PROCEEDINGS OF

OSSREA- ETHIOPIA CHAPTER (EC)

POLICY DIALOGUE WORKSHOP

ON

"Evidence Based Policy and Practice for Agriculture and Rural Development: the Role of Research in Achieving Middle Income Status in Ethiopia by 2025"

02 July 2015, RAS Amba Hotel, Addis Ababa, Ethiopia.

Organized by OSSREA- Ethiopia Chapter

Liaison Committee Members

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Introduction

OSSREA is a non-governmental and non-profit research network that was founded in 1980 by a group of social scientists from Eastern Africa. Currently, there are about 19 active member countries in the region, where OSSREA has National Chapters and Liaison Offices, one of which is the Ethiopian Chapter. The Ethiopian Chapter (EC) is based on membership drawn from about 300 social scientists living in Ethiopia and engaged in teaching and/or research. One of the objectives of OSSREA Main is generating and disseminating knowledge in social sciences as well as promoting dialogue and interaction between social scientists and policy makers in the region with a view of enhancing the impact of social science research on policy making and development planning. In the light of this, the EC, in collaboration with and sponsored by OSSREA Main, held this workshop on Thursday, July 2, 2015 at Ras Amba Hotel, Addis Ababa, Ethiopia. The theme of the workshop was "*Evidence Based Policy and Practice for Agriculture and Rural Development: the Role of Research in Achieving Middle Income Status in Ethiopia by 2025."*

The intent was to pool research outputs that could possibly contribute and could be sources of policies that are geared towards the attainment of rural development and, thus, boost the country's effort to reach middle-income status by 2025. To this effect, five sub-themes: *agricultural production and productivity*, *natural resource management and utilization*, *food security and disaster prevention and preparedness*, *private sector participation and rural employment*, and social and *physical infrastructure in the rural setting that facilitate development and hence attainment of food security* were selected. In response to the call for abstracts, the OSSREA- EC received eleven abstracts of which ten were accepted with comments from the reviewers. The authors of the selected abstracts were then communicated to submit their final papers for the workshop. Out of the submitted ten papers, based on reviewers rigorous assessment results, only seven were selected for the workshop. Most of the selected manuscripts go with the main theme and have policy implications to issues of food security, land and agricultural product markets, and land resource management.

The work shop was attended by about sixty- four participants drawn from diverse social sciences

and humanities disciplines such as geography, sociology, social anthropology, psychology, linguistics, literature, history, political science, law, and human rights. The attendants of the workshop were university professors, Ph. D candidates and undergraduate students.

The Liaison Officer of the OSSREA -EC, Dr. Muluneh Woldetsadik Abshare, after giving a brief opening remark on the objective of organizing the workshop, introduced the program. He thanked members of the Liaison Committee (LC) of the Chapter for their unreserved efforts for the workshop to succeed. He also recognized and thanked OSSREA Main for its financial and other technical supports. Finally, after welcoming the presenters, distinguished guests and participants to the workshop, he invited Professor Herman Musahara, the Acting Executive Director of OSSREA Main, to make an opening remark.

Prof. Herman Musahara, on behalf of himself and OSSREA Main, gave thanks to OSSREA-EC for inviting him to address the workshop. Then, he gave a briefing about the nature of the workshop and said that it is one among the eight arranged in the region. In his opening remark, Prof. Herman emphasized on the importance of policy workshops saying that, they are the most recent and probably most influential flagship activities of OSSREA these days. He further noted that, the purpose of such a workshop should no longer be a question getting papers published for promotion or else only, but it should rather be geared more towards creating an interface and impact on socio-economic development issues. Prof. Herman expressed his deep appreciation saying that the workshop themes and topics on land matters are down to earth and relevant to all member countries today. Finally, he said that, as a result of geographic proximity, the OSSREA Secretariat and the Ethiopian Chapter have to work strongly together for the benefit of the entire network. He also brought to the attention of the workshop participants that OSSREA is undergoing a transition whereby the dependency on traditional donors has to be reduced and finally discontinued. To this effect, OSSREA Main is in the process of preparing the 2015-2020 Strategic Plan. He concluded his opening remark by reminding the participants that their contributions in this regard are very important as the Ethiopian Chapter knows more of the Strengths, Weaknesses, Opportunities and Threats than any other member country.

The seven papers presented at the one-day Policy Dialogue Workshop are summarized and presented as follow.

During the first session of the workshop, two papers were presented. The first presentation was made by Mr Moges Woyessa, a PhD Candidate at the Department of Sociology, AAU. The topic of his presentation was***Land Deals for Commercial Farming in Metekel Zone of Benishangul-Gumuz Region in Ethiopia: It's Implication on Local Communities.*** The presenter has identified a site, Metekel zone, where there is a large concentration of investors on commercial farms and where there is a big debate on how well the investors are doing their farming business and how they are welcomed by the local community.

The findings of the survey showed low or no participation of the local community in the land deals made between the government and the investors; there are low benefits gained from the investment process, even in creating job opportunities for the local community; services such as schools, health facilities, roads, etc. are not made available to the community; and there are accentuated competitions between workers of the commercial farms and the local community on some naturally available resources like water and others, which has instigated conflict between investors and the local community found in areas adjacent to commercial farms.

The presenter's reflections on some of the questions raised by the participants are as follow. Related to the cultural integration of investors' activities with the local community, the presenter noted that, naturally exposure to different cultures is advantageous especially for localities like those in Metkel area which are still dominated by traditional and backward cultural and farming practices. Related to the question, "Couldn't the investors have done more ...?", the presenter completely agreed that the investors should share part of their profit from the land with the community so that their investment in the area would be more secure, be more profitable and sustainable. The other reflection made was related to the question of land grabbing. The presenter said that, at the moment, there is no land grabbing taking place in the area. He even gave his own witness that some of the investors in the area haven't used much of the land allocated/transferred to them yet. Due to financial problems, prevalence of unproductiveness is very apparent for many of the investors. Indeed, the process of land transfer to the investors was made by the regional and the federal governments, which were over ambitious, without any financial/capacity assessment of the investors. About 77 percent of the land transfer in the area was made without having legal license of commercial farming business. In response to a que

forced displacement of members of the local community?, the presenter confirmed that there is no shortage of land in the area to displace members of local community.

The second presenter was Wondye Admasu, A PhD Candidate in Geography and Environmental Studies, AAU. The topic of his presentation was ***Apiculture Value Chain and Its Implications for Local Economic Development: A case from KilteAwlaelo District, Tigray Regional State.*** He reflected on apiculture, honey bee keeping, which is a potential farming business especially for areas deforested or degraded but potentially recoverable through area closure and soil and water conservation practices, and for localities with high landlessness problems. He convened the presentation on apiculture and its value chain importance as a business that ensures no land degradation and that which sustainsthe livelihood of the rural community, especially those landless people in the rural areas. Quoting the presenter, the moderator concluded the presentation as it is a business to be adopted not only to sustain livelihood in rural areas but also potentially to be a rich person. The moderator summarized the presentation by saying that the study can play a very important role in job creation in rural areas, especially for those landless farmers.

One of the questions posed was “Is the apiculture practice in Tigray Region adaptable or not in the other regions of Ethiopia?” The presenter’s response was 'yes, it is possible’.He also added that, the Amhara and southern regions have already asked trainingsto be given for their bee keeping technicians. The scaling up of experiences of Tigray region on apiculture to other regions, however, would not be achieved easily due to the prevailing problems of honey production, packing and selling spanning from the farmer level, through processor level to the retailer level and due to the presence of shortage of bee technicians, and the rise of the cost of bee keeping inputs like beehives and bee colonies.

The third presenter was Mr. Guyu Ferede, a Ph.D. candidate at the Department of Geography and Environmental Studies, AAU. The topic of his presentation was ***Wild Edible Foods in the Green Famine Belt of Ethiopia: Do They Contribute to Household Resilience to Seasonal Food Insecurity?*** He showed that, during the survey year, every household collected about 1.57qtl, which accounted for about 4.7% of the gross food obtained from all sources and 9.1% of net food available. They also earned an income of about 5885.00 birr from sale o

the households (47.7% indigenous and 17.7% non-indigenous) reported their dependence on WEFs as compared to 34.5% (7.3% indigenous and 27.2% non- indigenous) households who reported that they either didn't or depended little on WEFs. Wild vegetables were the most collected constituting 52.4% of the total WEFs obtained followed by fruits (11.6%), roots (10.4%), meat (7.7%), mushrooms (5.9%), fish (5.6%), bamboo shoot (3.6%), and honey (2.8%). Key informant information also shows the medicinal value of WEFs. The moderator summarized the presentation by saying that,wild edible food contributes to food security especially for those indigenous and/or vulnerable groups of the community in the western green belt area of Ethiopia. To a question,"*Have you considered the five components of food security*?",the presenter responded that he had already looked into all the components of food insecurity in his entire PhD study. In fact, he was given a recommendation to include a short summary on the presence of food insecurity in terms of all the five components of food insecurity.

The fourth presenter, Mr. Daniel Eba is a Ph.D. candidate at the College of Development Studies, AAU. His presentation title was ***Land use-cover Change Implication on Rural Livelihoods: the case study of Odo-shakiso forest,Oromia, southern Ethiopia***. The presenter tried to classify wellbeing in the area covered in his study into four quartiles and identified proximal variables of the long- term land use and land cover dynamics affecting rural livelihood in the study area and tried to estimate the magnitude and direction of the effects of these factors (unreliability of rainfall occurrence, livestock quantity and productivity decline, drought frequency rise and increase of flooding extents) on the livelihood of the community categorized in different wellbeing indices. It was commented that the presentation lacks information on the land use and land cover dynamics and, therefore, should include a brief summary including the methodology he adopted and the result of the land use and land cover dynamics he has carried out in the area.

The fifth presenter was BerhaneMulugeta, a Ph.D. candidate at the Department of Geography and Environmental Studies, AAU. The title of the presentation was ***Vulnerability and Resilience in the Context of Climate Change and Disaster Risk Prevention: Rural Household Food Security in North-Eastern Gurageland, Ethiopia.*** The presenter investigated factors that determine the status of rural households food insecurity in the face of climate change, and coping strategies that households adopted to enhance their resilience in this challenging environment and the issues of safety net program (PSNP) in North-eastern Gurageland, Ethiopia. The

result of the respondent households showed that about 58% were food insecure; hence, they are more negatively viable to shocks of climate change. Kola agro-ecological areas were the most food insecure zones in the study district. Socio-economic factors such as landholding size, annual income, possession of livestock and level of fertilizer application, drought occurrence, low household size, gender,owning oxen and farm system were found critical to agriculture and food security.

The sixth presenter was Daniel Ebba Gurmu, a Ph.D. candidate at CDS, AAU. His topic of presentation was ***Land use/cover Change and its Implications on Soil Organic Carbon and Emission Reduction: the Case of Odo-Shakiso Forest***. The researcher examined the extents of forest land use /cover change implications on soil carbon dynamics and CO_2 emission reduction from the atmosphere. The 1973 agricultural lands have lesser amount of carbon sequestration in ton/ hectare than the latter converted forest areas to agricultural land and forest covered soils. The sequestration potentials of soil organic carbon and CO_2 have also shown differences across soil depth and altitude. Since the result reveals carbon stock increases with an increase of vegetative and/or forest covers, ignite focus on potential soil carbon sinks and marks an important shift on the discussion of global warming, which has heavily focused on curbing emissions of fossil fuels. Thus, soil carbon sequestration needs to be part of the global picture and with urgent needs of restoring degraded and eroded lands, as well as avoiding deforestation, which are major reservoirs and gateways for increasing carbon sequestrations.

The seventh, indeed, the last presenter, was Mr Arragaw Alemayehu. His topic of presentation was ***GIS Based Land Suitability Evaluation for Barley and Maize: The Case of Enemay Woreda, Northwest Ethiopia.*** In his work, he examined land suitability for rain-fed barely and maize using GIS. Land suitability evaluation for barely and maize were done using the Maximum Limitation Approach. Reclassification and overlay analysis were made to determine the overall suitability class of the area upon the three sets of attributes. After the land had been evaluated, land suitability maps were prepared for the respective crops. Hence, more than 86% of the land falls under moderately suitable (S2) class for barely, and nearly 83% of the land was marginally suitable (S3) class for maize. To the question,*'Why were only barley and maize considered?*',the presenter replied that farmers have ample knowledge and experience about their surroundings. For instance, maize is a long cycle crop and due to variability of rainfall,

less interested to grow Maize in the study area. However, farmers may not notice minor changes and usually associate changes with the works of God.

The workshop came to an end by a closing remark made by Dr Workneh Nigatu, AAU Vice President for Institutional Development and LC member of OSSREA-EC. In his remark, the Vice-president underlined the importance of research in Agriculture and rural development in achieving Ethiopia's target of attaining middle income level by 2025. This is one of the important efforts of Ethiopian Chapter of OSSREA to promote research for development and academic discussions, particularly in the area of agricultural and rural development. Findings from such researches shall inform policy makers and development planners to design appropriate and effective policies and development interventions in the areas of land use change, food security and rural livelihood improvements.

Finally, the Vice President thanked OSSREA Main for funding the conference and the Ethiopia Chapter Liaison Committee members and all others involved in the organization and successful implementation of the workshop. With this remark, he declared the conference closed at about 4:00 p.m., July 2, 2015.

Opening Speech
by

Professor Herman Musahara, Acting Executive Director of OSSREA Main on National Policy Dialogue Workshop of the Ethiopian Chapter

The Liaison Officer Ethiopian Chapter, Dr. Muluneh W. Abshare

Members of OSSREA Ethiopian Chapter , and all protocols observed

I feel honored for coming to open this workshop, but, at times, I feel well at ease because it is a workshop among colleagues and members of the OSSREA family. I, therefore, will actually be semi-formal and talk about OSSREA issues besides being a Guest of Honor.

Firstly, let me introduce myself. I am Prof. Herman Musahara. Formerly, I was with the University of Rwanda. Before joining OSSREA last year, I was Acting Vice Rector of Academics at the National University of Rwanda. But as of 2005, for two terms, I was a Liaison Officer of OSSREA Chapter of Rwanda, and in 2010, I was a member of the Executive Committee. I travelled to different OSSREA events and had met some of you. I have had good relations with Ethiopian Chapter and, I think, this will continue.

Secondly, I want to talk about the nature of the workshop you are holding now. It is one among 8 national workshops organized with the support of DANIDA. Since we had to conclude the DANIDA activities by 31st of July, the workshop had to be held as soon as possible and I am glad the Ethiopian Chapter has managed to hold it before the end of the month. Other DANIDA supported projects involve 4 book projects, a Thesis publications and drawing a Strategic Plan for 2016-2020.

Thirdly, I want to talk about the importance of policy workshops. They are the most recent and probably the most influential flagship activities of OSSREA these days. They are important because they make use of knowledge harvest and policy recommendations to engage different actors and players in our countries. Due to such workshops, impacts on pc

values of social science research can be appreciated. It is no longer a question of holding a workshop and getting papers published for promotion only. An interface and impact on socio economic development issues has to be created. I thank you and appreciate that your topic on land matters is down to earth and relevant in our countries today.

Now, I want to talk about OSSREA and your chapter. You know OSSREA is 35 years old and was started here in Ethiopia, at Nazareth. The Ethiopian Chapter is important to OSSREA by the proximity and its role over the years. Ethiopian has, by constitution, to produce a Resident Vice President. Ethiopian Chapter has this role of sustaining the entire network. This position has to be used and consolidated. It's my belief and I have made no secret about this that OSSREA Secretariat and Chapter have to work strongly together for the benefit of the entire network. OSSREA is undergoing a transition whereby the dependency on traditional donors has to be reduced and finally discontinued. This is not from our own volition. It's also changing donor priorities all over the region. We have to go above some misunderstandings and work for continued existence of OSSREA.

Finally, I would like to mention that we are drawing a Strategic Plan. The Liaison Officer has circulated a form for SWOT Analysis. I will request that we depend on the Chapter mostly for this analysis as there has been limited return from other chapters. I am sure the Ethiopian Chapter knows more of the Strengths, Weaknesses, Opportunities and Threats than any other.

With these few words I declare the workshop open

July 2, 2015.

Papers Presented in the Workshop

Paper One: *Land Deals for Commercial Farming in Metekel Zone of Benishangul-Gumuz Region in Ethiopia: It's Implications on Local Communities*

By

Moges Woyessa

Abstract

The article examines the implication of the growing commercial agricultural investments on the local communities in Dangur and Guba Woredas of Metekel Zone in Benishanguel-Gumuz region. Specifically, the article highlights land deals and community participation in the process, assesses the type of investors as well as the nature of land made available and transferred for commercial farming. Finally, it explores the positive and negative impacts of commercial farming on the local communities. The article draws on qualitative and quantitative data primarily gathered through researcher's own fieldwork on top of secondary materials reviewed. The qualitative information is gathered through a survey of farming household heads; whereas, to collect the qualitative data, focus group discussion, key informant interview and observation were made. Focus group discussion was made with households composed of both sexes; and key informants were selected from among the community members, investors, and government officials at all levels. The findings show that all investors in the two woredas under study acquired land either from the federal or regional government. No land deals were made between investors and local community members. There are three types of investors in Metekel zone: domestic, disporic, and foreign, of which, domestic investors take the largest share. The type of land transferred for commercial farming is mainly woodland covered with dense bamboo trees and other tree species. Generally, the level of participation of local communities was, by and large, very low and meant solely for media consumption. Currently, land deals are made at both the regional and federal levels, community participation was sought only at the initial stage of land identification to put in the so-called "land bank". The finding shows that the government has pervasive power in land deals. Commercial farming has some contributions to local communities, though limited, such as employment opportunity, expansion of income generating activities around commercial farms, and provision of some basic social services such as school meals and transportation services. Besides, the commencement of commercial farms has also brought some form of socio-cultural integration and exchange among local communities and workers. However, compared with their number, the commercial farms' contributions to the host community in the study area are not significant. There are no corporate social responsibility packages put in place, and social services were given based on the interest and goodwill of individual investors. The services provided to community members by investors were offered in an unorganized and irregular manner. The main negative impacts of commercial farming identified are (i) conflicts due to boundary issues and straying of livestock into investor's farmlands, prohibition of former passages, disagreement over request for identification (ID) cards, and some unlawful acts committed by workers, such as theft of small ruminates and beehives; (ii) use of communal water points by investors; (iii) unseasonal [illegible] to communities' livelihood activities.

1. Introduction

1.1 Background of the Study

The Ethiopian government has been following the Agricultural Development Lead Industrialization (ADLI) strategy since 1991. In the past two to three decades, Ethiopia has been transferring land to investors for commercial farming to promote agricultural transformation and to increase the productivity of agriculture in the country. To this end, the government has developed policy and different poverty reduction strategies such as the Sustainable Development and Poverty Reduction Program (SDPRP) in 2002, the Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) in 2006, and the Growth and Transformation Plan (GTP) in 2010 that are in line with its ADLI strategy. Now, the country is designing GTP-II which is not yet finalized.

The government has clearly emphasized that for agriculture to continue to serve as an engine of growth for the domestic economy and as a crucial component of the export sector, it has to make substantial strides in terms of commercialization, particularly in the marginal lands, with more intensive farming enhancing the proportion of marketable surplus and providing raw materials for industries (MoFED, 2006). Accordingly, the economy has opened up for a wider and more active involvement of the private investors in commercial farming. Hence, recently, the Ethiopian government has made available, in the federal land bank, over 3.5 million hectares of land (both leased and awaiting lease decisions) to investors keen to develop large scale commercial farms (Dessalegn, 2011). As a result, investors have made an influx into every region of the country to invest in agriculture, particularly to the western lowlands of Ethiopia such as the *Benishangul-Gumuz* Regional State (hereafter BGRS) and *Gambella* as a result of the investment opportunities created by both the Federal and Regional Governments.

The reason for conducting this study on commercial farming in Metekel Zone of BGRS is that extensive development of commercial farming is a recent phenomenon and, until now, there are no detailed and sound studies done to investigate the implication of land transfer to commercial farming on the local communities in the region in general and Metekel Zone, in particular. The Oakland Institute (a think-tank organization), conducted a study on commercial agricultural land investments in 2011 entitled, "*Understanding Land Investment Deals in Africa, Country Report: Ethiopia.*" The study was carried out in three regions of Ethiopia, namely *Gambella*, *Benishanguel-Gumuz*, and *Oromia*. The study's main goal was to give a general country-wide assessment of land investment: where, how, and why it is happening, and discussed the social, environmental, economic, and food security impacts of land investment. The report was summarized at the national level and could not demonstrate the specific contexts in each of the three regions.

Besides, there are debates among scholars on the contribution of large scale commercial farming to nations in general and local population in particular. Some scholars, including most government officials, prefer and support commercial farming as a means to boost economic development and to benefit the local communities. Those with this view argue that large scale investments in agriculture are a means of attaining robust economic growth and, thus, benefit the local communities. For instance, Fan and Breisinger (2011) argued that investment in agriculture is one of the most effective instruments for achieving economic growth and a means of poverty alienation because commercial farming has the role of promoting overall development. They further contend that "… the role of agriculture is increasingly seen in a broader context, particularly as it relates to improving the nutrition and health status of poor people, providing new economic opportunities, and building resilience to conflict, land and environmental degradation, and climate change risks" (Fan and Breisinger, 2011:1).

However, to the contrary, those who argue against this optimistic view of large scale commercial farming claim that such farming leads to land acquisition. This acquisition of land by investors in poor and vulnerable countries poses a threat to their economies and livelihoods and endangers local communities' chances of achieving food security and improved nutrition (Dessalegn, 2011). There are also activists such as environmentalists and Human Rights Watches who act against the development of commercial farming. Their position is that, in addition to taking huge sizes of land, also known as 'land grabbing', commercial farming causes environmental degradation and threatens human rights such as cultural rights of local peoples.

Accepting the first optimistic position, the government (federal and regional) has attracted as many private investors and handed over huge tract of land for commercial farming. The regional government has transferred a total of 258,899.75 hectares[1] of land to investors for commercial farming until 2011/12. The official argument is that investment (both by domestic and foreign investors) could provide key resources for agriculture, including the development of needed infrastructure and expansion of livelihood options like employment opportunities for local people (MoFED, 2006).

Thus, the main concern of this article is to explore the implication of commercial farming on the local communities. The study was carried out in two selected woredas (*Dangur* and *Guba*) of Metekel Zone in the BGRS where, recently, a number of commercial farming has developed to cultivate what are referred to as 'marginal' unused and open lands to boost the economy of the country and attain food self sufficiency.

1.2 Objectives of the Study

1.2.1 General Objective

[1] Obtained from regional Environmental Protection, Land Administration and use bureau

The overall objective of this research was examining the implication of land deals for commercial farming focusing mainly on its implication on, and participation of, the local communities in *Dangur* and *Guba woredas* of Metekel Zone in the BGRS.

1.2.2 Specific objectives

The specific objectives the study are:

1. To examine the process of commercial farming land deals;
2. To explore the type of land made available and transferred to commercial farming;
3. To assess the positive and negative consequences of commercial farming on the locales;

1.3 Research Methods

1.3.1 Study Area

This study was conducted in *Dangur* and *Guba woredas* of Metekel Zone in the BGRS. The BGRS is one of the nine Federal States recognized in the Constitution of Ethiopia, following the decentralization process which established the Federal Democratic Republic of Ethiopia (FDRE). The region has three Zones, and Metekel Zone is one of them located in the northwest part of Ethiopia, about 550 kilometers away from Addis Ababa. In terms of geographical coverage, the Zone is the largest of the zones in the region, and it constitutes 53 percent of the total area of the region. It has about 10 persons per square kilometer (BGRS Investment Office, 2011/12) and an estimated area of 22,028 kilometer square sharing boarders with north *Gonder* Zone of Amhara region in the north, *Kemash* Zone of BGRS in the south, *Awi* Zone of Amhara region and east *Wollega* Zone of *Oromia* region in the east, and *Assosa* Zone and Sudan in the west (MZARDD, 2012) (See the map of the study area *Annex 1*).

There are three types of weather conditions in Metekel Zone: "*Kola*" (lowland), "*Dega*," (highland) and "*Woyina Dega*" (intermediate zone). Most areas of the Zone are hot lowlands (*Kola*). The area has mostly plain and terrain landscape with its altitude ranging from 600 to 2731 meters above sea level. The highest peak of the Zone (2,731 meters above sea level) is called *Belaya* Mountain (BGRSIO, 2004). The annual rain fall of the Zone ranges between 1,000 and 1,450 mm. The Zone has immense natural resources, the main ones being gold and marble. It has also all year round rivers such as *Beles* River, etc., which are suitable for irrigation. There are big forests, variety of wild animals, and dense and scattered bamboo trees found in the Zone (MZARDD, 2012).

Administratively, Metekel Zone has seven *woreda*s, namely *Debate, Bulen, Wombera, Dangur*, *Guba*, *Pawi*, and *Mandura*. Each *woreda* is further subdivided into administrative *kebele*s and *Gotts* (sub-*kebeles*). Metekel Zone is inhabited by indigenous communities and settlers (Gebere, 2001). The two dominant indigenous ethnic groups in the Zone are *Gu* and *Bera shinasha* that have a historic relationship to each other (Tsegaw, 2005). According t

Zone has a total population of 276,367, of which males and females account for 50.3 and 49.7 percent, respectively. There are five ethnic groups in Metekel Zone: *Gumuz* (36.77 percent), *Boro-shinasha* (21.6 percent), Amhara (17.38 percent), *Agew* (11.34 percent), and Oromo (11.09 percent). Other ethnic groups such as *Berta*, *Guragie*, *Nao*, etc, account for the remaining 1.86 percent. Although all these ethnic groups are found in Metekel, *Guba* is mainly dominated by the *Gumuz;* whereas, *Gumuz*, *Boro-shinasha*, and *Agew* ethnic groups are the biggest in *Dangur woreda*.

Farming is the main stay of the local communities in the study area. The majority of the economically active working population was involved in the agricultural sector including hunting, forestry, and fishing. For instance, in the region, only 0.5 percent was engaged in the industrial sector, and some 0.7 percent in the service sector (Facts about BGRS, 2007). The majority of the local communities are shifting cultivators. The BRGSIO document states "the indigenous ethnic groups of the region dominantly undertake shifting cultivation and hoe culture" (BGRSIO, 2004). The *Gumuz* are the most dominant ethnic group involved in shifting cultivation. They practice shifting cultivation using traditional tools. For instance, among the *Gumuz* ethnic group in *Guba*, "only 16 percent of the farmers do animal pooled plowing" (World Vision Ethiopia, nd: 38). Even if shifting cultivation was common among the ethnic groups under study, this does not at all mean that sedentary farming was totally lacking. Some local ethnic groups, like the *Boro-shinasha*, are sedentary farmers and they commonly use oxen for plowing.

Livestock rearing is the second mainstay of the local people in Metekel Zone. The region's livestock resources were estimated to be 0.4 million (BGRSCBCB, 2009). In the survey of farming household heads, respondents were asked whether they own livestock as part of their livelihood activities. The survey shows that of 340 respondents, more than half (55 percent) keep livestock in addition to farming. As a follow up question, those respondents who own livestock (187 household heads) were asked to indicate the number of livestock they possess. The average number of livestock reported was 14.3 per household head. In the study area, livestock was the second main means of livelihood and most households depend on livestock for their subsistence.

People's livelihood in Metekel Zone, besides farming and livestock rearing, was dependent on hunting of wild animals and gathering of wild fruits, tubers, and leaves. Bee keeping is another livelihood activity practiced by most local people. For instance, in *Guba woreda,* 48 percent of *Gumuz* people practice beekeeping and are involved in bee harvesting (World Vision Ethiopia, n.d). There are farmers involved in other economic activities to supplement their income such as traditional gold mining, fishing, handcraft, petty trade, selling of bamboo trees and firewood and sharecropping (Wolde-selassie, 2000; Gebere, 2001).

1.3.2 Study Design and Approach

The research employed a cross-sectional study design. For the purpose of the study, primary data was gathered through a methodological triangulation: both qualita approaches were used. Secondary sources were also thoroughly exam

support the data gathered through the primary methods of enquiry. Works of other scholars such as books, journal articles, bulletins, reports (both published and unpublished), etc, were consulted and examined in order to verify and strengthen the first hand data obtained through fieldwork.

1.3.3 Methods of Data Collection

Data were gathered using basically four data collection methods. As a quantitative tool, (1) survey was employed to collect qualitative data; (2) key informant interview, (3) focus group discussion (FGD), and (4) observation were used.

A. Survey Method

In the study, survey was employed to collect data from farming household heads residing in the study area. To undertake the survey, enumerators were recruited from agricultural development workers (DAs) and elementary school teachers located in and nearby each *kebele*. Before they were dispatched to collect data, they were given assistive clarification about each question and sufficiently oriented how to complete the questionnaires. Enumerators filled out questionnaires under the strict supervision of the researcher in the field.

To select respondents among farming household heads, probability sampling technique was used. Among the probability sampling techniques, simple random sampling was used to pick household heads for inclusion in the survey. List of household heads was acquired from *Kebele* Administration Offices that was used as sampling frame from which samples were selected for inclusion.

Survey questionnaire was designed to be completed by farming household heads. Household heads in five *kebele*s were used as the population for the survey from whom the samples were selected. The five *kebeles* (*Jimitia*, *Bengez*, and *Kota kebele*s in *Dangur woreda*; and *Abla Horus* and *Aysid kebele*s in *Guba woreda* were selected; see *Annex 2*) have a total of 1022 household heads of which 343 household heads (accounting for about 34 percent) were selected to complete the survey questionnaires. Among the completed questionnaires, three were abandoned because of incomplete information and misplacement by enumerators. Thus, for this study, a total of 340 questionnaires were returned and analyzed.

B. Key Informant Interview

It was the second method used to collect first-hand information for the research. It enabled the researcher to understand participants' views, perceptions, and attitudes in detail regarding commercial farming. A total of 48 key informants (21 government officials, 12 community elders, 5 investors/ farm managers, and 10 workers) were interviewed. All informants were selected using purposive sampling. Government key informants were selected from federal, regional, zonal, and *woreda* levels. They represented the Environmental Protection, Land Administration, and Use Bureau and Offices at all levels, the Investment Office at the regional level, and the Agriculture and Rural Development Bureau and Offices at experts from the MoA as well as Zonal and *Woreda* Administrators were

least, *Kebele* Chairmen were also consulted on some issues that required further explanation. A tape recorder was used for recording all the relevant information intact.

C. Focus Group Discussion (FGD)

In this study, a total of five FGD'S (one FGD per kebele) were held mainly with household heads. With the household heads, a total of five FGDs (one FGD per *kebele*) were held. Participants of FGDs were from both sex categories, i.e., both male and female, and were purposively selected to take part in the discussion. Their ages range from 25–60 years. To streamline the discussion process, guidelines were developed and used. In addition, a tape recorder was used to record all points raised in the discussion and were later transcribed during the data analysis and interpretation.

D. Field Observation

Observation technique involves watching and recording events and activities in their particular settings. During the fieldwork, the evident activities carried out for the sake of the communities, such as constructed basic social- service- provision- facilities, were noted. During the field work, the physical structure of the area, people's livelihood activities, the production and the camp situation of investors were observed. To aid observation, checklists were prepared and used. Moreover, photo camera was used to capture the things observed.

1.3.4 Data Analysis

Data gathered through survey, key informant interview, FGD and observation were processed using two techniques. Quantitative data was entered and analyzed using statistical software called Statistical Package for Social Sciences (SPSS), whereas qualitative data was analyzed manually using pattern matching. The outputs of SPSS were analyzed and presented using descriptive statistics such as frequency distribution tables, percentages, and averages. The data on tape record was transcribed and sorted into relevant themes based on the objectives of the study.

1.3.5 Study Period

The data for this study was collected between January 2013 and June 2013 in two rounds. During the first round fieldwork stay, until 30th of April 2013, FGD and in-depth key informant interviews were conducted; the farming household head survey questionnaire was administered and collected; and observation at the zonal, *woreda* and *kebele* levels was made. The second round data collection was started on 10th of May 2013. In the same manner during this period, key informant interviews at regional and federal levels were conducted. On 30th of June 2013, data collection was completed.

2. Review of Related Literature

2.1 Conceptual Framework Employed

This review of related literature part presents some principles (and as other authors call it code of conducts) that land deals for commercial farming must fulfill to be responsive investment. Among these principles is 'community consultation and participation of all stakeholders' and 'the rule of benefit sharing' to the locales (von Braun and Meinzen-Dick, 2009; Deininger et al., 2011). Both group of authors underscored that there should be participation of local communities who will bear the impact of commercial farms and affected by the land deals.

Commercial farming, to be socially sustainable and reduce the externalities on the local communities, needs to have benefit packages to be accrued to the local communities, and all stakeholders need to be consulted. Authors indicated that land deals for large scale commercial farming need to be beneficial to local community members and should create a desirable amount of social benefits. Farms can benefit local communities in different ways like use of institutional arrangements such as land rental, contract farming, and out-grower schemes (Deininger et al., 2011). This could capitalize the opportunities for smallholders to benefit creating a win-win scenario for both local communities and investors (von Braun and Meinzen-Dick, 2009).

2.2 Overview of Commercial Farming Development in Ethiopia

Literature reviewed shows that commercial farming in Ethiopia was started during the Imperial period, in the early 1950s. During this period, its expansion started in Awash Valley, the largest commercial farm being the Wonji Sugar Estate (Dejene, 1994). Following this, in the 1960s, rapid expansion that encouraged economic development took place in the same valley (Dessalegn, 2009). To lower the dependency of the country on small scale agriculture and enhance the development of the agricultural sector, the Imperial government had formulated different polices, strategies and plans that targeted the expansion of commercial farming as one strategy since 1957. The first agricultural policy that promoted commercial agriculture was enacted in 1957 (the *First Five Year Plan* that lasted from 1957–1962). The Imperial government had also designed two consecutive strategies to accelerate the development of the agricultural sector, the *Second Five Year Plan* (1963-67), and the *Third Five Year Plan* (1969 – 1973).

Kassahun (2012) argued that the first two five-year plans (the 1957–1962 and 1962–1967 plans) heavily favored large scale commercial farms for augmenting agricultural production for export, aimed at generating foreign currency. This was because, according to Kassahun (2012:4), "increase in production was expected to be achieved through accelerated investment in large scale farms in accordance with the dominant line of thinking of the Imperial government" at the time. However, the *Third Five Year Program* gave due emphasis to smallholder agriculture through the allocation of financial and human

2012; Derese, 2003). Commercialization of the agricultural sector was at the center of these three development plans (though the *Third Five- Year Plan* had focused more on smallholder farmers) and strategies of the Imperial government. In the 1960s and 1970s, big commercial farms were spread in high potential areas of the country such as in the Rift Valley and *Humera* areas (including the *Awash* Valley) to produce crops for export (Dessalegn, 2009). Yeraswork (2000) also indicated that commercial agriculture replaced the absentee bourgeoisie in the 1960s and 70s. He stated that "in the late 1960s and the early1970s , commercial farming began to gradually replace absentee landlordism in parts of the country where land has been privatized, causing eviction of farmers and helping to intensify the call for 'land to the tiller'" (Yeraswork, 2000: 100).

The development of commercial farming during this period was mainly donor initiated. Initially, the major donor agencies were the World Bank, SIDA, etc, and they were "quite enthusiastic about the prospect of commercial enterprises both as a source of foreign earnings and catalyst for the modernization of agriculture" (Sharp et al., 2007:47). However, towards the end of the 1970s donor agencies themselves criticized large scale commercial farming because of its inefficiency and proposed modernization of smallholders to enhance productivity of the majority of farmers in the country. Guided by outward oriented agricultural policies, the Imperial regime expanded commercial agriculture to earn hard foreign currencies. Sharp et al. (2007:47) stated:

> *Investors were supported by government policy which emphasized agricultural mechanization to improve productivity, by offering tax and financial incentives to investors. The government itself was also involved in such mechanized enterprises and was the largest commercial operator at the end of the 1960s.*

In essence, during the Imperial period, agricultural polices targeted the expansion of commercial farms mainly producing food and nonfood crops for export. The policy aimed not to enhance the productivity of the smallholders through the provision of inputs to the farmers; instead, it was meant to raise agricultural production through the development of commercial farms (Sharp et al., 2007; Dessalegn, 2009). Dessaglegn (2009:84) indicated that around 320,000 hectares of lands were cultivated by commercial farms up to 1975.

After the downfall of the Imperial regime in 1974, socialist policies began to be perused by the *Derg* regime. As a result, in March 1975, a Rural Land Reform Proclamation (Proclamation No. 31/1975) nationalized all communal and privately owned rural lands and put them under the control of the government. Large scale commercial farms were also put under State control. Thus, privately owned commercial farms during this period were nationalized and made mainly under State ownership. In this regard, Gizachew (1994:24) stated that "State farms were established in 1975, initially by nationalization of 67,250 hectares of large scale commercial farms". Further explaining, he indicated that the growth of State farms spanned over 200,000 hectares of land in (Gizachew, 1994).

Following the coming into power of EPRDF in 1991, the Ethiopian economy was liberalized and the free market principle was promoted by the transitional government. Although the EPRDF government gradually abolished the socialist principles such as 'input and financial market' control, the central principle of State ownership of land was retained. Since the coming into power of the transitional government, commercial farming has been encouraged and different legislative measures have been introduced. For instance, the transitional government formulated its investment Proclamation in 1992 as Council of Representatives Proclamation[2] No.15/1992 with an attempt to encourage, expand, and coordinate commercial farming in the country. Then, it promulgated the agricultural investment code[3] of Proclamation No. 120/1993 that clearly specified the requirements from investors who want to invest in agriculture such as expert review of project proposals (evaluation of proposals by the Ministry's experts at the *woreda*, zonal and regional levels within 15 days), proof of land acquisition (which attests the proposed site is free from farmer claims as signed by the *Kebele* Councils), investment certificate (for investors with capital investment exceeding 250,000 birr that guarantees their right to import capital goods indicated in the proposal for duty free) and other licenses such as a trade license to make purchase or sale of farm inputs and their agricultural products in large scale.

The EPRDF designed a policy framework called the ADLI that has guided any development endeavors in the country since 1994. In addition to modernizing peasant agriculture and intensifying yield productivity, one of the strategic pillars of the ADLI was encouraging private agricultural investors in commercial farming. As a policy target, the government had taken some measures related to government owned large scale commercial farms to enhance the productivity of the agricultural sector. Some big State farms were dismantled and handed over to farmers; some were transferred to private investors through lease, and still some were kept under State control for gradual transfer to private investors (Derese, 2006; Atsbaha and Tessema, n.d).

As discussed above, the EPRDF government has formulated rural development and poverty reduction policy and strategies targeting agricultural development. The rural development policy targets large scale commercial farming as one component to attain rural development. The poverty reduction strategy paper (PRSP) including the SDPRP and the PASDEP, generally attracted and promoted foreign and domestic investors in large scale commercial farm, on the so-called 'unused' lands. The main features the PASDEP designed to attain accelerated growth were commercialization of agriculture and accelerating private sector development in agriculture (MoARD, 2006:46). In the GTP, concerning private sector investment in agriculture, a clear

[2] Encouragement, Expansion, and Coordination of Investment Proclamation No. 15/199
[3] License for Agricultural Investment Activities, Council of Ministers Regulation No. 12(

direction was put and about 3.3 million hectare of land was planned to be transferred to investors for commercial farming by the end of the plan period (MoFED, 2010).

2.3 Factors Causing High Demand for Commercial Farmland in BGRS

In the past, for obvious reasons, investors were not interested to invest in BGRS. This was because of the fact that the areas had limited labor supplies, inadequate infrastructure, and were infested with malaria and tsetse fly. As a result, the movement of highland people into these areas was inhibited and the population density was extremely low. Therefore, government officials believed that the kind of agriculture that is suitable cannot be labor intensive, but must instead be intensive mechanized farming that requires considerable outlay of capital for irrigation systems (Makki and Geisler, 2011). But, recently, two major developments (national and international) have changed the situation and a large number of investors are streaming into the so-called 'marginal', 'unused', and 'virgin' lands. The first national factor was the government's Poverty Reduction Strategy Paper (PRSP) which was formulated in 2005. This strategy embraces foreign and domestic investment in large scale commercial farming on the so-called 'unused' lands (MoARD, 2006). The second factor was the expansion of transport infrastructure into the lowland areas following the decentralization process.

The international development that caused the expansion of investors in BGRS (including other regions of Ethiopia) has to do with the changing circumstances of the world's food market and bio-fuel production which has seen an escalation of the prices of food and demand in recent years (Makki, and Geisler, 2011). As a result, there is an accelerated penetration into the country, such as Benishangul-Gumuz and Gambella regions, of many investors to produce commercial agriculture.

2.4 Overview of Commercial Farming in the BGRS

Literature reviewed indicates that commercial farming in BGRS, particularly in Metekel Zone, was started as early as 1950s (Gebere, 2001). However, recorded data obtained from the Regional Investment Office shows traces of the establishment of commercial farms in the region IN 1987 EC (1994/95). Though there was no consensus on the number of commercial farms in the region, data obtained from the Regional EPLAUB report and confirmed by assigned team of experts by the Regional Government shows the presence of 272 investors involved in commercial farming. The graph 2-1 below shows the number of investors entering in the region by year.

Figure 2-1: Number of investors in the region by year

The graph 2-1above indicates the gradual increase in the number of investors in the agricultural sector between the years 1994/95 and 2005/6. However, after 2005/6 there was a sharp increase in the number of investors entering the region, followed by fluctuations after 2007/8. There were a large number of investors in 2007/8 due to the Federal Government's poverty reduction strategy of PASDEP enacted in 2005/6 which lasted for five consecutive years. As a result of the PASDEP, the overwhelming majority of investors (122 investors) entered the region in 2007/8. Of these investors, more than half (54 percent) established their commercial farms in Metekel Zone. In 2008/9, the number of investors coming into the region gradually declined but slightly peaked in 2010/11.

There are three types of investors in Metekel Zone: foreign, Ethiopian Diaspora, and domestic investors. But there is quite a significant difference in the number of these three categories of investors. Among the 138 investors found in the Zone (excluding the 4 investors whose license was cancelled but appealed), there is only one foreign, 2 diasporic, and 135 domestic investors engaged in commercial farming.

3.Results and Discussion

3.1 Commercial Farming Land Deals and Community Participation

3.1.1 Land Deals for Commercial Farming

Generally, in BGRS land deals were made either by the federal or the regional government. The Federal Government was involved in land transfer for commercial farming in 2009/10 (2002 EC) after making general assessment of the effectiveness of commercial farming in all regions of the country. During this time, the MoA identified many problems that deter the productiveness, expansion, and effective implementation of the sector. As a result, Regional Governments were made to hand over certain portions of their agricultural investment lands to the Federal Government to be administered on their behalf. The intention of the Federal Government is to reduce the bureaucracy and the difficulty investors encounter during land transfers, and help them to more easily access land based on full and accurate information about the type and function of land in the country. Thus, the Federal Government's objective is to assist investors to acquire land without too many impediments and commence their investment on schedule, preventing time and resources wastage.

In 2008/9 the BGRS attempted to freeze land transfer to investors owing to many factors that included the felt need for making changes in the system of land deals; in particular the formulation of a new regional land related policy, proclamation, directive, and guidelines to regulate commercial agriculture investments; select capable investors as well as neutralization of investors operating without a license. Besides, there was an increased pressure from different actors mainly from the Federal Government (MoA) that forced the region to restrain land transfers in 2008/9. Moreover, during this period, there were conflicting claims between two regional organizations, namely the Regional Investment Office and the EPLAUB, concerning the mandate for the allocation of land and the management of issues related to commercial agricultural investment land transfer.

However, despite the claim that land transfers were banned in 2008/9, on the basis of the recommendation of the Regional President, land was given to investors thenceforward for investors believed to have the capacity and potential to invest. But, after the enactment of the Regional Rural Land Administration and Use Proclamation No. 85/2010, land transfer on the basis of the approval of the Regional President was totally banned. Only land deals which were in the pipeline ahead of 2010 were completed and, under special conditions, investors who the Investment Board believed could benefit the region, were given land.

As of 2008/9 significant changes in regional land deal was made. Hence, four Regional Rural Land Administration and Use rules and regulations were formulated and introduced. In 2010, *Rural Land Administration and Use Proclamation No. 85/2010* was endorsed. This was followed by *Rural Land Administration and Use Policy* and the *Rural Land Administration and Use Directive No. 44/ 2011* in 2010/11, and in 2012 by the *Rural Land Administration and Use Guidelines*. After the enactment of these new investment legislations and regulations, the rivalry concerning the mandate and power over the management and administration of rural land between EPLAUB and the Investment Office was settled when the same powers were transferred to and now assumed by the Regional EPLAUB. The regional EPLAUB has taken most of the responsibility of regional level commercial farming land deals chiefly to integrate environmental issues with development projects and prevent the transfer of forest land to investors.

Consequently, at the regional level, the *Investment Board* was reorganized and strengthened to control and manage commercial farming land deals having eight member organizations, namely BoFED, Investment Office, EPLAUB, Bureau of Justice, ARDB, Bureau of Revenue, Bureau of Water, Mining, and Energy, and the President's Office. The Board has sole power on issues related to commercial agriculture and any other investments in the region. Composed of regional Bureau Heads who are high level decision makers in the region, it has supreme autonomy.

3.1.2 Community Participation in Land Deals

The study has attempted to assess the extent of local people's participation in land deals. To this end, the farming household heads survey respondents were asked whether they were consulted in order to give their prior informed consent before the commencement of commercial farms in their localities, and the result of the survey is presented in the Table 5-2 below.

Table 3-1: Frequency and percentage distribution of households being pre-informed about the coming of commercial farms in their localities

		Frequency	Percent
Farming households response to 'being pre-informed to get consent before commercial farms were commenced'	Yes	63	18.5
	No	277	81.5
	Total	**340**	**100.0**

Table 3-1 above indicates that, of 340 household head survey respondents, more than four-fifth (81.5 percent) were not consulted to give their pre-informed consent about the transfer of land to investors. Only 18.5 percent indicated that they were informed and gave their consent ahead of time about the transfer of land to investors in their localities. Besides, all farming household survey respondents were asked if they had played any role in land boundary delineation and handing over. Only 8.8 percent indicated that they were involved in boundary delineation and transfer process. However, the overwhelming majority (308 household heads) of respondents accounting for 91.2 percent indicated that they did not play any role in land delineation and handover to investors. This category of respondents (those who did not play any role in boundary setting) were asked whether or not they knew who represented them and carried out land delineation and transfer to investors, and the result of the survey is shown in Table 3-2 here under.

Table 3-2: Frequency and percentage distribution of households as to 'who represented them in land demarcation and transfer'

		Frequency	Percent
Response of farming households as to 'who represented them in land demarcation and transfer'	Government officials	191	62.0
	Community elders	60	19.5
	Members of committee elected by the local population	2	0.6
	Others	55	17.9
Total		**308**	**100**

Table 3-2 above shows that among 308 farming households who indicated that they did not play any role in boundary setting and transfer, more than half of the respondents (191 household heads) that accounts for 62 percent indicated government officials were the ones who delineated and transferred investment lands to investors. Community elders as a group representing the community members in land deals and transfer was reported by 19.5 percent of the respondents. 17.9 percent said that others represented them in boundary delineation and handover. Only two respondents (0.6 percent) indicated that members of the committee elected by the local population have represented them. As a follow up question, to know who has represented them, the 55 farming households survey respondents who said others represented them in boundary delineation and handover were asked to specify who "*others*" were. 91 percent of the 55 respondents reported that they did not know who transferred land to investors. Only a small proportion (9 percent) of them indicated that both community elders and government officials represented them and transferred lands to investors.

Data obtained through qualitative means also confirmed the existence of little and, in some *kebele*s, total absence of participation of the local communities in land deals. In some areas, the local community members took part in the final stage of land deals, that is, during land handing over to investors at the 'induction/ familiarization' ceremony arranged by *woreda* officials and *Kebele* Chairmen. The findings also indicate that the local communities did not directly participate in the land deals. Active participants in land deals are *Kebele* Chairmen, two or three community elders elected by government officials (but not by local community themselves), and *Woreda* and Zone Administrators and experts.

3.2 Types of Land Available for and Transferred to Commercial Farming

Lands made available and transferred to investors are covered with thick natural vegetations mainly by forests, bushes, and bamboo trees. Besides, there is lack of feasibility assessment made regarding the original function and nature of biodiversity within it by the concerned bodies. Investment lands are simply passed on to investors, and investors also do not undertake any kind of assessment concerning the function of the lands and the forests over it. Investors produce crops on the basis of a trial and error method which leads many investors to incur huge losses subsequently forcing them to transfer their lands to a third party or bring to a halt their investment. Regarding the type of lands transferred for commercial farming, discussants and informants indicated that the handed over land to commercial farming is full of vegetation and wild species. This is confirmed by almost all government key informants both at the regional and *woreda* levels.

As a result, in the region, land delineation and hand-over is made in the winter season. Lands are covered with dense forests and bamboo trees during other seasons of the year. In study *woredas,* during the summer season the grass and bushes grow taller than the trees and it becomes impossible to move in. Thus, the area has thick vegetation and shrubs

movement and render land transfer to investors impossible; and land transfer is made after vegetation on it has been burnt in the winter season.

3.3 The Contribution of Commercial Farms to the Local Communities

Basically, the contribution of commercial farming to local communities in the study area is classified as economic and social benefit. The economic benefits that local communities gain from commercial faming are employment opportunities and undertaking income generating activities around commercial farms.

1. Employment Opportunity

As stated in the regional investment policy document, one of the main objectives behind expansion of commercial farms is creation of employment opportunities for citizens residing within and around the investment sites. According to data obtained from the Regional Revenue Authority, of all investment sectors which have created employment opportunities for residents in the region, commercial farming ranks first accounting for 87 percent creating employment for about 29,036 peoples (including temporary and permanent workers) in 2011. In the survey, respondents were asked whether or not any one of their household members was employed in commercial farms in their localities; and the survey result is presented in Table 3-3 below.

Table 3-3: Frequency and percentage distribution of households having family members employed in commercial farms

		Frequency	Percent
Households having members employed in commercial farms	Yes	31	9.1
	No	309	90.9
	Total	**340**	**100.0**

Table 3-3 above reveals that one out of ten sampled farming household has members employed in a commercial farm. As a follow-up question, farming household heads who have members employed in commercial farms were also asked to indicate the number of household members employed in commercial farms.

Table 3-4: Frequency and percentage distribution of the number of family members employed in commercial farms

		Frequency	Percent
Number of family members employed in commercial farms	1	29	93.5
	3	2	6.5
	Total	**31**	**100.0**

Table 3-4 above shows that 29 respondents (93.5 percent) out of 31 respondents whose members of household were employed in commercial farms have only one family

commercial farms in their vicinities. There were only 2 household heads who reported that three of their household members were employed in commercial farms.

Thus, even though there were many people employed in commercial farms as indicated in the regional statistics, the labor participation of local communities was not significant. Hence, the contribution of commercial agriculture in terms of creation of employment opportunities for the local people residing around commercial farms is implicated to be low. Government officials (regional, zonal and *woreda* levels) also confirmed that the employment of the local people (be it professionals or not) is limited mainly due to the absence of investors' interest to hire them. Local officials pointed out that many investors post vacancies and recruit workers from other regions, especially *Sekela* area of *Amhara* Regional State. According to informants, investors often, just for display purpose, post vacancies in the *woredas* town in fear of disappointment of *woreda* officials. Most investors recruit daily laborers and professionals from other nearby regions due to the wrong perception they have of the work culture of the local people.

Interviewed investors also confirmed the observations regarding the low labor participation of locals. But, they indicated that concerning posts which demand professionals, priority is given to educated members of the local communities. Investors also reported that they also employ uneducated local people for weeding and harvesting functions and sometimes, as guards. There are some reasons mentioned by investors for preferring contract workers who come from other areas to the local ones. This is because contract workers brought from other areas have the motivation for earning more money and they do not want to stay for a long time at a single farm. In order to be able to work in other farms and make more money, they complete the job on schedule, and mostly, earlier than the expected date of completion. As a result, the land will be cleared and made ready for farming purpose on time. But the locals delay the preparation of land for farming.

2. Expansion of Income Generating Activities

The locales also earn better income through establishing small business centers like shops and cafeteria around commercial farms. During the fieldwork, a number of cafeterias and small shops established by local people to provide service for farm workers were observed. In addition, local people sale edible food items like '*injera*', and hot and soft drinks like coffee and tea, locally made alcoholic drinks like '*areki*', bake and sell bread, etc, to the workers. They also get income through the sale of small ruminants such as goats to the investors and their workers.
Regarding the social benefits, though not common to all *kebeles*, there are some social benefits members of the local communities are gaining from commercial farms. In the study area, some of the social benefits gained from commercial farms or investors are discussed as follows:

1. Construction of Some Basic Social Service Infrastructures

i) Establishment of Flour Mills

The establishment of flour mills for the sake of both the local communities and workers is evident. In the study area, in some *kebele*s, there were few investors who established and others on the way of opening a flour mill business. Flour mills were established in two *kebele*s, namely *Abla Horus* and *Bengez kebeles*. During fieldwork, it was found out that one flour mill in *Abla Horus kebele* was operating. In addition, one mill was in the process of being installed in *Bengez kebele* as observed in picture 3-1 below.

Photo 3-1: Flour mill on establishment in *Benegez Kebele*

Photo: By the researcher.

Although primarily these mills were established for the sake of the farm itself (commercial agriculture workers), community members use the services at affordable fees. All the same, given the tradition of local people to use traditionally made hand grinding stone, and the absence of other flour mills in the area, particularly for the *Gumuz* community, the flour mills have huge contributions, even though they are built primary for the benefit of the workers. Mills reduce the work burden of the women, who are culturally responsible for grinding grains. Since the women grind grain bending with knees down and moving a stone grinder back and forth, this results in calloused hands and knees, and physical exhaustion that has its own health impact.

ii) Construction of Delivery Rooms

Construction of delivery rooms (including toilet) for the local communities was evident in one of the study *kebeles*. In *Kota kebele,* an Indian investor has built a three room delivery center in the middle of the village to serve the members of local communities free of charge. The delivery rooms, as you can see from picture 3-2 below, are made of bricks and cement. However, these rooms are not functional during the fieldwork because they are not handed to the *kebele* and/ or other responsible government bodies.

Photo 3-2: Delivery rooms and toilet built by S and P Energy Solutic

Photo: By the researcher

iii) Construction of Road Infrastructure

Government officials and investors expressed that roads are constructed by investors in the study area. However, it has to be noted that no investor has built roads primarily in order to overcome the desperate needs of the local communities. Roads were built, first of all, for the sake of the investors themselves to drive and move their cars and harvesting machines safely. Side-by-side, in fact, members of local communities make use of these roads to reach their homes, market centers, and for other social purposes. One of the main gravel roads built by investors, and which could serve as a model, is the one constructed by *S and P Energy Solution Plc* which is about 41 kilometers long. Along the road sides, the local communities have built homes to live. This road has an immense economic value for the local people because it facilitates easy and fast access to market centers assisting the sale of local products and animals on time.

2. Socio-cultural Integration and Exchange between Local Communities and Workers

Social interaction and cultural integration of the local community members with workers from other ethnic groups is one of the positive social impacts of commercial farming. The local communities, particularly the *Gumuz*, have the tradition of living separately inside the bushes in a scattered manner, away from other ethnic and religious groups. In the past, *Gumuz* communities used to dwell in very far and distant areas inside the forests; and one could not easily locate them. It was after traveling for a long distance, for about two or more hours away from the main roads, that they could be traced. As a result, there has been no cultural exchange and interaction which could be the basis for social and mental development.

However, recently, mainly as a result of the development of commercial farms, there is a close relationship and interaction of these isolated ethnic groups with workers coming from different areas and various ethnic backgrounds in Ethiopia. As a result, there is change in local communities' work culture and feeding habits, particularly for those who reside nearby farm sites. Workers also tried to adopt the local culture although a few persons showed indifference. In some *kebeles*, workers move to the villages and they chat and ea

communities; try to speak the local language; drink and have fun together. They respect each others' culture and try to learn local language.

3. Provision of Some Basic Social Services

School meal is provided to children of local communities by *S and P Energy Solution Plc* in *Kota kebele* since 2011/12 in *Kota kebele*. The company provides free lunch to different categories of students such as zero class kids and elementary school students (grades 1–8) including teachers and supporting staffs. There are a total of 347 school meal beneficiaries, of whom 297 are students, 37 are zero grade kids, and 13 are teachers and other staff. The aim of serving school meals to students is to reduce the high dropout and attrition rates of students.

There are also some investors who offer transport services to the locales in some areas. But transport services are given not in planned and coordinated ways, rather spontaneously when investors meet residents on their way. Transportation is available for students traveling to school and returning home, for residents going to and coming back from markets, and government officials travelling to attend urgent meetings. Transport facilities are also there to aid shipment of books and school aid materials, fertilizers and improved seeds for farmers, and the like. Thus, the beneficiaries do not have the right to claim a transport service, but it is given based on the goodwill of investors. However, government officials sometimes formally request investors to offer them vehicles when they urgently need. They make such requests, for instance, to perform communal activities such as transporting teaching aid materials like exercise books, chairs, desks, etc, and transporting patients in critical condition, especially pregnant mothers to hospital. Under such conditions, informants acknowledged that investors cooperate and provide vehicles without resistance.

3.4 Negative Impacts of Commercial Farming on Local Communities

Based on the findings of the study, the negative impacts of commercial farming on local communities could be broadly summarized and presented in two ways: (i) social impacts and (ii) threat to livelihood activities of the people. In the study area, some of adverse social impacts of commercial farming are discussed below.

1. Conflict Between Locales and Investors / Workers

The study result has revealed that commercial farming has brought some sort of conflict between the host local community members and the new actors (investors and workers). The extent of conflict differs in the two *woreda*s under study resulting mainly from differences in settlement patterns. In more densely populated *woreda* of *Dangur*, conflict between the locales and investors/ workers is common. There is frequent complaint from both actors (locales and investors). But in *Guba woreda,* since the population is sparsely populated and the contact between investors/workers and community members is not frequent, there is no significant conflict between the two parties.

In the study area, conflict is not characterized by physical violence but mainly disagreement of ideas which are often verbally expressed. However, in *Kota kebele* of *Dangur*, back in 2012 there was one serious incident that caused an individual member of the local communities to react violently and gun shooting at the investor and his workers. The case was settled with the involvement of the *woreda* administration shortly afterwards. Even though the causes of conflict vary from one *kebele* to another, generally, in the study area, the common causes are intrusion of local communities and their livestock into investor's farmlands, prohibition of former passages, disagreement over request for identification (ID) cards, and occurrence of some unlawful acts such as theft of small ruminates and beehives.

2. Use of Community Water Points

In the *kebeles* under study, the government has constructed hand dug-wells for the local communities. However, in some *kebele*s, investors have been using communities' water supplies for their workers on continuous bases. In two *kebele*s, namely *Bengez* and *Kota kebele*s of *Dangur woreda* investors use communities' hand-dug wells. The crucial point is not the use of water points, rather the time community members are forced to spend queuing and waiting for their turn in agony. An investor fetches about 20 – 35 jerrycans a day; and a single Jerrycan holds about ten litters of water. Investors do not allow community members to fetch water until they complete fetching all of their containers. This makes community members stay long hours (approximately about an hour and more) queuing and waiting for their turn, which wastes their time. During the fieldwork, investors' workers were observed while fetching community water supplies with jerrycans on their tractors and were captured with camera in the two *kebeles* as seen from picture 3-3 below.

Photo 3-3: Workers fetching community water points by tractors in *Kota* and *Bengez kebeles*

Photo: By the researcher

3. Unseasonal Wildfire

Though wildfire is common in BGRS, recently, the unseasonal eruption of wildfire has become one of the main challenges facing local communities in the study area. Community members indicated that wildfire has become a concern for them. During the first month of the fieldwork (i.e., January 2013) two forest fire incidents has happened. These incidents occurred, according to local communities, while the workers were reluctantly burning down a heap of cut up bushes and trees and the fire spreading out to the nearby forest. It was further aggravated by lack of fire checking mechanisms put in place by investors to control the incidence. This unanticipated wildfire caused loss of harvests of the local people. FGD discussants in *Kota kebele* mentioned that in 2004 EC (2011/12) due to an outbreak of forest fire, about seven household heads' farms covered with crop were burnt and damaged and the victims were not compensated. Government officials also confirmed the outbreak of wildfire in the area by investors.

4. Threats to Livelihood Activities of Locales

The fourth drawback of commercial farming is threat posed on local people's livelihood activities. Concerned government officials reiterated that land made ready and transferred for commercial farming is almost always unused and open marginal land. Even though these officials insisted on such position, the study uncovered that at least some of the lands transferred for commercial farming in the study area are not totally vacant and unused. In one way or another, the lands were traditionally used by local communities for different purpose like shifting cultivation, livestock rearing, honey production, and hunting and gathering, and the like.

As indicated in the introductory section, the livelihood of local communities is dependent on farming, livestock rearing, hunting of wild animals, and gathering of wild fruits such as leafs, roots and tubers. Farming is the mainstay of the local people, and shifting cultivation is one of the widely practiced farming systems among *Gumuz* community who dominantly inhabit the area. Thus due to the commencement of commercial farming, in the short periods shifting cultivation would fall under threat. Though there is no shortage of lands for local communities in the study time, in the future they might face shortages that could shorten fallow periods and lead to the emergence of settled farming. Consequently, the traditional ways of making a living through shifting cultivation is under pressure and would be abandoned as a result of the likely occurrence of shortage of lands. Thus, in the study area, shifting cultivation as a means of securing livelihood is less likely to persist.

In addition to the threat to shifting cultivation, other means of livelihood that community members practice to cope with food shortage such as hunting and gathering are also endangered. Such ways of life are highly affected by the expansion of commercial farming that cleared land covered with forests, bushes, and bamboos. These forests and trees are centers of different varieties of species and shots of creeping plants that produce fruits and roots commonly consumed, and homes to wild animals hunted, by the community members

Besides, honey production, which is another livelihood activity of local communities, is highly affected by commercial farming. Beekeeping is one of activities commonly practiced by local communities to supplement their livelihood. It helps to generate extra income to households. Traditionally, among community members under study, beehives are dangled on big trees. The bees also use naturally made holes of big trees as shelter and produce honey that locales consume and sale to earn income. The bees also mostly use nectars of natural flowers in the forests to make honey. Clearing forests and big trees for investment means by default destroying the trees that local community members used to hang their beehives, drying up the sources of nectar for bees, and damaging the shelters of bees resulting in loss of honey production. Apart from deforestation, bee production is also highly affected by pesticides and herbicides that investors employ. Although the impact of use of pesticides and herbicides requires further study, most literature indicates that they have serious impact on bees (and the environment) because bees belong to the same family of insects.

4.Conclusion and Recommendations

4.1 Conclusion

The study found that, all investors acquired land from the government following a formal procedure. Land deals were concluded by the government (either Federal or Regional) upon fulfilling the requirements set. Local communities were not at the center of land deals for commercial farming. The level of participation of local communities in land deals was by and large very low. Community members were not actively involved in land deals run both by the Federal and Regional Governments, and they did not fully provide their informed consent. In most cases, community members were merely informed about the commencement of commercial farms in their localities after land deals were concluded and the preparation of the land for cultivation had started. Local communities' participation, in the real sense of consultation where all community members should give their permission and support to the transfer of land, was rare and in some *kebeles* was totally absent. Recently, community participation in land deals is sought only at the initial stage of land deals, that is, during land identification stage. Once land was identified and placed into the land banks, no consultation of local communities is made and it is to be made, only during land delineation and handover. It is the mandate and right of government bodies to transfer lands through bidding.

All stakeholders were not involved in the land deals. Government and investors are the two main actors in land deals. Hence, in land deals only the interests of the government and investors were accommodated and given priority. The concerns and needs of local communities and other stakeholders were not given due attention, and quite often they were ignored. This caused dissatisfactions among local community members in matters of commercial farming leading to opposition and hatreds.

According to the findings of the study, the contribution of commercia
community is not significant. Over all, the nature and type of benefits r

people was not organized, uniform, and it was unstructured. The benefit that local communities accrued form commercial farm are not based on the principles of benefit sharing such as contract farming, out growing, etc. Rather, mere provisions were based on the goodwill of investors (very few investors) as well as those benefits happening through time. Very few investors were part of the provisions of social services. Besides being limited, the benefits local communities gained were not evenly distributed among all *kebeles*. In some *kebele*s, such as *Kota* and some parts of *Bengez* and *Abla Horus*, there were better benefits, whereas in other *kebeles* not.

The findings of the study also indicated that the government has pervasive power in land deals. Whatever proposals were tabled for discussion with community members by government officials, it was certain that it would be definitely implemented. Whether local communities are in favor of or against the transfer of lands to investors in their localities, the establishment of commercial farms is inevitable as the decisions to do so rest in the hands of government officials. Some commercial farms were established regardless of the opposition and resistance of local communities. No investor has been turned back so far as a result of the objection or resistance of the local community members.

4.2 Recommendations

The findings of this study could be used by government bodies in policy formulation to facilitate the development of a healthy commercial farming that operates and coexists in mutually beneficent relationship with the local communities. On the basis of the findings, the following recommendations are forwarded:

- Consultation of all stakeholders, particularly local civil societies, in commercial land deals was none existent. Government bodies that are keen on working for rural development that aims at uplifting the poor should encourage the host community and civil society consultation in commercial farm land deals to reap benefits from commercial agricultural investments in Ethiopia.

- Commercial farms need not only be creators of profit for investors and tax revenue for the government; they should also bring benefits to the local people. The communities have to share the fruits of investments on commercial farms located in their vicinities which they host. Thus, standardized, regulated, and organized social service provision system to local communities needs to be emphasized when granting land for investors. The principle of corporate social responsibility should be strengthened and the provision of benefit packages to the local people where farms are located has to be a component of investment projects.

- There are no strict measures taken by the government (both federal and regional) against those investors who fail to properly develop their land and abide by the laws enacted to that end. Benchmarks that would serve to evaluate investors' p

stages need to be established that could allow officials to take the right decision later on. Hence, timetable within which investors should develop the whole land handed over to them should be clearly indicated and measures to be taken should be indicated that could enable the government officials take appropriate action against those falling behind.

- Government supervision, control, follow-up and support mechanisms were found wanting. Investors who were given land by the Federal Government typically tended to undervalue their relations with the regional Bureaus, and most did not take seriously the zonal or woreda experts and *Kebele* Chairmen during monitoring and supervision. Thus, there should be a clear indication of the duties and responsibilities of the Federal and Regional Governments together with those at lower echelons concerning lands transferred to investors by the Federal Government.

- Land has been transferred to investors without conducting any feasibility study of the function of the land and biodiversity inside it. The Regional State as well as the federal government should undertake feasibility study of the original function and nature of biodiversity within the lands before availing and making ready for commercial farming.

- Employment opportunity created to local community members was not sound. Members of communities employed in commercial farms are few in number (and most are employed as guards). Thus, commercial farms must give priority for employing community members.

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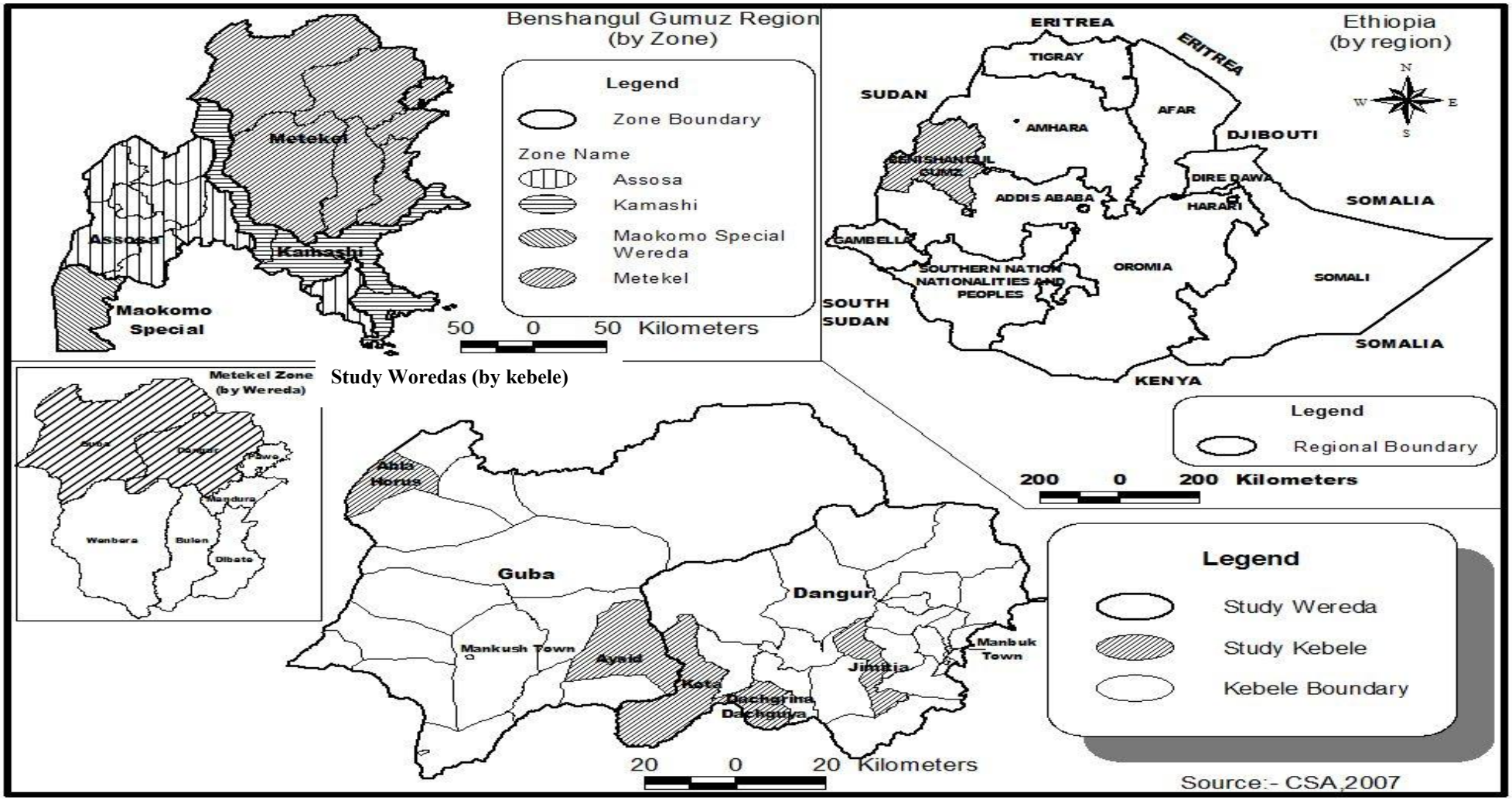
Annex a: Map of the study area



Paper Two: Apiculture Value Chain and Its Implication for Local Economic Development: A Case from Kilte Awlaelo District, Tigray Region

Wondye Admasu[1] Tegegne Gebre-Egziabher[2]

Abstract

The main purpose of the study was to identify, describe and analyze the major problems and the implications of the apiculture value chain to Local Economic Development (LED) manifested in employment creation, upgrading, value shares, and profitability. Hence, the interaction of the input suppliers with producer farmers and farmers with local processors or exporters and retailers were examined in order to determine the major constraints. The research solicited data, first, from apiculture value chain direct actors, such as three input suppliers, 58 cooperative member households from five peasant administrations, three processors, and one collector, as well as 17 retailing supermarkets in Addis Ababa. Second, indirect value chain actors such as community leaders, development agents, district agriculture and rural development experts, regional agriculture and rural development experts, researchers and NGOs were interviewed. Third, the business enabling environment was assessed by examining FDRE proclamations and other documents related with the apiculture sub-sector. Data were collected by making use of separate questionnaires for direct and indirect value chain actors. Once the data were collected, different data analysis techniques were applied. The qualitative data were analysed narratively, while the quantitative data were analysed statistically.

In Kiltie Awlaelo district, successful integrated watershed management has been implemented in the last two decades and the apiculture sub-sector is one of the fruits of the integrated watershed management efforts made in the locality. Thus, promoting apiculture results in local economic development through employment creation and income generation for the rural landless youths and women in the district, in particular, and it has led to the establishment of two honey processing plants in the region in general. The apiary sites were installed in the area closures. This facilitated the production of certified organic honey in which the Eastern Tigray Beekeepers Union was engaged directly exporting organic honey to EU markets. However, despite the numerous gains realized from apiculture, such as increasing income, creating employment and building sustainable livelihoods in rural areas and contributing to the national economy through foreign exchange earnings, there are challenges facing the sub-sector. Apiculture still suffers from lack of professional and technical manpower in extension services, linkage among producer farmers and processors is not smooth; no internationally accredited laboratory has been set up to assess honey quality, and issue of honey adulteration has progressively escalated throughout the country. Therefore, concerned bodies should facilitate the development of the apiculture sub-sector, by training technical manpower and professionals, facilitate the establishment of accredited laboratory, fervently fight against contraband trade, honey adulterations and take precautionary measures to prevent legal honey businesses from going into illicit trade.

Key words: apiculture, value chain, local economic development

1. Introduction

Since the early 1990s, about 700,000 ha of area closures have been established in Tigray Region in the last 20 years (FDRE, 2012). More recently, Ethiopia has begun to take steps in terms of a national policy

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response and formulated a Climate Resilient Green Economy (CRGE) strategy in 2008 and aims to achieve middle-income status by 2025 (ECRGE, 2011). The country is implementing the sustainable land management program (SLMP) in Oromiya, Amhara, Tigray SNNP, Gambela and Benshangul Gumuz regions (FDRE, 2012). Consequently, farmers of each region are contributing free labour for 30 to 60 days/year to soil and water conservation activities. Important feature of the SLMP is the explicit and clear focus on enhancing farmers' incomes and food security by small scale rain water harvesting, micro-irrigation, agro-forestry, apiculture and other income generation activities. A strategic mix with the food security and poverty reduction, employment creation and income generation are being practiced in line with the SLMP, through the improvement of the natural resource and conservation of the biodiversity. Moreover, the diverse agro-ecology of Ethiopia makes the country a home of about 6,500 - 7,000 plant species which are good sources of nectar and pollen to sustain the largest honey bee population (over 10 million bee colonies) in Africa (Ayalew, 1978, CSA 2012). The introduction of the modern apiculture was therefore, one of the income generating activities practiced along with rehabilitated area closures, paying special attention to the use of native and melliferous plants that provide a rich and varied source of nectar and pollen for bees.

Apiculture was thus, introduced in the rehabilitated area closures, forests and woodlands, and national parks in Tigray region by integrating with employment creation and income generation for landless youths and women (TRARDB[4], 2012). This was because of the following major reasons. First, while the addition of new livestock increases the pressure on the environment, honey bees impose no load on the vegetation nor pose any competition with other animals for food (Mader et al., 2010). Second, it is a low-cost, low labour intensive enterprise and does not require a lot of land and sophisticated inputs and is viable for landless youths and women. Rearing 4 modern hives needs a land less than $100m^2$ while the income generated from these hives is equal to growing crop in half a hectare of land (Gizachew (2011). Third, Bees' products are high value, non-perishable commodities that can be marketed nationally and internationally. One hive can give 60 to 90 pounds of honey pricing $ 300 to $ 600 every year (Mader et al., 2010). Fourth, bees also have a positive impact on the environment, creating important eco-systems, and play an important role in cross-pollinating crops. A honey bee can visit 50 to 1,000 flowers in one trip. A colony with 25,000 forager bees, making 10 trips a day able to pollinate 250 million flowers. Thus, through the pollination effected by honey bees, crop yields increased and food security sustained; ecosystems are enhanced and maintained (FAO, 2009). Fifth, during weather failures, say drought, bees are still able to forage in the wild vegetation and make enough honey and beeswax for beekeepers. Hence, environmental sustainability remains central to the beekeepers that they do not cut down trees; instead they plant bee-loving trees for nectar and pollen (Mader et al., 2010).

Although, beekeeping has long history in Ethiopia, it is still an undeveloped sub-sector of agriculture. The knowledge and skill of honey and beeswax production of farmers was still very traditional (MoARD, 2006). Hence, the activity has basically been traditional and of subsistence in nature, where honey was used as a food product for home, medicine and for brewing traditional liquor. The method of harvest and apiary tools are still in traditional way and the volume of production are very small and needs routine collection from fragmented small scale production. Moreover, farmers are isolated from the end-consumer and have little

[4] Tigray Region Agriculture and Rural Development Bureau

control over input costs or of the cost received for their goods and even exploited and marginalized (ACDI/VOCA, 2012). Cognizant of these facts and the potential of the beekeeping subsector for rural livelihood and local economic development, several initiatives were taken at the regional level and the study district by government, NGOs and the people to enhance the sub-sector. These include integrated water shade management and development of area closures from which the sub-sector benefits, introduction of modern beekeeping technologies, formation of beekeepers cooperatives and unions, establishment of regional beekeeping board and the establishment of honey processing plants. These initiatives form different stages of the value chain.

There were, however, some issues that are not clearly known and that need to be understood in order to strengthen the value chain and harness its contribution to local economic development. These issues relate to how the beekeeping value chain in Tigray Regional State operate with a view of understanding its strength and constraints, and how the value chain alternatives contribute to local development in the form of improved income, employment, environmental conservation and upgrading.

1.1 Objective of the Study

The main purpose of the study was to identify, describe and analyze the apiculture value chain and its implications to Local Economic Development in terms of formation of partnership, employment creation, value shares and upgrading.

1.2 Research Methodology

This research was conducted on pragmatist philosophical lens which uses both quantitative and qualitative paradigm. Creswell (2009) noted that as a philosophical underpinning pragmatism uses multiple methods, different worldviews, and different assumptions, as well as different forms of data collection and analysis in the mixed-approach. Thus, this approach was preferred because of: (1) On the one hand, the quantitative approach is applicable to propositional knowledge (that can be proved or disproved) with the exclusion of the tacit knowledge. (2) On the other hand, qualitative approaches which explore the feelings, understandings, and knowledge of others through in-depth interview, discussion or participant observation are very important to explore the complexities of everyday life in order to gain deeper insights.

The advantages of mixed approaches (quantitative and qualitative) are asserted on account of the capacity to answer the research questions properly and also to undertake “triangulation”. What is meant by triangulation is the use of a series of complementary methods in order to gain deeper insights on the research problem. The insights gained can strengthen confidence by providing multiple routes to the same result. According to Burgess (1984) cited in Hoggart, Lees and Davies (2002) and Denzin (1970) cited in Yeung (2008), there are four generic forms of triangulation: (1) data triangulation; (2) investigator triangulation among multiple observers of the same phenomenon; (3) theoretical triangulation- interpret evidence through different theoretical lenses; and (4) triangulation of methods, i.e., using more than one data collection techniques. Furthermore, Mikkelsen (1995) cited in Hoggart, Lees and Davies (2002) accepts these four types of triangulation and adds academic triangulation which is important for interdisciplinary research. Therefore, triangulating different data sources, theories and methods are needed in value chain research since the concept of value chain links multi-actors, multi-sectors, and multi-level activities. On the other hand, local economic development is also trans-disc

found in economic geography, economics, urban and regional studies; and development studies which can best be addressed by mixed approaches. Thus, value chain can also best be understood by implementing the pragmatist philosophy and triangulating different data sources and collection procedures. Finally, a case study research design was used to deal with the apiculture value chain from the farm gate in Kilte Awlaelo District to the supermarkets in Addis Ababa.

1.3 Descriptions of Kilte Awlaelo District and the Study of Peasant Administrations

Kilte Awlaelo district is located in eastern zone of Tigray Region. Wukro, the district town, is located at a distance of 825 kms away from Addis Ababa and 45 km north of Mekelle, the capital city of Tigray Region. It is found between13°33' to 13°58' North latitude and 39°18' to 39°41' East longitude. According to CSA (2011), the district has a total area of 1058.25km^2 (105,757.63ha). The district is bordered by Sease-Tsadamba and Hawzen districts in the north, Atsbi- wobrta in the east, Enderta district in the south, and by Hawzen and Dega Tembien districts in the west. Currently, the district has a total of 18 (17 rural and 1 urban) *Kebele* Administratives (See Figure 1 below)

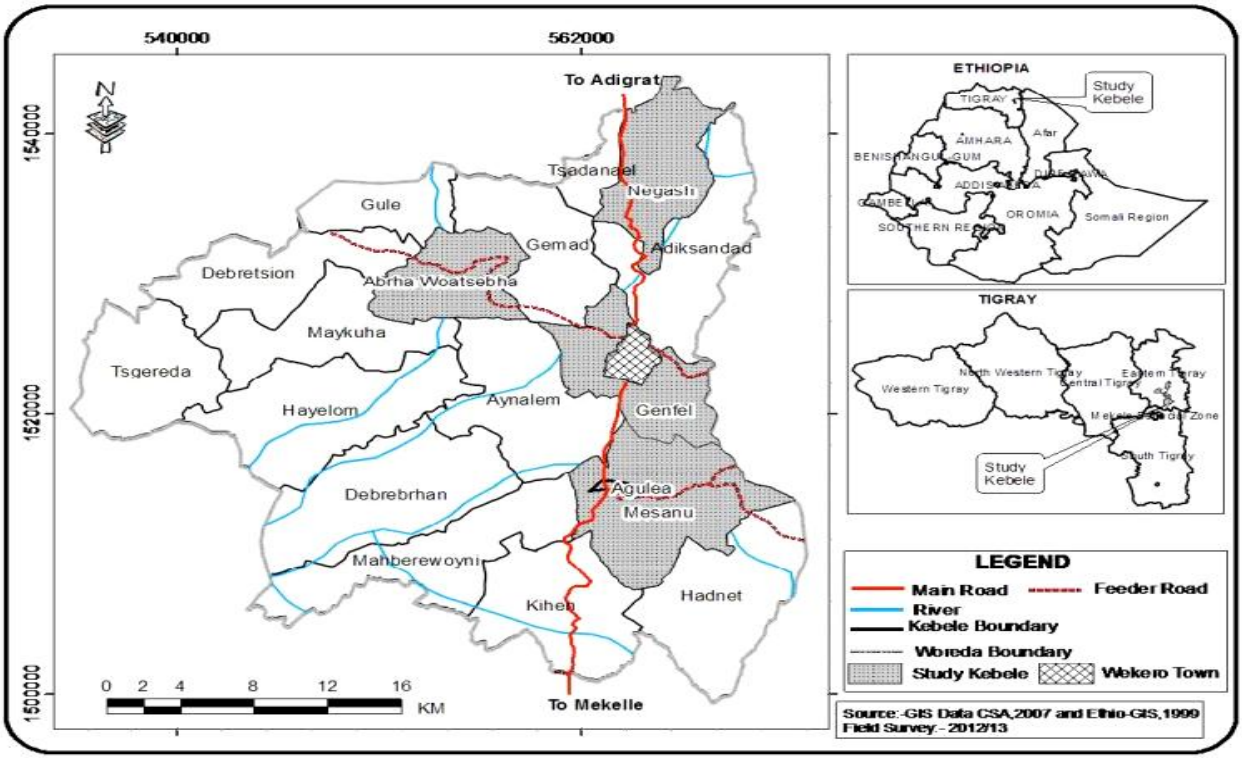

Figure1: Location Map of Kilte Awlaelo District and the Study Peasant Administrations

1.4 Sample Size and Selection Technique

The target populations of the study were the main value chain actors of the apiculture sub-sector who participated as input suppliers, beekeepers, collectors, processors/exporters, and retailers (supermarkets). Samples of beekeepers were selected using multistage sampling. First, three study PAs were drawn-out using lottery method from four beneficiaries of World Vision International Ethiopia Wukro Area Development Programme beekeeping projects. Second, *Mesanu* peasant administration was purposefully selected due to the presence of the only self-initiated cooperative (Selam bee
district. Third, the lists of cooperative members are enumerated from the

(Genfel, Negash, Abrha W/Atsebha and Mesanu). Fourth, the sample cooperative members (household units) were chosen using systematic random sampling technique in which every K^{th} subject from the list of the cooperatives are selected for inclusion in the sample by randomly taking the first household from the list. The "K" refers to the sampling interval that was determined by dividing the population size by the sample size. To this end, 58 sample households were selected, by taking proportional sample households from each of the five cooperatives. Finally, questionnaires were filled by household heads with the support of development agents.

1.5 Data Types and Sources of Information

The data inputs for this study were collected from two main sources, namely primary and secondary data sources. The primary data for this study was the main one, which was gathered through household survey questionnaire, FGD, and key informant interview. Formal and informal discussions were conducted with community elders, beekeepers association leaders, MSEs, peasant administration officials by including different age groups from both sexes. In addition, interviews were conducted with rural development professionals: District Agriculture and Rural Development Officers, DAs, District Finance and Economy Development officers, and adult training center workers and Dedebit Credit and Savings Institution (DECSI) workers. Secondary data from both published and unpublished documents, reports of both government and NGOs were used to supplement the primary data with relevant information. Various statistical information on occupational activities, especially on rural household expenditure and income survey, and livestock survey from different sources, such as CSA[5], MoARD[6] and MoFED[7] were used.

1.6 Data Analysis Techniques

The study attempts to catch the required information from different sources by using different data collection instruments. Once the data were collected, the qualitative data were analyzed narrativelly and the quantitative data were analyzed statistically. Finally, the data are presented in the form of tables, figures and written descriptions.

2. Review of Related Literature

According to Kaplinsky and Morris (2001) and van den Berg, et.al (2008), value chain is the descriptions of the "full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use".

According to Tegegne and Helmsing (2005), Local economic development(LED) is "a process in which partnerships between local governments, NGOs, community-based groups and the private sector are established to manage existing resources, to create jobs and stimulate the economy of a well-defined territory". Helmsing (2001) further explained that LED is: "a) a multi-actor. Its success depends on its ability to mobilize *public, private, and nonprofit actors*; b) multi-sector. It refers to public, private and

[5] Central Statistical Authority

[6] Ministry of Agriculture and Rural Development

[7] Ministry of Finance and Economic Development

community sectors of the economy; c) multi-level". On the other hand, Hasan (1998) and Hobson (2012) discussed that local economic development (LED) is a bottom up approach to generating equitable economic growth through unleashing the economic potentials of every territory. However, according to Parrayu and Syebubakar (2008), the intention of LED is not to replace the top-down sectoral policies but instead to complement them while building endogenous capacity. In situations where there is regional disparity in poverty and development, macroeconomic instruments alone do not provide the policy space for employment, income generation and poverty reduction (ibid). The LED approach thus plays a complementary role to the macroeconomic instruments in addressing these problems (Tegegne, Clacey and Godden, 2011). According Gregorio (2003), LED encompasses primarily "the economic sectors of local society – agriculture, commerce, trade, finance, and manufacturing -- and all types of enterprise from micro to large enterprises". It covers both the formal and informal sectors of the economy and extends from production and provision of goods and services to their distribution and use by local people.

There are also different approaches to LED as well as different entry points for starting on LED process (such as, value chain, capacity building, skills development, collective action, social protection, micro-finance, labour rights, safe conditions at work, elimination of child labour, etc) that should be tailored to the specific needs and resources of each community, region or territory (ILO, 2007). Hence, LED approach means different things to different interest groups. In line with this, Rogerson (2003) explained that, LED can be seen as a 'spectrum of interventions', from *pro-growth market-led approaches to pro-poor and market-critical approaches* (Rogerson, 2003). Therefore, value chain offers a strategic way to address potentials and constraints within prominent economic sectors of a locality so that apiculture value chain can be one of the entry points to local economic development. However, according to Hobson (2012), effective cooperation and communication among the stakeholders of a value chain is the key to enhance the potentials of the locality. Therefore, the dialogue, cooperation, communication and supportive action among the value chain stakeholders will have two implications. First, local economic development process that typically focuses on participation and social dialogue to identify the economic potential of a specific territory and empower local economic actors to take joint action for economic growth, job creation and poverty alleviation Second, it brings local economic development that could be manifested in employment creation, income generation, linkages: (vertical and horizontal linkages, rural-urban linkages) and profitability of the sub-sector (Hobson ,2012).

3. Results and Discussions

3.1 Apiculture Value Chain Implications to Local economic Development (LED)

According to Rives and Heaney (1995), because economic development is an amorphous and vaguely defined concept, the effectiveness of local economic development efforts cannot be directly measured. Consequently, researchers have employed a myriad of different approaches to obtain a proxy for economic development. Blakely (1989) also define local economic development as a process by which local government and/or community based groups manage their existing resources and enter into new partnership arrangements with each other to create jobs, generate income and stimulate economic activity of the local area.

Likewise, this study investigates whether, or not the above stated scenario is true in the study area. Based on this, the study tries to examine the implications of the apiculture value chain for LED, by viewing LED as a process and product. As a process, it examined how apiculture value chain l

together and forms a partnership for economic development. As a product, the research examines how apiculture value chain contributes to employment creation, income generation, and use of profits, linkages (input and market) taxation and contribution to the local community empowerment and in environmental conservation.

3.1.1 Building Partnership in the Apiculture Value Chain Intervention

Partnership is defined as collaboration between local government, private sector, and civil society to commit to work together on a project or programme to pursue common goals and in which the different partners bring complimentary resources, contribute to the design of the programme and share risks and benefits (Stibbe, 2008 cited in Rogerson, 2009). Thus, LED brings together local actors in public-private-partnerships (PPPs). Local Economic development is a process of building partnership among and between government, the industry associations and private business organizations, non-government organizations, people's organizations, cooperatives, and informal sector associations. Each of these actors has a role to play in Local Economic Development (Gregorio, 2003, ILO, 2008).

According to Kilte Awlaelo District Agriculture and Rural Development Animal Resource Expert and World Vision International Wukro Area Development Programme Officer, there was a good partnership among stakeholders (the local government, the community, and NGOs) in the district. There is also adequate coordination and collaboration in the value chain activities by the district administrative office. The interviewed Area Development programme Officer further noted that all actors that are involved directly or indirectly in the project actively participate and contribute their shares as specified in the project agreement document. Community members of the district, especially of the target peasant administration, were also involved in the project implementation process. Community based organizations, women and youth associations, cooperatives and peasant association leaders were also fully engaged in the project life. Their full engagement ensures the sustainability of the project in their respective areas of operation. Similarly, different government offices, NGOs involved in similar activities and programs and the private sector were involved in the production of honey in the project process. All stakeholders mentioned above participate in the process of design, planning, implementation, monitoring and evaluation processes of the project. The district Agriculture and Rural Development office had the responsibility to follow-up modern beehives distribution, installment, proper site selection and supporting the newly established cooperatives. The office also provided extension services and trainings on bee rearing, how to use different equipment, honey harvesting and extraction.

3.1.2 Employment Creation

Employment creation is one of the most important issues in increasing the income of the people, in providing their livelihood and thereby promoting local economic development. Agriculture including apiculture employed about 80 percent of the labour force in the country. According to the Ministry of Agriculture and Rural Development (2007), apiculture has proven to be one of the employment creating sub-sectors in rural areas particularly for landless youths. This is due to the fact that marginal land, less labour and capital is needed to start modern beekeeping; and it also generates income in a very short period of time. Moreover, modern beekeeping that avoids climbing of trees is increasingly a gender-inclusive activity because it can be done near the homestead and on the ground inside the area closures which is easier and safer for women (MoARD, 2007).

The apiculture sub-sector has created job opportunities for 1.8 million smallholder farmers throughout the country which is less than 10 percent of the potential of the sub-sector. The beekeeping also contributes US$1.6 million annually to the national economy (EAB, 2014). According to Tigray Regional Agriculture and Rural Development Bureau (2012) report, 153,531 farmers were engaged in the beekeeping sub-sector. Similarly, in Kiltie Awlaelo district, 14,230 framers were engaged in the beekeeping sub-sector (TRARDB, 2012).

Table 1: Number of Employment Created by Apiculture Enterprise

Year	Cooperatives	Members by Sex			Percentage of Females	Fixed Capital	Cash	Total Capital
		M	F	Total				
2006	1	12	5	17	29.4	2800	5500	8300.00
2007	4	60	15	75	20.0	136503	7300	143303.00
2008	11	248	47	295	15.9	340811	25520	348931.00
2009	2	46	58	104	55.8	247330	3000	250330.00
2010	5	168	18	186	9.7	229645.55	16880	246525.60
Total	23	534	143	677	21.1	57,089.55	58,200	997,389.60

Source: Kilte Awlaelo District Agriculture and Rural Development Office, 2012

As shown in Table 1 above, the total number of employment created by the beekeeping cooperatives was 677 in the last five consecutive years (2006-2010). It was very small at the initial year, 17 jobless youths compared with the 186 employment created by the end of 2010. The data show that the number of beekeeping cooperative members increased from time to time. Generally, this implies that the apiculture sub-sector is contributing a lot to the local economic development in terms of employment creation in the local community. Kilte Awlaelo district has successfully worked on the beekeeping sub-sector development, as it has a competitive advantage in relation to job creation, food security, and the production of quality white honey both for the local, national and export markets. During 2006-2010, employment creation through beekeeping sub-sector rose by 186 jobs (994 percent) and contribution to the food security as well as to the processing industry is also very important. The jobs created through the apiculture sub-sector were for vulnerable members of the community without regular income who were landless youths and women. In relation to the apiculture sub-sector 6 specialized beekeeping extension workers were also hired in the district and one bee technician was assigned for three peasant administrations. The apiculture subsector played an important role not only in job creation but also it improved the lives of farmers.

3.1.3 Value Shares

After having mapped the value chain, the next step is to study certain aspects of a value chain in-depth. One of these is costs and margins, or more simply said, the money that an actor in the value chain contributes (his/her costs) and the money that an actor in the value chain receives (his/her margins).

Measuring costs and margins enables to determine how pro-poor a value chain is. Studying actual costs and margins should be considered to find out whether a value chain is a good source of income for the poor and whether a value chain is accessible for the poor. The cost and profit margin was calculated based on the white honey which is the main type of honey produced in Kilte Awlaelo dis
interviewed said that they largely produce the white honey. Finally, as indic

Table 2 below, farmers sold their honey for Birr 151.00 to collectors in their farm gate, who then sold it on to a processor for Birr 156.34, who sold it to a retailer with Birr 184.27, who sold it to a consumer with Birr 200.00. Each actor in the chain has costs, shown in the second column which includes the purchase price of the honey from the previous actor plus transport, tax, salary and loading and unloading costs. Column 5 shows the gross margin–the percentage of the actor's revenue that is profit. We can see that farmers have a gross margin of 38.5 percent, while the processor has a gross margin of only 9.9 percent. Column seven of Table 2 and figure 2 show the value share – the percentage of the final retail price (Birr 200.00) that each actor manages to get.

Table 2: Summery of Cost and Profit Margin Analysis of Each Honey Value Chain Actors

Value Chain Actor (1)	Total Cost (2)	Revenue (3) (Selling Price)	Income (4)	Gross Margin (5)	Added value (6) (Revenue - Previous Actors Revenue)	Value Share (7) (Added value*100/Retail Price)
Farmer	92.9	151	58.1	38.5	151.0	75.5
Collector	154.09	156.34	2.25	1.4	5.3	2.7
Processor	166.02	184.27	18.25	9.9	27.9	14.0
Retailer	186.7	200	13.3	6.7	15.7	7.9

Source: Own Calculation, 2012

Beekeepers fetch the highest share of added value in the honey chain, on average 75.5 percent of this amount (Birr 151.00, in column 6). Collectors share only a small portion of added value, on average 2.7 percent. Processors receive on average 14 percent (Birr 27.9) of the added value in the chain and retailers receive 7.9 percent of the added value share.

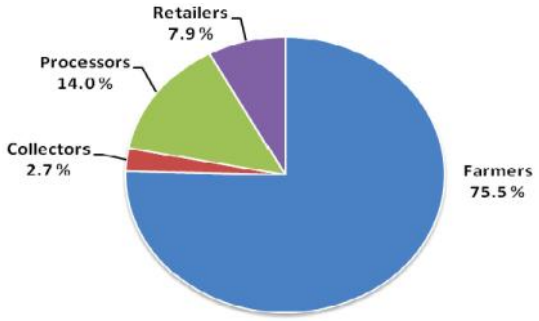

Figure 2: Value Share between Honey Value Chain Actors

Looking at the pie chart (Figure 2), we see that farmers' value share is the biggest of the total revenue. Van den Berg and et.al (2008) noted that, if the piece of the pie held by the poor grows, the poor get less poor compared to the rest of the actors in the chain. This shows how the value chain is pro-poor and is a promising mechanism for smallholder farmers to come out of poverty in the context of the study district.

3.1.4 Upgrading of the Apiculture

Any firm which wants to adjust itself to the ever changing market requirements needs to upgrade its products, production processes or organization. The concept of 'upgrading' refers to firm's ability to acquire new technologies or management techniques to increase its competiveness and resilience, and eventually improve its power position in the value chain (Bair, 2005; Giuliani et al., 2005). Value chain programs aim to establish a sustainable chain that provides employment and income to participants, and to prepare them to remain competitive as the market and the competition inevitably evolve. There are four value chain upgrading trajectory, which begin with process upgrading, moves on to product upgrading and then on to functional and inter-sectoral upgrading (Gereffi 1999; Kaplinsky and Morris 2001; Mitchell, Keane and Coles, 2009). These upgrading strategies were applied to see the apiculture value chain upgrading in the study district and the result is narrated as follows.

1. Process Upgrading

The process upgrading in Kilte Awlaelo District started in 1999/2000 by introducing 43 modern beehives on 23 farmers homestead. Since then, beekeeping activity has shown a dramatic increase on both the number of modern beehives, and thebquality and quantity of honey production in the district. According to the information from District Agriculture and Rural Development Office in 2012, a total of 14,230 farmers were engaged in the beekeeping activity. From these total beekeepers, 8,798 (61.8 percent) and 5,432 (38.2 percent) were engaged in modern and traditional beekeeping activities, respectively. The district has a total of 27,160 beehives, of which 22,885 (86.3 Percent) were modern and the rest 4,275 (15.7 Percent) were traditional. The modern beehive was more efficient in its productivity than the traditional ones. Farmers also use appropriate storage and plastic containers for their honey which was recommended to preserve its quality to make it more competitive in the market. Farmers also use honey extractor to separate the wax from the honey which traditionally was sold by crashing the honey comb without separation.

The two processing plants, Dimma and Wellela, transformed the crude honey into table honey. As the two processing plants interviewed, the process of table honey production passes through four steps: These are i) filtration- the crystals present in honey such as pollen, foreign particles and wax are removed by heating the crude honey to 45°c which is a temperature below the melting point of wax; ii) evaporation -heating the honey to 60°c - 65 °c for 10 to 15 minutes and passing into a falling film evaporator; iii) cooling and storing -honey cooled to an atmospheric temperature and stored in a cold vessel for 24-28 hours in order to settle and allow the air bubbles to go out; iv) filling and packing -honey filled immediately in attractive glass jars and plastic containers for consumers or drums in bulk as required and then packed to be distributed to the retailers. The above processing activities were high-tech that the two processing firms did all the activities with machine. The honey is then labeled containing all the information including the geographical origin.

2. Product Upgrading

In industrialized countries, honey remains to be one of the very few totally natural and unaltered foods available to consumers. Part of honey's image and reputation is as a wholesome, natural food, and there is therefore much interest to have sources of honey that are organic certification. There is also a premium price available to beekeepers who can supply organic certified honey which has strong demand within EU countries. Bees commonly forage within a range of two kilometers from their nest or hive i.e. over an area of 12.6 km^2. To ensure that honey is organic, this entire area must be organic, [illegible] that land within three kilometers should be organic (Bradbear, 2009). For a cou

honey to the EU, it is essential for the nation's name to be added to the EU's list of 'third countries' eligible to do so[8]. To achieve this, it is necessary to show that the nation has a 'Residue Monitoring Scheme' established for the analysis of honey for residues of antibiotics, sulphonamides, pesticides and heavy metals as defined in Decision 2001/159/EC and modified in 2001/487/EC (Bradbear, 2009). With the support of the SNV, Ethiopia obtained its First Third Country Listing 2008-2009 which is renewable every year (SNV, 2008). Thus, organic certification must also extend to producer level in order to insure traceability and quality management systems.

Figure 3: Apiary sites installed in the area closures in Abraha W/Atsebha (photo by the researcher)

Since the modern apiary sites were installed in the area closures (far from human and animal contact), this ensures the organic nature of the honey produced in Tigray Region in general and Kilte Awlaelo district in particular. More recently, the Eastern Tigray Beekeepers Union has got a one year internationally accredited Organic Certificate starting from January 30, 2014 to 31st January of 2015 from Nesvax Control Limited Nairobi, Kenya Office with certificate No: Nesc/ICS/002/2014 that should be renewed every year. The Union's certificate was concerned with organic beekeeping under an Internal Control System (ICS) processing and marketing of bee products like honey, wax, bee pollen, and royal jelly. To comply with the standards, the equipment and containers used in the extraction of honey were stainless steel, glass, non-contaminating plastics. Honey was sampled during the harvesting season with the participation of the competent authority, and the samples were prepared for expedition to a regional accredited residue monitoring laboratory found in Nairobi, Kenya as there are no accredited laboratory in Ethiopia. The sampling cycle is recurring every year. This shows that there is a product upgrading from producing ordinary crashed honey to certified organic honey production in the district.

3. Functional Upgrading

Functional upgrading refers to changing the mix of functions performed by actors in the value chain, which could be increasing (upgrading) or reducing (downgrading) the number of activities performed by individuals and firms (Mitchell, Keane and Coles, 2009). According to the interviewed cooperative leaders,

[8] Official Journal of the European Communities, Commission Decision of 12 February 2001(2001/158/EC).

beekeepers in Kilte Awlaelo were trained on how to process crude honey and separate it from beeswax so as to sell the two separately using honey extractors. As a result of their training, all of the beekeepers sold their honey by separating from beeswax. By extracting the honey, they save the frames of combs which can be reused and the bees will not need to make new combs for surplus honey storage. The bees may refill these combs with honey in a short period of time when nectar flow is in progress. The extracting honey has three advantages: First, it enabled farmers to supply pure honey for the market and they sold the honey and the beeswax separately if they didn't want to reuse the combs. Second, the reusable combs save labor, money, and time. Third, it resulted in greater total yield of surplus honey.

4. Chain Upgrading

Chain upgrading is the process of using skills gained in one value chain to participate in another. Though this was not true for all individual beekeepers, there are some farmers like Haleka Alem who transform into another production rather than honey and wax. Some of these activities were colony splitting, queen rearing, and the production of pollen.

5. Upgrading of the Enabling Environment

As with products, processes, functions and relationships within and between chain nodes affect the competitiveness of value chains, improvements of the support service, institutional, legal and policy frameworks in which value chains operate are also major factors in their success. Actions taken in the realms of standards, codes of conduct, policy and legislation and business development services are good examples of the upgrading of the enabling environment (Mitchell, Keane and Coles, 2009).

Recognizing the appropriate contribution of the apiculture sub-sector in the process of rapid economic development, the FDRE[9] government took the sub-sector as one of the priority areas to ensure food security, poverty reduction and local economic development in the arid areas. In line with this, the apiculture development and protection proclamation No 660/2009 which is necessary to promote households and commercial beekeeping in areas of high apiculture resource potentials was endorsed (FDRE, 2009). In addition, Quality and Standard Authority of Ethiopia (QSAE) developed standards specifications for honey, beeswax, and beehives with reference number ES1202 2005, ES1203 2005, and ES1204 2005 in their respective order for the first time in the history of Ethiopia (QSAE[10], 2005). This shows that the beekeeping sub-sector has been given attention. It was one step forward in upgrading an enabling environment for the apiculture sub-sector and, thus, control Ethiopian honey for both internal and international markets and protect consumers' safety.

Tigray Region Government investment document shows that the regional government was exerting its maximum effort to produce high quality honey so that the local farmers can get cash income and this in turn enables the farmers to assure food security in the potential areas of Eastern, Western, Central and some parts of Southern zones of Tigray. Modern beekeeping productions including honey, beeswax and royal

[9] The Federal Democratic Republic of Ethiopia

[10] Quality and Standards Authority of Ethiopia

jelly are the major focus of the food security and foreign currency earning strategy of the region. Hence, the regional government is committed to attract potential investors to the beekeeping sub-sector and provide all the necessary support. The investment incentive set by regional government for the beekeeping sub-sector investors includes exemption from duty payments for imported machines and equipments. In addition, processors targeting at least 50 percent of the output for export are also exempted from paying income tax for five years. All these show that there was good and upgraded enabling environment for the apiculture sub-sector in Tigray Region.

3.6 Profitability of the Modern Apiculture

The Regional Agriculture Research Center Beekeeping Researcher explained that there are three major types of honey produced in Kilte Awlaelo district and Tigray Region as a whole. The colours vary according to the seasons and the available bee forage during those seasons. These are white (cream), yellow (cream) and red (liquid) honey. The white honey is the most-sought-after honey from the region and was sold for up to 220 Birr/kg at the farm-gate as of March, 2012. White honey is typically produced from the beginning of October through to the end of November. Yellow honey is the next most sought after variety of honey and is produced between Augusts and September and was sold for up to 160 Birr/kg from the producer. The red, liquid honey is produced during May and was sold for up to 120 Birr/kg in March 2012. Table 3 shows that, the price of the honey production from modern beehives are by far very large than the traditional ones in the last six years. Particularly, the price of white honey (niche products of the district) is very far from the same type of traditional productions and other varieties of products.

Table3: Average Selling Price of Honey in Birr by Type at Wukro Town Year (2008-2013)

Year	Red Modern	Red Traditional	White Modern	White Traditional	Yellow Modern	Yellow Traditional
2008	24.83	20.85	41.96	29	31.76	28.06
2009	43.59	34.62	85.79	57.69	59.61	49.05
2010	40.35	33.18	99.73	58.72	60.3	41.26
2011	54.46	47.31	126.99	78.15	69.7	70.15
2012	66.19	54.67	149.13	87.87	89.72	71.52
2013	73.23	67	220	125	105	97

Source: Computed from Tigray Agricultural Promotion Agency (TAMPA)

Table 4 below, compared the white modern honey with the white traditional honey, it is clearly seen that the modern honey production is profitable than the traditional one.

Table 4: Profitability Comparison between White (Modern &Traditional) Honey

Year	White Traditional (1)	White Modern (2)	Profitability	
			Number (2-1)	Percentage
2008	29	41.96	12.96	44.69
2009	57.69	85.79	28.1	48.71
2010	58.72	99.73	41.01	69.84
2011	78.15	126.99	48.84	62.50
2012	87.87	149.13	61.26	69.72
2013	125	220	95	76.00

Source: Computed from Tigray Agricultural Promotion Agency (TAMPA)

The percentage difference in profitability between the modern and traditional honey ranges from 45 percent in 2008 to 76 percent in 2013. Therefore, farmers having modern beehives sold their honey with better price than farmers with the traditional ones.

4. Constraints and Challenges of the Apiculture Sub-Sector

Though, there were good opportunities for the beekeeping sub-sector in the district, there were also challenges that hampered value chain actors to exploit its potential benefits. These constraints are discussed as follow.

According to the results of the stakeholders' workshop[11], honey adulteration and lack of quality control systems were the major problems raised. The workshop participants clearly noticed that the practice of mixing quality honey with other material has had a damaging effect on the end market reputation of Tigrian honey in particular and Ethiopian honey in general and may result in more serious imagery issues on the export market if the practice remains unchecked. This is partly due to the deficiency of established traceability and coding systems without grower producers, as well as the lack of a national honey policy with acceptable quality control standards and monitoring mechanisms. The participant also quest the beekeeping board to lobby the Federal government to support the Apiculture Resource Development and Protection Proclamation No.660/2009[12] by effecting policies, regulations and rules.

The Federal Proclamation on Apiculture Resources Development (Proclamation No. 660/2009) under Penalty Article 8 No.5 states that: "a*ny person who found in act of processing transporting or market supplying to the market place or consumer market sale or transfer of adulterated, contaminated or poisoned bee products is punishable with a fine from Birr 10,000 to birr 15,000 or imprisonment from five up to ten years or both"*. However, the proclamation is not supported by the regulations, procedures and directives to penalize illegal traders if they continue to sell adulterated products. However, the harmful act of the honey adulterators still continued being a big challenge to the sub-sector by eroding the competitiveness of the Ethiopian honey in the global and regional markets. In August 13, 2014, Ato Yosef

[11] Stakeholders workshop were conducted in Atse Yohans Hotel, Mekelle March 23,2012
[12] Federal Negarit Gazeta No.6 24th December 2009…Page5126

Getachew a head Investigation and Advocacy Director of the Trade Competition and Consumers Protection authority narrated the following evidence:

> *The Authority seized a huge amount of sugar being melted for the adulteration of honey in the Addis Ababa's Kolfie-Keranio Sub-city, Woreda 3 on Tuesday, August 12, 2014 at 3:30 PM based on information given to the police by the community. The suspects were caught red-handed in one residential house by the Police and the Authority melting and mixing the sugar in three barrels with unknown chemicals which is under investigation for the time being and while the melted sugar was being packed for sale in the Merkato Gojjam Berenda markets. According to the Director, sixty quintals of sugar ready to be melted for honey adulteration and two minibuses for the service were seized and ten individuals who were suspected of involving are put under custody. The Director further noted that the main honey adulterators were four and 18 workers were recruited from rural areas for the adulteration purpose. These people melted up to 500 quintal of sugar per month and they sold the product at a price of Birr 25 to 35 to Merkato Gojjam Berenda retailers (Sintayehu Girma-Public communication officer). If we simply calculate profit margin by 7 Birr per kilogram they would have 350,000 Birr profit per month (that means 7 X 500 X 100 = 350,000). This shows that honey adulteration, if unchecked is really profitable business at the cost of the public health.*

Honey adulterators are violating the law of the country "*Apiculture Resources Development (Proclamation No. 660/2009)*" and the "*Trade Practice and Consumers' Protection Proclamation No. 685/2010 Page 5479*[13]*". The Trade Practice and Consumers' Protection Proclamation under Part Three in the Protection of Consumers from Unfair and Misleading Acts (Act.30) sub article (10) which totally prohibited the unfair and misleading acts from being committed by any person or business person is: "preparing or making available for sale or selling goods or services that are dangerous to human health and safety or those source of which is not known or whose quality is below standards set in advance or are poisoned or have expired or are adulterated"*.

This shows that the newly emerging beekeeping enterprise is seriously affected by honey adulterators from the start, and the health of the people is put in danger if the beekeeping sector continues to be managed without national policy. Unless the proclamation is supported by regulations and directives to penalize illegal traders and awareness-raising campaign is done on the consequences of honey adulteration on human health, targeting producers, traders, consumers and the general public, these risks will continue.

According to the intertwined farmers and *Tigray Region Agriculture Research Center – Beekeeping Researcher*, the main constraint to the beekeeping sub-sector was the high price of beehives/colonies. The fact that a hive/colony costs about1100 to 1200 Birr is too high for farmers in comparison with the level of income of the poor farmers. This often makes it impossible for most of the farmers to purchase it independently. Although Dedebit Saving and Credit Institution was actively involving in the district, farmers were reluctant to take loans fearing the risks of diseases and climate variability that may lead the colonies to die or move to unknown destinations.

Human resources determine the potential development of a locality to turn into realities, where skilled labour force is an asset to exploit the natural resource endowment (Hasan, 1998). The Tigray Regional State

[13] Federal Negarit Gazeta No. 6 16th August , 2010…. page 5479

assigned one extension agent for three peasant administrations to harness the natural resource endowment potentials. The beekeeping extension services were provided by one beekeeping technicians assigned in the three peasant administrations. However, though the presence of these extension workers was a new venture for the sub-sector in the region, the service was no longer sustainable and in most areas such services couldn't satisfy farmers' demand due to large catchment areas and the rapid increasing of the beekeepers number. The District Rural Development and Agriculture Office Animal Resource Department Head also reiterated that the district faced logistical challenges (such as lack of motorcycle) and the extension staff are not sufficient to satisfy farmers' needs. As a result of lack of skill in method of harvest and proper apiary tools, farmers sometimes fail to supply honey with standard moisture content and sanitation. On the other hand, honey processing firms faced input constraints.

5. Conclusion and Policy Implications

5.1 Conclusions

Recently, honey production and processing falls within the FDRE Government's investment priorities. Investors are 100 percent exempted from duty payments for imported machines and equipments. Investors participating in farming of bees/ productions of honey are exempted form income tax for 4 years. In addition processors targeting at least 50 percept of their output for exports are also exempted from paying income tax for five years[14]. In line with this, honey is listed as one of priority commodities targeting both the local and export markets by Tigray Regional Government. The value chain activities in the district were planned in a participatory manner and were relevant to addressing the local needs and were compatible with government policies.The apiculture sub-sector in the study district showed paramount contribution to employment creation, income generation for the rural landless youths and women, food security, environmental sustainability, poverty reduction and local economic development. Moreover, the apiculture value chain has wider importance. First, it improved the living conditions of peasant households as they fetch income through the sale of their honey to agro-processing industries. Second, it benefited particularly input producer MSEs in the urban areas by creating backward linkages. Third, it persuaded an increasing number of the rural population to engage in environmental conservation through the beekeeping sector.

The apiculture value chain brought prosperity to some outlier farmers and improved the living conditions of those farmers and their families. Promoting value chain has resulted in local economic development and created large scale rural employment in the district in particular and led to the establishment of two honey processing plants in the region, in general.

All the apiary sites were installed in the rehabilitated area closures. Consequently, exploring the potentials of the locality the Regional Agriculture Bureau worked for organic honey production and farmers were trained on bee management, honey extraction, quality control; marketing and business planning and become conscious on product traceability. The Eastern Tigray Beekeepers Union claim Organic Certification which makes it competitive in the international market and farmers are conscious about the rewards they receive from quality honey production and producers have much greater control over pricing and choice of sales outlets.

[14] Federal Negarit Gazeta Regulation No. 270 29th November , 2012…. page 6662

5.2 Policy Implications

The findings of this study imply that, indeed, the apiculture sub-sector value chain is making a positive contribution to local economic development, mainly in employment creation, income generation, linkage with MSEs, establishment of agro processing industries, upgrading and environmental sustainability.

However, the followings are some suggestions to improve the apiculture sub-sector:

1. Public policy plays a critical role in creating an enabling environment for value chain upgrading. Thus, the government should develop mandatory enforceable honey quality assessments regulation in order to minimize the public health risk.
2. There are no legal frameworks (regulations and guidelines) for the implementation of the Apiculture Resources Development and Protection Proclamation No. 660/2009 and this demand an urgent solution from the government side before it risks the health of the society and shadow the image of the country's quality honey production. Honey adulteration has reached its peak point throughout the country indicating that inefficiencies at some end of the value chain nodes may cause serious bottlenecks that will arrest the entire effort of value chain development.

3. The establishment of internationally accredited National Quality & Safety Control Laboratory (for testing of residues of antibiotics, vet drugs, pesticides and heavy metal elements) is critical for the sustainable upgrading of production processes and for the survival and growth of apiculture subsector in a competitive marketplace.

4. With respect to strengthening legal trade of honey and strengthening the weak links between farmers and processors, the government at local, regional and national levels should fervently fight against contraband trade, honey adulterations and take precautionary measures to prevent legal honey businesses from going into illicit trade.

5. The Ministry of Agriculture should enhance beekeeping extension training and research and development activity to improve methods of production, increase productivity per colony and per given apiary sites and maintain quality standards of bee products.

6. The Ministry of Industry should encourage the establishment and development of beeswax value adding industries by creating incentives to private investors in order to exploit the full potentials of the commodity.

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Paper Three: Wild Edible Foods in the *Green Famine Belt* of Ethiopia: Do They Contribute to Household Resilience to Seasonal Food Insecurity?

By

Guyu Ferede Daie

Abstract

A cross-sectional study of 220 households was conducted in order to examine the contribution of wild edible foods (WEFs) in household resilience to seasonal food insecurity using a structured questionnaire, key informant interviews and semi-participant observations. Quantitative data were analyzed using SPSS version19 and supplemented with qualitative information.

344.53qtl of WEFs with mean 1.57qtl and standard deviation of 1.69qtl was collected by households during the survey year. This is 4.74% of gross food obtained from all sources and 9.12% of net food available. They also earned some amount of income (5885.00birr) from sale of WEFs. WEFs contribute considerably to household resilience as viewed through income and food access (IFA). The proportion of variance accounted for in WEFs by other variables (initial communality = 0.170) and by factors in the factor solution (extraction communality = 0.226) were acceptable showing that the variables used to estimate IFA had certain association between themselves and IFA, which is useful in structure detection towards IFA. The 3 factors used to estimate IFA variable accounted for about 68% of total variance. WEFs' load as captured by Factor2 (0.467) is considerable showing their significant contribution to household resilience as it is significantly larger than the minimum recommended factor load by literature (i.e. 0.300). The standardized Beta coefficient was acceptable (Beta = 0.117) showing the importance of WEFs in constituting IFA and their correlation with IFA was also significant (r = 0.174). Moreover, 65.5% of households (47.7% indigenous and only 17.7% non-indigenous) reported their dependence on WEFs as compared to 34.5% (7.3% indigenous and 27.2% non-indigenous) households who reported that they either didn't depend or depended little on WEFs. On the vulnerability-resilience spectrum, 43.6%, 10.9%, 9.5% and 1.4% of households in the vulnerable, moderately resilient, resilient and highly resilient group respectively reported their dependence on WEFs showing that dependence on WEFs increases as resilience status decreases and, that vulnerable households depended more on WEFs than the resilient households. Wild vegetables were the most collected constituting 52.4% of total WEFs obtained followed by fruits (11.6%), roots (10.4%), meat (7.7%), mushrooms (5.9%), fish (5.6%), bamboo shoot (3.6%), and honey (2.8%). Key informant information also shows the medicinal value of WEFs. The majority (76%) reported that they didn't depend on WEFs due to problems associated with WEFs (i.e. reduced WEFs, legally forbidden, WEFs totally vanished) showing that they want to feed on WEFs but constrained by those problems.

In conclusion, although the amount of WEFs obtained was much less than the cultivated source of food, their role in helping to cope with food shortages is considerable, and their contributions being more to the indigenous than the non-indigenous group. Therefore, the national food security policy should include WEFs as a component of resilience building strategies and incorporate strategies that improve sources of WEFs and household access to them. Moreover, research that aims at WEFs' current status and future prospect is urgently required to create

awareness among all stakeholders so that they can work to regenerate disappearing wild plants and regain wild vanishing animals.

Keywords: Wildfood, Resilience, Food-insecurity, Green-Famine-belt, Belo-jiganfoy, Ethiopia

1. Introduction

1.1. Description of the Study Area

Although difficult to clearly delineate the *green famine belt* of Ethiopia, it roughly covers the Northwestern, Western, Southwestern and Southern parts of Ethiopia (Guyu, 2015:139). In order to gain an in-depth understanding of the contribution of wild edible foods (WEFs) to household resilience to seasonal food insecurity, Belo-jiganfoy district is selected as a case study area. This district is located in Benishangul-gumuz region, one of the five administrative regions of Ethiopia, which falls in *green famine belt.* As a result, the description of the study area context given below focuses on this case study area.

Belo-jiganfoy district is one of the 20 'districts, located in Southern part of Benishangul-gumuz region (BGR) in Kemashi district. It is bounded by Oromiya region in the Northeastern, Eastern, Southeastern and Southern directions, by Kemashi zone in the Southwestern, Western and Northwestern directions, and by Yaso district in the Northern direction. According to FDRE-ERA (2008) report, the district consists of 10 rural 'kebeles' where Soge town (capital of the district) is part of Soge 'kebele'. The administrative structure in the Federal Democratic Republic of Ethiopia, district refers to administrative unit lower than the zonal level but larger than a 'kebele'. While a zone is an administrative unit next to regional level, 'kebele' refers to the lowest administrative unit consisting of villages. Belo-jiganfoy has an area of 1628km^2 in which a total population of 37471 with 7347 households are living with average density of 23 persons per square kilometer. Berta, Gumuz, Shinasha, Mao and Komo form the indigenous ethno-culture group of BGR. All except the Shinasha ethno-culture are found in Belo-jiganfoy district. But, despite their fewness , some Shinasha individuals employed and working in different government offices are found in the district. In addition, there are a number of non-indigenous people living in the region and in Belo-jiganfoy district, Oromo and Amahara ethnic groups being dominant. The district is characterized mainly by plain topography although certain mountainous features exist with altitude ranging between 1100m and 1450m above msl. Its climate can be categorized as moist tropical that shows very hot temperatures ranging

between 20 – 25^{0}c during rainy season while its minimum temperature varies from 12 – 20^{0}c according to the relief and seasons. Economically, the people in the district depend on agriculture. Malaria is the leading cause of human health problem while livestock sector is also threatened from several diseases. Poor road infrastructure and socioeconomic services are the main challenges to the district (all summarized from FDRE-ERA, 2008).

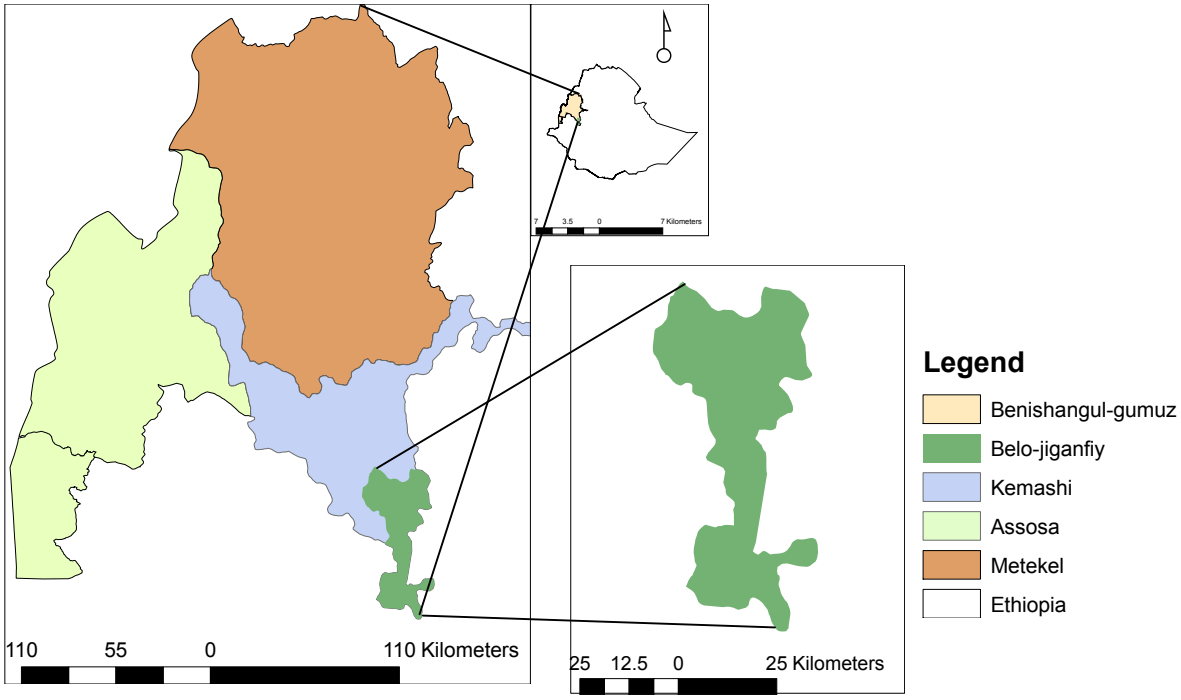


Figure1.Location of Belo-jiganfoy District at National, Regiona and Zonal Settings

1.2. Background of the Study

"The cause of my sickness is the shortage of wildfood, especially wild meat. Formerly, different types of wild animals such as antelopes were found in our backyard, killed easily and eaten. Today, a 3 to 4 hours walk is required to see an antelope because there is no forest to host them." (Mr. Mesha, an elderly sick Gumuz man in Soge *kebele*, Benishangul-gumuz region, Ethiopia, April 2013)

This man intuitively mentions the food, environmental and medical value of wild edible foods (WEFs). This paper examines and highlights the contribution of WEFs in household resilience to food insecurity in the *green famine belt* of Ethiopia.

Famine and food insecurity have continued challenging the lives of people in many parts of the world. In the 20thc alone, worldwide over 70 million people died of famine shocks (Deveeux, 2000:6; Sarracino 2010:2). It has persisted in the 21stc, too (Sarracino, 2010:2) despite improved agricultural technologies increasing food availability at global and national levels. At present, malnutrition has become a major health burden in developing countries, specifically in the Sub-Saharan Africa (Bharucha and Pretty, 2010:2917). But, the Food and Agricultural Organization (FAO) reports show that the absolute number of hungry people of the World shows a declining trend. The number of chronically food insecure people that was 1.015 billion during 1990-92 had become 805.3million during 2012-2014 (FAO, 2014:11). This may imply that achieving the Millennium Development Goal (MDG) of halving the proportion of hungry people in the developing countries by 2015 is promisingly within reach. However, such a gross global level report may not indicate the specific national level condition of food insecurity.

In Ethiopia, an estimated 5-6 million and 2-7 million people are chronically and transitorily food insecure, respectively, every year (Haan et al., 2006:7). Famine that is thought to have started since the 9thc AD (Mesfin, 1981:31 cited in Mulugeta, 2014: 1) has also persisted throughout the 20th and 21st centuries. The 1973-74 great famine of Wollo (Sen, 1981:431), the 1984-85 nationwide famine (Alemayehu, 2001:6), the 2002-03 famine and near famine conditions (Haan et al., 2006:11), and the 2007-08 *green famine* of the *ense*t dominant areas of Southern Ethiopia (Mulugeta, 2014:122) can be mentioned as examples.

Although historically existed, the occurrence of *green famine* in the *green famine belt* is recently explored and clearly explained in Mulugeta (2014). This source concludes that *green famine* occurs due to a complex web of demographic, policy, political, social, economic and natural factors (Mulugeta, 2014:63). These factors are similar to those in the drought-prone famine belt of the country showing the definitional inadequacy of the source. Evidences show that the extent and severity of food insecurity in this *belt* are much more than their counter part drought-prone famine belt of the country. For example, child malnutrition (weight-for-age) in BGR is indicated to be severe (USAID, 2004:8). As compared to 44% at national level (Haan et al., 2006:11), 58.1% of people in BGR (BGR, 2004:9), 85% in Assosa district (Dagnachew, 2004:42), and 58% in Bullen district (Guyu, 2014:59) were living below food poverty line. A qualitative study in BGR also indicates that poverty and food insecurity are extremely severe leading people

(mainly the indigenous) to resort to dependence on wild foods as coping mechanism (Guyu, 2012:188). Dependence on wild food, on the one hand, is mentioned as one of the indicators of famine conditions (Mayhew, 1997:167). Coping mechanisms, on the other hand, are one of the defining components of household resilience, in that having more coping strategies means having more probability of mitigating food insecurity after the shock (Alinovie et al., 2008: 145). In general, the food insecurity situations of this belt are much more severe than those in the drought-prone and high population density areas of the country.

In fact, food insecurity is not a new concept to researchers, in policy debates and for humanitarian workers. They have been working with ultimate objective of understanding the causes of, and reducing, vulnerability and building resilience. However, such efforts focused almost entirely on cultivated sources of food. Consequently, food security policies and programmes often target at improving availability, accessibility, consumption, and stability, of/to cultivated foods. But, there is a substantial source of evidence that WEFs constitute an important part of global food basket (Bharucha and Pretty, 2010:2913; Ermias et al., 2011: 72). Since time immemorial, food from wild and semi-wild plants (Agea et al, 2011:134) and wild animals (Muchaal and Ngandjui, 1999:386) have sustained human populations. WEFs were once important sources of food that offer flavor and essential nutrient to diet. This importance has gradually declined as human's focus shifts from WEFs to foods from cultivated plant and domesticated animals since agricultural revolution that started about 10,000 years ago (Agea et al., 2011: 134). Such a decline of the dependence on WEFs is due to the decline in the traditional ways of living (Bharucha and Pretty, 2010: 2923). This has been exacerbated perhaps due to the increased impacts of cultural globalization which has created a near universal cultural system based largely on Western values, customs and habits (Illgner and Nel, 2000: 336). This has perhaps deteriorated the food culture of people mainly in Africa due to perceived superiority of the Western culture. For example, as quoted from Quin (1954), Ethiopians have been known *locust-eaters* since the early second century BC (Illgner and Nel, 2000: 340). But, today this culture seems to have ceased and there is no tangible evidence that shows an Ethiopian culture depending on *locust-eating*. Similarly, in Western Ethiopia, many of the food cultures seem to have ceased as those sources of food are perceived as inferior to other cultures. For example, hunting and eating apes is the most popular recent practice of the Nilotic people living in the Nile (Abay) river catchment but today rarely practiced perhaps due to such a perceived

inferiority of wild food sources. In spite of these facts, dependence on WEFs has persisted in this part of Ethiopia. The existence of relatively better forest covers in this area has provided better supply of WEFs to people than other areas. As a result, it is believed that WEFs have contributed to household resilience to seasonal food insecurity in the *green famine belt.*

1.3. Statement of the Problem

Studies show that food insecurity in the *green famine belt* of Ethiopia is much more severe than drought-prone and high population density areas (Dagnachew, 2204; Guyu, 2014). Food insecurity and famine conditions have been masked by relatively favorable environmental, agricultural and demographic conditions. But a substantial source of evidences show that WEFs constitute an important part of food basket for households (Bharucha and Pretty, 2010:2913) and that they have irreplaceable nutritional contents and economic values for individuals and communities (Illgner and Nel, 2000: 339-349; Kajembe et al., 2009; Agea et al., 2011:135). Their role in coping food shortages and famines is also paramount (Mayhew, 1997:167). Despite WEFs' wide range uses, researchers, policymakers and humanitarian interventions in Ethiopia have, however, entirely focused on cultivated sources of food, and drought-prone and high population density areas. Unfortunately these actors have never considered WEFs' contribution to household resilience while prior researchers largely emphasized their ethno-botanical knowledge (Guinand and Dechassa, 2001: 34; Fantahun and Hager, 2009: 210-212; Ermias et al., 2011: 90-122). In light of this, the central argument of this paper is twofold. First, the national rural development and food security policies that have merely focused on drought-prone and high population density areas will never bring a desired level of overall rural development as well as ensuring food security without equally considering the *green famine belt*. Second, food security policy programmes which aim at vulnerability reduction and resilience building will not be achieved without taking WEFs into account as they constitute part of daily meals for households in many parts of rural Ethiopia. Thus, by examining the contribution of WEFs to household resilience to food insecurity, this paper has both short term and long term purposes. In short term, the findings can serve as a guideline for policymakers to consider WEFs when planning and implementing resilience building programmes against food shortfalls. In long term, they stimulate academic and policy discourses by providing baseline information on food

insecurity and role of WEFs in the *green famine belt.* Accordingly, the study addresses literature gap in the field of food security in terms of spatial and variable scopes.

1.4. Objectives of the Study

The main objective of this paper was to assess and understand the contribution of WEFs to household resilience to seasonal food insecurity in the *green famine belt* of Ethiopia taking Belo-jiganfoy district (a case study area) from Benishangul-gumuz region, Western Ethiopia and drawing certain policy implications of the findings of the study.

The following specific objectives were addressed:

- Identifying the major types/sources of WEFs, estimating the amount obtained from them, and appraising their food, medicinal and economic (income) values as perceived by study subjects. .
- Measuring the extent to which WEFs contributed to households' resilience to food insecurity.
- Comparing the extent of WEFs contribution to resilience between indigenous and non-indigenous ethno-culture groups.

2. Theoretical and Empirical Literature

2.1. Theoretical Framework

2.1.1 Conceptualizing Food Insecurity, Famine, Green Famine and Wildfood

The concepts of food insecurity and famine are dynamic, complex and vary over time and differ across geographic space. Such a temporal and spatial dynamism in food security can be seen from the fact that many households in different countries frequently move in and out of a state of food/nutritional insecurity regardless of specific measurements adopted (Capaldo et al., 2010, pp.3). The defining concepts and models that were used yesterday to understand them may not be used today. They may need to be modified, or replaced by another one. Such thinking that famines and food insecurity in a dynamic sense can be more understood by reviewing their definitions and conceptual evolutions associated with those definitions.

Food security/insecurity, which was initially defined in terms of availability has later widened its scope to incorporate accessibility, utilization, stability (Gross et al., 2000:5), and more

recently sovereignty. The present day application of the definition should, therefore, reflect all of these components of food security. The widely used definition that perhaps encompasses these components is given as "food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (Canali and Slaviero, 2010:1267). Food insecurity occurs when this definition cannot be ensured and given as "a situation that occurs when a household is not capable of sufficiently feeding its members from either its own production or purchase on market …" (Degefa, 2005:10). Households that face food shortages on a permanent basis are termed as chronically food insecure (Degefa, 2005:10). If it is caused by disasters or shocks, it is termed as transitorily food insecure, and if the food shortages become cyclical, it is termed as cyclical or seasonal food insecurity (Brown and Amdissa, 2007:7). In Ethiopia, chronically poor and food insecure people are found throughout the country (Brown and Amdissa, 2007:7). But, more attention has been given to drought-prone, high population density and pastoral areas. The present paper adapted Degefa's (2005) definition with minor modifications as it seems incomplete and doesn't consider all sources of food and potential causes of food insecurity. Accordingly, food insecurity is defined as "a situation that exists when a household is incapable of sufficiently feeding its members from either one or more possible sources: own production, purchase, social and cultural networks, wild foods, and food aids". Seasonal/cyclical food insecurity mostly characterizes the *green famine belt* although observation shows there are chronically food insecure households too.

Famine, too, is a dynamic and evolving concept. The narrow definition begins with its dictionary meaning as well as definitions given by earlier authors. It is noted that most definitions give famine as a discrete event that is triggered by food shortages and results in mass deaths (Devereux, 2000:4). The Oxford dictionary of geography defines it as "A relatively sudden flare-up of mass death by starvation …" (Mayhew, 1997:167). Authors, for example, Kumar (1990:173 cited in Devereux, 2000:4) defines famine as 'virulent manifestations of intense starvations causing intense loss of life'. Such a narrow view that famine is triggered solely due to food shortages and mass mortality has, however, been criticized. For example, the *entitlement* theory emerged arguing that famines are not always triggered by declines in food availability because they can occur in situations of moderate good food availability (Sen, 1981:1). Moreover, Illife (1979) cited in Devereux, 2000:4) argues that excess mortalities are not

perceived by the victims as prerequisites for famines to have occurred and indicated the possibility of dividing famines into famine as an ordinary food shortage and famine that kills. de Waal (1989) argues that deaths during famines are related more to epidemic diseases than starvation so that they can be divided into minor famines causing hunger, severe famines causing destitution, and catastrophic famines resulting in mass deaths (de Waal, 1989 cited in Devereux, 2000:4). Following these arguments, recent writers have widened the concept beyond early meaning understanding that famine is a complex phenomenon. As a result, the wave of definitions avoided a simplistic theoretical position incorporating the idea of multiple impacts, and behavioral responses and 'insider' perspectives (Devereux, 2000:4). Based on the above arguments and as considered in this paper, famine is not defined only for starvation that results in mass deaths but also a hunger condition, breakout of human diseases, diseases and death of livestock, that causes destruction of livelihood bases and dissolution of a family. Seasonal occurrence of food shortage in the present study area can be regarded as a recurrent famine of the *green famine belt.*

Green famine is considered as an innovative term that is very infant and recently emerging concept used to describe a famine condition which occurs in the g*reen famine belt* (Guyu, 2015:139). This concept is well defined by Mulugeta (2014) when exploring the event in Southern highlands of Ethiopia, one of the densely populated parts of the country. This source came up with the conclusion that famine occurs due to a complex web of demographic, policy, political, social and natural factors (Mulugeta, 2014:63). Although this conclusion is acceptable, rather the concept of *green famine,* as used in this paper, should more appropriately and broadly be defined for *environmentally, demographically and agriculturally conducive areas*. In this sense, drought, population pressure and the resulting land fragmentation do not play a major role in inducing famine in the *green famine belt*. As opposed to famines that occur due to drought and high population pressure, the primary causes of *green famine* are cultural, social, political, policy and institutional. As a result, the more comprehensive definition is given as " food insecurity conditions that are characterized by favorable natural conditions such as climate (sufficient rainfall, absence of drought, and vast fertile agricultural lands), low population pressure, and less resource degradation" (Guyu, 2015:139). The present study was conducted in the green famine belt and examined the extent to which wildfood contributed to seasonal food shortages.

There are no easy distinctions between 'wild' and 'cultivated' foods. Researcher and policymakers try to separate them while such differences are rarely mirrored by local communities (Bharucha and Pretty, 2010:2915). The term 'wildfood' may refer to food for human consumption obtained from non-domesticated plants and animals. But, wildfood can be seen as existing as a continuum ranging from an entirely 'wild' to semi-domesticated food (Bharucha and Pretty, 2010:2915). Like food from domesticated sources, the culture of consumption of wildfood varies from place to place and people to people. Some wildfood which are edible in one culture may not be edible in another but still being potentially edible. There is a substantial body of literature on edible plants while rare on edible animals. The role of edible plants as supplementary to nutritional requirements, coping food shortage and emergency (famine food) is clearly shown (Assegid and Tesfaye, 2011:9-11). In most cases, these functions overlap as all type may be eaten all times although the extent to which people engage in them may vary depending on food security situation. In this paper, the term wildfood is used to define wildfood sources from entirely wild plants and animals, and excludes semi-wild ones. Had semi-wild vegetables been used in the definition, their contribution to household daily meals would have been very much specially after the onset of the *belg* (spring season) rains.

2.1.2 The Concept of Resilience

The concept of resilience was originally proposed in ecological literature (Holling, 1973:17), as a result familiar in ecology but new in social sciences (Ciani, 2012: 3). Resilience in ecology is regarded as the persistence of relationships within a system and the measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters (Holling, 1973: 17). Since then, it has been applied in a variety of disciplines including social sciences (Martin-Breen and Anderies, 2011: 5). Well established formulation of the concept for studying food systems and then food security has, however, begun since the novel contribution by the work of three individuals (Alinovi, Mane and Romano) at FAO in 2008. They should be acknowledged for their contribution of strictly statistical model for analyzing resilience to food insecurity. However, the work of Frankenberger and others in 2007 is a precursor of the application of resilience approach to poverty and food insecurity a year earlier in their study of *The Path to Self resiliency* in Northern Ethiopia. They employed sustainable livelihood approach to examining the resiliency and vulnerability of beneficiary communities and households of Non-Governmental Organization (NGO) intervention (Frankenberger et al. 2007: vi).

Resilience consists of two broader worldviews: ecological resilience and engineering resilience (Holling, 1996:32; Sakurai et al, 2012: 2). Both deal with aspects of stability of equilibria providing alternative measures of a system's ability to maintain its functions following disturbance (Alinovi et al, 2009: 3). Their differentiation lies on the paradox between efficiency and persistency, or between constancy and change, or predictability and unpredictability (Holling, 1973 cited in Holling, 1996:32-33).

The engineering definition that resembles the engineer's desire for "fail-safe" design focuses on the efficiency, constancy and predictability. That is, resilience focuses on efficiency and assumes constancy and predictability of a system's properties (King, 2008: 113). It can, therefore, be defined as the speed of return to the steady state following a perturbation perceiving a system as existing close to a stable state (Sakurai et al, 2012: 2). It focuses on stability and a near equilibrium steady state, in which resistance to disturbance and speed of return to the equilibrium is used to measure resilience. Thus, an increased resilience implies the system's ability to *bounce back faster after stress, enduring greater stress, and being disturbed less by a given amount of a stress* (Martin-Breen and Anderies, 2011: 5). Engineering resilience is therefore grounded more of within the theory of positivist tradition, both epistemologically and ontologically (King, 2008: 113).

The ecological resilience focuses on the persistency, change and unpredictability, the core idea celebrated by biologists with an evolutionary perspective and by those who search for "safe-fail" designs (Holling, 1996:33). Ecological resilience is a dynamic model that focuses on persistence despite changes in, and unpredictability of, a system's properties (King, 2008: 114). It assumes multiple stability domains and is measured by the magnitude of disturbance that can be absorbed before instabilities shift/flip into another regime of behavior (Sakurai et al, 2012: 3). In line with this, vulnerability is regarded as the flip side of resilience (Alinovi et al., 2008:139) because when a system loses its resilience, it becomes vulnerable to changes. The ecological resilience model is therefore grounded in constructivist tradition epistemologically and ontologically (King, 2008: 114).

Ecological resilience approach is applied in this paper assuming that different equilibria exist, at least, among different households. Thus, household resilience to seasonal food insecurity is

analyzed considering the existence of different levels of resilience among households. Resilience thinking is a systemic thinking, where food systems can be seen as complex systems and households as a complex adaptive subsystem of food systems (Alinovi et al, 2009: 4), a definition applied in this article too. In this regard, household resilience can be defined as their ability to maintain self-organization in the face of stress or shocks (Alinovi et al., 2008:139).

2.1.3 The Concept of Ethno-culture

The concept of ethno-culture, like *green famine,* is a newly used term to explain the differences between people of different cultural and ethnic backgrounds no matter their present state of borrowed cultures. Its root could be found in Guyu (2011) that tries to apply the concept implicitly to understand the differences between the Gumuz, the Non-gumuz and the Mixed ethno-culture areas in their food security status. The concept is also explicitly applied to understand the disparity in food insecurity status between the indigenous and non-indigenous ethno-culture groups (Guyu, 2014:57-60). A clear definition of ethno-culture is given in Guyu (2015) as "simple approach that assumes that the cultural background of different ethnic groups as a base of all factors of food security/insecurity" (Guyu, 2015:143). According to this source, the rationale behind proposing ethno-culture approach for studying food security lies on the fact that different ethnic groups have different social, cultural, economic, demographic and even political backgrounds and/or experiences the situation of a given system (ibid). This concept is also applied in this paper by analyzing and determining the extent to which wildfood were used and contributed to their resilience to seasonal food insecurity.

2.1.4 Theories of Famine Causation and Food Insecurity

A brief review of theories that explain causes of famine and food insecurity has become essential as many perceive that the *green famine belt* in general and the present study area in particular is less vulnerable or more resilient than its counterpart drought-prone and high population density areas of Ethiopia. Theories of famine causation seem to have appeared in a linear fashion from the demographic theory through availability decline, entitlement failure to complex emergencies explanations (Devereux, 2000:3). These theories are divided into four main categories: demographic, climatic, food policy, entitlement and complex emergencies theories (Sarracino, 2010:8). This can be seen as a paradigm shift in famine and food insecurity thinking.

Malthusian and Neo-Malthusian demographic theories have been used to explain famine and food insecurity conditions since the publication of R.T. Malthus's (1789) book entitled *Essay on the Principles of Population*. Since then, it has become a framework for studying the population and resource nexus and its utility has been peaked up mainly since the second half of the 20th c perhaps due to the booming population over the century from about 1.6 billion in 1900 to 6 billion at the end of the century (Devereux, 2000:16) and then to the present day 8 billion. According to this theory, while population grows geometrically, agricultural productivity grows arithmetically so that population cannot continue to grow indefinitely due to limits imposed by scarce resources of the land. This is because, according to Neo-Malthusians, famine serves as a natural check on the population growth balancing the supply and demand for food (Devereux, 2000:17).

However, this theory had played a major role until the 1980s (mainly in 1960s and 1970s), when writers began to challenge some of his assumptions (Sarracino, 2010:9). It has been argued that the Neo-Malthusians fail to forecast the geometric growth of food production due to improved technologies as well as the ultimate stabilization of population at 9 billion late in the 21st c when demographic transition will be completed throughout the world (Devereux (2000:16). Despite this critique, demographic factors have continued to cause famines and food insecurity (Mulugeta, 2014:63). In the *green famine belt* of Ethiopia, demographic factors are not the primary causes of famine and food insecurity (Guyu, 2015:140). Specifically, population density in the present study area is very low although Ethiopia's population is one of the highest, about 74 million in 2007 (CSA, 2008:8).

Climatic theory of famine causation also known as the food availability decline (FAD) model assumes that famine occurs due to sudden reduction of per capita supply of food (Sarracino, 2010:10). It is usually triggered by natural disaster including (drought, floods, pest infestation, etc), wars, and epidemics determining a contraction of food supply (Sarracino, 2010:10). But, the FAD approach is also criticized for its limitations with the advent of the entitlement theory explanation of famine and food insecurity. For example, considering the relationship between famine and availability, Sen argues that starvation is not necessarily linked to a decline in food availability (Sarracino, 2010:6). What is perceived to be crucial is whether a particular individual or households has/have access to sufficient food. This is the point where the

entitlement theories or explanations to famine and food insecurity emerge to reshape the traditional view that famine and food insecurity occur solely due to failure in availability of food.

In relation to Sen's entitlement theory, Ravallion cited in Sarracino (2010:6) clearly shows that famines are not strictly linked to a contraction in the aggregate availability of food and that people who experience a threat to their food consumption not necessarily have to face death. This implies that a food shortage that result in both mass death (as a traditional definition says) and critical shortage of food leading to starvation and hunger conditions can be regarded as famine. The *green famine* condition is therefore thought to have led to both conditions although no empirical studies have been conducted on the death effect. In analyzing the contribution of WEFs to household resilience to food insecurity, households' access to WEFs through gathering and/or hunting as alternative mechanism of food entitlement was assessed. As such, it relates to the FED approach employed to explain WEFs contribution to household resilience in this paper although a full theory is not applied.

Food Intervention decline (FID) is another theory that explains famine causation. According to Sarracino (2010:11), this model is quite new that originates from the recent and growing awareness that governments, and more generally political institutions, humanitarian agencies, and NGOs have to protect all citizens promoting direct public interventions. The FID approach is therefore related to policies and argues that people starve because food policies and services fail to guarantee a sufficient nutrition (Sarracino, 2010:12). This approach seems more applicable in the *green famine belt of* Ethiopia as the causes of food insecurity are mostly due to the fact that policy interventions have much overlooked the event. One of the models that would be used in the future for understanding the situation should be FID approach. But, the present paper doesn't. As usual practice, it is also criticized for mainly that people exposed to such intensive intervention might develop a dependency syndrome.

Complex emergencies here refer to the civil instabilities and drought that altogether trigger mainly famine. It emerged as a model focusing on political strains and strives which, through the breaking up of co-operations, peace, and trust among people, aggravate the problems of access to food resources and cause their destruction, directly or indirectly (Sarracino, 2010:25). This

theory was used in explaining the famine occurrence in the Horn of Africa including Sudan and Ethiopia (Devereux, 2000:15). As some instabilities due to ethnic tensions exist in some areas (for example between Wollega Oromos and the Gumuz of Benishangul-gumuz region), food insecurity could be caused due to such features of the model. But, the present study doesn't apply it.

In general, in light of the above brief review, the cause of famine is not just demographic, climatic, or institutional but are due to complex web of natural and man-made, the later being the most dominant in the *green famine belt* of Ethiopia.

2.1.5 Food Security Policy

The Agricultural-Development-Led-Industrialization (ADLI) has been pursued as an umbrella policy framework and taken as an engine for development since 1991. The national food security strategy (FSS) is founded on ADLI and FSS was formulated in 1996 and revised in 2002 (Amdissa, 2006:18). The FSS is integrated with the poverty reduction programmes: the sustainable development and poverty reduction strategy (SDPRP) and the plan for accelerated sustainable development to end poverty (PASDEP) which were launched in 2002 and 2005/06, respectively to achieve the objectives of MDGs (ECOSOC-NVR, 2007:4). As an umbrella framework, ADLI focuses on creating conditions for national food self-sufficiency while the overall objective of FSS is ensuring food security by increasing food availability through domestic production, ensuring access to food for food deficit household, and strengthening emergency response capabilities (ECOSOC-NVR, 2007:xiii). FSS focuses on the chronically food insecure households (Amdissa, 2006:18) through different programmes such s resettlement/villagization, social safety nets, etc. From this view point, the *green famine belt* of the country that has historically been perceived as either more resilient or less vulnerable to food insecurity seasonally is disregarded. Despite an overambitious goal of ensuring sustainable food security by increasing households' access to cultivated sources of food, it doesn't mention a word about the need for wildfood in combating problems of food and nutritional shortages. Its major programmes such as the productive safety net, resettlement, pastoral development policy and other food security programmes (Devereux et al., 2014:17-18) are either applied in few areas or totally absent in most parts of the *green famine belt* of Ethiopia.

2.2. Empirical Literature

Evidences show that the extent and severity of food insecurity in the *green famine belt* are much more than its counterpart drought-prone and high population density areas of the country. For example, in BGR child malnutrition (weight-for-age) is found to be one of the most severe (USAID, 2004:8). In the region, 58.1% of the population was living in poverty trap in 2004 (BGR, 2004:9). The district level studies also show that 58%, 85% and 71.8% of households in Bullen (Guyu 2014:59), Assosa district (Dagnachew, 2004:42) and Belo-jiganfoy (Guyu, 2015:147) districts, respectively, are food insecure. All these figures are much more than the national figure of about 50% in the mid-2000s (CIDA, 2013:10), 44% in 2005 (Haan et al., 2006:11) and 33.3% in 2013 (CIDA, 2013:10). The food insecurity situation of this area is also much more than those in the drought-prone and high population density areas of the country. For example, in Central Ethiopia (Nonno district, Shewa) and Northern Ethiopia (Tigray region), about 21.09% (Messay, 2013:209) and 42.3% (Tsegay, 2009:50) were respectively food insecure. Moreover, a qualitative study in *BGR* indicates that poverty and food insecurity are extremely severe leading people (mainly the indigenous) to resort to dependence on wild foods as coping mechanism (Guyu, 2012:188). Based on these evidences, people in BGR in particular and the part of Ethiopia termed as *green famine belt* in general are generally regarded as vulnerable to food insecurity that reflects famine condition, and hence *green famine* (Guyu, 2015:153). As elsewhere in the world, people in the *green famine belt* are not passive beings who do not respond to the seasonal food insecurity shocks. They used to cope with food shortfalls through a number of mechanisms, depending on WEFs being one but less recognized source of household resilience to the shock.

Obviously most agricultural societies today primary rely on staple crop plants and domesticated animals. Despite this, the tradition of eating WEFs has continued until today (Ermias et al., 2011: 71). Especially for many indigenous communities, wildfood outweigh the modern cultivated items in terms of nutrient contents (Bharucha and Prettty, 2010: 2917). As quoted from Abermound (2009), about 1billion people in the World depend on WEFs on a daily basis (Ermias et al., 2011: 72). In Africa, about 400,000 hunter-gatherers can be found in the three regional super-categories. These include 200,000 Pygmies of Central Africa; 100,000 East African Non-Pygmy hunter-gatherers, and 100, 000 Bushmen/San of the semi-arid savannahs of the Southern Africa (Lee and Hitchcock, 2001: 260). The hunters and gatherers of Ethiopia belong to one of the six East African countries: Rwanda, Uganda, Tanzania, Kenya, Somalia and Ethiopia (Lee and Hitchcock, 2001: 260). But, no document shows how many of the 100,000 East African Non-Pygmy hunter-gatherers belong to Ethiopia. The only fact is that a varied topography of the country offers a wider spectrum of natural harbor for biodiversity (animals and plants). As a result, the country is rich in both wild edible plants (WEPs) (Ermias et al, 2011: 76) and wild edible animals (WEAs) despite a declining trend in their availability.

Information on the type and number of WEPs is available and well documented. As quoted from Walters and Hamilton (1993), globally about 75,000 plants are edible and 12,000 of these have

been used as food, and only 2,000 have been domesticated (Kajembe et al., 2000: 9). Likewise, available information indicates that Ethiopian floral consists of about 6000 species of higher plants, 10% of which are endemic, as a result the country is known as *hot-spot of biodiversity* (Tilahun and Miritse, 2010: 2). However, there is no reliable data on the number of edible plants in Ethiopia. For example, while one source indicates that more than 200 wild and semi-wild edible plant species exist in this country (Fantahun and Hager, 2009: 208), another one indicates over 300 species (Tilahun and Miritse, 2010: 2).

Whatever the number, WEPs are recognized sources of micronutrient, food security and income for those depending on them. For example, micronutrient comparison of WEPs and cultivar foods show that WEPs have some better qualities than cultivated sources of foods (Milton, 1999: 491-496). Their contribution to cope with famine shock is also immense (Mayhew, 1997:167). Despite conventional understanding that poorer households more depend on wild foods, researches show that there is less correlation between wildfood use and socioeconomic status. Rather it depends on the abundance of the source of wild foods (Bharucha and Prettty, 2010: 2919). Trading and uses of wildfood provide an important supplement to general incomes from the market (Bharucha and Prettty, 2010: 2919). Incomes from wild food selling are especially critical during economic hardship (Bharucha and Prettty, 2010: 2919). For example, it is reported that bush meat in Ghana market is worth of $275millon annually (Bharucha and Prettty, 2010: 2919).

In general, existing literature on WEFs in Ethiopia entirely c oncentrates on counting of species of WEPs. For example, Fantahun and Hager (2009: 210-212) tried to list 44 species of edible fruits. 120 species of WEPs were listed in Southern Ethiopia (Guinand and Dechassa, 2001: 34). In a similar fashion, while conducting ethnobotanical study of WEPs (Tilahun and Miritse, 2010: 3) found 38 plant species used as food in Southern Ethiopia while other study listed 37 such species in Eastern Ethiopia (Debela et al., 2010: 140-142). Another study by Asegid and Tesfaye counted 30 such species in Southern Ethiopia (2011: 9). At national scale, while trying to study the role of WEPs in combating food insecurity in Ethiopia, Ermias et al (2011: 90-122) indicated and documented 413 species of WEPs in Ethiopia. Despite all these contributions, there still remain important issues about WEFs that need to be further investigated, i.e. at least their resilience dimension.

2.3. Analytical Framework

Figure 2 below shows the analytical framework used in the paper. Amount of WEFs obtained by households through different ways constituted the backbone of the study. WEFs contribution to resilience is viewed through the mirror of IFA (a latent indicator) of overall household resilience because the IFA variable itself was constructed as a composite index of seven variables including WEFs. It is assumed that WEFs serve as both observed variables constituting the IFA and latent variable measured from different sources of WEFs. During period of food shortages, it is mainly used as a coping mechanism, whose contribution to household resilience to food

insecurity is measured as a component of IFA, one of the main latent variables of resilience. The whole process is shown in the following analytical framework.

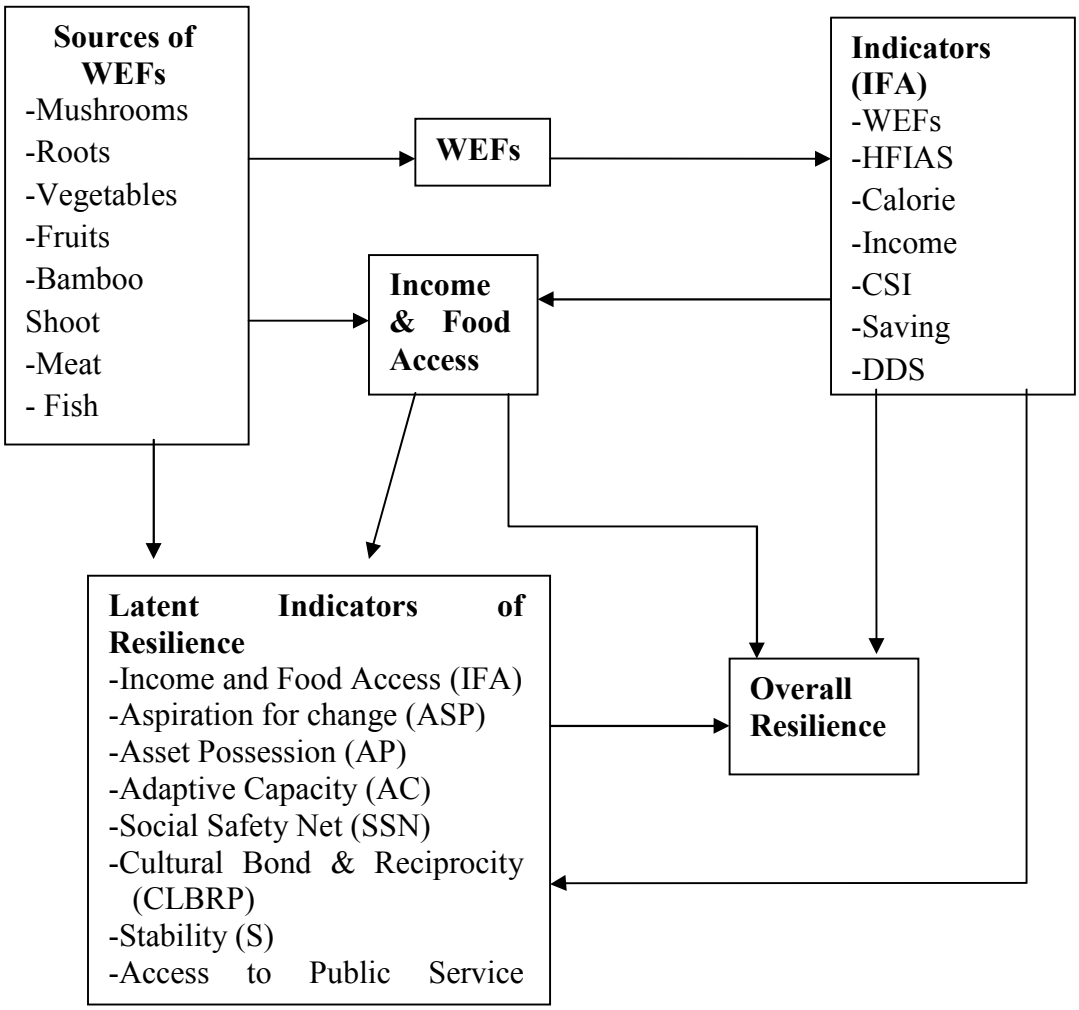


Figure2. Analytical Framework

3. Methodology

3.1. The Population and Sample Size

This paper was produced based on Belo-jiganfoy district taken as a case study area in order to provide a clear picture of the *green famine belt* in terms of both food insecurity and use of WEFs. In 2012, the district had a total population of 37471 and 7347 households with average family size of 5.1 (FDRE-ERA, 2008). Thus, the population for which the study will be generalized is 7347 households, which is found between 7000 and 8000. According to the formula suggested by Krejcie & Morgan (1970) cited in Agea et al (2011: 136), if N = 7,000,

sample size of 364, and if N=8,000 sample size of 367 is enough, the average being 366 that statistically represents the total population. But, considering the relative homogeneity of households within each ethno-culture group, the sample size was reduced to 220. The sampling procedure is indicated in Table1.

Accordingly, a cross-sectional survey was conducted during the last week of August 2013 based on 220 households. Both non-random and random techniques were employed to select sample households. A stratified random sampling technique was employed to ensure the representativeness of the sample households and size. First, 3 kebeles out of 10 in the district were purposively selected based on their distance from district center and road infrastructure. Accordingly, Senne, Say Dalecha and Soge kebelles were selected. Second, based on information about total number of population and ethno-cultures in each kebele, households were divided into two groups: the indigenous and the non-indigenous. Third, the number of sample size in each kebele and ethno-culture group was determined through proportional allocation method. Finally, sample households for interview were selected using simple random method.

Table1 Sampling Procedure for Selection of sample households

Kebele	**Dist.from Soge Town**	**Tot. hh**	**Ethno-culture**	**HH size**	Sample HH	**Sample** (Both)
Senne	>=30km	633	Indigenous	239	28	74
			Non-indigenous	394	46	
Say Dalecha	15-30km	282	Indigenous	180	21	33
			Non-indigenous	102	12	
Soge	<=15km	966	Indigenous	615	72	113
			Non-indigenous	351	41	
Total		1881	Indigenous	1034	121	220
			Non-indigenous	847	99	

3.2. Data Sources and Method of Collection

Quantitative data were generated from households for this study although few information from key informants and semi-participant field observations were used. Data on amounts of WEFs collected and/or hunted and consumed, perceived causes of reduced dependence on WEFs were gathered. Information from key informant interviews and field observations were obtained. For this purpose, a questionnaire was prepared and administered to sample households through face-to-face interview technique by oriented enumerators who are familiar with the local language of the study area.

3.3. Data Analysis

Both quantitative and qualitative methods were used to analyze in a mixed-methods fashion as this paradigm underpins the current study. Accordingly, objective data from questionnaire were first analyzed and interpreted, and then substantiated by data from qualitative sources (i.e. key informant interviews and observations) in a sequential manner. Accordingly, multivariate techniques (factor analysis and linear regression) and descriptive statistics methods including cross-tabulations were used to examine the contribution of WEFs to household resilience to food insecurity. For his purpose, statistical package for social sciences (SPSS) version 19 was used.

One of the serious limitations associated with the data generated on WEFs was rough estimations used when converting into kilogram equivalents. Thus, the analysis was performed recognizing this limitation. In attempting to understand WEFs' contribution to resilience, sum of all sources of WEFs was calculated for each household. The summed values of WEFs and the other six observable indicators of IFA latent variable were analyzed using factor analysis using principal axis factoring method. The seven observed variables (including WEFs) were used to constitute the IFA index. It should be noted that IFA was in turn employed as one of the latent variables in constructing an overall RI for surveyed households. In this paper, the RI is used to assess the proportion of households that depended on WEFs in resilience category based on the vulnerability-resilience spectrum. Above all, in order to secure a reliable and valid data, ethical issues were well addressed. Attempts to get the informed consent of each respondent and building their confidentiality before the actual interview was made. This was done through explaining the purpose of the study, dispersion of the results, participant rights and risks prior to participation as suggested by Hakkett et al (2008).

4. Results and Discussion

4.1. Food Security and Household Resilience Statuses

The result of the study shows that 71.8% of households were food insecure and 60% of them were exposed to hunger situation. Analysis of food insecurity access prevalence shows 20.57%, 22.59% and 17.76% of households were mildly, moderately and severely food insecure respectively. This implies that food insecurity was severe among households even more than in drought-prone and high population density areas. It was more severe among the indigenous than the non-indigenous group calling for intervention strategies that target more at cultural variables than the environmental factors. As indicated on a resilience-vulnerability continuum, 65.25%, 14.83%, 14.64% and 4.28% of households were vulnerable, moderately resilient, resilient and highly resilient, respectively. This shows that only 34.75% of households were resilient at different levels. More non-indigenous (19.72%) than Indigenous (15.03%) ethno-culture groups were resilient to green famine condition. But, if one considers a moderately resilient category as vulnerable, the percent of vulnerable households to seasonal food insecurity would increase up to 80%. The overall observation shows that food insecurity in the green famine belt is more severe than in the drought-prone part of Ethiopia.

4.2. Amount of Wildfood and Income Generated from Sale of Wildfood

As indicated in Table2 below, surveyed households gathered and/or hunted 344.53qtl of WEFs from all sources during the survey year. This shows average WEFs of 1.57qtls as compared to 31.47qtls obtained from cultivated sources. This amount is very small with respect to the total family size of 922.81 adult in equivalent (ADE hereafter) and when compared to food obtained from cultivated sources (i.e. 6922.77qtl). Accordingly, WEFs covered only 4.74% of the total food produced by the households and covers significant portion (9.12%) of the total net available food (NAF) for the year (i.e.3777.25quintals). This result is nearly similar with the findings of some studies in Sub-Saharan Africa countries, for example, Tanzania where wild fruit contributed 11% of food consumed by surveyed households (Kajembe et al., 2000: 9). In fact, as opposed to the contribution of crop produced, this amount might seem small, but it played significant role in combating food shortages and enhancing resilience as some WEFs have better nutrition content than cultivated crops. Most often, in a given survey, the amount of WEFs is under-reported perhaps because hunting forest or bush meat is illegal (Bharucha and

Prettty, 2010: 2919). Likewise, the present smaller amount of WEFs than cultivated sources might be due to under-reporting.

Table2.Food available from Wild and *Cultivated Sources for Surveyed Households, 2013

Food Source	**Amount produced (Quintal) and Family size**					
	Total	**%**	**Mean**	**Std**	**Min**	**Max**
Household Size(ADE)	922.81	-	4.20	1.65	1.68	13.65
Cultivated Food	6922.77	95.26	31.47	23.68	0.06	131.15
WEFs (all)	344.53	4.74	1.57	1.69	0.00	6.85
Total	7267.30	100.00	33.03	22.80	0.06	146.10
Net Available Food (NAF)	3777.25	51.98	4.09	2.93	0.06	19.59
Income from WEFs (birr)**	5885.00	-	26.75	109.03	0.00	1000.00

NB: meat of 1 antelope = on average 25kilogram; 1bird = on average 0.5kilogram; 1kg fish = 10fish; 1 'medeb' cattle meat= on average 10kg
*includes own produce, grain purchased and grain borrowed.
**19.45ETB was equivalent to $1.00 at the time of survey.

Moreover, WEFs were also used as a source of income for households. Households sold some amount of WEFs and earned 5885.00birr with mean 26.75birr and standard deviation (STD hereafter) of 109.03birr. The larger STD shows the greatest disparity in their dependence on WEFs as source of income. This shows another way by which WEFs contributed to households' resilience to seasonal food insecurity. It is indicated that in tropical Africa, significant proportion of WEFs (mainly bush meat) is sold at market places. For example, on average, 66% of hunted meat is sold in Cameroon (Muchaal and Ngandjui, 1999: 390). In the study area, however, it seems that most of the WEFs were eaten rather than being sold at market. But, the finding shows the presence of tradition and interest of selling WEFs among the households in the study area. But, perhaps due to lack of surplus WEFs produced, they sold small portion. By implication, households in the study area would have depended on sale of WEFs if surplus amount could

have been found. Anyways, for those who sold it, they might have covered some of their food shortage gaps during the shocks, and used to enhance their resilience.

In general, both the amount of WEFs and income from them were smaller than cultivated sources. The field observation shows that almost all indigenous and most non-indigenous households used to collect WEPs although hunting WEAs was reported mainly by indigenous ones. As the field experience shows households were extremely reluctant to report their dependence on WEFs, mainly WEAs. This was perhaps the reason for reporting smaller amount of WEFs than cultivated sources, the same reason applying for smaller income obtained from WEFs.

4.3. WEF's Contribution to Household Resilience to Food Insecurity

Results of Multivariate Analysis

The contribution of WEFs to household resilience was analyzed and understood through its contribution to IFA. IFA was used as one of the latent dimensions used to construct the overall index to household resilience to food insecurity. As stated in the methodology section, factor analysis using principal axis factoring method was run in order to examine the extent to which WEFs constituted to the IFA latent variable.

Testing for Sampling Adequacy and Sphericity

The Kaiser-Meyer-Olkin (KMO hereafter) test was used to check the sampling adequacy for the study. The KMO measure of sampling adequacy is nothing but a statistics that indicates the proportion of variance in the latent variable that might be caused by underlying factors. It shows the level of compactness or diffusion of correlations in the correlation-matrix (i.e. R-matrix) indicating the appropriateness of the factor analysis run with the data used. As a rule of thumb, SPSS suggests that the higher KMO values (close to 1) generally indicate that a factor analysis is useful with the data used, because it shows more compactness of data distribution. KMO value should be >0.50 if sample size and the proportion of variance in variables that might be caused by underlying factors are adequate for running factor analysis (Field, 2005: 6). This method of testing sampling adequacy has been used by different authors. For example, Keil et al (2006: 6) found the KMO measure of 0.760 indicating good compactness of pattern of correlations so that factor analysis yielded distinct and reliable factors. Likewise, the results of this study (Table3) show the KMO statistic of 0.631 implying that the sample from which data

were collected is adequate, that the pattern of correlations in the R-matrix were compact and factor analysis is appropriate for the data used, that the sample size from which data were collected was adequate for running factor analysis and, that the first principal component is reliable and can represent IFA latent variable.

Table3.The KMO and Bartlett's Tests of Sampling Adequacy and Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.631
Bartlett's Test of Sphericity	Approx. Chi-Square	325.902
	Df	21
	Sig.	.000
Determinant of correlation	R^2	0.221
Extraction Method: Principal Axis Factoring.		

Source: Analyzed based on Survey Data

As hypothesized, Bartlett's test of sphericity was also found highly significant ($p < 0.001$) showing that factor analysis is useful with the data used. This test is used to test the null hypothesis that the original correlation matrix is an identity matrix in which all correlation coefficients (R-matrix) would be zero (Field, 2005: 6). As a rule, SPSS suggests that the Bartlett's test of sphericity with smaller values (<0.05) of significance level suggests that it is significant and identity matrix is not a problem. On the other hand, if R-matrix shows higher values ($R \geq 0.9$), then there is a problem of singularity (Field, 2005: 5). Based on this criterion, there were no problems of singularity in the present study. Moreover, there were no problems of multicollinearity ($R^2 = 0.221$) because for multicollinearity to exist, the determinant (R^2) of the correlation matrix should be > 0.00001 (Field, 2005: 5). Overall, the data used for the factor analysis was appropriate with the data available for the study. As a result, the first factor produced was quite meaningful and can be used as a latent variable (IFA) as it fulfils most requirements mentioned above. However, all three of the factors generated were used to construct the IFA latent indicator of household resilience to food insecurity for reasons explained (see the next discussion that deals with this issue).

WEFs Contribution to Resilience as Viewed through Income and Food Access (IFA) Latent Indicator

As stated earlier, the role of WEFs in household resilience to food insecurity is assessed indirectly through its contribution to the IFA latent variable. Results of factor analysis including the communalities and factor loadings as well as the correlations and standardized coefficients of linear regression analysis were examined to show this.

Table4 Communalities, Factor Loadings, Correlation with IFA and Standardized Coefficients

Indicators of IFA	**Communalities**		**Factors & Loads**			**Corr. (IFA)**	STDZ coef(B)
	Initial	Extraction	1	2	3		
WEFs (quintal/hh/year/)	.170	.226	-.055	.467	-.070	.174*	.114
HFIAS scores	.535	.952	-.880	.343	.245	-.457*	-.314
Kilocalorie/ADE/day	.486	.573	.741	-.035	.150	.743*	.443
Income/ADE/year	.324	.424	.405	-.339	.381	.402*	.197
CSI Score	.363	.733	-.181	.836	-.047	.287*	.616
Saving (birr/ADE/year)	.229	.498	.324	-.151	.609	.581*	.431
DDS (No. meal/hh/day	.049	.027	-.040	-.002	.158	.051	.041
Extraction Method: Principal Axis Factoring							

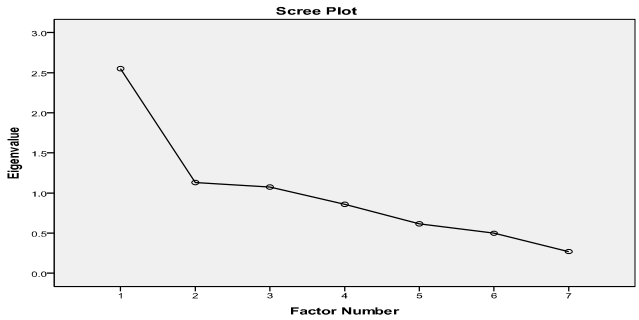
*Significantly correlated

Table 4 above shows that the proportion of variance accounted for in WEFs by the rest of the variables (as indicated by initial communality = 0.170) and by the factors in the factor solution (as indicated by communality after extraction, 0.226) were acceptable. In fact, as a rule of thumb, variables with smaller values of communalities after extraction should be dropped although the extent to which a smaller value is small is not determined. In this paper, all

variables are maintained as the objective was to compare the importance of each variable (mainly WEFs) in constituting IFA with each other. Accordingly, 17% of the variance in WEFs was shared by the rest of the variables. This shows that, although small, WEFs were associated with the rest of the variable in the process of detecting the structure towards forming the IFA variable. Moreover, 22.6% of variance in WEFs was shared by the factors generated in the factor solution, i.e., IFA indicating their direct contribution to IFA although relatively smaller than most other variables except DDS. Although the proportions are smaller compared to others, the result shows that households depended on WEFs as a source of food. As the researcher's field observation signifies, the smaller share of WEFs in contributing to IFA was perhaps due to two reasons. First, the households were too much reluctant to report all of the amounts collected/hunted. Second, those who want to report it fully might have forgotten the exact amount they collected and hunted. However, the researcher observed especially WEPs in daily meals of almost all indigenous households and some non-indigenous households.

Other important outputs of factor analysis were the factors generated as a process of structure detection. Such analysis generated three factors with eigenvalues greater than 1. As shown earlier, tests of KMO and Bartlett's statistics proved that the first factor can be a representative of IFA variable. Specifically, the examination of Scree plot suggests that the third factor should be dropped from further analysis because the slope between the second and third factors was gentle (see Figure2). In contrast, the steeper slope between Factor 1 and Factor 2 suggests that the first two factors would be used in further analysis. However, as the variance explained by both second and third factors was relatively large enough, it is maintained and considered in the estimation of IFA.

Figure 2. The Scree Plot indicating the Slopes between Factors Generated in the Factor Solution



However, further examination of the amount of variance explained by each factor encourages the use of all factors to construct the IFA latent variable for three reasons. Firstly, proportion of total variance accounted for by the first factor alone is not adequate. Secondly, the second and third factors accounted for significant proportion of the total variance in IFA. Thirdly, the combination of the three factors together explained a significant proportion (67.94%) of the variance in the latent variable. Even after rotation, the three factors explained about half the variance are acceptable ones (see Table5).

Table5: Total Variance Explained: Initial, after extraction and Rotation

Total Variance Explained									
Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	Variance (%)	Cum. %	Total	Variance (%)	Cum. %	Total	Variance (%)	Cum. %
1	2.55	36.44	36.44	2.20	31.41	31.41	1.63	23.29	23.29
2	1.13	16.17	52.60	.68	9.71	41.11	1.17	16.76	40.04
3	1.07	15.34	67.94	.56	7.94	49.05	.63	9.01	49.05
Extraction Method: Principal Axis Factoring.									

As a result, the IFA dimension is determined based on the three factors as follow:

IFA = [0.3644*Factor1 + 0.1617*Factor2 + 0.1534*Factor3]/3

Then, the factor loadings and correlations of the observed (underlying) variables with IFA scores were shown in Table 4. The correlation coefficients show the direction and the strength of the relationships of each variable with IFA. Accordingly, WEFs are positively related with IFA showing a unit increase in WEFs increases the IFA score by 0.174 units and their relationship is significantly strong as it is different from 0. The factor loadings of each variable on IFA are very important outputs of factor analysis derived from the rotated factor matrix showing the extent of contribution of WEFs to IFA. In fact, the contribution of WEFs to IFA would have been shown from a single IFA indicator. But, IFA is constructed as a composite index of the three variables. However, by observing the load on Factor 2, one can say WEFs

have moderate contribution (see Table 4). But, the importance of WEFs in contributing to IFA can best be examined using standardized coefficients obtained by analyzing linear regression. For this purpose, linear regression was run using IFA score as dependent variable and seven of the observed variables as explanatory variables. The regression model was given as follows:

IFA = 0.294 + 0.015*WEFs - 0.42*HFIAS + 0.059*Kcal + 0.026*Income + 0.082*CSI + + 0.057*Saving + 0.006*DDS + e

Where, IFA is Income and Food Access

WEFs is Wild Edible Foods

HFIAS is Household Food Insecurity Access Scale

Kcalorie is Food Energy measured in terms of kilocalorie

Income is the amount of earning gained by a household

CSI is Coping Strategies Index

Saving is the amount of Money saved for the time of hardship

DDS is Dietary Diversity Score measured as the total number of meals eaten per day

E is an error term

In addition to the factor loadings, the standardized coefficients (B coefficients) were used to show the importance of WEFs in constituting IFA variable. As shown in Table 4, the relative importance of WEFs in constituting IFA variable (B = 0.114) was smaller than five other indicators but much more than that of DDS. This is also seen from the unstandardized coefficients with the exception of HFIAS which were very small. In both cases, although smaller than most variables, WEFs well contributed to IFA and hence household resilience to food insecurity.

Analysis of Information Related to Dummy Responses to Household Dependence on WEFs

Consuming WEFs as a response to food shortages (Tairo, 2007: 208) shows their real contribution to household resilience. In addition to serving as a coping mechanism, WFFs in some cultures, like the present study area, are consumed as part of regular meals when available. In the present study area, WEFs seem to have been used more of as coping mechanism although it is also part of a regular meal mainly for indigenous people of the study area. The indigenous people were more confidential in their ability of gathering and hunting WEFs than the non-indigenous so as to resist the impacts of seasonal food shortages. In addition to data collected and analyzed based on the amount of WEFs collected and/or hunted, households' responses to

their dependence on WEFs was also analyzed. All surveyed households were, therefore, asked the following question: *Have you depended on any source of WEFs this year?*

Table6: % Distribution of Households Who Reported Their Dependence on WEFs by Ethno-culture Group

Have you depended on any source of WEFs this year?				
Response	Description	Ethno-culture Group		Total
		Indigenous	Non-indigenous	
Yes	Number	105	39	144
	%	47.7	17.7	65.5
No	Number	16	60	76
	%	7.3	27.3	34.5
Total	Number	121	99	220
	%	55.0	45.0	100.0

The results in Table 6 indicate that 65.5% of households responded that they used to depend on WEFs. Of those reported "yes", 47.7% belongs to indigenous and 17.7% belongs to non-indigenous ethno-culture groups. Only, 34.5% of them didn't report their dependence on WEFs out of which 7.3% and 27.3% of them belongs to indigenous and non-indigenous ethno-culture groups, respectively. These results have several implications about the practices and consumptions of WEFs. Clearly, more households in the indigenous ethno-culture group were dependent on WEFs than the non-indigenous ones. The proportion of households depending on WEFs (65.5%) was about twice higher than the percent of those who weren't (34.5%). This shows that households were highly dependent on WEFs as a response to food shortages because data were collected after the incidence of *food shortfalls*. 34.5% of households who didn't report their dependence on WEFs may not mean that of households had never collected and consumed WEFs. Rather, according to semi-participant observations, some households didn't actively engage in gathering WEPs and hunting WEAs, but they used to eat when and where available. As a result, they had nothing to report during the survey. The other observation was that whatever informed consent was obtained, most households were reluctant to report mainly

hunting WEAs such as wild mammals except fish due to fear of legal punishments as hunting is an illegal act. Field observations, however, revealed that households had practiced hunting edible mammals until the time of this survey. Evidences existed in some houses of households where the skins of wild mammals (i.e. antelopes) were hanged up as a wall decoration (Appendix 1) after the flesh is eaten. The other implication of the results is that the households in the non-indigenous group were likely to perceive hunting and gathering activities as indicator of traditionalism so that they were likely to have minimized these activities. As a result, the data in table 6 above indicate that only very few non-indigenous households reported their dependence on WEFs. But information from semi-participant field observation reveals that the non-indigenous households were actually engaged in at least collection and consumption of wild mushrooms, roots, and honey as well as in hunting birds and mammals. The fact that considerable percent of indigenous households depended on one or more types of WEFs, therefore, implies that WEFs were one of the determinant variables of resilience of households in the indigenous ethno-culture group than the non-indigenous one.

Results of Cross-tabulation of Resilience Status and Dummy Responses

Cross-tabulation between resilience status and dummy responses were conducted in order to understand in which categories (of vulnerability-resilience spectrum) households who reported "yes" and "no" to their dependence fall.

Table7: Dependence of Households on Wild edible foods by Resilience-status

Have you depended on any source of WEFs this year?		Household Resilience Status				Total
		HRI<0.100	0.100<RI<=0.250	0.250<=RI <0.500	RI>=0.500	
Yes	Number	96	24	21	3	144
	%	43.6	10.9	9.5	1.4	65.5
No	Number	36	18	17	5	76
	%	16.4	8.2	7.7	2.3	34.5
Total	Number	132	42	38	8	220
	%	60.0	19.1	17.3	3.6	100

NB: Vulnerable (RI ≤ 0.100); Moderately Resilient (0.100≤RI<0.250); Resilient (0.250≤RI<0.500); Highly-resilient (RI≥0.50)

The contribution of WEFs to household resilience can also be indicated on the vulnerability-resilience continuum. As can be seen from Table 7 above, overall, 65.5% of households reported their dependence on one or more type of WEFs. Out of this, the larger proportion of households who reported their dependence on WEFs (43.6%) belongs to the vulnerable group. Considering 10.9 % of households in the next group on the spectrum (i.e. moderately resilient) as almost vulnerable, the proportion of vulnerable households reported their dependence on WEFs is increased to about 54.5%. Only the remaining 11% of them was found in the higher resilience category on the continuum. Therefore, the higher proportion of vulnerable households reporting their dependence on WEFs implies that the role of WEFs to household resilience was significant in the study area mainly during food shortages. On the other hand, considerable proportion (34.5%) of all households reported that they didn't depend on WEFs. The largest proportion of such households in the vulnerability category (16.4%) may imply that these households either belong to non-indigenous group or reluctant to report their dependence on the WEFs.

4.4. Types of WEFs and Households' Dependence on Them

Identifying the main categories of WEFs consumed in the study area helps to emphasize, when formulating policy and intervention strategies, on relevant types that were frequently consumed and thought to have better enhanced household resilience. Presently, WEPs are the dominant sources of WEFs than WEAs in the study area. Hunting animals was reported much less than collection of WEPs.

Table 8: Distribution of Households Reporting Types of WEFs by Ethno-culture Group

Type of WEFs	Amount (kg)	% of Total	Indigenous	Non-indigenous	Total	% of Tot (N=220)
Mushroom	2065.25	5.9%	75.9%	24.1%	100.0%	60.5%
Roots	3595.95	10.4%	89.9%	10.1%	100.0%	49.5%
Vegetables	18043.50	52.4%	73.8%	26.2%	100.0%	64.1%
Fruits	3982.30	11.6%	79.7%	20.3%	100.0%	55.9%
Bamboo Shoot	1235.40	3.6%	98.5%	1.5%	100.0%	29.5%
Meat	2647.70	7.7%	80.4%	19.6%	100.0%	46.4%

Fish	1915.00	5.6%	76.4%	23.6%	100.0%	48.2%
Honey	968.00	2.8%	100.0%	0.0%	100.0%	25.0%
Total	**34453.1**	**100.0%**	**55.0%**	**45.0%**	**100.0%**	

Source: Computed Based on Household Survey Data

Wild Edible Mushroom and Household Resilience

The role of Wild Edible Mushroom (WEMRs) in households' resilience to food insecurity seems significant as considerable proportion (60.5%) of surveyed households (75.9% indigenous and 24.1% non-indigenous) reported them (Table 8). Overall, surveyed households collected and consumed 2065.25 kilograms of mushrooms. This is 5.9 % of the total WEFs gathered and hunted during the year. Fortunately, WEMRs are available seasonally following summer rains and this often coincides with the seasons of food shortages. In this regard, collection and consumption of WEMRs may be considered as a coping strategy to food shortages although it is practiced during periods of food surplus, too, when available. The fact that data were collected immediately after the period of food shortages occurred implies that the households collected and consumed WEMRs during these periods in order to combat food shortages. Therefore, coupled with their delicacy and palatability, the role they played in contributing to household resilience was considerably high. Key informants were asked for their availability, responsibility of collection and preparation, and form eaten of WEMRs. They told that, formerly, every field was full of mushrooms and the collector makes preference of one species to the other. It had, however, been drastically declined and only few species could be found (see Appendix 1). In the study area, similar to the case of Tanzanian households (Kajembe et al., 2000: 11), all capable members of family were engaged in collection of WEMRs while the preparation was the role of females. WEMRs were eaten either roasted or boiled in the form of sauce. Both indigenous and non-indigenous ethno-culture groups also eat them as main food with ground chilly as a sauce mainly when drinking "borde", locally brewed drink by indigenous people, which is likely to have less alcoholic content.

Wild Edible Roots and Household Resilience

The survey result shows that wild yams are known edible roots in the study area that both ethno-culture groups used to collect and feed their families. Table 8 above shows that 49.5% of all

surveyed households (89.9% indigenous 10.1% non-indigenous) reported their dependence on the wild edible roots (WERs) during the survey year. All surveyed households collected 3595.95 kilograms of WERs during the survey year, which was 10.4% of the total WEFs produced during the year. Field observation shows that wild yam collection was the role of both male and female members of a household by the indigenous group but the role of males in the non-indigenous ones. Photo in Appendix 1 taken during field observation shows a Gumuz boy digging out wild yam on a cliff side of a small river in Soge *kebele.* Wild yam can be eaten both in a roasted or boiled forms. But, most often males used to roast it in the forest where they collect it, eat some portion there, and bring some other portion to home to feed household members. On a temporary basis, the indigenous households never worry about hunger (if it occurs) as every member can go to forest and can collect and eat the WERs. In this regard, the role WERs played in alleviating problems of food shortages and enhancing households' resilience was enormous especially for the indigenous households. However, the increasing rate of deforestation has threatened this activity as it totally depends on the availability of natural forests.

Wild Edible Vegetables and Household Resilience

Wild edible plants including wild edible vegetables (WEVs) may often show higher contents of some important minerals and vitamins than cultivated plant foods (Milton, 1999: 491). This implies that even a small amount of WEVs consumed by household members might have higher potential of alleviating nutritional inadequacies and enhancing household resilience to food insecurity. WEVs are the most available and consumed type of WEFs in the study area. The largest proportion (64.1%) of surveyed households (73.8 indigenous and 26.2% non-indigenous) collected and consumed WEVs (Table 8). During the survey year, 18,043.50 kilogram of WEVs was produced by all surveyed households. This accounted for the largest percent (52.4%) of the total WEFs produced during the year indicating its significance in contributing to household resilience. It was about 5 times larger than the second large contributor (i.e. fruits with 11.6%). This finding is not based on the semi-wild vegetable collected and eaten in the study area. Had semi-wild vegetable (i.e. including domesticated vegetables growing unwanted here and there in fields) been considered, 100% of surveyed households would have reported their dependence on WEVs. This is what the researcher observed during semi-participant field observation in sample *kebeles,* where every household did not miss it in dishes for most days of a week during summer

(rainy) season of Ethiopia. As indicated by Kajembe et al (2000: 9), WEVs are easily obtainable, palatable, and have good taste, and are also important sources of vitamins. Due to these qualities, the role WEVs played in enhancing resilience can be regarded as high. Although males were occasionally engaged, the collection and preparation of WEVs was dominantly the responsibility of female members of a household in the study area. This idea matches with the findings in Tanzania where collection and preparation of WEVs is the responsibility of girls and women (Kajembe et al., 2000: 10). WEVs were most often eaten boiled although some males from the indigenous group eat roasted when they are in forests and when drinking "borde" during the "borde ceremony".

Wild Edible Fruits and Household Resilience

Wild edible fruits (WEFRs) also contributed a lot to households' resilience to *green famine* conditions as a considerable proportion (55.9%) of surveyed households (79.7% indigenous and 20.3% non-indigenous) reported their dependence on them (Table8). About 3,980.30 kilograms of WEFRs were collected during the survey period. This is the second largest production (i.e. 11.6% of total WEFs produced) next to vegetables showing how important it was in alleviating food shortages. Some studies, for example, Milton (1999), indicate that wild fruits have higher average protein levels and essential micronutrients than their counterpart cultivated fruits (Milton 1999: 491). These and other qualities of WEFRs made them play a considerable role in household resilience to seasonal food insecurity in the present study area. Usually collection of WEFRs is regarded as the task of children and they were observed here and there in trees collecting and eating fruits during field observation. Older women and men were also observed collecting and eating wild fruits, which is similar to the Tanzanian case where children were most frequently engaged in these activities while other members were less engaged in it when they are in the forests for other activities (Kajembe et al., 2000: 9). According to field observations, the collection and consumption of wild fruits were as important and equally considerable as vegetables although more households reported the consumption of WEVs than households reported WEFRs. Most members of a household who have an opportunity to travel outside their home have a chance to eat at least one type of fruit per day in the study area.

Wild Edible Bamboo Shoots

Wild edible bamboo shoots (WEBSs) were consumed by 29.5% of the surveyed households (98.5% indigenous and 1.5% non-indigenous). Overall, 1235.4 kilograms of WEBSs were collected and consumed by surveyed households (Table 8). Consumption of bamboo shoots is the tradition of all indigenous households. But, few of the surveyed households reported that dependence on wild edible bamboo shoots has declined perhaps due to an increased deforestation of the resource itself. At present, patches of bamboo forest can be found in remotest and inaccessible areas as a result of which collection of edible shoots had become difficult. As field observation shows, bamboo forest is likely to extinct in the near future unless sound policy measures are taken. Collecting bamboo shoots is the responsibility of older women as they have the experience about which part of the shoot to be cut and the skill of preparing it. All households in the indigenous ethno-culture group believe that the sauce prepared from bamboo shoot might kill if consumed without cooking it for a longer time. However, how long "a longer time" is still questionable. Some women say half a day while others say a day, a day being 12 hours of bright sun in tropics. This is why the older and experienced women often take the responsibility of collecting and preparing WEBSs.

Wild Edible Meat

The range of animal species eaten by man includes birds and their eggs, insects, rodents, fish, and larger mammals (Kajembe et al., 2000: 12). However, households in the present study area reported consumption of birds and mammals only. No evidence of eating rodents, insects and worms was reported although these were said to have been consumed formerly by the Nilotic people, one of the indigenous peoples of the present study area. However, households were extremely reluctant to report their dependence on wild meat sources. The data in table 8 indicate that 46.4% of all surveyed households (i.e. 80.4% indigenous and 19.6% non-indigenous) reported that they consumed wild meat during the survey year. In some African countries, for example Cameroon, more than 98% of animal protein consumed in vicinity of some reservoirs comes from bush meat (Muchaal and Ngandjui, 1999: 386). All surveyed households in the present study area, however, produced 2647.70 kilograms of wild meat during the year. This covers only 7.7% of all WEFs available from all sources. Although the source of wild edible meat has been deteriorated, birds were frequently killed and eaten especially by the indigenous ethno-culture group. Although it is legally forbidden, households used to hunt and consume

bigger mammals, as a result of which most of them didn't want to report it. In the present study area, hunting wild edible animals (WEAs) is entirely the responsibility of male members of households while cooking is that of the female members. The amount produced during the year had played important role in alleviating food and nutritional shortages due to better protein content of wild meat. The nutritional content of wild meat is comparable to domestic meat (Kajembe et al., 2000: 13); as a result, its role in combating nutritional insecurity was high.

Wild Edible Fish

Overall, 48.2% of surveyed households (76.4% indigenous and 23.6% non-indigenous) reported their consumption of fish. About 1915.0 kilograms of fish was produced from rivers in the study area. This covers 5.6% of the total WEFs produced (Table 8). Fish had been caught and consumed in some of the rivers such as Didessa, Fuafuate and Anger that cross the district. With regard to current status of fish resource, there should be sound policy measures that should be taken because use of some toxic substances to catch fish is damaging river fish in the district. During the field observation, the researcher saw the color of water in the lower Fuafuate (Didiga) changed into reddish due to excessive toxic substance extracted from barks of trees added to it to catch fish. Fish was caught by both men (young and old) and women in the district.

Wild Edible Honey

The lowest proportion (25%) of all surveyed households (100% indigenous) reported that they collected and consumed wild honey. 968.00 kilograms of honey (2.8%) of total WEFs was produced in the district (Table 8). In fact, this seems small amount, but most non-indigenous ethno-culture group did not report it because field observation shows that they used to collect it from traditional beehives. The role it played in alleviating food shortages can be viewed through the income obtained from it than direct consumption. Wild honey is entirely collected by male members of a household. Honey is an important source of carbohydrate that gives energy (Kajembe et al., 2000: 13). In this regard, through energy provision, honey consumed in the study area to some extent might have alleviated problems of nutritional inadequacies.

4.5. Human Health and Wild Edible Foods Nexus

Many indigenous households of the study area related the recent increased frequency of sickness of their members to shortage of WEFs. This can be better understood by investigating the opinion of key informants, Mr. Mesha and his older sun, Mr. Tesfaye Mesha, both living in Soge *kebele* during survey year. Mr. Mesha was an elderly Gumuz man, about 60 years old, had been persistently sick due to what is locally known as *berd-beshta,* meaning *sickness due to cold weather*. He and his son told that they visited any available health center for treatment. But Mr. Mesha couldn't recover from his sickness. The researcher tried to understand the reason for his inability to recover from this sickness based on the way the son and his father perceived it. Both believed that lack of wild meat caused the sickness explaining that formerly one did not miss at least a dried wild meat in kitchen. The reason for decreased consumption of wild meat, according to Mesha and his son, Tesfaye, are two. Firstly, wild animals are forced to migrate and are located in remotest areas as a result of increased deforestation. Secondly, hunting available mammals was legally forbidden although they continued to try to practice it in a hidden manner.

4.6. Perceived Factors Determining Household Dependence on WEFs

Households were asked to mention the factors determining their dependence on WEFs. Five possible factors (Table 9) were proposed after field observations and informal communications were made with some villagers and office workers of the district.

Table 9: Factors That Determine Household Dependence on WEFs by Ethno-culture Group

Reasons for Not Dependent on WEFs (N = 220)	**Response**	**Ethno-culture Group**				**Total**	
		Indigenous		**Non-indigenous**			
		No.	%	No.	%	No.	%
Crop Produce is enough	Yes	9	4.1	18	8.2	27	12.3
	No	112	50.9	81	36.8	193	87.7
Reduced Source of WEFs	Yes	31	14.1	54	24.5	85	38.6
	No	90	40.9	45	20.5	135	61.4
Hunting & gathering are legally forbidden	Yes	14	6.4	29	13.2	43	19.5
	No	107	48.6	70	31.8	177	80.5
WEFs have currently vanished	Yes	12	5.5	26	11.8	38	17.8
	No	109	48.5	73	33.2	182	82.7
It is not our culture	Yes	2	0.9	42	19.1	44	20.0
	No	119	54.1	57	25.9	176	80.0
Total Frequency	Yes	68	11.2	169	34.1	237	21.5
	No	537	88.2	326	65.9	863	78.5

	Total	605	55.0	495	45.0	1100	100.0

Table 9 shows interesting findings about the relative importance of each factor as perceived by the households. Of the total surveyed households, only 12.3% (i.e. 4.1% indigenous and 8.2% non-indigenous) perceived production of enough food from crops as a reason for their less dependence on WEFs. In other words, for 87.7% of surveyed households, enough produce from crops was not the reason for their less dependence on WEFs. This implies that non-indigenous households were less dependent on WEFs as there was enough produced food from crops as compared to indigenous ones. Reduced source of WEFs as a cause of less dependence on WEFs was reported by 38.6% of all surveyed households (i.e. 14.1% indigenous and 24.5% non-indigenous). In other words, reduced amount of WEFs was not the reason for the majority (61.4%) of the households. This implies perhaps that the WEFs are available at distant forests and hunting WEA is legally forbidden while they are found in those forests. Furthermore, only 19.5% of surveyed households (6.4% indigenous and 13.2% non-indigenous) reported that they were either little practiced or totally didn't practice WEFs because it was legally forbidden. The remaining 80.5% didn't perceive this as a reason implying that this was not truly the case for their less dependence on WEFs. Similar to previous reason, this also implies that, while there might be some wild animals for hunting, they were forbidden to practice it legally. 17.7% of households (5.5% indigenous and 11.8% non-indigenous) reported *totally vanished sources of WEFs* as a cause for limited or total absence of dependence on WEFs. The remaining 82.3% perceived it was not the reason for not depending on WEFs implying that there are still WEFs resources to depend on. The proportion of those who didn't depend on WEFs because it is not their culture was *20.0*% (i.e. 0.9% indigenous and 19.9% non-indigenous). This has two implications. First, for majority of them, it was not the cause for them not to depend on WEFs. Second, large proportion of non-indigenous households' reports show that, as stated earlier, hunting and gathering is an indicator of traditionalism and as a result the practice is of indigenous people of the study area. In general, for 21.5% of households, all were the reasons for their less dependence on WEFs while for significant proportion of households (78.5%), these were not the reasons. This calls for detailed investigation of the reasons, this being future research direction.

Conclusion

This study examined WEFs' contribution to household resilience to food insecurity in the *green famine belt* of Ethiopia. The findings show that the amount of WEFs gathered and hunted was much smaller than the cultivated food sources. Similarly, households used to generate income from WEFs but very small. Despite these, WEFs had fairly adequate factor loading onto IFA and significantly correlated with it. Moderately high standardized coefficient and slope coefficient of WEFs in regression model also show their importance in constituting IFA latent variable and hence to household resilience. Moreover, the fact that significant proportion (65.5%) of households reported their dependence on WEFs implies that there is greater interest in WEFs mainly to cope with food shortages. As data on WEFs were gathered during the time of acute food shortage, it is safe to conclude that WEFs played important role in households' resilience to food insecurity. Moreover, the fact that considerable proportion of indigenous households depended on one or more types of WEFs implies that WEFs were one of the dimensions of household resilience among the indigenous ethno-culture group than the non-indigenous one. In the vulnerability-resilience continuum, significant proportion (54.5% out of 65.5%) of households who reported their dependence on WEFs belongs to the vulnerable group. This implies that WEFs were consumed mostly as a coping mechanism although regularly eaten in the study area. More than half of the WEFs came from WEVs while considerable contributions also came from the remaining types. This is due to the fact that WEVs are relatively better available than other types of WEPs while WEAs are gradually disappearing. With regard to perceived causes of less dependence on WEFs, the majority of households reported that the reasons mentioned were not the causes for their less dependence on WEFs. This implies that the people in the study area had the interest in WEFs but due to unreported reasons, they depended less on WEFs. More importantly, WEFs contribution to health was mentioned by the elderly man from his experience which is also another use of WEFs. Generally, from the findings of the study, it is concluded that WEFs have contributed to household resilience to food insecurity although the amount reported was much less than what was eye-witnessed during semi-participatory field observations. Moreover, their contribution was much more among the indigenous than the non-indigenous ethno-culture group. Despite their importance in contributing to household resilience, the sources of WEFs have, however, been declining although the relative adequacy of WEVs was better than others.

6. Implication for Policy and Research

Based on the above conclusions, the following policy implications are drawn:

- The first implication of the study is related to addressing issues of diversity in rural development and food security policies. In this regard, Ethiopia is environmentally and culturally diverse country. By considering the geographical-cultural characteristics, Ethiopia can roughly be divided into two broad regions: the drought-prone and high population density half including eastern, northern, central and southern parts on one side and the moisture-sufficient and low population density half of northwestern, western and southwestern parts (i.e. *green famine belt)*. As a result, the environments in the Western Ethiopia have better capacity to supply WEFs and the households in this part are likely to persist on feeding on WEFs than other parts. Accordingly, the following specific recommendations are suggested:
  - ✓ A geographically and culturally differentiated strategy that addresses the different needs of people in each region and each culture group should be devised and implemented.
  - ✓ More specifically, a strategy that addresses the differences between indigenous and non-indigenous ethno-culture groups in access to food sources should be designed and implemented.
  - ✓ Research and policy intervention should equally focus on western half of Ethiopia, and the role of WEFs in addition to cultivated food sources because food security policy, programmes & research that focus on one part of a nation ignoring the other part will never be effective in bringing the desired level of development.
- The second implication is related to the link that exists between WEFs improvement and forest/ecosystem development.
  - ✓ In general, there is a need for improving the condition of WEFs in order to enhance household resilience, mainly the indigenous ones. Such an improvement in the availability of WEFs has a direct implication for development of biodiversity for healthy functioning of an ecosystem. This calls for a strategy that links food security and biodiversity development when considering WEFs in food security policy. Therefore, a strategy that integrates approaches from food security and protection of ecosystem should be designed and implemented so as to improve availability of WEFs.
- Finally, urgent measures should be taken in order to protect the natural forests that harbor WEFs if mainly the resilience of indigenous households is to be enhanced. Sound policy and

legal measures that protect deforestation, monitor wild life conditions, and delineation of farmlands from forest development areas must be made. For this purpose, there should be an urgent need to incorporate research on WEFs, their current status and future prospect.

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Paper Four: LAND USE-COVER CHANGE IMPLICATION ON RURAL LIVELIHOODS: THE CASE OF ODO-SHAKISO FOREST, SOUTHERN ETHIOPIA, OROMIA

DANIEL EBBA GURMU

Abstract

To assess the implication of land use/cover changes on rural livelihood characteristics, the study employed both quantitative and qualitative study designs. The households' livelihood wellbeing levels; households' capitals/assets were aggregated by using principal component analysis, to aggregate into a single dependent variable. The proxy land use/cover change indicators were run in multinomial logistic regression analysis to examine the direction and magnitude of the impacts upon the rural livelihood wellbeing using quartile cut point to differentiate household's livelihood statuses. Accordingly, those independent variables shown statistically significant difference in explaining livelihood wellbeing level like unreliability of rainfall occurrence, livestock quantity and productivity decline, drought frequency rise, increase of flooding extents on own land, crop disease prevalence increase were selected after passing through the different assumptions of multinomial logistic regression analysis. As a result, in quartile 1 (i.e., the poorest) households has more likely to lose their wellbeing referring to quartile 4 by 73% due to unreliability of rainfall occurrence. In quartile 2 (i.e., the poor) if other things are being constant the probability of the households being in the better-off livelihood wellbeing was reduced by 34.7%. Similarly, the rainfall unreliability for quartile 3 (i.e., the medium category) affected by reduction in livelihood wellbeing by 31.1%. Drought frequency rise also create statistically significant difference on households wellbeing at $p < 0.05$, and hence, households' livelihoods in quartile 1 and 3 reduced by 64.5% and 61.5%. Moreover, the proxy impacts of land use/cover changes of increase of extents of flooding on their own land stands first in compromising the sustainability of rural livelihood quality. For instance, it increases the status of the vulnerable households by 91.2% in the 1st quartile, 89.9% in the 2nd quartile and 73.7% in 3rd quartile. The crop disease occurrences shown statistically significant difference among the households in 2nd quartile, and hence it result in reduction of rural households livelihood wellbeing by 93.1%. In this regard the key informants also described, among the crop disease such as fungi and rust its local name wagi affect most cereal crops; coffee beery disease its local name kororima affect coffee, whereas zantomones enset its local name shanto affect all enset species and also termite the main pest that affect all crops. In general, the study concludes the poorest and relatively poor households i.e., categorized in quartile 1 and quartile 2 are more vulnerable to the impacts of land use/cover changes and its associated environmental and social impacts than the better of categories, which resulted in households livelihood deteriorations of the study area. Thus, it required urgent development, conservation, and sustainable utilization of natural resources and forests which plays a crucial role in making stronger the needs of society especially for poor natural resource dependant people.

Key Words: Land Use Livelihoods Quartile Wellbeing Venerability

1. Introduction

Land use/cover change dynamics have been recognized as an important driver of environmental change on spatial and temporal scales (Habtamu, 2011). Changes in land use directly influence the regional air quality, energy consumption and climate at global, regional and local scales (Chawla, 2012); complex process that arises from modifications in land cover to land conversion process (Lambin.*et al.,* 2001; Peter *et al.,* 1997). Land use patterns result in land cover changes that cumulatively affect the global biosphere, climate and a threat to livelihoods (Tumwebaze, 2012); considered as one important factor influencing livelihood of rural community (Pensuka and Shrestha, 2007).

Ethiopia is a country characterized by fast forest cover conversions and modifications attributed to various adverse human actions, like expansion of farm plots at the expense of vegetated lands, massive fuel wood and charcoal production, overgrazing and encroachment of farmsteads into vegetated lands (Messay, 2011). Similarly, various studies conducted in Ethiopia have shown that land use/cover changes (LULCC) in the country during the second half of the 20th century exacerbate deforestation and land degradations (Solomon 1994; Woien 1995; Gete 1997; Belay 2002; Woldeamlak 2002; Muluneh 2003). Most of these studies indicated that deforestation and cultivation of marginal areas were the major causes of forest loss, particularly in the highland part of the country.

Due to varying reasons such as political, social, and economic factors, the heavy use of natural resources to supply a rapidly growing global population and economy have resulted in unintended mismanagement and degradation of land and ecosystems. Moreover; rapid growing of population results increasing demands of the resources bringing extra pressure on the available resources all over the world. At the present time, land use practices in many developing countries like Ethiopia have resulted in soil, biodiversity, and forest degradation with significant unexpected effect for the countries which entirely depend on agricultural sectors, natural resource bases and eco-environmental factors (Ali, 2009). The current understanding of historic LULCCs in Ethiopia is not adequate. Future understanding of LULCCs will need to be greatly improved with systematic methods and designs addressing land use change research. In order to understand the forces of change, it will be necessary to conduct studies that explicitly

reveal the variations in change characteristics and problems related to land use/cover change implications on rural socio-economic features of the area. Therefore, this study investigates the impact of land use/cover changes on livelihoods of rural community in high forests' of *Odo-Shakiso*, Southern Ethiopia.

2. Description of the study area

Astronomically, *Odo-Shakiso* district is located between 5°2'29" - 5°58'24" N latitudes and 38°35'0" - 39°13'38" E longitudes. The district is characterized by three agro-climatic zones, namely *Dega*, *Woina-dega*, and *Kola*. The percentage coverage of each climatic zone is *Dega* 33%, *Woina-dega* 47%, and *kola* 20% (*Odo-Shakiso* District profile, 2013). The 2007 national census reported a total population for this woreda of 206,372, of which 107,224 were men and 99,148 were women; 33,643 or 16.3% of its population were urban dwellers. The majority of the inhabitants were protestant, with 56.64% of the population, while 14.07% of the population practiced Ethiopian Ortodox Christanity, 11.4% were Muslim, 10.69% practiced traditional beliefs, and 1.86% was Catholic (CSA, 2007). The main economic activity of the study area comprises farming, livestock rearing, and traditional gold mining. Farming of crops like maize, barley, teff, coffee and enset are dominantly practiced. In addition, livestock rearing of chicken, sheep, goat and cattle are well known. The middle and better off community groups mostly produce cash crops like coffee in addition to other economic activities.

3. Methods

The study was employed both quantitative and qualitative approaches, hence, Yin (2003) revealed that two strategies might be possible and attractive, when using multiple strategies in a given study are considered to be vital. Hence, a community-based survey with both quantitative and qualitative study design was applied to collect information's on land use/cover change implication on rural livelihoods. The sample size for collecting quantitative data, the study used sample size developed by Cochran's 1977, and hence 330 household was selected. To keep sampling distribution normal and to avoid personal bias, the study considers random selection of peasant kebeles and calculation of their probability proportional to size.

The measurement of the rural livelihoods considers the livelihood outcomes of wellbeing index, since it cover both monetary and non-monetary assets (Rutstein & Johnston 2004), and even in

some cases, the non monetary household characteristics may be considered to be a better or more valid reflection of living standards than monetary income and capture long-term wealth and asset accumulation (Filmer & Pritchett 2001). Thus, the rural livelihood wellbeing index used in the current study is based on a set of household characteristics and asset ownership and was explicitly designed to overcome acknowledged challenges in measuring income (Filmer & Pritchett 2001). In addition, since there is no single household characteristic or asset that gives enough information to determine whether someone is poor or not, measuring households' wellbeing/wealth index based on a variety of household characteristics and assets accumulation are relevant to predict and understand the effects of land use/cover changes of the study area using principal component analysis.

The instruments employed to gather the necessary data for this study includes; questionnaire, Key informant interview, field observation, and document analysis. According to Cohen and Manion (1994), use of combination of methods is suggested as having advantages to correct some of the deficiencies of any one source of data. Data collected from the survey entered into a computer for analysis mainly using micro soft Excel and Statistical Package for Social Sciences (SPSS). Before running the analysis, some internal consistency checks were made to assess the quality of data. To determine and analyze the households' livelihood wellbeing levels, households capitals/assets was aggregated by using principal component analysis, since it allows reduction of variable with similar patterns and natures, while aggregating into a single dependent variable. The proxy land use/cover change indicators (i.e., the independent variables) were run in multinomial logistic regression analysis to investigate the direction and magnitude of the impacts upon the rural livelihood wellbeing (i.e., dependent variable) using the principal component analysis. Moreover, to supplement the quantitative data, qualitative data collected through open-ended questionnaire, key informants interview, and documents analysis are narrated following the quantitative data results basing its importance.

4. Results and Discussions

3.1. Land use/cover change Dynamics

Change in land use/cover may result in land degradation that manifests itself in many ways depending on the magnitude of changes. For instance, natural dense forest which may provide environmental and socio economic service becomes increasingly decline, wetlands are drying

up, and shrub lands are shrinking, and hence expands degraded and infertile bare lands. All these symptoms have potentially severe impacts on land users and people's livelihood which rely for survival on the products from a healthy landscape. The land use/cover dynamics detected in *Odo-Shakiso* forest areas during the entire periods of change investigations i.e., during 1973 to 2011 revealed that forest land, shrub land, and wetland covers are forced to be transformed dominantly into agricultural land and built up areas.

Accordingly, the percentage changes of forest lands in the study area are very discouraging, since, in the last four decades of 1973 to 2011 about -33107.6 hectares of the *Odo-Shakiso* forests were converted to other types of land uses. From these changes about -9931.9 and -23404.05 hectares of forest land conversion were during 1973 to 1986, and 1973 to 2000. Comparatively, the forest covers are highly devastated during the period of 1986-2000, since it accounts for overall forest land use changes of -13472.2 hectares. The forest covers are also reduced by -9931.9 and -9703.53 hectares of land during the 1973-1986 and 2000-2011 periods respectively (table 1). The subsequent deforestation and degradations are brought changes in the other natural resources. For instance, wetlands reduced by -1368.8, -530.4, and -658.7 hectares of land covers during 1973-1986, 1986-2000, and 2000-2011 respectively. Similarly, the Shrub land which considers the land covered by small trees, bushes, shrubs, and woods, experiences successive conversion to other land uses. But, agriculture, degraded bare lands, and built-up areas of settlement covers are expanding by 22522, 2916.7, and 6586.4 hectares of land during 1973 to 2011 respectively.

Table 5: Percentages of Land use/ cover change in the Odo Shakiso forest (1973 – 2011)

Lu/Lc type	Change 1973-1986		Change 1973-2000		Change 1973-2011		Change 1986-2000		Change 1986-2011		Change 2000 - 2011	
	Ha.	%	Ha.	%	Ha.	%	Ha.	%	Ha.	%	Ha.	%
Wetland	-1368.8	-48.7	-1899.2	-67.6	-2557.9	-91.1	-530.4	-36.8	-1189.1	-45.7	-658.7	-72.4
Forest land	-9931.9	-14.7	-23404.1	-34.6	-33107.6	-48.9	-13472.2	-23.3	-23175.7	-16.8	-9703.53	-21.9
Shrub land	3144.7	34.6	139.95	1.5	-683.55	-7.5	-3004.74	-24.5	-3828.2	-6.7	-823.5	-8.9
Grassland	507.0	4.3	2384.46	20.1	4311.54	36.3	1877.49	15.2	3804.6	15.6	1927.08	13.5

Agri-land	5476.4	9.9	14781.9	26.6	22521.9	40.5	9305.55	15.2	17045.6	12.7	7740	11.0
Bare land	1153.6	144.3	3671.91	459.4	2916.72	365.0	2518.29	129.0	1763.1	-38.7	-755.19	-16.9
Built-up area/ Settlement	1030.1	164.6	4395.42	702.4	6586.47	1052	3365.28	203.2	5556.3	132.3	2191.05	43.6
Total 1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The factors that make the land use/cover change of the study area more dynamic are broadly, includes primary and secondary, as confirmed by the analysis of land use/cover change detections and discussion made with elderly and key informants. The primary causes of deforestation and forest degradation in the study area are includes agricultural land expansion, settlement/built up expansion, migration which is dominantly coming from SNNP especially from Gedeo people and Harar, investment of coffee plantations which was mostly done by clearing natural forest, and over grazing respectively. Whereas, the secondary causes of forest deforestation and degradation in the area are associated with firewood and charcoal collection, land tenure arrangement, illegal wood cutting, forest fire, and weak forest laws and its enforcement measures.

3.2. Households livelihood wellbeing

As a result of its difficultness to analyze household livelihood wellbeing/ wealth through direct use of each of the household asset characteristics collected from the field survey data, it required variable standardization before running the investigations. Hence, one way to summarize the different asset of household characteristics across the different periods of land use/cover changes is through adapting the principal component of variable analysis (PCA). The PCA can measure those variables having different characteristics, i.e., categorical with Likert scale and/or continuous variables, by changing into transformed standardized coefficients of the variables. For instance, five scale likert from strongly disagree to strongly agree (i.e. ranges 1-5) was used by Cope *et al* (1986), and quoted in Beaumont (2012). Moreover, the PCA also offers solution for change in having one given asset is stronger indicator of relative wealth and the assumptions of each asset change during the study period contributes equally in measuring household

livelihood wellbeing index, since it determines the relative importance of each variable to summarize a set of variables (DeVellis 2012).

Since, the main objective of application of PCA to create one summary measure of household livelihood wellbeing (Vyas & Kumaranayake 2006), it relies on different statistical assumptions. For instance, in survey data with different variables that have correlated in unknown ways, PCA can reduce such variables and their relationships to each other by creating a new set of variables called principal component. The order of the variance of the principal component shown differences among the variables, for instance, the first principal component refers to the largest possible variance across the given variables. The first principal component accounts for the largest possible variance across the specified variables. Likely, each succeeding component accounts for as much of the remaining variance as possible and are not linearly correlated to any of the preceding variables.

Based on this first principal component, each variable is given a 'factor weight.' The factor weight represents the relative importance of each variable to the constitution of the first principal component. Once the PCA has been done, extraction of the factor weights for each variable is undergone through multiplying the standardized variable by the factor weight, and then adds all the values together to calculate household livelihood wellbeing index scores for each respondent of the study area. Then, after, by using the country's poverty index reported as starting step i.e., which is 26.7% (MOFED, 2014) quartile classification was made. The reason why the cut point for the classification of livelihood wellbeing index was based on the quartile rather than classifying into quintiles, which is the most usual approach of classifying livelihood wellbeing indexes, is to consider the poor population adequately in the first quartile using the national reported data.

3.3. Implication of land use/cover change on household livelihood wellbeing/Welfare[15]

[15] Prediction of LULCC on household welfare status initially checked with Ordinal logistic Regression analysis to satisfy the hierarchical levels of the dependent variable. But because of the rejection of the assumption of parallelism in the ordinal test and its possibility to change into multinomial logistic regression, the researcher used multinomial regression to predict the effects of LULCC of the study area.

To examine the impacts of land/cover change upon the household livelihood wellbeing, the index cut point generated from principal component analysis was used to classify household into four quartile groups. For instance, those households having rural livelihood wellbeing of less than or equal to -.5290 cut point into the first quartile, .0071 for the second quartile, .5152 in the third quartile, and with cut point of less than or equal to 2.8405 in the fourth quartile. Meaning, as we go from quartile 1-4 the households calculated wellbeing value increases, showing the more accumulation of the assets. Thus, to find the effects of land use/cover changes on livelihoods of the rural community, it considers the mentioned households quartile wellbeing categories as a dependent categorical variable in multinomial logistic regression i.e., Q1= the 1st 25%, Q2 = the 2nd 25% or 50%, Q3= the 3rd 25% or 75%, and Q4 = the 4th 25% or 100%. Moreover, the independent variables data collected through five scales Likertscale was recorded as dummy categorical variables, since the multinomial logistic regression result output organized for each independent variable with respect to each categorical dependent variable, which may complicates the understanding ability of the reader and data management techniques.

Hence, the independent variables of unreliability rainfall, livestock quantity and productivity decline, drought frequency rise, increase of flooding extents on land, soil degradation, crop disease prevalence increase, incidence of animal diseases, and non timber forest product (NTFP) decline were computed so as to examine their role on wellbeing of rural livelihoods at household levels. Accordingly, those independent variables shown statistically significant difference in explaining the dependent variables (i.e., wellbeing level) were selected after passing through the different assumptions of multinomial logistic regression analysis.

3.3.1. Regression analysis

To run regression analysis one has to stick on a number of different relevant assumptions to characterize the features and interrelation of the variables which includes analysis of Multicollinearity effects and model characteristics.

3.3.1.1. Multicollinearity effects

Analysis of Multicollinearity effects in the multinomial logistic regression detected by examining the standard errors for the *B* coefficients. A decision rule of a standard error larger than 2.0 indicates numerical problems and needs rejections of the variables. Hence, none of the

independent variables in this analysis had a standard error larger than 2.0, confirm absence of Multicollinearity effects (table 6).

3.3.1.2. Determining how well the model fits

The model summary table 2 provides information on the how well the model fits, which can be used to determine regression model-fits the data. The initial log likelihood value (411.815) is a measure of a model without considering the independent variables, but only a constant or intercept. The final log likelihood value (293.501) is the measure computed after all of the independent variables have been entered into the logistic regression. The difference between these two measures is the model chi-square value (118.314 = 411.815 - 293.501) that is tested for statistical significance. This test similar with F- test in linear regression of R^2 is which tests whether or not the improvement in the model associated with the additional variables is statistically significant. Hence, in the current study, the model Chi-Square value of 118.314 is significant at $p < 0.0001$, which confirm the presence of statistically significant relationship between the dependent and independent variables included in the model.

Table 6: Model summery

Model Fitting Information				
Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	411.815	118.314	24	.000
Final	293.501			

The next step in multinomial logistic regression output is checking the strength of the relationship between the dependent variable and the independent variables, and also referrers to the proportion of variance in the dependent variable that can be explained by the independent variables. Accordingly, there are three ways of explaining such variance in logistic regression analysis i.e., Cox and Snell, Nagelkerke, and McFadden R^2 measures. That is, the higher R^2 measure indicates, the greater model fit. For instance, both the R^2 value of .529 and .551 stated in the model summery table 3 shows the independent variables explain 52.9% and 55.1% of the variability of the dependent variable, livelihood wellbeing.

Table 7: proportion of variance

Pseudo R-Square	
Cox and Snell	.529
Nagelkerke	.551
McFadden	.344

Moreover, the Chi-Square (see table 4) test whether the overall regression model is a good fit for the data and/or checks whether the model as a whole is significant. In other words, it confirms the adequacy of the independent variables, taken together, in predicting the dependent variable better than just predicting the mean scores. The table 4 shows that the independent variables statistically significantly predict the dependent variable, $X^2 = 175.568$, $p < .05$ (i.e., the regression model is a good fit of the data).

Table 8: Best fit Model

Goodness-of-Fit			
Chi-Square		df	Sig.
Pearson	175.568	150	.105
Deviance	166.032	150	.175

3.3.1.3. Regression model with significant explaining variables

Regression analysis is a process for determining the statistical relationship between a random variable (Dependent Variable) and one or more independent variables that is used to predict the value of the dependent variable. Given as $\boldsymbol{y = b_0 + b_1x_1 + b_2x_2 + \ldots b_kx_k + u}$ **(i.e., where** b_0 is the intercept (constant); b_1 to b_k all called slope parameters and u is the error term (or disturbance) which considers a zero conditional mean assumption, and hence conventionally assumed as $\mathbf{E\ (u|x_1, x_2 \ldots x_k) = 0)}$. Hence, for the current problems after testing the different assumptions of multinomial logistic regression analysis, the next step is fitting the regression model with best explaining variables by examining the power of the explaining variables. Accordingly, the current model is sufficiently fitted with independent variables like increase of flooding extents on own land i.e., which is significant at p<0.0001, and unreliability rainfall

growth; livestock quantity and productivity decline; and crop disease prevalence increase at $p<0.05$ (table 5).

Table 9: Selection of significant explaining variables

Likelihood Ratio Tests				
Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	293.501[a]	.000	0	.
Unreliability rainfall growth	306.409	12.908	3	.005
Livestock quantity and productivity decline	305.406	11.906	3	.008
Drought frequency rise	299.645	6.144	3	.105
Increase of flooding extents on land	317.672	24.172	3	.000
Soil degradation	294.773	1.272	3	.736
Crop disease prevalence growth	302.457	8.956	3	.030
Incidence of animal diseases	294.080	.579	3	.901
NTFP decline	296.086	2.585	3	.460

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Besides the above, likelihood Ratio Tests and Parameter Estimates, which shown the contribution of the variable to the overall relationship, table 6 below describes the role of each independent variable in differentiating between the quartile groups specified by the dependent variable (i.e., livelihood wellbeing).

Table 10: Individual Parameter estimates

Parameter Estimates										
HH livelihood wellbeing [a]		Response given	B	Std. Error	Wald	df	Sig.	Exp(B) / odds Ratio	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
Q1	Intercept		-1.436	.645	4.957	1	.026			
	Unreliability rainfall occurrence increment	Yes	-1.613	.502	10.338	1	.001	5.270	1.877	13.411
		No	0[b]	.	.	0	.	.	.	.
	Livestock quantity and productivity decline	Yes	-1.372	.486	7.975	1	.005	3.105	1.522	10.226
		No	0[b]	.	.	0	.	.	.	.
	Drought frequency rise	Yes	-1.032	.494	4.362	1	.037	.356	.135	.938
		No	0[b]	.	.	0	.	.	.	.
	Increase of flooding extents on land	Yes	-2.428	.537	20.435	1	.000	.088	.031	.253
		No	0[b]	.	.	0	.	.	.	.
	Soil degradation	Yes	.437	.485	.814	1	.367	1.548	.599	4.002
		No	0[b]	.	.	0	.	.	.	.
	Crop disease prevalence increase	Yes	.904	1.129	.641	1	.423	2.470	.270	22.585
		No	0[b]	.	.	0	.	.	.	.
	Incidence of animal diseases growth	Yes	-.051	.924	.003	1	.956	.951	.155	5.813
		No	0[b]	.	.	0	.	.	.	.
	NTFP decline	Yes	.805	1.334	.364	1	.546	2.236	.164	30.537

		No	0[b]	.	.	0	.	.	.	.
Q2	Intercept		-.805	.576	1.951	1	.162			
	Unreliability rainfall occurrence increment	Yes	-1.538	.495	9.648	1	.002	4.653	1.764	12.278
		No	0[b]	.	.	0	.	.	.	.
	Livestock quantity and productivity decline	Yes	-1.543	.485	10.102	1	.001	4.678	1.807	12.113
		No	0[b]	.	.	0	.	.	.	.
	Drought frequency rise	Yes	-.885	.465	3.618	1	.057	.413	.166	1.027
		No	0[b]	.	.	0	.	.	.	.
	Increase of flooding extents on land	Yes	-1.269	.484	6.864	1	.009	.281	.109	.726
		No	0[b]	.	.	0	.	.	.	.
	Soil degradation	Yes	.164	.456	.130	1	.718	1.179	.483	2.879
		No	0[b]	.	.	0	.	.	.	.
	Crop disease prevalence increase	Yes	1.956	.920	4.518	1	.034	7.069	1.165	42.901
		No	0[b]	.	.	0	.	.	.	.
	Incidence of animal diseases growth	Yes	-.273	.823	.110	1	.740	.761	.151	3.821
		No	0[b]	.	.	0	.	.	.	.
	NTFP decline	Yes	-1.033	1.071	.930	1	.335	.356	.044	2.903
		No	0[b]	.	.	0	.	.	.	.
Q3	Intercept		.102	.525	.038	1	.846			
	Unreliability rainfall occurrence increment	Yes	-1.197	.488	6.014	1	.014	3.311	1.272	8.622
		No	0[b]	.	.	0	.	.	.	.
	Livestock quantity and productivity decline	Yes	-1.274	.468	7.408	1	.006	3.575	1.428	8.947

		No	0[b]	.	.	0	.	.	.	.
	Drought frequency rise	Yes	-.956	.447	4.565	1	.033	.385	.160	.924
		No	0[b]	.	.	0	.	.	.	.
	Increase of flooding extents on land	Yes	-1.337	.470	8.103	1	.004	.263	.105	.659
		No	0[b]	.	.	0	.	.	.	.
	Soil degradation	Yes	-.019	.439	.002	1	.965	.981	.415	2.319
		No	0[b]	.	.	0	.	.	.	.
	Crop disease prevalence increase	Yes	-.549	.898	.374	1	.541	.577	.099	3.355
		No	0[b]	.	.	0	.	.	.	.
	Incidence of animal diseases growth	Yes	.309	.762	.165	1	.685	1.363	.306	6.069
		No	0[b]	.	.	0	.	.	.	.
	NTFP decline		.334	1.083	.095	1	.757	1.397	.167	11.661
			0[b]	.	.	0	.	.	.	.

a. The reference category is: Quartile 4.

b. This parameter is set to zero because it is redundant.

NB: for easy understanding of the quartile categories, the researcher named Q_1 = the poorest household; Q_2 = the poor; Q_3 =the medium; Q_4 = the reference category / the better off

3.3.1.4. Interpreting the Results of the regression

Interpreting the regression coefficients enables to make statements about the direction of the relationship between the dependent variable and each of the independent variables, the size of the contribution of each independent variable to the dependent variable, and the relative importance of the independent variables as predictors of the dependent variable. To determine the direction of the relationship between each independent variable and the dependent variable, the sign of the *B* coefficient in each household livelihood wellbeing category is considered (i.e., Quartile 1-4). In addition to interpreting the sign of the *B* coefficient, also required interpretation of the odds ratio which derived from exponent of the *B* coefficient, referring to the degree loses or gains due the factors in reference to highest livelihood wellbeing category i.e., quartile four. Moreover, the odds ratio indicates the relative impact of each variable on the dependent variable within the category, verifying the amount of change to the upper wellbeing ca

the variable with the largest impact on the dependent variable is the one with the largest percentiles changes to the highest households' wellbeing category. Basing this here under mentioned the effects of proxy land use/cover change impacts upon livelihood wellbeing of the study area.

Unreliability of rainfall occurrence

In Quartile 1 (i.e., the poorest) unreliability of rainfall occurrence increment had shown negative association with households' livelihood progresses to wealthier classes, i.e., the increase in variability of rainfall in the study area are negatively affecting households' livelihood statuses. As a result the odds ratio revealed the poorest households has more likely to lose reaching the wealthier category by 73% as compared to those respondents in this category confirming no change in variability of the rainfall in the last decades. In quartile 2 (i.e., the poor) unreliability of rainfall also negatively associated with households livelihood wellbeing, and hence the households verifying the presence of rainfall variability in their area affected by a decreased in livelihood wellbeing. Meaning, if other things are being constant the households the probability of being in the richer livelihood wellbeing was reduced by 34.7% as compared to with households not supporting the presence of rainfall variations. Similarly, the rainfall unreliability for quartile 3 (i.e., the medium category) affected by reduction in livelihood wellbeing by 31.1% as compared with households did not confirm rainfall change within the same category. As a result their odds not to be in this category and/or shift of wellbeing to better off were reduced by 60.9%. Therefore, rainfall unreliability and productivity character across the study area had a significant impact resulting in shortfall of food and weakens sustainability of rural livelihood. In line with this finding, Hirpa *et al*., (2013) found that farmers' livelihoods are threatened by the variability in the amount and distribution of the rainfall in Diga District of Western Oromia, Ethiopia.

Livestock quantity and productivity decline

The number and type of animals owned by a household and /or an individual within that household is essential information for characterizing the household wellbeing. Livestock ownership is also an important welfare measure because in many regions livestock are an important asset through which households are able to store their wealth, and it also reflects a household's long term capacity to manage risk and meet its consumption requirements (Njuki, *et al*., 2011). In this regard, the key informants mentioned, before a decade's a given household had on average more than 10 cattle's but now due to shortage of grazing lands and animal diseases their number and products gained from them are declining, and hence affected by livelihood insecurity.

Similarly, the effects of livestock quantity and productivity decline of the study area shown statistically significant upon livelihood wellbeing. For instance, the households revealed the decrease of livestock unit and their productivity in the first quartile is reduced by 10.1% in their livelihood wellbeing/wealth from those their livestock unit not reduced. Moreover, these groups of households were reduced by 89.9% to reach the richer categories in quartile four. But households found in the quartile 2 reduced by 80.7% with those households livestock unit not decreasing. In quartile 3 the probability of the households suffered from reduction of livestock units to obtain the wealthier category (i.e., Quartile 4) is reduced by 42.5% as compared to not affected by reduction of livestock both in number and quality. The regression shown, impacts of livestock unit decreased in quantity and quality, with increase of households livelihood welfare/wealth ownership.

Drought frequency rise

The multinomial logistic regression confirm drought frequency rise create statistically significant difference on households wellbeing at $p < 0.05$ in quartile 1. As results those households more vulnerable to the impacts drought frequency rise will declined by 64.5% from their probability of being in quartile 4, if assumed other things are remain constant. Likely, households in quartile 3 were also affected by drought frequency rise and their livelihood wellbeing reduced from quartile 4 households by 61.5%. In line with this finding, Amanuel and Mulugeta (2014) indicated that loss of vegetation cover and drought had significant contribution on agricultural productivity decline which had an impact on livelihood survival in Southwestern Ethiopia. In addition to this, Dercon (2004) finding agrees that climate risks and economic fluctuations make rural households vulnerable to serious shocks in Ethiopia. Moreover, rapid deforestation and vegetation degradation associated with periodical drought allover Ethiopia affects agricultural productivity which is the backbone for the country's economy and households' livelihood sustenance (Eyayu *et al*., 2010 and Diress *et al.* 2010).

Increase of flooding extents on land

The proxy impacts of land use/cover changes of increase of extents of flooding on their own land stands first in compromising the sustainability of rural livelihood quality. For instance, it reduces the status of the vulnerable households by 91.2% in the 1st quartile, 89.9% in the 2nd quartile and 73.7% in 3rd quartile as compared to households in the 4th quartile. The severity of the impact was increases with decrease in livelihood wellbeing classes, i.e., the poorest and the relatively poor households are more vulnerable than those of medium and better off categories. Similarly, Efrem (2009) found that erratic rainfall causing floods, population growth, deforestation, soil degradation, and declining crop p[illegible] on rural livelihood continued existence due to land use/cover dynamics in the ce[illegible]

The aggravated land use/cover change accompanied by accelerated deforestation, overgrazing by livestock, and poor agricultural practices complicates soil management mechanisms (king, 2008). Similarly, in most parts of Ethiopia also, the presence of poor farming practice, which includes intensive tillage of the soil, tillage of steep slopes, absence of fallow and lack of effective soil and water conservation practice, aggravates the rate of soil erosion. In accordance the key informants also described, deforestation and agricultural land expansion to higher slope and elevation areas increase soil erosion especially during rainy season it affects their farm plot and this problems worsen coupling with poor land use, forest and soil managements practices. The survey result also confirm sheet and rill erosion is most dominant type's soil erosion occurring in the study area.

Crop disease prevalence increase

The crop disease occurrences shown statistically significant difference among the households of 2nd quartile, and hence it result in reduces rural households livelihood wellbeing by 93.1% as compared to households in the 4th quartile. In this regard the key informants described, among the crop disease such as fungi and rust its local name Wagi affect most cereal crops; coffee beery disease its local name *Kororima* affect coffee, whereas *Zantomones Enset* its local name *Shanto* affect all enset species and also termite the main pest that affect all crops. Moreover, the key informants were aware of most of the crop disease and pests was the result of land degradation and climate change due to unsustainable natural resources exploitation which shortfalls food self sufficiency and also had impact on rural livelihood welfares. Similarly Hirpa *et al.* 2013 revealed that the decreases in crop production and productivity due to land degradation added up with the direct damages caused by termites on crops have affected farm income and household food security in Diga District of Western Ethiopia.

4. Conclusion and policy options

4.1. Conclusion

The rapid land use/cover changes of the study area worsen the livelihoods of the rural community in many ways. The area once known by large livestock holdings, which capacitate the ability of households to withstand environmental and social crises, are diminishing in number and quality. Mostly, this is due to aggravated deforestation, shortage of grazing lands, and animal diseases. The natural dense forest which provide environmental and socio economic service becomes increasingly decline, wetlands are drying up, and shrub lands are shrinking, as a result rainfall variability increases, and not adequate rain in times usual seasons. Moreover, agricultural productivities are becoming declining per plot of lands in the last decades, and not able to give production unless chemical fertilizers applied. But, the sky rocketing of chemical fertilizers and other farm inputs worsen the problems. In addition, climate [illegible] increases the expansion of crop diseases and pests, which highly affects

livelihood sustenance of the rural households. The non timber forest products are also affected by exacerbated deforestation which resulted from acute forest land use/cover changes. Aggravated deforestation and agricultural land expansion to higher elevation areas increase soil erosion, the problem deteriorates households livelihoods coupling with poor land use and soil managements practices. In general, the study concludes the poorest and relatively poor households i.e., those households categorized in quartile 1 and quartile 2 are more vulnerable to the impacts of land use/cover changes and its associated environmental and social impacts than the better of categories, which resulted in households livelihood deteriorations in the study area.

4.2. Policy options

Natural resource contributions for rural livelihood support have significant if the poor endowed with adequate access and use rights, i.e., access by the poor to livelihood asset and natural capital is essential for sustainable poverty reduction, and hence, promotes rural livelihoods. Sustainable management and utilization of the forests and natural resources should give guarantee for the participation (PFM) and benefit sharing of the local community through creating strong institutional and social integration ties. These policy options required in accordance of boosting the current government efforts of soil, water and environmental resource preservation and management systems, which also have a decisive role in preventing soil erosion, expansion of desertification, disturbance of ecological balance, depletion of biodiversity and reduction of agricultural production.

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Paper Five: *Vulnerability and Resilience in the Context of Climate Change and Disaster Risk Prevention: Rural Household Food Insecurity in North-Eastern Gurageland, Ethiopia*

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Abstract

Agricultural production in Ethiopia is highly vulnerable to climate change with major implications for food security. It is, therefore, important to identify the households who are at risk of incidence of food insecurity. This report, therefore, is a result of a study undertaken to investigate factors that determine the status of rural households' food insecurity in the face of climate change, the coping strategies that households adopt to enhance their resilience in this challenging environment and the issues of safety net program (PSNP) in North-eastern Gurageland, Ethiopia. The study adopted a mixed method research design. The necessary data were generated from both primary and secondary sources. Field observations, sample household survey, key informant interview and focus group discussions were the major means of generating data from primary sources. Secondary data were also obtained from concerned organizations. Both qualitative and quantitative techniques were employed to analyze the data. A quantitative technique known as household food balance model was used to look into the household per capita dietary energy supply. Additionally, regression analysis was employed to see the determinants of household per capita dietary energy supply in the study area.

The results of the study showed that sampled households in the study area were prone to food insecurity. The per capita kilocalorie result confirms that around 58% of the sampled households were food insecure, thus, have more chances of being negatively impacted by climate change. The results of kilocalorie intake analysis showed that Kolla and Highland agro-ecological zones were the most food insecure zones in the study district. According to the analysis, landholding size, annual income, possession of livestock and level of fertilizer application, drought occurrence, low land, household size, gender, oxen and farm system were the critical factors determining both the agriculture and food security status (food availability) of the farm households. Food insecurity coping strategies adopted by the households were mainly used to anticipate the impact of food insecurity on a short term basis. The study concludes that food insecurity existed in the study area among farming households, and recommends that farming households should be supported in terms of both short term and long term strategies to improve food production and supply.

Introduction

Food security is influenced by and sensitive to variability and change in climate. The fourth assessment report (AR 4) of the IPCC confidently contends that the observed climate variability and predicted changes in climate will potentially impact food security in Africa (Boko et al. 2007). Evidence in support of this argument includes the considerable incidents of famine, food insecurity and water stress across Africa, which are partly associated with the variability of climate and the domination of El Niño-Southern Oscillation (ENSO) events on the regional climatic patterns (Dai, 2011). For example, about 40% or more

of people in Africa go to bed without enough nourishing food due to environmental changes and the rain-fed nature of farming (Cordell et al. 2009).

Ethiopia, like many other African countries, continues to experience high levels of food insecurity despite decades of implementing poverty alleviation and prevention programs. Poverty and food insecurity are mutually reinforcing in Ethiopia, where over 30 per cent of the people live below the poverty line, and it has a long history of famines and food shortages that can be traced back to 250 BC (Ramakrishna and Demeke, 2002). Though the poverty situation in the country has shown signs of improvement over time, Ethiopia still has a high level of food insecurity, and food shortages continue to be an on-going problem in the country.

Similarly, despite having three main agro-ecological zones with varieties of both food and cash crops and benefiting from agricultural extension, North-eastern Gurageland is among food insecure areas in Ethiopia (Gurage zone rural development office, 2012). For the last two decades, the study area has been receiving food relief from the government and other organizations like the Word Food Programme (WFP). Especially, Meskan and Mareko districts have high incidences of chronic food insecurity within the region (Gurage zone rural development office, 2012**).** Analysis of vulnerability to food insecurity is fundamental for policy makers to classify which groups of the community and geographical regions are susceptible to hazards and, thus, need policy interventions to ease the dilemmas. In view of that, the severity of food insecurity by agro-ecologies were discussed which might help local governments to target PSNP beneficiaries. As an academic issue, to the best of our knowledge, vulnerability to climate change induced food security is not adequately addressed by researchers in the study area. This study, therefore, aims to investigate the vulnerability to climate change induced food insecurity and how farm households cope with the situation in North-eastern Gurageland of Ethiopia.

Objectives of the study

The general objective of this study is to investigate vulnerability to climate change induced food insecurity and the coping strategies that households adopt to enhance their resilience in North-eastern Gurageland.

To meet the above mentioned general objective, the following specific objectives have been set:

- To analyze the current rate of food insecurity in the study areas;
- To assess the factors responsible for increasing rural household vulnerability to food insecurity;
- To identify the determinants of households' food insecurity;
- To explore the coping strategies employed by households to increase their resilience to food insecurity;
- To explore the benefits of PSNP to achieve households' food insecurity.

Based on these objectives, the following research questions have been developed:

- How does food security status differ among households in different agro-ecologies?
- Which livelihood activities and assets are important in assessing vulnera

- What specific factors determine food insecurity level of households?
- What are the main coping strategies of food insecure households adopt to enhance resilience?
- Are PSNPs possible alternatives in caring for households from food insecurity in the study area?

The significance of the study will be two-fold:

Firstly, it helps in filling the knowledge gap on the vulnerability to climate change induced food insecurity in Ethiopia in general and North-eastern Gurageland of Ethiopia in particular. Although lots of efforts have been exerted to study and document determinants of food (in) security in different parts of Ethiopia, there has been no adequate attempt to investigate the vulnerability to food insecurity in the study areas. Therefore, this study is meant to add to the existing body of knowledge about the area. Additionally, it highlights the different responses e.g. PSNP program and coping strategies that households adopt to enhance their resilience in the face of climate change induced food insecurity and related disasters in the rural households.

Secondly, the findings of the study will inform local and regional food security policy makers of the differential impacts of climate change induced food insecurity in rural households. It is as well essential to classify which groups of the community and geographical regions are susceptible to hazards and need policy interventions to ease the dilemmas. In view of that, the severity of food insecurity by agro-ecologies were discussed which might help local governments to target PSNP beneficiaries.

Concept of Food Security

The definition of food security provided by the FAO during the World Food Summit in 1996, recognizes food security as "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (Ericksen, 2008). It covers four aspects: availability of food, access to food, utilization of food and stability (FAO, 2003). Food availability is determined by the ability of households to produce, distribute and exchange; whereas, food access by households and individuals is determined by affordability (purchasing power), allocation and preferences (social and cultural determinants influencing consumers). Stability of access requires that households and individuals should not be at high risk of losing access to food. Food utilization is influenced by the nutritional value of the food, its social value and by food safety (Ericksen, 2008).

Amaza et al. (2009), in a study of changes in household food security and poverty status in PROSAB Project area of Southern Borno State of Nigeria, estimated household food security status as a function of household characteristics, crop production, and participation in PROSAB activities. Olayemi (1998), isolated determinants of household food security into supply-side factors, demand -side factors and stability of access to food which include household food and non-food production variability, household economic assets, household income variability, quality of human capital within the households, degree of producer and consumer price variability, and household food storage and inventory practices.

Concept of Vulnerability to Food Insecurity

Vulnerability to food insecurity embraces dual concepts; namely, vulnerability and food insecurity. Food insecurity is often due to unavailability of food, insufficient purchasing power,

inadequate utilization at household level (FAO, 2002). On the other hand, vulnerability has been described as exposure to risks, shocks and stress and difficulty in coping with them. It can also be the factor that influences exposure to food insecurity and a household's predisposition to the consequences.

Based on the framework of vulnerability developed by Lovendal and Knowles (2005), current socio-economic characteristics and exposure to risks determine household's future characteristics and their risk - management capacity. At every point in time, households' current food security status is affected by their past status and this could also affect their future status. Present characteristics are known by households and determine households' current food security status. However, between the present and future, risks and shocks manifest and determine the future food security status depending on households' risk management abilities.

Study Area

The study was conducted in North-eastern part of Gurage zone - Meskan, Mareko and Soddo districts of Ethiopia taking three agro-ecologies - highland, midland, and lowland. These areas were selected considering the fact that they fall under the drought-prone zone.

Sampling Procedure and Data Collection

To determine the sample households, a stratified random sampling method was used. At the first stage, the 125 Kebeles, kebele refers to the lower administrative unit in a district, were stratified into three agro-ecological zones. Once this was done, two kebeles were randomly selected from each category, namely; Semen-koshe, Elala-gebiba, Mirab-meskan, Adele-gose, Dega-gogot and Dega-nurena. Then, a total of 257 sample households were drawn using simple random sampling (using lottery system) with probability-proportional- to-size technique.

The data used for this study were collected both from primary and secondary sources. Much of the primary data were collected through household survey, field observations, key informant interviews and focus group discussions. Sample household heads filled structured questionnaires supported by trained enumerators. Interviews and target group discussions were also made to substantiate the data obtained through questionnaire-based survey. Kebele officials, household heads, elders and agricultural development agents had provided crucial information for this study. The data were collected from October to December 2014.

Method of analysis

The collected data were analyzed using both quantitative and qualitative techniques. For quantitative analysis, raw data generated through field surveys and those compiled from several government documents were coded and entered into computer. Data entry and analysis was done using computer software packages such as Microsoft Excel spreadsheets, Statistical Packages for Social Science (SPSS) and Instat.

To get a general overview of data, the initial analysis was based on simple descriptive analysis such as frequencies, percentages, and cross tabulations. The other statistical tool adopted for data analysis was regression analysis. Qualitative data were analyzed using qualitative techniques, which basically involved establishing the categories and themes, relationships/patterns and conclusi

objectives. The different statistical, econometric models and variables used in the analysis are presented below.

The quantity of food produced was calculated and converted into dietary calorie equivalent based on the Ethiopian Health and Nutrition Research Institute, (EHNRI)'s food composition table. Following FDRE FSS (1996), the minimum daily recommended food energy intake of 2100 Kcal per AEU was used as the cut-off level for classifying households into food secure households and food insecure households. In the calculation of kilocalorie intake, the amounts of calorie available to a household were determined through an equation called Household Food Balance Model which was a modified version of regional food balance model (Mesay, 2009). The model was constructed as: HHFA = Y+FP+ FA+ R/G – S – SR – PHL. Where HHFA = household food availability; Y= own production; FP = food purchased; FA = food aid; R/G = remittance/gift; S = amount of grain sold; SR = seed reserves (5%); PHL = post harvest loss (10%).

Household Demographic and Socio-economic Characteristics

These characteristics which include gender, age, occupation literacy, size and landholding of households, may be factors which determine food security situation of households as they indicate quantity of food demanded by the respective households.

Table 1: Household Size

Agro-ecology	Minimum	Maximum	Mean	Std. Deviation
Highland	**1**	**10**	**5.76**	**2.046**
Midland	**1**	**11**	**5.88**	**2.014**
Lowland	**1**	**12**	**6.16**	**2.432**
All sites	**1**	**12**	**5.91**	**2.151**

Source: Author's field data (2014)

Results in Table 1 show that household size of the respondents ranged between 1 and 12 members; the mean was 5.91, and the standard deviation was 2.15. Across agro-ecology, the mean household sizes for highland, midland and lowland areas were 5.76, 5.88 and 6.16, respectively. It can be inferred that most of the households had enough labour to produce because the average household size was about 6 people per household. In general, the household size has an implication on the availability of labour for the various activities undertaken by a household. Large household sizes often mean that more labour is available for the household to expend in various livelihood activities.

The number of years spent in formal education is one of the important determinants of increased agricultural production. Education catalyses the process of information flow and leads farmers to explore as wide as possible, the different pathways of getting information about agriculture and technology, especially the use of modern technologies such as use of hybrid seeds, fertilizers and herbicides. Foster et al. (1999)

also noted that illiteracy is one of the factors that limit economic, social, physical, technical and educational development in less developed countries.

Table 2: Educational Level of Household Head

Agro-ecology	Mean	Std. Deviation
Highland	**2.70**	**2.258**
Midland	**2.80**	**2.285**
Lowland	**2.42**	**2.088**
Total	**2.66**	**2.217**

Source: Author's field data (2014)

In the villages, it would be difficult to expect large numbers of respondents who have attained higher levels of education, because usually individuals with higher levels education take up paid employment and reside in towns. The finding uncovered that the average level of educational attainment among households was about 2.7 years of formal education. In addition, midland has a higher literacy rate as compared to the other two sites, with the largest mean (2.8) of people who have attained education. As the headquarters for Meskan district, several educational institutions surround midland: three primary schools, two secondary school and a private College; the presence of the institutions could have provided motivation for more people to attend formal education. Those who are literate stand a better chance to make use of written information/communications regarding resource management and livelihoods in general.

Sex of the household head plays an important role in providing the households with basic needs including food, shelter and clothing (Kuwornu et al., 2012). The study results (Table 3 below) indicate that out of the 257 households, 73.5% were male headed households (MHH) while 26.5% were female headed households (FHH). This has clearly explained the dominance of male headed households in the study area.

Table 3: Gender of Household Head

Agro-ecology	Gender		
	Male	Female	Total
Highland	**64.3%**	**35.7%**	**100.0%**
Midland	**82.6%**	**17.4%**	**100.0%**
Lowland	**75.3%**	**24.7%**	**100.0%**
Total	**73.5%**	**26.5%**	**100.0%**

Source: Author's field data (2014)

The age of the respondents ranged from 18 to 88 years (Table 4 above). The age distribution enabled the collection of information on food insecurity to extend across different historical periods. In highland, the age ranged from 18 to 88 years with a mean age of about 48.67 years. In midland site, the age of the respondents ranged from

age of 44.97 years. In lowland site, the age of the respondents ranged from 22 to 75 years, with an average of about 44 years and a standard deviation of 9.58. The wide age range has ensured that coping strategies experiences across age groups are fairly represented.

Table 4: Age of Household Head

	Minimum	Maximum	Mean	Std. Deviation
Highland	18	88	48.67	12.257
Midland	21	82	44.97	9.893
Lowland	22	75	43.93	9.576
Total	18	88	46.09	10.933

Source: Author's field data (2014)

In the study area, the main livelihood source is crop production followed by livestock production (Table 5 above). Petty trade, casual labour and remittance were also important sources of income in all of the sites. Food or cash for work was also important in midland and lowland. Therefore, the livelihoods of the people in the study areas largely depend on arable agriculture, with very little input from other sectors. Although such dependence on the natural resource base is typical of many rural areas in Ethiopia (Cooksey and Likwelile, 2002); nonetheless, it is rather risky to depend solely on the natural resources since land will eventually be scarcer than it is now due to the growing human and livestock populations. The situation, hence, will become even worse because of the climate variability and change of the area, which calls for more diversified occupational and livelihood opportunities.

Table 5: Main source of livelihoods

Livelihood	Agroecology			
	Highland	Midland	Lowland	Total
crop production	96%	95%	99%	96.5%
livestock keeping	86%	76.5%	71.2%	78.2%
petty trade	13.3%	9.3%	5.4%	8.6%
food or cash for work	0	16	28	9
casual labour	8%	7%	5%	6.8%
Remittance	2.0%	1.2%	1.4%	1.6%

Source: Author's field data (2014)

Livelihood assets

Land and livestock are the key livelihood assets to people in the study areas. Ownership of these resources among the sample households is presented in Table 6. The average livestock ownership is about 3.8 TLUs (Tropical Livestock Unit) with a range from 3.5 TLUs in lowland to 4.18 TLUs in highland. Oxen are mainly kept for draught power, and they are traditionally used as indicators of l
mean number of oxen owned across the sites was less than a pair (1.61), wh

minimum for a household. Regarding land holding size, households in high land, mid land and low land possessed 0.7, 1 and 1.7 hectares, respectively.

Table 6: Livelihood assets

Agro-ecology		Land hold size	TLU	Oxen
Highland	Mean	.7398	4.1816	1.21
	Std. Deviation	.37464	1.75043	.412
Midland	Mean	1.0407	3.6093	1.77
	Std. Deviation	.97608	1.65640	.588
Lowland	Mean	1.6986	3.4658	1.96
	Std. Deviation	1.08570	2.00355	.889
Total	Mean	1.1128	3.7868	1.61
	Std. Deviation	.92408	1.81676	.710

Source: Author's field data (2014)

Climate change perception and food insecurity

Perceptions expressed doubts that there has been an increasing trend of temperature for the past 20 years. Many of the key informant interviewees and the participants in the FGDs had the view that the temperature is increasing. In the following quote, the elder from midland opined that:

> *"In my view and practice temperature is increasing. Since ten or twenty years ago, it was not very hot as it is nowadays. For example, these days, it is not easy to reside in the house during day time in dry season. It's very warm in the day." (Elder, 64, midland).*

With regard to rainfall, the interviews with key informants and FGD participants generally indicated the lateness of the coming of the rains, its early cessation and the decrease in its amount. The interviewees confirmed that there are changes in terms of rainfall in the area and the amount is decreasing compared to the past 20 years. As one elderly respondent in Semen-koshe village put it:

> "*The climate of this area has changed so much when you contrast it with the last two decades. These days, the rainfall is insufficient and it comes late and short. Perennial rivers are now flowing seasonally. The severe change is being noted in the belg rain than in the kiremt" (Elder, Semen-koshe).*

Climate change and variability pose serious threats to food security in Africa specifically, to most smallholder farmers and poor rural communities. In this study, farmers were also asked to indicate whether or not changes they perceived and experienced have threatened food security in their areas including food insecurity level. As it is presented in the qualitative data, farmers themselves raised their voices that they are now more threatened by food insecurity than in the past 20 years. Exampl
frequent food aid provided by the government in two of the four villages as a r

regard, it is an indicator that they experience food insecurity. This claim was justified by an elder in low land:

> *Food insecurity is obvious due to climate change; we have been receiving food aid from the Government. Such food aid is normally and always not enough. In most cases, it does not sustain our families. Besides, we feel humiliated as well for our families to depend on food aid while we can work and feed ourselves if there is available water for us to irrigate like our colleagues in Eresha do" (Elder, Elala-gebiba village).*

The finding is in agreement with that of Acquah and Frempong,(2011) who found that most of the farmers perceived an increase in temperature and decrease in precipitation in Ghana. Moreover, a study by Woldeamlak and Conway (2007) reported decrease in food crop yield and subsequent decrease in income both combine to increase threats on food availability and ability to access what is available.

Causes of food shortages in the study area

An inquiry was further made about factors that are locally perceived to influence food security in the study area. Table 7 below summarizes the perceptions of various factors influencing food security. Weather change (Drought)(90%), lack of credit facilities (67%), soil erosion (54%), and small sizes of land owned (70%) and lack of agricultural inputs (65%), featured among the high ranking factors that often influence household food security. It can be clearly seen that a large proportion of the respondents consider change in weather (drought) as the most important cause of food shortages. This can be expected considering that the agriculture of the area is totally dependent on rain-fed cropping, which is a very vulnerable practice in an area of high rainfall variability. This result is in agreement with Kangalawe (2012) who found that at the household level, less land ownership, drought or water scarcity, loss of off-farm jobs, poor technology, indebtedness, and food price fluctuation were the main risk factors contributing to food insecurity in Tanzania. Others include weak agricultural extension services, poor division of labour at the household level, financial inability to use improved seeds, fertilizers, pesticides, and herbicides and bad farming practices leading to various environmental hazards.

Table 7: Main causes of food shortages (n = 257)

Causes	Percent
Changes in weather patterns	**90**
soil erosion	**54**
poor farming methods	**68**
pests and disease	**48**
poor access to credit	**67**
high costs of input	**65**
inadequate farm land	**70**

Multiple responses existed hence column tallies may exceed 257 and 100% respectively

Source: Author's field data (2014)

Perception on seasons of food shortage

In order to examine the food security status of the farm households in the study area over the months of the year, respondents were asked to state the food security condition of the year. As shown in Table 8 above, under normal circumstances, harvest and post-harvest periods are generally the times when, on average, food supply is adequate. About three quarters (70%) of the respondents said that the most critical period of food shortage is June to August, while many families have sufficient food between the months of December and February. This is the period when crops are harvested. About half, (52%), of the households believed food status is moderate between March and May. This implies that there was high seasonal variation with respect to food supply shortage in the study areas. Thus, there are months in which the farm households have sufficient food.

Participants in focus group discussions (FGDs) in the lowland pointed out that, months of critical food shortages were June to August, while key informant in the Highland opined that April to May were the period of food shortage. These findings are similar to those reported by FAO and WFP (2012) which confirmed that the central and northwestern parts of Ethiopia usually face food shortage between June and September.

Table 8: Percentage distribution of households' perception on seasons of food shortage at quarterly basis (n = 257)

Availability	June –August	Sept.- Nov.	Dec.-Feb.	March-May
Sufficient	30%	57%	95%	52%
Insufficient	70%	43%	5%	48%

Source: Author's field data (2014)

Food security status of rural households in the study areas

Food security analysis helps to estimate the proportion of people who are food insecure. Accordingly, the degree of households' food insecurity was estimated using the method stated in the data analysis part of this report. The following table summarizes the distribution of households in the study areas based on degree of their food insecurity.

Table 9: The percentage distribution of households' degree of food insecurity (level of dietary energy supply per person per day) on agro-climate zone

Agro-ecology	
Highland	57.1%
Midland	51.2%
Lowland	65.8%
Total	57.6%

Source: Author's field data (2014)

The analysis of food insecurity indicates that the average degree of food insecurity in the study area is about 58%. Households in lowland sites are highly food insecure (65.8%) followed by those in highland (57.1%). However, households in midland were less food insecure (51.2%). There is considerable difference in food insecurity across the sites. This indicates that location specific coping strategies are needed. Hence, food security intervention programs should give priority to highly food insecure areas like lowland and highland sites.

Regression Results on Daily per Capita Kilocalorie Consumption

A linear regression model was used to predict the probability of household food security status (level of dietary energy supply per person per day). Of the 13 predictor variables included in the model, ten were significantly correlated to the probability of a household being food secure (see Table 10 below). All the variables showed the expected relationship with food availability. Education, midland agro-climate zone, and illness did not contribute significantly to the model. These finding is consistent with the finding of Mesay (2009).

Table 10: Regression results of the model of per capita kilocalorie consumption

Variables	Unstandardized Coefficients		Standardized Coefficients	t	
	B	Std. Error	Beta	B	Sig.
(Constant)	1675.256	325.837		5.141	.000***
Education level	2.666	12.598	.009	.212	.833
Land hold size	232.286	35.725	.332	6.502	.000***
Annual income	.008	.003	.181	2.727	.007***
TLU	59.966	16.288	.168	3.682	.000***
Oxen	125.894	51.842	.138	2.428	.016**
Low land	-168.868	80.107	-.105	-2.108	.036**
Mid land	104.445	86.396	.071	1.209	.228
Drought occurrence	-308.192	73.460	-.235	-4.195	.000***
Fertilizer use	274.461	71.261	.188	3.851	.000***
Household size	-8.391	2.773	-.142	-3.026	.003***
Gender	146.787	58.004	.113	2.531	.012**
Farming system	225.703	77.820	.170	2.900	.004***
Illness	-37.707	64.233	-.027	-.587	.558

**statistically significant 5% level, ***statistically significant 1% level, Number of observations =257, Dependent Variable: Dietary energy/day/person

Source: Author's field data (2014)

The relationship between per capita food availability in kilocalorie and various variables was examined. As indicated in the table above, the 13 selected independent variables explained variations of food availability among the farming households in the study ar

indicated that five variables- landholding size, annual income, possession of livestock TLUs), level of fertilizer application and drought occurrence were among the most significant variables determining both the agriculture and food security status (food availability) of the farm households. The combined effect of the five screened most significant variables alone account for 81.2 percent of the variance.

Household Coping Strategies and Resilience

Coping strategies in food security are the activities that households use to offset threats to their food and economic resources in times of hardship and to stave off destitution with the hopes of reversing the situation and the possibility of ,once again, attaining food and livelihood security in future (Adams et al., 1998). Coping is, therefore, a process in which households switch from their normal performance to survival strategies. The ultimate aim of these strategies is to make sure that the household continues to maintain its various objectives, which include livelihood security, consumption, health status and overall well-being. During this struggle to survive, some households are more successful than others as they persist even in the face of difficult challenges. Others cease to function and disintegrate. Those households that continue subsisting are the ones that are termed resilient. Thus, embedded in the idea of coping is the concept of resilience. In general, resilience relates to 'the ability of an entity or system to maintain function when shocked' (Rose, 2007). This continued functioning may not necessarily be at the same level at which the household was able to function before encountering the shock; nevertheless, it is able to continue existing even at a lower level of consumption and food provisioning. It is in line with this reasoning that this study adopts a definition by Klein et al., (2003:40) who see resilience as relating 'to the functioning and interaction of the systems rather than to the stability of their components or the ability to return to some equilibrium state'.

To identify households coping strategies of food insecurity, farmers were asked during data collection about how they manage the problem of food shortage and how they handle food insecurity. Based on their responses, the major coping strategies commonly used by the households were identified and presented in Table 11below. More than three quarters (76%) of the households reported to have been relying on less preferred foods. About half (55%) reported to have been borrowing food from friends/relatives so as to improve their food availability. About half (52%) reported to have been purchasing food on credit; and over two fifths (41.6%) of the respondents reported to have been reducing the size of meals. About a fifth (23%) of the households reported to have consumed seed stocks. This has serious consequences on crop production and evidence shows that lack of seeds during planting periods might lead to low agricultural productivity and hence food insecurity. Moreover, two thirds (63%) of the respondents reported to have been reducing the number of meals. A small proportion (5%) of the households reported skipping meals for the whole day. These coping strategies indicate a decreasing food security situation temporarily that a household cannot destroy future livelihoods assets. The finding mirrors that in Uganda (Maxwell, 1996).

Table 11: Farm households' coping strategies to enhance resilience to food insecurity (% of Respondents)

Coping/resilience strategies	Highland	Midland	Lowland	Total
Food aid	-	25	35	19.5
Rely on less preferred foods	77	72	79	76

Borrow food from friend/relative	**56**	**50**	**59**	**55**
Purchase food on credit	**54**	**48**	**54**	**52**
Gather wild food, hunt, or harvest immature crops	**9**	**12**	**18**	**13**
Consume seed stock for next season	**18**	**24**	**27**	**23**
Send household members to eat elsewhere	**7**	**5**	**9**	**7**
Limit portion size at mealtimes	**43**	**37**	**45**	**41.6**
Reduce number of meals eaten	**62**	**60**	**67**	**63**
Restrict consumption by adults in order for small children to eat	**16**	**10**	**19**	**15**
Skip entire day without eating	**5**	**3**	**7**	**5**
Petty trade	**35**	**45**	**25**	**35**
Casual work	**45**	**25**	**30**	**35**
Sell of livestock	**17**	**19**	**39**	**25**
Sell of firewood and charcoal	**30**	**20**	**31**	**27**
Remittance	**55**	**33**	**20**	**36**

Source: Own survey, Percentages do not add up to 100% because of multiple responses

Apart from the above mentioned coping strategies, households do also adopt other long term strategies. Table 11 above also shows the coping strategies that were mentioned by individual households. About 35% of the households are involved in small businesses, while very few households are engaged in other activities such as charcoal making and selling of livestock. The findings also imply that apart from farming activities, people also have some non-farming jobs which help them to increase food availability at the household level. Working as a casual laborer is a widely-adopted livelihood strategy in the study villages, particularly among resource poor households. Working as a casual laborer includes engagement in agricultural production during farming season. A key informant from highland zone narrated his experiences as follows:

> *I usually work on other people's farms from the time of land preparation until the rains start. When I do so, I always fail to perform all the agricultural operations on my own plots in time. I own about 0.5 hectare but I rarely manage to cultivate even half of the land. Many times, my wife alone is involved in farming. During the off-farm period, I move from one house to another in search of any available casual labour tasks such as fetching water for other people or helping people with house repairs. Whatever I manage to earn from this work, I use partly for food and partly for alcohol drinking. I consume whatever I get immediately and the farming period often catches me without any food in my house. (Key informant, highland).*

Making and selling charcoal as well as firewood were the most common inco
village. Many of the smallholder farmers who participated in both interviews a

they normally cut down trees from small forests nearby their village to make charcoal and firewood for selling as part of their source of income. It was claimed that the rate of cutting down trees increased in recent years as a result of the perceived poor rainfall and unreliability. While the claimed increase in the rate of forest harvesting for charcoal and firewood could not be verified, interviewed smallholder farmers as well as the village government leaders agreed that firewood and charcoal had been one of the dependable source of income for many in the village in recent years. It was reported that,

> *"The changes are very bad ones my son. Currently, as you can see yourself, the area is dry and we have no hope for rains. Our main alternative is charcoal making. Even now, after I finish this discussion with you, I will go down to the forests to make charcoal. What do you think I can do for my survival?" (Elder, Lowland).*

Other coping or risk minimizing strategies reported during key informant interview include remittances; mutual support and resource transfer/sharing systems, and renting out farm-oxen to neighboring crop cultivators. Remittance was found to be an important alternative income source to some smallholder farmers in the area, which supports them to meet their needs outside the farms. Much as it was identified in all four villages, many of those who cited it as a main source of their income were elders in Dega-gogot village. It is an alternative to support farmers using their sons, daughters and relatives who happen to have moved to urban centres and work to support themselves, at the same time supporting their parents and relatives back in the villages. One of the elders in Highland had this to say:

> *"For these years, the onset of the rains is not predictable, too. Dry spells are very frequent. So I mostly depend on my children who work in Butajira and Hawassa to support me; otherwise, the farms are no longer giving me enough food for my family." (Elder, Dega-gogot village, Highland).*

Mutual-support and resource transfer/sharing systems, and renting out farm-oxen to neighboring crop cultivators are also among the coping mechanisms used in the study areas. The households do not rely only on agriculture and resource management strategies to survive drought consequences and livelihood shocks. They also rely on mutual-aid associations and resource sharing mechanisms in times of need. The social and economic organizations of the community are based on clan and kinship systems whereby members call on their kinship group in times of crisis. Mutual-support is often based on lineage, kinship relations, bond-friendship and neighborhood. In this connection the study community has a number of mutual-aid and stock-transfer mechanisms that enable different members to build up their own herds and to recover from crisis. Individuals/households linked by decent also exchange gifts (in kind or cash) at birth, marriage and during other ceremonies (circumcision, funeral, religious feasts, etc).

Renting out oxen to the midland crop-cultivators and those who do not have oxen within the community has been an important strategy of obtaining food grains (maize). It has been also used as risk reduction strategy, as it enables ox-owners to store some grains for a stress time and to disperse bulls during drought. Many informants have traced the commencement of this practice back to some four decades ago. In those days, the midland farmers had large landholdings where they needed more farm oxen for ploughing. In the same way, the local community had many oxen/bulls at the time. Therefore, the households seized this opportunity by renting out oxen to crop cultivators in exchange for grains. Recently, however, this practice is being reduced due to decline of oxen population in the lowland community.

decline of landholding and repeated crop failure in the farming community. Moreover, in recent years, the highland cultivators have began receiving cash credit from the government to buy farm-oxen. Consequently, the demand for oxen from cultivators has declined in recent decades.

Institutional Response: Implications of the PSNP on Food Security

To curb the situation of food insecurity, the Government of Ethiopia and its development partners launched the New Coalition for Food Security in 2003. The outcome of the New Coalition for Food Security consultation process was a Food Security Programme (FSP) for Ethiopia with the aim of supporting chronically food insecure households to reach a level of food security necessary to survive and thrive. This FSP was launched in March 2005 with three major components, including the Productive Safety Net Programme (PSNP), Other Food Security Programme (OFSP) and Voluntary Resettlement Programme (VRP) (NCFSE, 2003).In recent years other initiatives have been added to improve effectiveness and ensure program success, and these include a program of asset building for vulnerable households called Household Asset building program(HABP), which was designed to run in coordination with the PSNP, a Complementary Community Investment facility(CCI) which is meant to identify and fund small-scale community infrastructure to build up essential community assets. In the study area, PSNP is active, thus, it was assessed.

The PSNP was designed to provide cash and food transfers to chronically food insecure households to protect household asset depletion and create community level assets. The OFSP was put in place to complement the PSNP that aim to lift households out of poverty and food insecurity by building asset base for successful graduation (MoARD, 2006). According to the key-informant interview held with Mareko Woreda Agriculture and Rural Development Office, Food Security Desk experts, the safety net program was targeted for 15,302 households in the wereda. Similarly, the interview with one of the Development Agents in Semen koshe Kebele revealed that a total of 345 households are benefiting from the safety net program out of which 45 are receiving free aid and 300 are supported through cash for work program. Some of the households covered by the PSNP have improved their livelihoods to some extent by the resource transfers. In connection to this, an elder focus group participant in Elala-gebiba kebele summarized:

> *PSNP is saving our lives by enabling us to get through to the harvest season. Because of it, people do not move away from their home villages because of food insecurity. We are now able to send our children to school. PSNP has helped beneficiaries to build assets, which they can use to buy fertilizer, improved seeds and to build corrugated iron roofed dwellings. Further, the saving culture of beneficiaries has also improved as a result of PSNP. Overall, the trend before PSNP was to spend what was earned without planning. At the moment, PSNP has brought about a positive change in this respect, by training beneficiaries to properly manage the assets that they have built and the transfers received. (*Elder, Elala-gebiba, Lowland*).*

The PSNP and the process of graduation is quite complex and requires a high level capacity of the local bureaucracy. In practice, there appeared to be many problems. According to a key informant from Zonal agriculture and rural development experts, there was lack of uniform understanding of graduation bench mark as well as process across different levels of implementers. At the same
setting of target or quota works as a disincentive for the quality of the program.

informants, the local committees that are responsible for implementing graduation do not function properly due to lack of information and organization; and there is no effective mechanism for households to complain against unjust graduation. These institutional impediments result in the premature graduation of households.

The major problems remain that the food security program, the PSNP, and OFSP, have not resulted in a structural improvement of the food security capacities of households in the study area. According to FGD participants in Elala-gebiba, households have graduated from the program even though they are food insecure. They leave the program with a modest asset base, often acquired with a loan that they have not yet paid. In order to survive, they depend on the sale of household assets such as farm tools and livestock, and renting land.

Conclusion

Empirical evidence revealed that climate is changing and farmers are already aware about it. There is also evidence that climate change is likely to have adverse effect on the food security status of people especially those in the developing world as they rely on agriculture for their livelihoods. Our analysis showed that climate and disaster induced food insecurity is prevalent in North-eastern Gurageland, Ethiopia. The descriptive statistics result reveals that the current rate of food insecurity (food availability) is about 58% with differences across locations. Lowland area is found to be prone to food insecurity. The finding also indicated that most of the households had adopted both long and short term coping strategies. The most popular coping strategies were relying on less preferred foods, borrowing food from friends or relatives and purchasing food on credit, and being involved in petty trading and casual works for short and long term, respectively. The step wise regression results as well showed that many factors significantly affect food production and supply of farming households in the study area, and the most important were landholding size, annual income, possession of livestock (TLUs), level of fertilizer application and drought occurrence.

The Ethiopian food security program, the PSNP in particular, represents a major effort on the part of Ethiopian government and the international donor community to assist millions of households to get humanitarian assistance and achieve food security. This research highlights that, despite benefiting some households to escape chronic food insecurity, there are major institutional impediments to a successful program. There was a lack of uniform understanding of graduation benchmark, the setting of target or quota works as a disincentive for the quality of the program, and there is no effective mechanism for households to complain against unjust graduation. The major problems remains that the food security program, the PSNP, and OFSP, has not resulted in a structural improvement of the food security capacities of households in the study areas.

Policy Recommendation

The following recommendations/suggestions are proposed based on the outcome of the research.

- Government should enhance providing basic inputs and farm implements such as fertilizers, tractors/animal drawn equipment, improved seeds, among others in order for households to increase their food production levels.

- Rural development measures should be implemented in areas such as afforestation, family planning, non-farm income generating activities and the development of small-scale communal irrigation schemes. Voluntary resettlement scheme may also be another most notable option to ease the problem of overpopulation and acute farmland scarcity in the study areas.
- Micro-credit should be enhanced to the households so that they gain more economic empowerment to boost their livelihood activities.
- The PSNP on its own may not allow large numbers to graduate from food insecurity, but that combined with other food security programs and especially the extension packages loans and more recently the Household Asset Building Program, it can be made possible.
- Government Agencies, Development Partners and NGOs should also come up with meaningful programmes aimed at assisting farmers at household level especially in communities where no interventions have taken place such as the three agro-climate zones involved in the study

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Paper Six: ***LAND USE/COVER CHANGE IMPLICATION ON SOIL ORGANIC CARBON AND EMISSION REDUCTION: THE CASE OF ODO-SHAKISO FOREST***

by

Daniel Ebba Gurmu

Abstract

This study aimed at examining the extents of forest land use /cover change implications on soil carbon dynamics and Co_2 emission reduction from the atmospheres by considering land use changes of 1973-2011 and forest soils of 2014. To meet the objective of the research, soil samples were taken randomly from agricultural lands existed during 1973, forest lands of 1973 but converted to agricultural lands during (1986, 2000, and 2011), and soil under forest covers of 2014 by using GPS. Accordingly, 45 soil samples were tested for carbon stock assessment at three different layers, namely 20cm, 40cm, and 60 cm and they were analyzed in the laboratory using Walkley-Black method for percentage of carbon dynamics, percentage of organic matter, and Bulk density (g/cm^3) of the sample soil. Accordingly, the result of the analysis has shown existing agricultural land during 1973 sink soil organic carbon of 130.8 ton/hectare, converted forest land to agricultural land (1986, 2000, & 2011 sink 131.94 ton/hectare, and soil under forest covers during 2014 sequester 170.36 ton/hectare of soil organic carbon. This means that, the 1973 agricultural lands have lesser amount of carbon sequestration in ton/ hectare than the latter converted forest areas to agricultural land and forest covered soils. Similarly, Co_2 equivalent values showed the same trend as soil organic carbon, since it sequester on the average 479.5478 ton/hectare of Co_2 in existing agricultural land during 1973, 483.7870 ton/hectare of forest lands in 1973 but converted to agricultural (1986, 2000, and 2011), and 624.6422 ton/hectares of soil under forest covers during 2014. The sequestration potentials of soil organic carbon and Co_2 have also shown differences across soil depth and altitude. In sum, soils of the study sites played significant role by capturing, on the average, 139.39 and 511.11 ton/hectare of carbon and carbon dioxide in soils which are major causes of global warming and climate change. Since the result reveals carbon stock increases with the increase of vegetative and/or forest covers, ignite focus on potential soil carbon sinks and marks an important shift in the discussion of global warming, which has heavily focused on curbing emissions of fossil fuels. That means, the study is not denying the importance of reducing emission from fossil fuels and other sources of green house gases, but soil carbon sequestration needs to be part of the global picture and with urgent needs of restoring degraded and eroded lands, as well as avoiding deforestation, which are major reservoirs and gateways for increasing carbon sequestrations.

Key words: Land use/cover change, Odo-Shakiso Forest, Soil Carbon, Co_2, agricultural land, forest soil

1. Introduction

Nowadays, in this changing world coupled with expanding populations and growing needs of agricultural lands, it has become very crucial to study how human activities affect the physical environment with the hope either to mitigate or develop adaptation measures for the changing environments. Carbondioxide is only one of the many critical variables under scrutiny given its exponential incr

the last two centuries (Reay and Pidwirny, 2011). Rising Co_2 concentrations are worrisome because of the serious threat they pose on global climate and productivity of the agricultural activities. Land-use/cover change (LUCC) is a key driver of global environmental change and has important implications for many national and international policy issues. The impacts of land use/cover change are critical to many of the government's agricultural programs, population, environment, and development activities, etc. Population pressure is inducing the clearing of forests for agriculture and other purposes, and the attendant accelerated soil erosion, is gradually destroying the soil organic matters and increased Co_2 emissions to the atmosphere.

One way of controlling Co_2 is through terrestrial carbon sequestration, and hence, a plant removes Co_2 from the atmosphere through photosynthesis whereby the Co_2 is broken down into carbon and oxygen (Yadav *et al.,* 2009). On the other hand, the decay of a plant's leaves, stems, and roots in the soil increases soil organic carbon (SOC). The SOC constitutes more than twice as much stored carbon as that of the earth's vegetation and the atmosphere combined (USEPA, 2011). The amount of carbon sequestered at a site reflects the long-term balance between carbon uptake and release mechanisms. Because those flux rates are large, changes such as shifts in land use and land cover practices that affect pools and fluxes of SOC have large implications for the carbon cycle and the earth's climate system (Lal and Bruce, 1999; Lal, 2008). Soils can act as sinks or as a source for carbon in the atmosphere depending on the changes happening to soil organic matter. Equilibrium between the rate of decomposition and the rate of supply of organic matter is disturbed when vegetation/forests are cleared and land use/cover is changed (Lal, 2004). Soil organic matter can also increase or decrease depending on numerous factors, including climate, vegetation type, nutrient availability, disturbance, and land use and management practice etc. About 75% of the total terrestrial carbon is stored in the global soils and 40% of it resides in forest ecosystem (Six and Jastrow, 2002; Baker, 2007).

But this fact was affected by various factors in developing countries including Ethiopia, where notably human activity attributed to deforestation and vegetation degradation, land conversion, land mismanagement, soil disturbance/degradation, etc exacerbate the rate of climate change, by affecting carbon sequestration potentials of the soil and forest biomasses (Wilson *et al.,* 2011). The Ethiopian government sought to reverse environmental degradation and food insecurity of the rural community in its agricultural, economic and natural resource conservation strategies though the problem is still pervasive. Hence, forest land change was between 150,000 and 200,000 ha /annum; with such a rate, there will be nothing but a heavily disturbed forest land in inaccessible parts of the country within a few decades (Damel, 2001). Similarly, the EFAP (2010) country report estimated the rate of forest land cover change/deforestation as 140,000 ha/annum (EFAP, 2010). These acute losse

country have adverse effects on the livelihoods of the communities, on the

preservation.

Today, little of the natural vegetation of the highlands remains, except for the southern and southwestern parts of the country. In this regard, the *Odo-Shakiso* forest is one of these remnants, which are used to be habitat for various wild lives and different plant species. Although the *Odo-Shakiso* forest is located where there is a strong traditional institution of *Geda* system, which offers an opportunities for natural and forest resource preservation, it has weakened by the influx of people from different parts of the country. In consequence, different actors were exploiting the area for different purposes including coffee production, gold and other precious metals' mining, agriculture, settlement etc., which intensify the rate of land degradation and soil erosion. Despite the sensitivity of the area, as such, no significant studies were undertaken to show the impact of land use/cover change on natural and social resources so as to draw intervention programs and sustainably use the forest resources of the study area. Therefore, the current study is aimed at investigating the impacts of land use/cover changes on soil carbon dynamics and its contribution for Co_2 emission reduction during the last four decades (i.e., 1973, 1986, 2000, and 2011), by comparing soil contents of agricultural land during 1973, forest lands but converted to agricultural lands during 1986, 2000, 2011; and soil under forest cover in 2014.

2. Physical Setting of the Study Area

2.1. Location

Odo-Shakiso district is situated at a distance of about 500 kilometers away from Addis Ababa. It has an area of about 1686.82 km^2. It is an area where mixed farming economic activities are the major livelihood of the people. Astronomically, *Odo-Shakiso* district is located between $5^o2'29"$ - $5^o58'24"$ N latitudes and $38^o35'0"$ - $39^o13'38"$ E longitudes. It is surrounded by Saba-Boru in the south, Melka-Soda in the southwest, Kercha in the west, Adola Rede in the northeast and Anna-Sora in the north and Uraga in the Northwest of the District (*Odo-Shakiso* District profile, 2013).

2.2. Climate

Odo-Shakiso district is characterized by three agro-climatic zones, namely *Dega*, *Woina-dega*, i.e., locally known as *Bada-dare* and *Kola (Gamoji)*. The percentage coverage of each climatic zone is *Dega* 33%, *Woina-dega* 47%, and *kola* 20%. The mean annual rain fall is about 900mm and the annual temperature of the district is $25C^0$ (NMSA[16], 2013).

2.3. Soils

[16] National Meteorological Services Agency

The major soils of *Odo-Shakiso* district are chromic, Eufric and calcic combisal with high spatial coverage of 70%. The Cambisols found mostly on higher slope areas have very little agricultural potentials but the remaining soil types especially developed on gentle slopes (i.e., broadly comprising of chromic and Eufric soils) are dominantly used for agriculture. Besides, Orthic acrisols soil type comprises the remaining portion of 30%.

2.4. Vegetation

Odo-Shakiso district is covered with rich floristic diversity forests and woodlands. The montane forest is dominated by, *Aningeria adolfi-friderici in areas where the rainfall is higher; it is the* tallest and most important tree in forests. The under canopy cover comprises *Albizia gummifera* and other *Albizia* spp., *Celtis africana*, *Ekbergia capensis*, *Fagaropsis angolensis*, *Ocotea kenyensis*, *Olea capensis*, *Phoenix reclinata*, *Polyscias fulva* and *Prunus africana*. There are also many smaller trees and shrubs making the forest floristically rich. In the midland area, the largest tree is *Podocarpus falcatus*, growing with a range of broadleaved species such as *Croton macrostachyus*, *Hagenia abyssinica*, *Ilex mitis*, *Olea capensis*, *Schefflera abyssinica* and *Syzygium guineese afromontanum*. Relatively, in the lower altitude area, dry montane forest dominates, primarily *Barbeya oleoides*, *Catha edulis*, *Olea europaea cuspidata*, *Pistacia aethiopica*, *Pittosporum* spp. and *Schrebera alata* which is very open, verging to shrub lands (EWNHS[17], 2001).

3. Methods

To investigate the impacts of land use/cover changes on soil carbon dynamics and its contribution for emission reduction, the four periods of the Landsat images of L1-5MSS, L1-5MSS, L7ETM+, and L8OLI/TIRS for 1973, 1986, 2000, and 2011, respectively, were downloaded from Google earth. The soil samples were collected randomly from each period's agricultural land using GPS to compare with current soil contents under forest cover during 2014. Accordingly, 3 samples from agricultural lands existed during 1973, 9 sample from forest lands in 1973 but converted to agricultural land during 1986, 2000, and 2011; and 3 samples of soil under forest covers during 2014 were taken from 1m *1m plots of land. Besides, to examine the effects of land use/cover changes on soil carbon dynamics, each soil sample was taken from three different layers, namely 20cm, 40cm, and 60 cm (table1 below). Therefore, a total of 45 soil samples were analyzed in the laboratory using Walkley-Black method for percentage of carbon dynamics, percentage of organic matter, and Bulk density (g/cm^3) of the sample soil. Moreover, qualitative information was also included in the study through key informants' interview and field observation.

[17] Ethiopian Wildlife and Natural History Society

Table 11: Soil sample selection

No.	Sample Area	Sampling Type	No. of sample area	Sample/depth			Sample size	Land Use type	Periods it represent
				20cm	40cm	60cm			
1	agricultural lands during 1973 existed	Random	3	3	3	3	9	Agricultural lands	1973
2	forest lands in 1973 but converted to agri-land (1986, 2000,and 2011)	Random	3*3	9	9	9	27	Agricultural lands	1986, 2000, & 2011
3	oil under forest covers, 2014	Random	3	3	3	3	9	forest lands	2014
		Total	15	15	15	15	45		

To form an accurate inventory of organic carbon stocks in mineral or organic soil, three types of variables were measured: (1) soil depth, (2) bulk density (calculate from the oven-dry weight of soil from a known volume of sample material), and (3) the concentrations of organic carbon within the sample. For convenience and cost-effectiveness, it is advised to sample at a constant depth, maintaining a constant sample volume rather than mass (Person *et al*., 2005). In this study, soil samples were taken at constant depth of 20cm, 40cm, and 60cm to investigate the effects of forest land change to agricultural lands on soil carbon dynamics in different periods of land use investigations.

$$V = h \times \pi r^2 \quad \text{..... (equ.1)}$$

Where, V is volume of the soil in the core sampler augur in cm^3, h is the height of core sampler augur in cm, and r is the radius of core sampler augur in cm (Pearson *et al.,* 2005).

$$BD = \frac{Wav,\ dry}{V} \quad \text{..... (equ.2)}$$

Where, BD is bulk density of the soil sample per, W_{av}, dry is air dry weight of soil sample per 1m × 1m quadrant, V is volume of the soil sample in the core sampler auger in cm^3 (Person *et al.,* 2005).

$$SOC = BD * d * \%C \quad \text{..... (equ.3)}$$

Where, SOC= soil organic carbon stock per unit area; BD = soil bulk density (g cm^{-3}); D = the total depth at which the sample soils are taken (20cm, 40cm, and 60cm cm), and %C = Carbon concentration (%) (Person *et al.,* 2005), where Carbon fraction in soil pools were analyzed in the laboratory, using Walkley-Black method.

In addition, to explore soil Carbon stock per 1m*1m/ land uses and its equivalence in ton/hectare is estimated by; Summation of SOC in each land uses/area are undertaken……. *(equ.4)*

Finally, estimation of the mean SOC per unit sample of each land uses in carbon dioxide (Co_2) equivalent is calculated as;

SOC stock/land use type in ton/ha * 44/12…… (equ.5)

4. Results and Discussion

4.1. Description of the Results of Soil Sample Contents

The laboratory results of National 1-8 Walkley-Blacks confirm the percentage of both soil organic carbon and soil organic matter as it decreases with the increase of soil depth. For instance, the collected soil sample contents at 20 cm, 40cm, and 60 cm depth have 4.0513, 2.9947, and 2.7453 percentage of organic carbon on average, respectively (i.e., in g/100g soil sample). Moreover, more percentage of organic carbon variability is seen at the upper parts of the soil depth, but decreases with the increase of the soil depth.

Similarly, the percentage of organic matter per 100g soil sample has shown decreasing trends with increase in soil depth, and have 6.9853, 5.1633, and 4.7340 of percentage of organic matter at soil depth of 20cm, 40cm, and 60cm, respectively (table 2). Like the results of the percentage of organic carbon, the organic matter content variability also decreases with the increase of soil depth. Whereas, the results of the contents of soil bulk density in g/cm^3 reveal contrary to the percentage of organic carbon and soil organic matters because of scientific reasons. For instance, Chaudhari *et al,* (2013) and Arshad (1996) described that bulk density of a soil is a dynamic property that varies with the soil structural conditions and it increases with profile depth due to changes in organic matter content, porosity and compaction. Thus, the soil samples have 1.1587, 1.1827, and 1.2013g/cm^3 contents of bulk density, respectively. The analysis result verified the more of the contents of soil bulk density, the lesser the amount of percentage of soil organic carbon and organic matters.

Table 12: Descriptive statistics for contents of soil samples

Contents		N	Mean	Std. Deviation
Percentage of carbon (in g/100g soils)	20	15	4.0513	2.14167
	40	15	2.9947	1.66858
	60	15	2.7453	1.64377
	Total	45	3.2638	1.87957
Percentage of organic matter (in g/100g soils)	20	15	6.9853	3.69408

Bulk Density (g/cm^3)	40	15	5.1633	2.87497
	60	15	4.7340	2.83192
	Total	45	5.6276	3.24003
	20	15	1.1587	.09942
	40	15	1.2027	.10566
	60	15	1.2013	.14096
	Total	45	1.1876	.11596

As a result of such associations, the mean plot of the sample soil contents of percentage of organic carbon, organic matter, and soil bulk density, as called by the researcher have inverted V shape (see fig. 1 below). This happens because of the paradoxical relationships between percentage of soil organic carbons and organic matter.

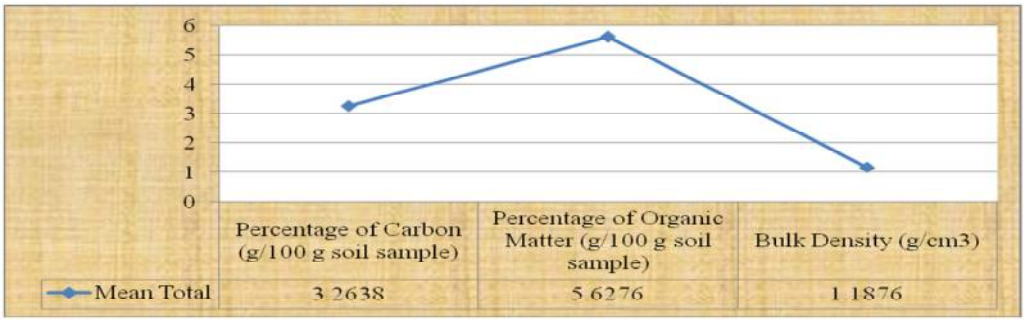

Figure 2: Total Mean Comparison of the Sample soil contents

Furthermore, the percentage of soil organic carbon and soil organic matter recognized a high degree of reverse or negative correlation with soil Bulk Density of the sample soil taken from the study area (i.e., r = -0.751). Thus, the current study indicate that, as the percentage of organic carbon and organic matter increases in the soil, the bulk density of soil decreases which ultimately increases soil Co_2 sequestration potentials (table 3).

Table 13: correlation of soil sample contents

Correlations		Percentage of carbon	Percentage of Organic matter	Bulk Density
Percentage of carbon	Pearson Correlation	1	1.000**	-.751**
	Sig. (2-tailed)		.000	.000
	N		45	45
Percentage of Organic matter	Pearson Correlation		1	-.751**
	Sig. (2-tailed)			.000
	N			

Bulk Density	Pearson Correlation			1
	Sig. (2-tailed)			
	N			45

NB: **. Correlation is significant at the 0.01 level (2-tailed).

4.2. Carbon stock by soil depth

Study results have shown 90.46, 139.54, and 188.19 ton /hectare SOC stock at 20cm, 40cm, and 60cm soil depth, respectively, which reveals increasing trends of SOC as soil depth increases. Moreover, at the same level of soil depth, it sequesters 331.67, 511.63, and 690.03 ton/hectare of Co_2, respectively. Both the SOC stock and soil Co_2 sequestration potentials are statistically significant at $p \leq 0.001$ (table 4).

Table 14: SOC stock by depth

Depth		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SOC ton/hectare	20	15	90.46	41.72	10.77	67.35	113.56	19.43	174.24
	40	15	139.54	72.70	18.77	99.28	179.80	19.03	230.14
	60	15	188.19	104.21	26.91	130.48	245.90	25.83	324.34
	Total	45	139.39	85.55	12.75	113.69	165.10	19.03	324.34
Co_2 ton/ hectare	20	15	331.67	152.96	39.49	246.97	416.38	71.26	638.89
	40	15	511.63	266.56	68.83	364.01	659.25	69.78	843.86
	60	15	690.03	382.11	98.66	478.42	901.63	94.71	1189.23
	Total	45	511.11	313.69	46.76	416.87	605.35	69.78	1189.23

ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
SOC ton/hectare	Between Groups	71641.922	2	35820.961	6.008	.005
	Within Groups	250396.108	42	5961.812		
	Total	322038.030	44			
Co_2 ton/ hectare	Between Groups	963152.364	2	481576.182	6.008	.005
	Within Groups	3366431.866	42	80153.140		
	Total	4329584.230	44			

4.3. Implication of land use/cover change

4.3.1. By sample Area

The assessment of the implication of LULC on soil carbon dynamics has shown differences between existing agricultural land during 1973, converted forest land to agricultural land (1986, 2000, & 2011), and soil under forest covers in 2014. As a result, they have SOC of 130.8 131.94, and 170.36 ton/hectare, respectively. This means that the 1973 agricultural lands have lesser amount of SOC stock ton/ hectare than the latter converted forest areas to agricultural land and forest covered soils (table 5).

Table 15: comparison of SOC with 1973 agricultural land

SOC ton/hectare	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
Existing agricultural land during 1973	9	130.7856	101.09143	33.69714	53.0798	208.4913	19.03	280.44
Converted forest land to Agricultural land (1986,2000, & 2011)	27	131.9426	78.78792	15.16274	100.7751	163.1101	43.19	312.84
soil under forest covers 2014	9	170.3578	92.25736	30.75245	99.4425	241.2731	48.51	324.34
Total	45	139.3942	85.55142	12.75325	113.6917	165.0967	19.03	324.34

Moreover, there is -8.61, -7.45, and 30.96 ton/ hectare SOC difference from the sample mean for the existing agricultural land during 1973, converted forest land to agricultural land (1986, 2000, & 2011), and soil under forest covers in 2014 (fig. 2). The negative numbers had shown the amount of SOC stock decrease from the sample mean, whereas the positive number refers to extents of increase in SOC stock beyond the sample mean.

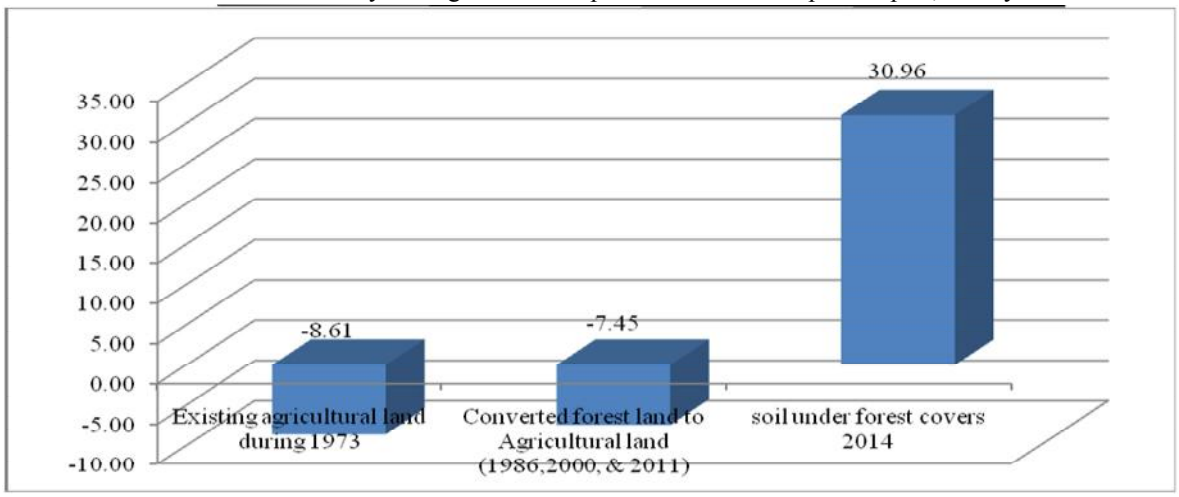

Figure 3: Difference SOC stocks from sample mean in ton/hectare

Existing agricultural land during 1973 and converted forest land to agricultural land (1986, 2000, & 2011) have a difference of about -39.57 and -38.42 ton/hectare SOC stock from forest soils of 2014 (fig. 3). The result reveals SOC stock increases with the increase of vegetative and/or forest covers, which may ignite focus on potential soil carbon sinks and marks an important shift in the discussion about global warming, which has been heavily focused on curbing emissions of fossil fuels. This creates good opportunities to overcome degraded and eroded lands, as well as avoiding deforestation, which are a major reservoir and gateways for increasing carbon sequestrations. In line with this, the study of NSW (2012) has shown soil carbon increases through increased biomass production and retention and application of carbon-rich amendments. The main losses of carbon from the soil are through organic matter decomposition by micro-organisms, soil erosion, biomass burning, and product removal in food and fiber (NSW, 2012). Moreover, Jones (2013) found that groundcover management is the prime determinant of whether soils act as a source (net loss) or a sink (net gain) for atmospheric carbon. Carbon equilibrium levels in soil are determined by carbon inputs and outputs, which in turn are influenced by temperature, rainfall and management. Organic carbon (such as humus) has many benefits in soils, making effective carbon management the key factor for productive farms, revitalized catchments and a greener planet Jones (2013).

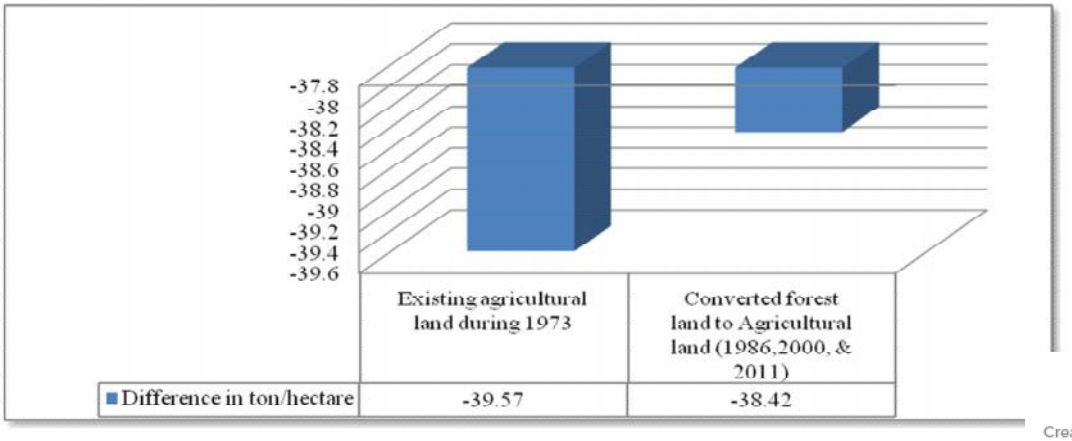

Figure 4: SOC stock difference from forest cover soils in ton/hectare

Similarly, Co_2 equivalent valves showed the same trend as soil organic carbon, and hence, existing agricultural land use during 1973 sequester lesser Co_2 than the converted forest land to agricultural land (i.e., during 1986, 2000, & 2011) and soil under forest covers in 2014. As a result, the former sequester on the average 479.5478 ton/hectare of Co2 in the soil and the latter two also sequester on the average 483.7870 and 624.6422 Co_2 ton/hectares, respectively. In sum, soils of the study sites played significant role by capturing 139.39 and 511.11 ton/hectare of carbon and carbon dioxide in soils which is major causes of global warming (table 6).

Table 16: Co_2 sequestration difference by land use

CO2 sequestration ton/hectare						
Comparison of Co_2 by Land uses	Mean	N	Std. Deviation	Minimum	Maximum	Range
Existing agricultural land during 1973	479.5478	9	370.66253	69.78	1028.28	958.50
Converted forest land to Agricultural land (1986,2000, & 2011)	483.7870	27	288.89131	158.36	1147.08	988.72
soil under forest covers 2014	624.6422	9	338.27084	177.88	1189.23	1011.35
Total	511.1102	45	313.68717	69.78	1189.23	1119.45

4.3.2. SOC dynamics by land use type and depth

The agricultural land refers to the aggregates of both the existing agricultural land during 1973 and converted forest land to agricultural land (i.e., during 1986, 2000, & 2011) sinks lower amount of SOC at depth of 20cm, 40cm, and 60cm comparing to the forest lands. At average level, agricultural land captured 86.7, 131.47, and 176.78 SOC at depth of 20cm, 40cm, and 60cm, respectively. This is significantly smaller than the forest lands, which sequester 105.44, 171.80, and 188.19 SOC at depth of 20cm, 4ocm, and 60cm, respectively (table 7).

Table 17: SOC stock difference by land uses and soil depth

SOC Stock in ton/hectare				
Depth	**Land use type**	**Mean**	**Std. Deviation**	**N**
20	Agricultural land	86.7092	41.10811	12
	Forest land	105.4400	49.66477	3
	Total	90.4553	41.7	

40	Agricultural land	131.4708	73.64584	12
	Forest land	171.8000	72.20584	3
	Total	139.5367	72.69881	15
60	Agricultural land	176.7800	102.79469	12
	Forest land	233.8333	118.30933	3
	Total	188.1907	104.21154	15
Total	Agricultural land	131.6533	83.35138	36
	Forest land	170.3578	92.25736	9
	Total	139.3942	85.55142	45

Like the SOC, Co_2 sequestration potentials of the study site differ by land use types. For instance, agricultural lands sequester 317.94, 482.06, and 648.19 Co_2 in ton/hectare at depth of 20cm, 40cm, and 60cm, respectively. Whereas, the forest lands sequester more Co_2 than agricultural land in the selected soil depth with 386.62, 629.93, and 857.38 ton/hectare, respectively, which verified the importance of forest covers for Co_2 emission reduction and global warming (table 8).

Table 18: Co_2 sequestration difference by land uses across soil depth

Co_2 sequestration in ton/ hectare				
depth	Land use type	Mean	Std. Deviation	N
20	Agricultural Land	317.9350	150.72910	12
	Forest Soil	386.6167	182.09961	3
	Total	331.6713	152.95976	15
40	Agricultural Land	482.0575	270.03666	12
	Forest Soil	629.9267	264.74885	3
	Total	511.6313	266.56256	15
60	Agricultural Land	648.1892	376.91514	12
	Forest Soil	857.3833	433.79449	3
	Total	690.0280	382.10880	15
Total	Agricultural Land	482.7272	305.62161	36
	Forest Soil	624.6422	338.27084	9
	Total	511.1102	313.68717	45

The above results of SOC in the forest land uses also show adequacy of soil organic matter found in the forest land uses than the agricultural land uses since organic matter is a perfect correlates of organic carbon. Regarding this, the field observation and interview with key informants disclose the presence of these adequate organic matters in forest soils initiate both investors and local community to use the forest areas for coffee plantation coupling with large trees needs for coffee shades and other agricultural activities. But such activities adversely affect the forest resources and worsen deforestation since it opens the doors for illegal settlement encroachments and agricultural expansion to dense forests areas (fig. 4).

The findings of the study confirm those of Victoria *et al.,* (2012) which state that soil carbon stocks are highly vulnerable to human activities, decrease significantly (and often rapidly) in response to changes in land cover and land use such as deforestation, urban development and increased tillage as a result of unsustainable agricultural and forestry practices. Moreover, Jones (2013) said, deforestation and land mismanagement cause significant amount of soil organic carbon stock. Since people cannot function without a skin, soil also cannot function without cover.

Figure 5: agricultural encroachments to forest lands

Moreover, traditional mining is also one of the remarkable aggravators for fo

and exacerbating deforestation in study areas, since the study area is one the country's and region's potential areas to mine gold and tantalum (fig. 5). The interview made, with one of the traditional gold miners key informants asks, 'Why do you and other miners find gold under the root of larger tree species? He replied that, traditionally, there are communities' believes saying that larger trees can store and handle even larger weight of gold particles under it since the area is not easily exposed to erosion and other disturbances. He also replied that majority of the traditional miners are successful in most of the cases though there are some exceptional cases with no returns after a lot of effort exerted.

Figure 6: traditional gold mines in forest area

4.3.3. SOC[18] dynamics by altitude

The effect of altitude on SOC and SOM was noticeable since it affects the rate of change in decompositions, soil compactions and porosity. Accordingly, the current study confirms the presence of substantial SOC and Co_2 sequestration difference across vertical increments of an elevation and hence, the analysis for SOC in ton/hectare and Co_2 sequestration potentials rise with increase in elevation (table 9 and 10). Meaning, the concern of this study is not to say SOC stock and Co_2 sequestration potentials are growing always with the rise of elevation though this, in some cases, may happen, to a certain extent. For

[18] Soil Carbon Dynamics

instance, in the current study, altitude from soil sample taken ranges between 1853-2222 meter above sea level and on the average it is 1979.8.

Table 19: SOC in ton/hectare by altitude and land use type

SOC ton/hectare					
Depth	**Land use type**	**Altitude category**	**Mean**	**Std. Deviation**	**N**
20cm	Agricultural land	<1900	69.4337	33.07524	8
		1901-2000	104.0900	.	1
		>=2001	126.9833	41.08045	3
		Total	86.7092	41.10811	12
	Forest land	<1900	48.5100	.	1
		>=2001	133.9050	8.46407	2
		Total	105.4400	49.66477	3
	Total	<1900	67.1089	31.71545	9
		1951-2000	104.0900	.	1
		>=2001	129.7520	29.59873	5
		Total	90.4553	41.71660	15
40cm	Agricultural land	<1900	95.5100	62.37918	8
		1951-2000	181.0500	.	1
		>=2001	210.8400	18.98335	3
		Total	131.4708	73.64584	12
	Forest land	<1900	88.4400	.	1
		>=2001	213.4800	2.00818	2
		Total	171.8000	72.20584	3
	Total	<1900	94.7244	58.39795	9
		1951-2000	181.0500	.	1
		>=2001	211.8960	13.53820	5
		Total	139.5367	72.69881	15
60cm	Agricultural land	<1900	124.9363	84.50854	8
		1951-2000	255.2200	.	1
		>=2001	288.8833	21.04608	3
		Total	176.7800	102.79469	12
	Forest land	<1900	99.960		

		>=2001	300.7700	33.33301	2
		Total	233.8333	118.30933	3
	Total	<1900	122.1611	79.48770	9
		1951-2000	255.2200	.	1
		>=2001	293.6380	23.27293	5
		Total	188.1907	104.21154	15
Total	Agricultural land	<1900	96.6267	65.01667	24
		1951-2000 M	180.1200	75.56929	3
		>=2001	208.9022	74.42793	9
		Total	131.6533	83.35138	36
	Forest land	<1900 M	78.9700	27.00067	3
		>=2001	216.0517	76.22405	6
		Total	170.3578	92.25736	9
	Total	<1900 M	94.6648	61.86657	27
		1951-2000 M	180.1200	75.56929	3
		>=2001	211.7620	72.48186	15
		Total	139.3942	85.55142	45

But the rate of increment in SOC and the rate of Co_2 sequestration potentials by soil, especially at lower elevation levels of forest lands have shown lesser stock than the agricultural lands, as it sinks 48.51, 88.44, and 99.96 SOC in ton/ hectare at soil depth of 0-20cm, 20-40, and 40-60cm, respectively; whereas, the agricultural lands have been observed to have about 69.43, 95.51, and 124.94 ton/hectare of SOC at soil layer of 0-20cm, 20-40cm, and 40-60cm, respectively. This is because the agricultural land management seems more favorable for organic matter decompositions than the forest lands which are subjected to higher level of disturbance by animals and humans (table 9 & 10). In accordance with this, mismanagement and disturbances of the ground cover of the soil resulted in loss of soil carbon, soil structure, porosity, infiltration rates, sequestration of nitrogen and sulphur etc. which affect biodiversity and crop productivity (Jones, 2013).

Table 20: Co_2 in ton/hectare by altitude and land use type

Co_2 ton/ hectare					
Depth	**Land use type**	**Altitude category**	**Mean**	**Std. Deviation**	**N**
20cm	Agricultural land	<1900 M	254.5900	121.26989	8
		1951-2000 M	381.67(		

		>=2001	465.6100	150.63298	3
		Total	317.9350	150.72910	12
	Forest land	<1900 M	177.8800	.	1
		>=2001	490.9850	31.04906	2
		Total	386.6167	182.09961	3
	Total	<1900 M	246.0667	116.28376	9
		1951-2000 M	381.6700	.	1
		>=2001	475.7600	108.53260	5
		Total	331.6713	152.95976	15
40cm	Agricultural land	<1900 M	350.1987	228.72124	8
		1951-2000 M	663.8400	.	1
		>=2001	773.0867	69.61069	3
		Total	482.0575	270.03666	12
	Forest land	<1900 M	324.2800	.	1
		>=2001	782.7500	7.35391	2
		Total	629.9267	264.74885	3
	Total	<1900 M	347.3189	214.12350	9
		1951-2000 M	663.8400	.	1
		>=2001	776.9520	49.64230	5
		Total	511.6313	266.56256	15
60cm	Agricultural land	<1900 M	458.0950	309.86555	8
		1951-2000 M	935.7900	.	1
		>=2001	1059.2400	77.16774	3
		Total	648.1892	376.91514	12
	Forest land	<1900 M	366.5200	.	1
		>=2001	1102.8150	122.20926	2
		Total	857.3833	433.79449	3
	Total	<1900 M	447.9200	291.45557	9
		1951-2000 M	935.7900	.	1
		>=2001	1076.6700	85.32784	5
		Total	690.0280	382.10880	15
Total	Agricultural land	<1900 M	354.29		

		1951-2000 M	660.4333	277.07571	3
		>=2001	765.9789	272.90195	9
		Total	482.7272	305.62161	36
	Forest land	<1900 M	289.5600	98.99682	3
		>=2001	792.1833	279.48386	6
		Total	624.6422	338.27084	9
	Total	<1900 M	347.1019	226.84196	27
		1951-2000 M	660.4333	277.07571	3
		>=2001	776.4607	265.76466	15
		Total	511.1102	313.68717	45

Similarly, the Co_2 sequestration level for the forest lands found at lower altitude verified lesser observation of Co_2 from the atmosphere than the agricultural lands found at lower altitude for every soil layer. For instance, the forest lands sequester about 177.88, 324.28, and 366.52 ton/hectare Co_2, while the more conserved agricultural lands sequester about 254.59, 350.01, and 458.10 ton/hectare Co_2 at soil layers of 0-20cm, 20-40cm, and 40-60cm, respectively. The contribution of forests for absorption of co_2 from the atmosphere were reduced because of limited soil organic matter decompositions in the soils and poor management of the forest area at lower elevation of the study area.

Except at lower level of altitude, <1900m in 1951-2000m and >=2001m, forest lands sink more SOC and Co_2 from the atmosphere, and the sample reveals SOC and Co2 sequestration potentials increase with increase of altitude. This confirms the presence of land use/cover change effects with rise of elevations, and the land use/cover change investigation results also conveyed the same pattern, and this approves that, areas which are currently forest covers are found on higher elevations. Also the availability of forest covers increases with the increase of elevations and slopes. Because of the requirements of fertile forest soils, tree shades for coffee plantation and subsistence needs of the local community, settlements' encroachments and agriculture dominantly follow the pattern.

5. Conclusion and Policy Implication

5.1. Conclusion

The aggregated factors of land use/cover changes have negatively affected the forest resources and the soil carbon dynamics of the study area. The soil samples collected from *Odo-Shakiso* forest areas at a depth of 20cm, 40cm, and 60cm to assess the effects of land use/cover changes among agricultural land and currently forest covered areas confirm differences in soil carbon sequestration potentials. The forest covered soils sequestered more carbon than the land used for agriculture in the selected

the previous agricultural lands have lesser amount of SOC and Co_2 sequestration potentials in ton/ hectare than the forest areas that were latter converted to agricultural land and those which were forest covered soils.

The sequestration potentials of soil organic carbon and Co_2 have also shown differences across sample agricultural and forest land's soil by altitude. The rate of increment in SOC and Co_2 sequestration potentials by land use type, especially at lower elevation levels, forest lands have lesser stock than the agricultural lands due to mismanagement of the forest resources in areas which are easily accessible to humans and animals. Except at lower level of altitude of less than 1900masl, forest lands sink more SOC and Co_2 from the atmosphere. Because of the requirements of fertile forest soils, tree shades for coffee plantation, subsistence needs of the local community, settlements encroachments, and agriculture forest lands nutrient content is dominantly disturbed at the lower elevations. In sum, soils of the study sites played significant role by capturing, on average 139.39 and 511.11 ton/hectare of carbon and carbon dioxide in soils which are major causes of global warming and climate change.

5.2. Policy Implication

Since soil is one of the largest carbon pools among the terrestrial carbon sinks, giving adequate recognition for the vital role played by soil carbon could mark an important shift in the discussion about global warming, which has heavily focused on curbing emissions of fossil fuels. That means, the study is not denying the importance of reducing emission from fossil fuels and other sources of green house gases, but soil carbon sequestration needs to be part of the global picture and with urgent needs of restoring degraded and eroded lands, as well as avoiding deforestation, which are major reservoirs and gateways for increasing carbon sequestrations. Generally, the *Odo-Shakiso* forest areas required urgent government attention for implementation of appropriate natural resource management systems, replacement of deforested and degraded forest areas through planting trees, demarcate the forest areas for regeneration, and avoiding total illegal encroachment for agriculture and settlements. Therefore, for its success, aggressive implementation of forest and other penal laws of the country are needed, in addition to enhancing communities and stakeholder's awareness.

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Paper Seven: ***GIS Based Land Suitability Evaluation for Barley and Maize in Enemay Wereda, Northwest Ethiopia: Management Options for Sustainable Agricultural Development Corresponding author.***

By

Arragaw Alemayehu

Abstract

The major objective of this study was to examine land suitability for rain-fed barely and maize using GIS. The evaluation made in this study was a qualitative land evaluation based on physical land suitability assessment, using agro-climatology, topography and soil parameters. Land suitability evaluation for barely and maize were done by using the Maximum Limitation Approach. Reclassification and overlay analysis have been made to determine the overall suitability class of the area upon the three sets of variables/attributes. After the land had been evaluated, land suitability maps were prepared for the respective crops. The land suitability analysis result showed that more than 86% of land falls under moderately suitable (S2) class for barely and nearly 83% of the land was marginally suitable (S3) class for maize. For the sustainable development of agriculture in the study area, appropriate soil and water conservation techniques should be strengthened. Present land suitability evaluations should integrate the climate components. This is because, the non- climatic factors can be managed by different stakeholders either in the short or long term. With the above management options and future research directions in mind, farms under "marginally suitable" (S3) and "moderately suitable" (S2) category can be improved and probably might be rated as "highly suitable" (S1) and the study area remains as the crop mosaic/hub of the country.

Key Words: Land suitability, Barley, Maize, Enemay wereda

1. Introduction

Land evaluation refers to the systematic assessment of land for different purposes by considering bio-physical and socio-economic entities. A land suitability evaluation involves identification of the current land-use, land utilization types and their requirements, and comparison of land between different land utilization types. Land suitability assessment enables to achieve sustainability of land for a specific use. Besides, adoptions of suitable land use and farming systems and technologies are also crucial in exploiting land resource more sustainably (FAO, 1976; 2007).

Theoretically, the productivity of any land depends on three broad categories of factors: namely the physical resource base, management and input level, and conservation measures. Thus, land suitability evaluation for a certain purpose, especially for rain-fed agriculture, should consider the sets of requirements indicated above (FAO, 1976; 1983; 1984; London, 1991). The physical re

attributes which determine growth and productivity of a certain crop. For instance, temperature amount, sun shine, moisture or rainfall (amount and distribution), topography (slope gradient), soil structure, nutrient availability, soil reaction (soil pH), drainage (soil oxygen availability), etc., are "physical" variables which influence land productivity. The "management" factor refers to human related variables that influence utilization of land for a purpose. For instance, land preparation, labor availability, farm inputs, level of mechanization (traditional, small, medium, or large scale), etc., belong to the "management" of land use requirements. Soil "erosion" and "degradation" hazards are the "conservation"-related variables that affect land productivity.

However, all the variables mentioned above can't be accounted at once in the practical evaluation of land for a particular use (crop) in a locality. The variables to be selected depend on the purpose of evaluation, and the locality where the evaluation is conducted (FAO, 1983; 1984). In a land evaluation, for instance, it becomes significant to incorporate as many factors as possible if the goal of the evaluation is targeted to the implementation of an investment project on crop production. On the other hand, only some selected soil-related variables can be used if the purpose of evaluation is for soil fertility management decisions.
Over-cultivation, rising rate of soil erosion, declining soil fertility and overall land degradation have threatened level of land productivity in many Sub-Saharan countries of Africa, including Ethiopia. Because of this and the rising cost of food, food insecurity is still a critical problem in Ethiopia and other African nations. That is why "ensuring food security" is one of the eight MDG which have been targeted to be attained by the end of 2015, but this goal seems one of the most difficult MDG to get achieved in the targeted year, and food shortage may continue to be a challenge of governments until some decades in the future. This requires the need to increase agricultural production and improve land productivity.

Land suitability evaluation for sustainable land management in general and agricultural production in particular at local scale/farm level has not been well assessed in Ethiopia. As a result, this local level study will contribute for policy makers and development planners at local, regional and national levels on sustainable land management in general and agricultural production in particular by generating first hand and evidence based data. Therefore, such study is important since it comes up with some management options and policy recommendations.

The farming tradition of farmers in Enemay district, Northwestern Ethiopia, is not far from that of the farmers in most other parts of the country. In other words, most farmers in this district carry out farming traditionally without research based knowledge about the limitations of the land exploited. Thus, this requires assessing the degree of suitability of land for the production of selecte

the requirements on selected key land related parameters in this particular area. This study is aimed at assessing the suitability of land for the production of selected crops in rain-fed farming in Enemay Woreda, Gojam province, Northwestern Ethiopia. Thus, the specific objectives of the study are:

1. to evaluate the degree of land suitability for barely and maize cropping using GIS, and
2. to compare the land suitability levels of the cereals accounted in the evaluation (i.e. barely vs. maize).

2. Materials and Methods

2.1 Description of Study Area

Enemay Wereda is one of the 18 Weredas in East Gojjam Administrative Zone. It is divided into 27 KPAs, 24 rural and 3 urban. This Wereda, with a total area of 762.5km^{2,} is located 265 km away from Addis Ababa and 225 km away from Bahir Dar. It is bordered by Enarje Enawga in the North, Dejen in the South, Shebel Berenta in the East and Debay Tilat Gin in the West (figure 1).

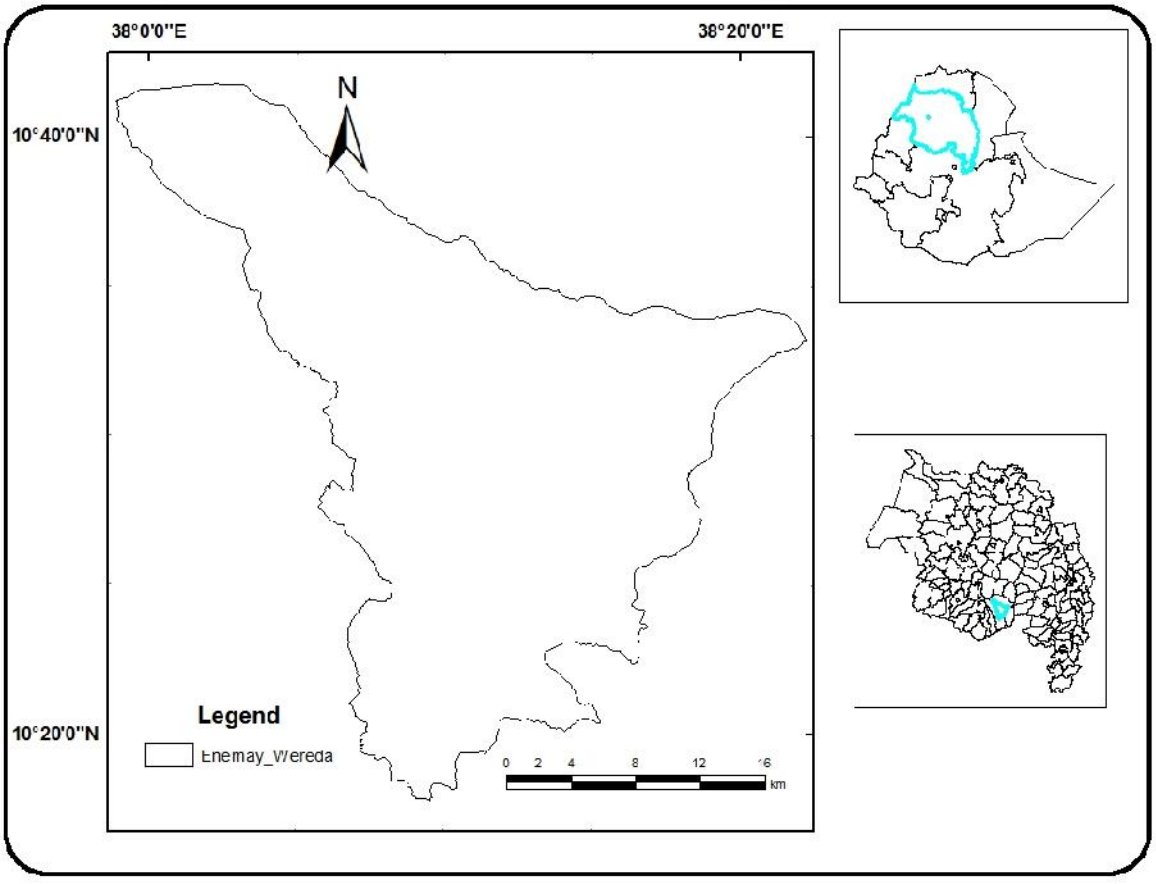


Figure 1: Location of Enemay Wereda

The study area, Enemay Wereda, lies within three agro-ecological zones (based on micro-climatic variation); namely, tepid moist mid highlands (93%), cool moist mid highlands (6.8%) and warm moist lowlands (0.2%). The greatest part of the Woreda is extensive plain and the rest is marked by rugged topography. The altitude ranges from 1362 - 3245 meters above sea level. About 73.5% of the area has slope gradient between 0 - 8%. Pelvic vertisol covers large proportion of the area (>70%) followed by euritic cambisol (15%). Leptosols, euritic nitosol and chromic luvisols are other soil types of the study district - with area coverage in a decreasing order.

Two stations are found in the Wereda; the first is in Bichena, and second is in Yetmen. Since the number of missing years in Bichena is more, only Yetmen is used. The mean annual rainfall is >1000 mm. The rainfall showed positive trends in annual rainfall amounts (107 mm/decade) and summer rainfall totals (220 mm/decade) but a decline in spring totals (60 mm/decade). In addition, the daily rainfall analysis revealed that annual and seasonal mean rainy days were increasing and have values 26.4 days/decade, 15.7 days/decade and 5days/decade, respectively for annual, summer and spring seasons. This implies that there is a high potential for crop production in the study area.

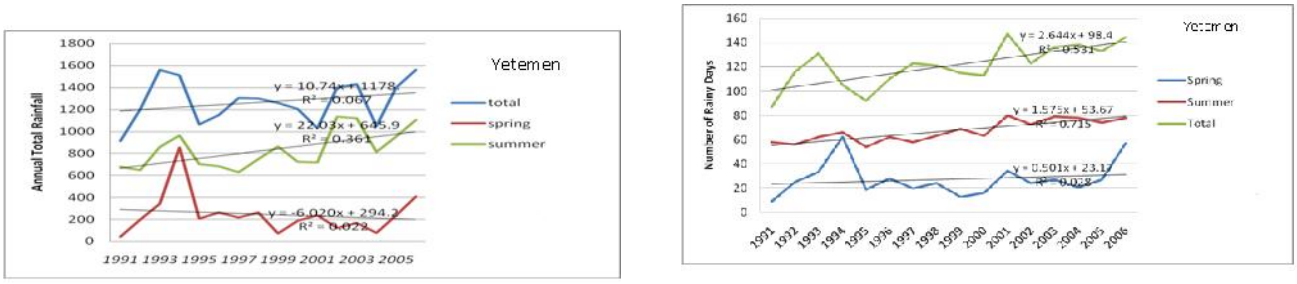


Figure 2: Trends in Rainfall totals (left) and Number of rainy days (right)

Source: Computed from NMSA Data, 2009

The Woreda experienced mean maximum, minimum and average annual temperature of 27.8, 11.2 and 19.5 ^{0}C, respectively. Regarding temperature, there is positive trend of minimum, maximum and average temperatures and the corresponding values were 1.4, 0.5 and 0.8 ^{0}C /decade, respectively.

It is essential to determine the sawing, growing and harvesting period of crops by observing the rainfall coefficients, number of rainy days or the combination of the two. As the rainfall coefficients have shown, most months have rainfall from moderate to heavy. This coupled with the positive slope in rainfall amount and rainy days shows, the Wereda is conducive for rain-fed agriculture. Although crop production in the study area is traditional with mainly one cropping season stretched from mid-May to late-January, the extensive plain surface and high proportion of fertile soils along with the climatic conditions in the study area make the Wereda surplus producing area. Generally, the major crops c

categorized as Cereals (Teff, Wheat, Barely, Maize, Sorghum and Millet); Pulses (Beans, Chick Pea, Lentiles and Peas); Oil seeds (Noug, Telba, and Gomenzer); Vegetables (Potatoes, Onions, and Peppers) and others. Much of the food production comes from cereals (68%), pulses (29%), oil seeds (1.63%), vegetables (0.65%) and others (0.63%) (ARDO, 2009). As a result, the Wereda is identified as a surplus producing area by the government and not included under the Productive Safety Net Program. In connection to this, Warner et al. (2015) concluded that Enemay Wereda is the 2nd largest producer of teff in the country.

2.2 Methods of Data Collection

In this study, a qualitative physical land suitability assessment was made based on agro-climatology, topography and soil parameters. Soil data were obtained from the Ministry of Agriculture (MoA) of Ethiopia, and data on soil depth, base saturation, pH and drainage were extracted from FAO-UNESCO world soil resource reports. Climatic records were obtained from the National Metrological Agency of Ethiopia. The GIS platform was also employed to generate data for the study. Agro-ecology, soil and topography data (maps) were extracted using GIS.

The land suitability evaluation was conducted based on the the FAO (1976) method. The physical suitability of a land is the function of different factors such as climate (temperature, rainfall, etc.), soil (base saturation, depth, drainage, pH, etc.), topography (slope, elevation), etc. Since the purpose of this study is comparison of land suitability between two crops (barley vs. maize), only some selected parameters were considered based on data availability.

$$LS = f(T, Rf, S, E, Sd, D, pH, Bs \ldots)$$

Where: LS is the theoretical land suitability of a given land; and T, Rf, S, E, Sd, D, pH, Bs, stand for temperature, rainfall, slope, elevation, soil depth, drainage, soil pH and base saturation, respectively. In this study, evaluation attributes were selected, and evaluation criteria (land use requirements) were set based on the data at hand and upon literature. Thus, values were assigned for each parameter based on the level of requirement of LQ/LC of each land use type (crop).

The suitability classes of each crop upon each attribute (LQ/LC) were determined by the “most limiting factor” technique. Land attributes were compared/matched aginst the land use requirments to specify suitability levels of each land use (crop). The matching and rating tables were developed based on Sys et al. (1991) (general) and the FAO (1982) about Ethiopia. Land suitability levels of each “land unit,” upon each variable (LC), were rated as S1 (highly suitable), S2 (moderately suitable), S3 (marginally suitable), and/or N (not suitable) depending on the cost of input required and output expected (I

cumulative) GIS-based land suitability evaluation of barley and maize were analyzed through the weighing and scoring technique.

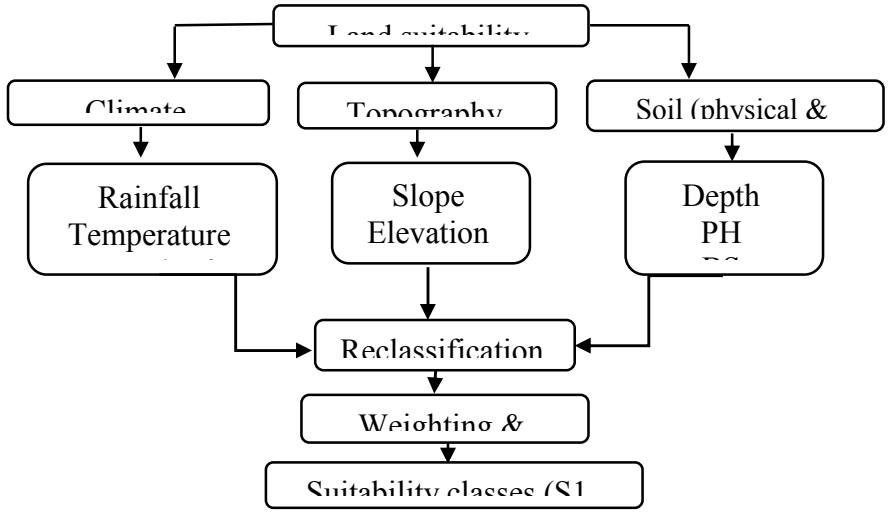


Figure 3: The land evaluation model.

3. Results and Discussion

3.1 Level of Land Suitability Based on Selected Physical Attributes (LQ/LC)

Land suitability evaluation for barely and maize was done by using the maximum limitation method. For this study soil, topography and agro-ecology data were used. The suitability of each variable was also analyzed after reclassification has been made. Overlay analysis was made to determine the overall suitability class of the area upon the three sets of variables/attributes.

Table 1: Comparative Land Suitability Analysis for Barely and Maize

Land Characteristics	Suitability Level	Barely	Maize
		Percent (%)	Percent (%)
Agro-ecology	S1	93.0	6.8
	S2	0.2	93.0
	S3	6.8	0.2
	N	-	0.00
Elevation	S1	20.4	79.3
	S2	0.3	20.4
	S3	79.3	0.3
	N	0.0	-
	S1	71.3	71.3

Slope	S2	10.0	10.0
	S3	8.3	8.3
	N	10.4	10.4
Soil	S1	-	3.4
	S2	18.3	19.5
	S3	4.4	-
	N	76.5	77.1

Source: Own computation, 2014

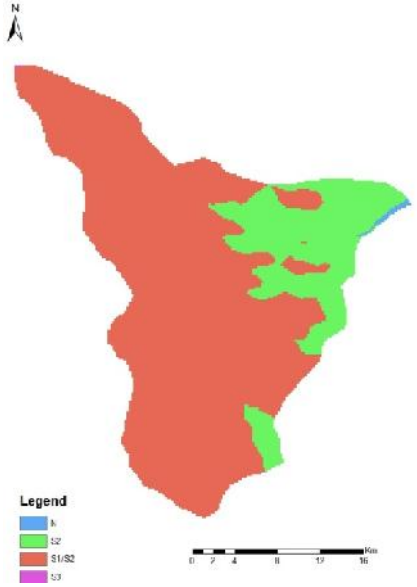
A comparative land suitability analysis was made for barely and maize based on selected physical parameters. It is not a deniable fact that slope affects degree of mechanization, soil erodibility, runoff generation and moisture availability of any soil. So, it is significant to evaluate the suitability of slope gradient of the study area for the crops considered. According to Sys et al. (1991), the conventional slope category for both crops in general falls between 0-8, 8-16, 16-30 and 30-100 percent for suitability class S1, S2, S3 and N, respectively. Thus, upon this set of values as classification criteria, the greatest proportion of the district (71.3%), with slope within 0 - 8 percent, was found to be "highly suitable" (S1) for the two crops. Close to 10 and 8.3 percent of the study area was rated "moderately" (S2) and "marginally" suitable (S3) for both crops, respectively. The proportion of the district that falls under N class was 10.4%.

In addition, soil types have a highly significant effect on soil moisture and nutrient availability as well as the ease of work. The challenge in this evaluation was the lack of spatially referenced soil data for each chemical and physical property. But, to narrow the gap, general soil characteristics were extracted and the common chemical and physical properties were applied. Thus, as indicated in the table below, the evaluation result upon soil type has shown that none of the area falls under highly suitable (S1) for barley; but only 3.4% of the area falls under this category for maize. For both crops, more than 75% of the area was found to be marginally suitable (N class).

Since the Ethiopian agro-climatic classification is conducted upon altitude and temperature, it is included in the suitability analysis for barley and maize. Thus, the mean annual temperature, rainfall and elevation were incorporated in the evaluation. These factors, in turn, affect maize and barely production in particular and agriculture in general. About 93% of the study area falls under S1 suitability class for barely, but the same area falls under moderately suitable (S2 class) for maize. The rest 0.2 and 6.8% of the area falls in moderately suitable (S2 class) and marginally suitable (S3 class), respectively, for barely. The

corresponding figures, respectively, are marginally suitable (S3 class) and highly suitable (S1 class) for maize.

Similar patterns have been followed in the elevation classification process. The altitudinal brake points for agro-ecology classification of Ethiopia were followed for this study. The extent of the suitability analysis of elevation for the two crops have shown that more than 79% of the area falls under suitable (S1 class) for maize but marginally suitable (S3) for barely. None of the area in the Wereda falls into unsuitable class (N) for the two crops.



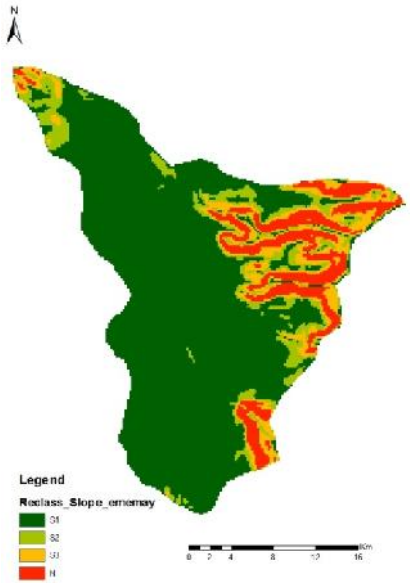


Figure 4: Reclassified Soil (upper left), Agro-climatology (upper right), Elevation (lower left) and Slope (lower right) map for Barley

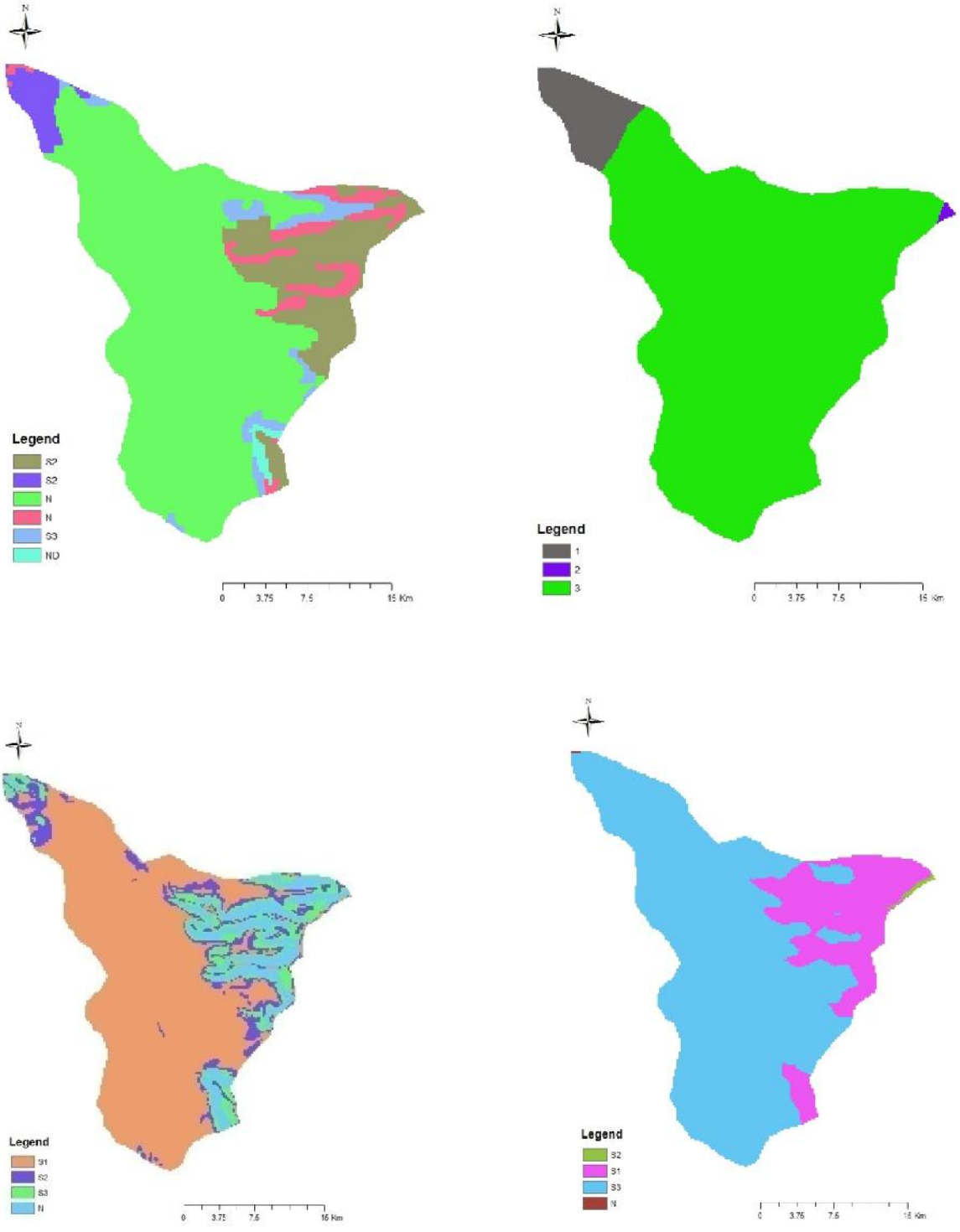


Figure 5: Reclassified Soil (upper left), Agro-climatology (upper right), Elevation (lower left) and Slope (lower right) map for Maize

3.2 Results of the Overall Land Suitability Evaluation

The overall suitability analysis result was obtained after conversion of the raster data to vector data in Arc GIS. Each parameter was given a weight to indicate the degree of influence (severity) of each land characteristic (land quality) on the overall suitability of the area for the crops evaluated. As shown in figure 8, land suitability categories were obtained for barely and maize. Thus, on the basis of the available data, matching tables assisted by GIS were used to run the suitability evaluation process for barley and maize.

Results of the overall suitability analysis revealed that only < 3% of the land, which is the northwestern part of the Wereda, was highly suitable (S1 class) for barely. About 10% of the area in the east and northeast falls under marginally suitable (S3 class), while the remaining large proportion (>86%) falls in moderately suitable (S2 class). But, none of the area in the Wereda falls into the unsuitable (N class).

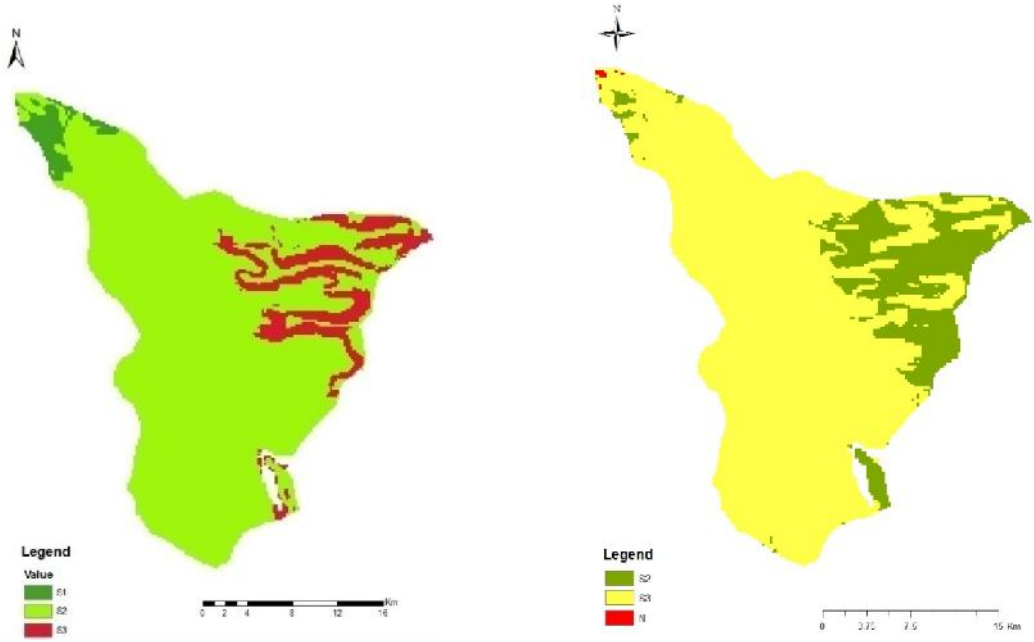


Figure 6: Barely (left) and Maize (right) suitability map of Enemay Wereda

Table 2: Suitability for barley and maize

	Barley		Maize	
Class	Area (ha)	%	Area (ha)	%
S1	1889.9	2.8	-	-
S2	57876.6	86.7	11657.3	17.4
S3	7002.3	10.5	55069.1	82.5
N	-	-	67.1	0.1
Total	66768.8	100.0	66768.8	100.0

In the same fashion, land suitability evaluation result for maize has shown that there is no land under highly suitable (S1) class for maize. Close to 17.4% of the area in the east and northeast part is moderately suitable (S2) class; more than 82.5% is marginally suitable (S3) class. These areas are found in the south, southwest and northern parts of the Wereda. A very small proportion of land in the northwest falls under unsuitable (N) class. As the results show, Enemay Wereda is more suitable for the production of barley than maize.

4. Summary and Management options for Sustainable Agricultural Development

Land suitability assessment for the sustainable development of agriculture is important for countries like Ethiopia, to achieve the government's poverty reduction strategy and Climate Resilient Green Economy (CRGE). This is because, as clearly indicated in the CRGE, the country has the target of reaching middle-income status before 2025 by boosting agricultural productivity along with the industrial base. Therefore, sustainable land management and land use efficiency are some of the mechanisms to increase the productivity of farmlands.

The land suitability analysis results showed that 2.8% of land in the Wereda was found to be suitable (S1) class for barely; but, none of the area in the Wereda falls under this category for maize. The study results further showed that 86.7% and 17.4% of land falls under moderately suitable (S2) class for barley and maize, respectively. The remaining 10.5% and 82.5% of the land was marginally suitable (S3) for barley and maize, respectively. About 0.1% of land falls under unsuitable (N) class only for maize. To improve productivity of the land on a sustained base, the different limitations should be managed and appropriate soil conservation measures should be launched and/or strengthened.

Poorly drained soils are susceptible for floods especially during the rainy seasons. When excess water is accumulated in the soil, it can severely limit the use of land for agriculture. The excess water in the soil may impede work and result crops to wilt. This problem is clearly shown on vertisols. Thus, the excess water/ moisture from the soils should be drained and removed from the soil through different mechanisms.

Some soils of Enemay Wereda like Nitisols and Leptosols have low PH level, i.e., they are acidic. In fact, the pH requirement for optimum production of maize is 6.0 – 7 and for barley it is 6.5 – 7.8 (Landon, 1991). In other words, best production of these crops can be obtained in soils which have neutrality. Thus, to improve the productivity of these soils for barley and maize production, the

surmounted, and application of lime is supposed to be a better solution since liming has a neutralizing effect on acidic soils.

Since, leptosols are found on mountainous and sloppy areas where runoff is known to exceed infiltration, the possible solution should be improving the slope length and slope gradient through the construction of structural and biological conservation measures. In this regard, application of terraces, stone/soil bunds and grass strips is thought to be relevant. Of course, the management options for the productivity problems of leptosols have to go beyond application of conservation structures; since leptosols are shallow, they do have severe problems in terms of nutrient storage and moisture retention capacity; therefore, it is significant to apply organic manure in areas (soils) where leptosols are dominant. Moreover, applying irrigation could be another management option for the constraints of leptosols. Above all, proper soil and land management techniques should be realized for the sustainable use of the land in the study area.

On the basis of the findings, the following recommendations were forwarded: strengthening soil and water conservation measures, use of irrigation and water use efficiency, application of chemical fertilizers and organic matter, and better land management techniques should be strengthened. As a result, farms under "marginally suitable" (S3) and "moderately suitable" (S2) category can be improved and probably might be rated as "highly suitable" (S1). Consequently, the Wereda remains as the crop mosaic of the country.

Realizing the current climate change and variability, future researches on land suitability assessments should incorporate the climate component as well. This is because, the non- climatic factors can be managed and controlled to some extent by farmers, government and other stakeholders either in the short or long term. Land suitability evaluation for specific crops should give more emphasis to geo-informatics / GIS to make the decision successful, and it should be done at local level. In addition, studies like this should incorporate the knowledge and experience of the local farmers to make the evaluation complete.

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ANNEXES

Annex 1: Workshop Program (July 02, 20150)

Time	Presentation	Presenter	Moderator	Rapporteur
Registration 8:30 - 9:00 AM				
Opening Session 9:10 - 9:45				
9:10-9:20	Program Introduction	Muluneh		
9:20- 9: 45	Opening Speech	Prof H. Musahara	Muluneh	
9:45 - 11:00 AM Session One				
9:40 -10:00	Land Deals for Commercial Farming in Metekel Zone of Benishangul-Gumuz Regional State: Its Implication on Local Communities in Selected two Woredas	Moges Woyessa	Dr Abeje B.	Ato Molla M.
10:05 -10:25	Apiculture value chain and its implication for local economic development: a case from Kilte Awlaelo District, Tigray Regional State	Wondeye Admasu		
10: 30- 11:00	Discussion			
Refreshment 11:00 -11:20 Ras Amba Hotel				
Session Two 11:20 AM - 12:30 PM				
11:20 - 11:40	Wild edible foods in the *green famine belt* of Ethiopia*:* do they contribute to household resilience to seasonal food insecurity?	Guyu Ferede	Dr Workneh Negatu	Ato Molla M.
11:45 - 12:05	Land use-cover Change implication on rural Livelihoods: the case study of Odo-shakiso forest, southern Ethiopia, Oromia	Daniel Eba		
12: 10- 12:40	Discussion			
Lunch 12:40 - 2:00PM Ras Amba Hotel				
Session Three 2:00 - 3:45				
2:00 - 2:20	Vulnerability and resilience in the context of climate change and disaster risk prevention: rural household food insecurity in north-Eastern Gurageland, Ethiopia	Barhane Mulugeta	Dr Messay Mulugeta	Ato Fikremariam
2:20 - 2.40	Land use/cover change implication on soil organic carbon and emission reduction: the case study of Odo-Shakiso forest	Daniel Eba		
2:45- 3:05	GIS based land suitability evaluation for barley and maize: the case of Enemay Woreda, Northwest Ethiopia.	Arragaw Alemayehu		
3:05 - 3:35	Discussion			
3:35-3:40	Closing Ceremony & Refreshment by Ras Amba H[illegible]			

Annex II: List of Workshop Participants

	Participant	Organization
1	Abeje Berhanu	AAU
2	Addisu Meseret	AAU
3	Andnet Gizachew	Wollo University
4	Arragaw Alemayehu	AAU
5	Assefa Tafese	AAU
6	Aynadis Yohannes	IOM
7	Balew Demssie	AASTU
8	Bekalu Sinshaw	AAU
9	Berhanu Mulugeta	AAU
10	Bitew Atnaf	Wollo University
11	Daniel Ebba	AAU
12	Diriba Idare	AAU
13	Endalew Addis	AAU
14	Engida Esayas	AAU
15	Ezana Amdework	AAU
16	Gebayaw Kassie	AAU
17	Getaneh Mossie	AAU
18	Girma Belachew	AAU
19	Guday Emirie	AAU
20	Guyu Ferede	AAU
21	Hachalu Anbessa	AAU
22	Herman Musahara	OSSREA
23	Hirut Terefe	AAU
24	Jire Jabessa	AAU
25	Kassahun Gashu	AAU
26	Kassu Hailu	AAU
27	Lammi Tulu	AAU
28	Mamo Hebo	AAU
29	Meheret Adnew	AAU
30	Mehreteab G/selassie	AAU
31	Melake Mihret	UU
32	Melat Lukas	AAU
33	Messay Mulugeta	ASTU
34	Moges Woyessa	AAU
35	Molla Maru	AAU
36	Mulugeta Aabte	AAU
37	Mulugeta W/Michael	Dire Dawa University
38	Muluneh Woldetsadik	AAU
39	Sewagegne Asrat	AAU
40	Selam Esayas	AAU

41	Sileshi Abate	AAU
42	Tadesse Melaku	Hawassa University
43	Taye Alamirew	AAU
44	Tekle H/Michael	UNISA
45	TemesgenTilahun	AAU
46	Tesfaye Angassa	DBU
47	Tesfaye Zelalem	AAU
48	Tesfu Belachew	Mada-Walabu University
49	Teshome Beyene	AAU
50	Tiglu Geza	AAU
51	Tilahun Tefera	AAU
52	Tizita Mulugeta	AAU
53	Tomas Mekoma	AAU
54	Tsigie Genet	AAU
55	Woldeab Teshome	AAU
56	Wondye Admassie	AAU
57	Workneh Negatu	AAU
58	Wossenu Yimam	AAU
Plus **six** others who appeared after the session started		

Annex III: Pictures of the Workshop

Banner of OSSREA-EC Workshop at Ras Amba Hotel.

Opening Remark by Dr. Muluneh W, Abshare, Liaison Officer, OSSREA-EC

Opening Speech by Prof. Herman Musahara, Acting Executive Director of OSSREA

Chairperson and Presenters, Morning Session

Chairperson and Presenters, Morning Session

Lunch Service to Workshop Participants

Chairperson and Presenters, Afternoon Session


Workshop Participants

Closing Remark by Dr. Workneh Negatu, Member, OSSREA- Ethiopian Chapter Liaison Committee