: Free listing by key informants

Purpose:

List of indigenous trees, fruits, agroforestry practices, its components, traditional soil and water conservations,	Potential uses

Instrument 8: Structured interview with sampled participants (Age: 12-65)

Purpose:

Theme 1: Plant domains, local climate and local seasons (Eco-cognitive dimension)

1. Mention name of Indigenous trees

S no	Indigenous trees	Their uses
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

2. Non indigenous/ exotic trees

Sno	Name of the trees	Their uses
1		
2		
3		
4		
5		
6		

3. Local soil types

Local soils types and their importance

4. Local enset cultivates

S no	Name of the cultivars(Local)	Their uses
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

5. Local coffee cultivates

The cultivars and their importance

6. Local seasons

Name of the local season	Major agricultural activities conducted

7. Local herbaceous non woody plan species

S no	Name of the plant	Their uses
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

8. Name of wild fruits

S no	Name of wild fruits	Their uses
1		
2		
3		
4		
5		

Theme 2: Traditional Agroforestry practices (Practical and normative dimension)

1. Among the indigenous tree species which one is/ are

Propagate naturally and/or through vegetative methods	Through modern methods(in nursery sites)

2. Ecological interaction and cultural and medicinal importance of indigenous trees

Mention indigenous trees which have deleterious effects on the undergrowth and perennial crops(coffee and enset)
Mention indigenous trees which have good contribution to the growth of coffee and enset
Can you mention some of the sacred indigenous trees? Indigenous trees which are not used for fuel, house construction, timber and other purposes because of the value attached to

them?

Indigenous trees that are known for their medicinal values

3. Production and management of enset

- ✓ Can you explain how enset seedling (locally known as simma) is prepared?
- ✓ Explain how the emergent seedling of enset (locally known as huffee) is planted?
- ✓ How long will an enset tree take to be ready for harvesting?
- ✓ What type of management it requires once it is planted? Does it need fertilizer? Organic or inorganic?
- ✓ Doest enset tree require compost? If so at what time? After plantation or before plantation? Why?
- ✓ Can you please explain how one can do to prevent the impact of pests and disease that affect enset plant?
- ✓ What is the local name of place, which is used to harvest enset? Can you mention local tools used to harvest enset? For how long can a harvested enset stay without deterioration of its quality?
- ✓ Can you please mention some of the traditional food prepared from enset?

4. Coffee production, management and harvesting
    - ✓ Can you please explain methods of coffee seedling preparation?
    - ✓ How long wills a coffee tree takes to give production?
    - ✓ What type of management does a coffee plant needs?
    - ✓ Is it possible to prevent coffee diseases and pests?
5. Annual crops production, management and harvesting
    - ✓ Crop calendar(for annual and perennial crops)

Agri. Activity	Maize	Wheat	Barley	Bean	Enset	Coffee	Yam
Land preparation							
Seedling preparation							
Sowing period							
First round cultivation							
Weeding							
Application of fertilizer							
Harvesting							

5.1. Ecological interaction of annual crops(cereal and root crops and fruits)

- ✓ Crops that do not love shade trees and why?
- ✓ Crops that do need shade trees and why?
- ✓ Crops that maintain the fertility of the soil or enhance soil fertility
- ✓ Crops that have relatively deteriorate soil fertility?

6. Ecological interaction, cultural and medicinal importance of herbaceous non woody plants

- ✓ Can you please mention the ecological importance of herbaceous non-woody plants?
- ✓ Why do farmers intentional keep the non woody herbaceous weeds without weeding them for a certain period?
- ✓ Can you pleases mention some of the weeds that have cultural and medicinal importance? For what kind of cultural importance can the local people use? What kind of illness can they cure?

7. Animal production and their ecological importance

- ✓ Can you please explain common animal feeding systems in you locality?

- ✓ Do you thing that manure obtained from animals is important for soil fertility management? How?

8. Beehive production

    - ✓ Can you explain how hive is prepared? Which indigenous trees are most useful for the preparation of hive and why?
    - ✓ Which indigenous trees are used to hang the beehive and why?
    - ✓ When do you think is the right time(season) to hang hive for beehive production? Who is responsible to hang and at what time(day or night) and why?
    - ✓ What kind of care does the hive needs before hanging?
    - ✓ How long will it take to give production?

9. Soil and water conservation activities

Indigenous	Modern

10. Soil fertility management

Indigenous	Modern

11. What is urnae?
12. What is Hoffa?
13. What is Fawo?
14. Do you think plants litters can prevent soil erosion and how?
15. Do you think that litter can enhance the fertility of soils?
16. Can you please explain indigenous methods of compost preparation?

17. Why do local people left pruned leaves of trees, slashed weeds and harvested enset on their farmland? Do you think it has some importance? Can you pleases explain?

18. Cultural practices

- ✓ Can you please mention the traditional ruling system of Gedeo people?
- ✓ What is ballee or gada system in the context of Gedeo?
- ✓ Who is the current aba gada?
- ✓ For how long will aba gada stay in position?
- ✓ How many clans exist in Gedeo?
- ✓ From which clan is the current aba gada leading the baallee institution?
- ✓ Why do Gedeo people plant indigenous trees on the graveyard of their family? Can you please mention indigenous trees used for this purpose?
- ✓ What do you mean by *ciincessa*?
- ✓ What do we mean by *worqa*?
- ✓ What do we mean by *Gadabo*?
- ✓ What do you mean by *haafa*?
- ✓ What do we mean by *xeeroo*?
- ✓ What do we mean by *wilisha*?
- ✓ What do we mean by *shello*?
- ✓ What do we mean by *kalacha*?
- ✓ What do we mean by *faro*?
- ✓ In Gedeo culture, it is forbidden to build once, house using an indigenous tree known as *dega* or *Oonono()*? What do you think is the reason?

- ✓ Why do the local people consider *songo* tree as sacred tree? Do you support such belief?

19. Indigenous knowledge transmission (put tick mark in the column labeled if you have ever participated in any the activities listed below and if not in column labeled as no)

Yes.	Have you ever participated in the following farm activities	Yes	No	If your answer is yes who taught you	If your answer is no explain why you did not participate
1	Land preparation Both annual and perennial crops				
2	Seedling preparation				
3	Preparation f *simma*				
4	Transporting seedling to farm land				
5	Cultivation of farmland				
6	Prunning and pollarding of shades				
7	Preparation of animal fodder				
8	Coffee harvesting				
9	Enset harvesting				
10	Preparation of farm tools				
11	Fetching water				
12	Preparation of traditional foods				
13	Collection of firewood				
14	Animal fattening				
15	Hive preparation				
16	Hanging the hive				
17	Soil and water conservation				
18	Soil fertility management				
19	Preparation of compost				

20	Cultivations of home garden				
21	Marketing of enset				
22	Marketing of domestic animals				
23	Traditional dances				
24	Participation in songo				
24	Participation in traditional belief systems				
25	Participation in traditional conflict resolution				
26	Participation in qexxella				
27	Tree plantation				
28	Cattle keeping				

Instrument 10: Questionnaires for Head of Households (Household survey)

General Instruction: This questionnaire is designed to collect data with regard to the traditional agroforestry system of Gedeo. The questionnaire contains questions addressing the socio-cultural, economic, biophysical and institutional aspects of the agroforestry system of Gedeo. Give answer only for the questions you know. You are not obliged to give answers for the questions you don't want to give responses.

1. **Personal Background**

1.1. Name of the respondents

1.2. Sex Male ☐ female ☐

1.3. Age

1.4. Marital status: Married ☐ ingle ☐ ivorced W ☐ owed ☐

1.5. Ethnic group:

1.6. Mother tong language

1.7. Any other language you speak other than mother tong

1.8. Level of education

1..9. Family size Male: --------- female: ----------

	Age	Sex	Level of education	Marriage status	Work status				
					Student	Merchant	Farmer	Gov't employee	Any other
First child									
2nd									
3rd									
4th									
5th									
6th									
7th									
8th									
9th									
10th									

1.10. Role in the community

1.11. Do you have child/children who left home for towns? How many? Why?

1.12. Source of income/ Major livelihood

Agriculture only ☐ Trading only ☐ Both ☐ Any other

Major source of income	**Estimated annual income**
From coffee sale	
From enset sale	
From indigenous tree sale	
From domestic animal sale	
From fruit sale	
From government(PSNP)	

From honey sale	
From annual crops	

1.13. In which months do you get highest income and why?

1.14. In which months do you get lowest income and why?

1.15. What do you think the major source of income during summer season?

1.16. The income you get in summer season as compared to other season

Low ☐ Medium ☐ High ☐

1.17. Are you the beneficiary of safety-net program?

1.18. Land holding size :

	Size of land you inherited from family	Land you have through purchase	Land through gift from relative or others	Total land size
Before marriage				
After marriage				
After marriage of your first son				
After marriage of second son				
Current land holding size				

- Total land size you inherited to
  - First child: ----------
  - Second child: ----------
  - Third child: ----------
- The land you gave to your children when married

- New ☐
- Fertile but not new ☐
- Both ☐
- Any other

- The land you gave it to your children when married
  - Only in one site ☐
  - in different site ☐
- Your farmland is found
  - only in one site ☐
  - in different site ☐

1.19. You spend most of your time in

Agriculture ☐ trading ☐ doing nothing oth☐

1.20. How many hours you spend in your farmland per day?

1.21. Number of days per week you spend in your farmland?

1.22. If you are marchent how many day you spend in trading ?

2. Nature and characteristics of the land

2.1. Do you think that the land you have now is enough to live with no major threat to your livelihood?

2.2. Do you have land to inherit to your children?

2.3. If you do not have enough land to inherit, what do you think is the fate of your children?

2.4. Do you have unused land?

2.5. If so, how much hectares of land?

2.6. Do you encounter shortage of land? What about in your locality? Did you observe any sign of land shortage? Have you heard people complaining about shortage of land?

2.7. What would be the cause of shortage of land?

2.8. Is there any problems encountered due to shortage of land? Do you think that it has an impact?

2.9. Can you please mention some of the impacts of shortage of farmland?

2.10. If you believe that there is shortage of land in your locality, what do you recommend the young people who expect to have land from their family? What do you think is the fate of future generation?

2.11. Is there any land you have rented?

2.12. Do you have land you gave to other people to share the products? Why?

3. Production and productivity of agroforestry components

3.1. How do you see the productivity of perennial and annual crops in the last three decades? It is increasing or decreasing?

3.2. What do you think is the reason for increasing of crop productivity? If it is decreasing what do you think is the reason.

3.3. Can you please mention the average age of indigenous trees found in your farmland?

3.4. Are there indigenous trees which are endangered?

3.5. Enset plant found in your farmland

- Matured one ☐
- Immatured one ☐
- newly planted ☐
- Partely matured and partly immatured ☐

3.6. Coffee seedling found in your farmland

Local coffee cultivars ☐

Project coffee ☐

3.7. Crops and trees found in your farmland

In your farmland	Abundantly found	Sparsely	Not at all
Indigenous trees			
Exotic trees			
Coffee			
Enset			
Cereal crops			
Root crops			
Beehive			
Fruits			

3.8. Where do you plant new enset seedling

- On new land ☐

- on land containing enset plant ☐

3.9. Type of enset cultivar common in your farmland.

3.10. Type of enset cultivars rarely found on your farmland

3.11. Enset cultivars important for soil fertility

3.12. Can you please explain Animal feeding system you have been using?

3.13. Do you have land for your animal to graze?

3.14. If there is no grazing land, how do you feed your cattle?

3.15. What do you think is the major bottleneck for lack of extensive production of domestic animals?

4. Soil fertility mgt and soil and water conservation

4.1. Soil and water conservation practices you have been using so far

Modern ☐ Traditional ☐ Both ☐

4.2. Among modern and traditional SWC, which one do you think is relatively appropriate and effective?

4.3. What have you been doing to enhance and maintain fertility of the soil?

4.4. Have you ever participated in watershed development?

5. [Parent- child relation and interaction]

5.1. Who support you while you conduct farm tasks?

5.2. Among your childern whom do you think support you

- the one who is attending school ☐
- the one engaged in tradiing ☐
- the one at home after completing grade 10 ☐
- the one who is married ☐
- None of them ☐

5.3. Among the family who has relatively strong relation with you and why

My son ☐ my daughter ☐ Both ☐ No relation with both ☐

5.4. Among your children with whom do you go to farmland

My son ☐ my daughter ☐ Both ☐ None of them ☐

5.5. Do your daughter accompanied you to farmland to assist you?

5.6. If so, what kind of support you get?

5.7. At what age did you go to farmland for the first time?

5.8. At what age you begun to work independently, without the assistance from your family?

5.9. At what age your children go to farmland.

5.10. How do you the present day children in terms of giving support to their family? Are they willing to support their family?

5.11. Do you think that the present day young people are willing and have interest to engage in agriculture?

5.12. What have you done to equip your children to learn about agriculture?

I have been teaching them by taking them to farmland ☐

I have been teaching them at home through oral methods ☐ I let them to learn at school ☐ I do nothing ☐

5.13. Majority of young people(who completed schooling) in your locality are engaged in

Agriculture ☐ Trade ☐ both ☐ None ☐

5.14. From where do you get the knowledge and skills you have about your locality

from family ☐ Local community ☐ Brother/sister ☐ Peer ☐

School ☐ Any other:

5.15. Have you tried to share your knowledge to your children?

5.16. If so, how?

5.17. Are your children eager to learn from you?

5.18. Do you believe that the present day young people of Gedeo have the interest abd courage to handle the responsibility of protecting and keeping their environment from destruction and culture from loss and degradation?

5.19. If you believe they are not, can you please justify your answer?

5.20. What would you like your children to be?

- Farmer ☐
- Merchant ☐
- Government employee ☐

5.21. If you wish to see your children being engaged in out of farm, what do you think is the motive?

5.22. Do you prefer to see your children being a farmer and why?

5.23. Have you ever employed labor and why?

5.24. Can you get the labour force you wish to employee

5.25. How much you pay per day for one worker?

6. Religious and cultural issues

6.1. Your religion

Traditional ☐ Protestant ☐ Orthodox ☐ slim ☐ r

6.2. Have you ever participated in traditional belief system such as *qexxella*?

6.3. How do you evaluate the acceptance of *songo* and *qexxella* among the local people?

6.4. Do you think that present generation have the knowledge of traditional belief systems, and social institutions?

7. Support from experts and development agents

7.1. Did you selected as model farmer? Why?

7.2. Do you get support from development agents? What kind of support do you get?

7.3. Do you accomplish all tasks that development agents tell you to do?

7.4. Do you accept all the programs and packages of the government?

8. Market and transportation conditions

8.1. Is there market centers in your locality? How many?

8.2. How often do you go to market center?

8.3. From where do you buy household utensils?

8.4. Is there any small scale shop in your locality?

8.5. When did they established?

8.6. Who is the owner of most of the shops?

8.7. What is the effects of establishment of small scale shop, market cnter and other

- On the livelihood of the people
- In creating job opportunity
- In satisfying the demand of the local people

8.8. Do you have transport service to your locality? when did it start?

8.9. Any changes observed due to the introduction of bajaj?

8.10. Do you access to power>

8.11. Do you get access to mass media

8.12. When did you start selling coffee?

8.13. When did you start selling your coffee under the union?

8.14. When did you get highest income from coffee?

8.15. When do you think the right time of introduction of coffee marketing in the area?

8.16. Is there any coffee broker? Who are they?

9. Technology

9.1. Do you have mobile? When did you start using mobile?

9.2. Do you use improved seeds?

9.3. Have you ever used modern and improved cultivation system?

9.4. Have you ever used artificial fertilizer?

10. (challenges and problems)

10.1. Why do the contemporary young people are hesitant to listen to their rlders?

10.2. Why the young people are not willing to acquire knowledge from their ancestors?

10.3. What do you think is the causes for the weakening of cultural values and norms?

10.4. Do you think that the present day children can have the ability to transfer the knowledge to the consecutive generation without loss?

11. Exploring changes that have been registered in three consecutive regimes. Please give your own rate of the changes observed in biophysical and socio-economic characteristics you have observed in three regimes (How do you evaluate the biophysical and socio- economic conditions during H/Silase, Derg and EPRDF)

Biophysical and socio-economic Characteristics	Regimes		
	H/Silase I regiem	Derge	EPRDF
Income level			
Land holding size			
Productivity of perennial crops			
Productivity of annual crops			
Animal production			
Soil fertility			
Soil erosion			
Utilization of trees for fuel wood and timber production			
Plantation of indigenous trees			

Plantation of exotic trees mainly eucalyptus			
Plantation of kchat			
Preparation of compost through traditional methods			
Use of artificial fertilizer			
Construction o physical structure			
Harvesting of immature enset plant			
Support given by the government			
Flow of information			
Young people participating in farming			
Number of children & young people acting as per their parents advice and instruction			
Parent-child relationship			
Young people's attitude towards their culture and place given to their own culture			
Knowledge of young people about their culture			
Coffee marketing			
Children and young people's perception about modern religion			
The time young people spend in church			
Perception of young people towards their local environment			
The extent of time that young people spend with their parents			
The support given by the government and development agents			

12. Do you think that the agroforestry activities you have been performing have exhibited change? Can you please the changes you have observed in any of the practices using the table below?

	Agroforestry activities	Past practice		Current practice	
		Modern	Traditional	Modern	Traditional
Indigenous trees	Seedling preparation of trees				
	Plantation and management of trees				
	Prunning and pollarding of trees				
	Trees management				
	Selection of indigenous trees seeds/seedlings				
Enset	Seedling preparation				
	Transfer of seedlings				
	Land preparation				
	Plantation of the seedlings				
	Management practices				
	Protection from pests and disease				
	Harvesting				
	Tools used to harvest enset				
	Preparation of traditional food from enset products				
Coffee	Seedling preparation				
	Land preparation				
	Plantation of the seedlings				
	Management				
	Harvesting				
	Storage				
	Coffee pruning				
	Protection from diseases and pests				

Cereal crops	Land preparation				
	Seedling preparation				
	Sowing				
	Weeding				
	Slashing				
	Application of fertilizer				
	Harvesting				
	Storage				
Root crops	Land preparation				
	Seedling preparation				
	Sowing				
	Weeding				
	Slashing				
	Application of fertilizer				
	Harvesting				
Fruits	Seedling plantation				
	Plantation of seedlings				
	Management				
	Harvesting				
Animal production	Preparation of fodder				
	Management and care				
	Marketing				
Beehive production	Preparation of hive				
	Plantation of flowers				
	Management				
	Harvesting				
Soil and water conservation					
Soil fertility management	Preparation of compost				
	Preparation of manure				

	Mulching				
	Plantation of trees				
	Fallowing				

Annex 5: Sample size determination

$$n_0 = \frac{Z^2 pq}{e^2}$$ …….. Equation

Where

$\mathbf{n_0}$ is the sample size,

$\mathbf{Z^2}$ is the abscissa of the normal curve that cuts off an area α at the tails (1 - α equals the desired confidence level, e.g., 95%)[1],

e is the desired level of precision,

p is the estimated proportion of an attribute that is present in the population, and

0.05^2

q is 1-p.

Sample size for exam type structured questionnaires

$$=\frac{(1.96)^2(0.25)(1-0.25)}{0.05^2}$$

=288.12

Sample size determination for household survey

$$=\frac{(1.96)^2(0.20)(1-0.20)}{0.\ 05^2}$$

=245.8

Annex 6: List of key informants

List of key informants						
no	Name of the key informants	Sex	Age	Kebele	Woreda	Role in the community/ job
1	Gujo Gudana	M	82	Kara soditi	Wonago	Local elder
2	Kassu Fondoqa	M	49	Kara soditi	Wonago	Local elder
3	Robe wodesa	M	67	Kara soditi	Wonago	Local elder
4	Kassaye Dayu	M	68	Kara soditi	Wonago	Songo memeber
5	Udessa Gebre	M	67	Kara soditi	Wonago	Farmer
6	Negash Gedeo	M	52	Kara soditi	Wonago	Farmer
7	Figa Deyaso	M	>100	Kara soditi	Wonago	Songo member
8	Abebech Beka	F	28	Kara soditi	Wonago	Farmer
9	Abaynesh Dinko	F	35	Kara soditi	Wonago	Farmer
10	Woraso Dado	M	80	Sugale	Wonago	Songo member
11	Walaso Nusho	M	70	Sugale	Wonago	Songo member
12	Gobana Dogoma	M	63	Sugale	Wonago	Songo member
13	Mekuria Melka	M	52	Sugale	Wonago	Songo member
14	Tadesse Assefa	M	78	Sugale	Wonago	Songo member
15	Mekuria Korjo	M	60	Sugale	Wonago	Songo member
16	Berhanu Dayo	M	60	Sugale	Wonago	Songo member
17	Senay Bulbula	M	43	Sugale	Wonago	Supervisor
18	Yeshi Nigatu	F	30	Sugale	Wonago	Farmer
19	Tsehaynesh Eyasu	F	32	Sugale	Wonago	Farmer
20	Sara Ashenafi	F	34	Sugale	Wonago	Farmer
21	Aynalem Bekele	F	40	Sugale	Wonago	Farmer
22	Almaz Tadesse	F	36	Sugale	Wonago	Farmer
23	Dumare Gemede	F	60	Mokonissa	Wonago	Farmer
24	Atalelech Kassu	F	35	Mokonissa	Wonago	Farmer
25	Gedecho Badecha	M	75	Mokonissa	Wonago	Local elder
26	Shendo Xeyaso	M	70	Mokonissa	Wonago	Local elder
27	Zelalem Udo	M	87	Mokonissa	Wonago	Songo memebers
28	Worasa Tiba	M	75	Sika	Bule	Songo member
29	Lole Eribaye	M	70	Sika	Bule	Songo member
30	Nigusse Negash	M	52	Sika	Bule	Songo member
31	Ware Elema	M	48	Sika	Bule	Songo member
32	Gezhagn W/Mariam	M	80	Sika	Bule	Songo member
33	Shonde Udo	M	82	Sika	Bule	Songo member

34	Mariam Jara	M	90	Sika	Bule	Songo member
35	Korse Sawa	M	55	Sika	Bule	Songo member
36	Azalech Tadesse	F	36	Sika	Bule	Farmers
37	Assefa Fayisa	M	35	Dibandibe	Gedeb	Farmer
38	WolasaTeko	M	67	Dibandibe	Gedeb	local elder
39	Jilo Atomisa	M	58	Dibandibe	Gedeb	Local elder
40	Ture Jalana	M	82	Gedeb Galcha	Gedeb	Local elder
41	Tsegaye Badacha	M	34	Gedeb Galcha	Gedeb	Farmer
42	Hunde Balina	M	44	Gedeb Galcha	Gedeb	Farmer
43	Woliyu Badecha	M	56	Buno	Kochore	Local elder and model farmer
44	Berhanu Fayisa	M	44	Buno	Kochore	Local elder, model farmer, kebele admistative worker
45	Jigso Gobana	M	45	Buno	Kochore	local elderd and farmer
46	Tsige Woliyu	M	32	Buno	Kochore	Farmer
47	Tadelech Yadani	F	38	Buno	Kochore	Farmer
48	Wodesa Dege	M	60	Bonke Busa	Kochore	songo member
49	Gebeyeu Gemede	M	57	Bonke Busa	Kochore	songo member
50	Kebede Yabo	M	53	Bonke Busa	Kochore	songo member
51	Efrem Jago	M	42	Bonke Busa	Kochore	Local edler
52	Mengesha Gadicho	M	58	Bonke Busa	Kochore	Local edler
39	Genet Gelicho	F	38	Bonke Busa	Kochore	Farmer
40	Aberash Bali	F	39	Bonke Busa	Kochore	Farmer
55	Beqete Tekula	M	100	Bula	Dilla Zuria	Songo member
56	Bali Gadicho	M	120	Bula	Dilla Zuria	Songo member
57	Beyene Robe	M	65	Bula	Dilla Zuria	Songo member
58	Gamade Sarba	F	45	Bula	Dilla Zuria	Farmer
59	Etenesh Robe	F	40	Bula	Dilla Zuria	Farmer
60	Shue Worera	F	43	Amba	Dilla Zuria	Farmer
61	Haxaya Serbo	M	75	Amba	Dilla Zuria	Songo member
62	Mengesha Jarso	M	76	Amba	Dilla Zuria	Songo member
63	Bekele Gadicho	M	47	Amba	Dilla Zuria	Kebele adminstrative
64	Xero Jago	M	65	Amba	Dilla Zuria	Songo memebr
65	Beyene Xero	M	60	Amba	Dilla Zuria	Songo memebr
66	Jiso Dogoma	M	76	Amba	Dilla Zuria	Songo memebr
67	Fayisa Beraso	M	45	Amba	Dilla Zuria	Kebele adminstration
68	Ebise Kasaye	F	40	Konga	Yirgacheffe	Farmer
69	Tadesse Galicho	M	43	Konga	Yirgacheffe	Farmer
70	Negash Dhugama	M	38	Konga	Yirgacheffe	Farmer