agricultural extension and its impact on food crop diversity and the livelihood of farmers in guduru, eastern wollega, ethiopia

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Agricultural Extension and Its Impact on Food Crop Diversity and the Livelihood of Farmers in Guduru, Eastern Wollega, Ethiopia.

By

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Credit

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Declaration

I, Gizachew Kebede, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature: _____

(Gizachew Kebede)

Date _____

Dedication

I dedicate this work to my dad, who is not lucky to collect a fruit of what he has planted.

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Abstract

Agricultural extension could be one tool in attaining the millennium development goal related to the reduction of extreme poverty and hunger in developing countries like Ethiopia. Though extension was practiced for many years in Ethiopia, it is recently that small-scale farmers have got attention. This study aimed at understanding the impact of extension on the livelihood of farming communities and diversity of local crop varieties in Guduru district, East Wollega zone of Oromiya regional state. A survey of 120 households at different wealth categories and at different distances from the district center, and group discussion with a variety of farmers was carried out. Farmers have significantly higher number of pairs of oxen today compared to what they had five or ten years ago ($F = 14.657$, $P < 0.001$). On average, 3.26 children of farmers are attending school now compared to 1.81 and 0.78 five and ten years ago respectively. Now, 92.5% of the farmers are living in a house whose roof is made of iron sheet. Though there was difference between farmers in different wealth categories regarding the number of pairs of oxen and children attending school five and ten years ago, the mean difference is larger at the present compared to the past. There is no significant difference in holding size, pairs of oxen, children attending school, and the number of iron sheets of farmers' house at different distances from the center, while price of fertilizer was significantly lower at the center. Farmers' landraces of maize 'Boqqoloo haadha, Feeshoo, Jaarma, Amaarikaanii' and wheat 'Qomixee, Qamadii biilaa' together with other crops are lost from the study area. Generally extension have played role in improving the living status of farmers in the study area. However, it seems that it has an impact in creating difference and/or increasing the wealth gap between farming households and also replace local landraces with improved varieties. In input use is increasing as time goes in the study area, but currently the negative impacts from input use, such as pesticides, do not affect activities of farming communities like beekeeping.

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List of abbreviations and acronyms

ADLI: Agricultural Development-Led Industrialization

ANOVA: Analysis of Variance

ARDU: Arsi Rural Development Unit

CADU: Chilalo Agricultural Development Unit

CSA: Central Statistics Authority

DA: Development Agent

DAP: Di-ammonium Phosphate

E.C: Ethiopian Calendar

EEA: Ethiopian Economic Association

EMTPs: Extension Management Training Plots

FAO: Food and Agricultural Organization of the United Nations

GDP: Gross Domestic Products

IFAD: International Fund for Agricultural Development

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

MPP: Minimum Package Program

NGO: Non Governmental Organization

PADEP: Peasant Agricultural Development Extension Project

PADETES: Participatory Demonstration and Training Extension System

SG-2000: Sasakawa Global 2000

SIDA: Swedish International Development Authority

SPSS: Statistical Package for Social Science

T&V: Training and Visit

WADU: Wolayta Agricultural Development Unit

WMQBAG: *Waajira Misoomaaf Qonna Baadiyyaa Aanaa Guduruu*. Guduru district bureau of agriculture and rural development

1. Introduction

1.1. Background

Extension is both a political and an organizational instrument implemented to facilitate development and it is ranges from transfer of mono-crop technology to participatory problem solving educational approaches, which aims at reducing poverty and enhancing community involvement in the processes of development (Rivera and Qamar, 2003). Agricultural extension works in a wider knowledge system that embraces different components of which research and agricultural education are some (Rivera, et al 2001).

According to Jones and Garforth (1997), agricultural extension is important because in the first place, information about good or new agricultural practices in a particular environment from research station or farmers experience can be assembled, synthesized and made available to use. Secondly, this information can be used especially for educational purpose to further investigate it or to disseminate knowledge. Thirdly, it results in creation of organizational and administrative setup which can make dissemination of technologies easier. Natural calamities such as famine, crop failure and problems like soil degradation and economic crises can also result in immediate initiation of extension work.

Ethiopian agriculture is rainfall dependent and subsistence-oriented. Most of the outputs come from small-scale farmers who undertake traditional farming practices using traditional farming tools. There is a significant variation in terms of land form, soil types, climate, farming practices, etc., which provides the country with different types of livestock and a variety of food crops, vegetables and fruits.

Chemical fertilizers and improved seeds are the most important inputs adopted by Ethiopian farmers; even though extension packages are applied to livestock sector, high value commercial crops (e.g. coffee, peanuts, onions, tomatoes, cabbage, carrots and sweet potatoes) as well as food crops (e.g maize, wheat, *teff*, barley, sorghum, and millet) (Carlsson *et al*., 2005). Despite the fact that Ethiopian government removed any kind of input subsidy starting form 1997/8, the country's fertilizer consumption raised from

3,527 tons to 216,876 tons between the years 1995 and 1999, while the amount of improved seeds distributed to the farmers during the same year increased from 1,104 to 17,778 tons (Ibid, 2005).

Even if agriculture is the most important sector in the country's economy, Ethiopia has experienced food shortages since the 1970s and millions of people have been suffering from hunger. For the last three decades, information on the performance of Ethiopian agriculture indicates that there is a gap between food supply and demand and the sector is unable to produce adequate amounts of food to meet the growing human population in the country (Belay and Abebaw, 2004). As a response to the large gap between food supply and demand, a collaborative agricultural project that follows extension approach was initiated by the Sasakawa Global 2000, in 1993 and applied to different parts of the country through the involvement of the Ethiopian government. As part of the federal government, the Oromiya Regional State has taken the mandate to implement the project. Although chemical fertilizers were being used before, it is since then that the idea of using improved varieties has been expanded in Guduru district[1] of East Wollega zone of Oromiya Regional State.

1.2. Problem statement and justification

Government involvement at different level is important in relation to agricultural sector improvement. According to Rivera et al (2001), governments of developing countries are confronting new extension challenges: on the one hand, there is a need to increase production to provide food for all citizens, raising the income of the rural population and reducing poverty; on the other hand there is a need to manage the natural resources in a sustainable way in a rapidly changing world with new technologies developed all the time. Therefore, it is important that policy-makers are aware of the key role that extension plays in the national economy development before modernizing and reforming the existing agricultural system (Qamar 2005). Though achievements in crop improvement in the last 20 years are undeniable, poor farming families' needs are unaddressed. On the other hand exotic cultivars can give better yields under selected

[1] District is to mean the second level of administration from the lower level (locally called *Aanaa*), next to Peasant Association (locally called *ganda*)

demonstration sites with good management, but under conditions that prevail in most peasant farms, where there is low inputs and varying climatic conditions, local landraces usually perform better than exotic ones (Lakew *et al*., 1997).

Bad agricultural practices like cultivation of marginal land, widespread use of chemicals and pesticides, over cultivation and overgrazing, use of chemical fertilizers rather than organic fertilizer result in degradation of soils and vegetation (Darkoh 2003). Flowering plant pollination systems are also under threat because of human induced impacts like habitat destruction, land use change, and use of chemicals (pesticides and herbicides) (Kearns *et al*, 1998). This causes in reduction of both the number and species of native bee pollinators (Richards, 1993). That is why nowadays honeybees are considered as an indicator of the condition of the environment in which they are kept and guides the means of assessment of ecosystem health as their number and species diversity is helpful for the assessment of many forms of pollutions (Kevan, 1999).

Agricultural intensification at the moment and the potential intensification in the future will also have significant impacts on non-agricultural aquatic and terrestrial ecosystems. According to Tilman (1999), only since three and half decades back from the beginning of 21st century, doubling of agricultural food production resulted in 6.87 times increase in use of nitrogen fertilizers, 3.48 times increase in phosphorous use, 1.68 fold increase in size of irrigated and 1.1 fold increase in the size of crop land. This author also indicated that a three fold and doubling of nitrogen and phosphorous fertilization rates respectively and doubling of irrigated land and 18 percent increase in crop land can be expected in the future. These projected changes would have significant impacts on the composition, diversity and normal functioning of the remaining world's natural ecosystem.

Extension mission by itself is challenging as it deals with uneducated rural poor with the aim of changing their behavior positively as compared to dealing with animals and plants at safe and comfortable research stations (Qamar, 2005). In the Ethiopian condition, past extension approaches have been planned and implemented in top down approach without the involvement of the people for whom they have been designed (Belay, 2003). While in

many parts of the country the number of extension workers is very small, the existing ones lack qualification and communication skills (Belay and Abebaw, 2004). Recently, in Ethiopia by initiation of both the federal and regional governments there is an adoption of different extension packages in different parts of the country of which Guduru district is one. Farmers have been supplied with improved seeds and agricultural inputs like fertilizers and pesticides. But, in the absence of in-situ conservation, such activities can cause genetic losses and result in land degradation. Under poor management, extension programmes can also have a profound implication on the livelihood of the community and may create wealth differences among individual households as those who are close to the extension workers and those who can afford the cost can be better-off while the others are the losers.

In spite of the fact that the Ethiopian government gave special attention to the agricultural sector and tried to establish and support agricultural research institutes, research stations in the country are too few to cover the whole country. Improved seeds are basically tried in few research stations and at farmers' fields near the stations but disseminated to a large area. Fertilizers are also applied on dose recommendation bases without site specific plant or soil nutrient analysis. In some parts, there is also problem of market access, resulting in low prices of agricultural products as production increases, which is expected under extension based farming. Besides, there is no any kind of research undertaken in the study area on any specific crop or management practices, or on how the extension programme is performing. Therefore, this study helps to give an image of agricultural extension going on in Guduru district with the following objectives.

1.3 Objectives of the study

The objectives of the study were;

- To assess the benefits of agricultural extension to farmers,
- To understand whether agricultural extension is equally benefiting farmers at different wealth status and at different localities from the center,
- To see the effect of agricultural extension on local varieties of food crops,
- To analyze the level of agricultural inputs used and its impact on bee economy,

Having the above specific objectives, the study has tried to answer the following basic questions.

- Is really agricultural extension benefiting the rural poor?
- Are the farmers at different locations from the district center equally benefiting from agricultural extension?
- Is there a wealth difference between the poor, middle and wealthy class of the society following the introduction of extension?
- Is there loss of crop variety or landraces because of extension?
- What is the trend of input use in the area? Increasing or decreasing?
- Is there any impact from input use on beekeeping activities?

1.4. Structure of the thesis

The next section, chapter two, refers to what others wrote on the issue of agricultural extension. However, studies that reflect the prevailing conditions in the study area are very limited, because no study of any type is undertaken in the study area. The third chapter gives an insight of the study site in terms of its location, population, land use types, vegetation and others. It also explains the setup of the study and sample size of the household survey. The fourth chapter explains in-depth the impact of agricultural extension on livelihood of farmers in terms of holding size, draft animals, children attending school etc. and also presents differences between farmers at different locations and different wealth categories. The impact of agricultural extension on local crop diversity and the surroundings is also discussed under this chapter. The fifth chapter gives concluding remarks based on the findings from the fourth chapter.

2. Review of Literature

2.1. Contribution of agriculture to the Ethiopian economy

As it is the case in many less developed countries, Ethiopia's economy is highly dependant on agriculture. The agriculture in turn depends on unpredictable and erratic rainfall and is basically subsistent in its nature. The contribution of agriculture to the Ethiopian economy is so immense that the GDP will fluctuate following the boom and burst in agricultural production. According to FAO (2007), in the year 2002/03 the real GDP of Ethiopia declined by 3.5 percent as a result of low performance of the agriculture because of major drought. After that, for three consecutive years, Ethiopia showed a steady growth of real GDP by 11.5 percent, 10.5 percent and 9.6 percent in the years 2003/04, 2004/05, and 2005/06 respectively. The highest contribution to the GDP is from agricultural sector (47%) followed by service sector (39%) and industrial sector (14%). This is the result of increased production because of more or less sufficient rainfall, increased input used and increase in cultivated land.

In a long time perspective the contribution of agricultural sector to the national GDP is declining form time to time. As an example, the percent share of agriculture in the national GDP was 74 percent in the year 1965, 62 percent in 1978, 50 percent in 1988 and 45.1 percent in the year 2001 (Abdella, 2002). There is also sharp variation between the years with an increase by 15 percent in the good years and a decline up to 12 percent in drought years (EEA, 2005). The decline in the contribution to the GDP is not an indicator of the growth in another sector or replacement of agriculture by industry as a sign of development, because it is still source of livelihood for 85 percent of the population living in rural areas and also covers 85 percent of employment opportunity (Abdella, 2002).

The country's export is also highly dependant on agriculture. In the past four decades, about 80-90 percent of merchandise export earnings of Ethiopia were coming from primary agricultural products (Gemechu, 2002). Of the country's total export earning of 5.17 Billion Birr in foreign currency in the year 2003/04, the share of agriculture was 82.2 percent (coffee alone covered about 37.3 percent and the rest is from semi processed

products) (EEA, 2005). According to the same source, except flower which joined the list of export trade very recently, the structure of export trade of the country remained the same for a very long time. Very few of the agricultural products (especially skins and hides, meat and sugar) are semi-processed export material while the bulk are in raw product form. The most important unprocessed agricultural export materials include; coffee, fruits and vegetables, pulses, oilseeds, live animals, and chat.

Coffee has a long history in the Ethiopian export earning and foreign trade. Ethiopia is also a center of origin of Coffee Arabica. Despite of the fact that coffee alone contributed for about 60 percent of the country's export earning, most coffee growers are found in remote areas and absence of feeder roads to the central market was and is the major problems. Because of this, significant amount of coffee is consumed domestically and cross the border illegally (Abdella, 2002). The reduction of coffee price at international market also brought a significant change on the country's export earning in general and the livelihood of coffee growers in particular. Because of this problem some coffee growers uprooted their coffee plants and replaced it by some other crops which have better market value, especially chat in the eastern part of the country.

The performance of the agricultural sector also plays role in the level of inflation rate in the country. As compared to the other sub-Saharan African countries, rate of inflation in Ethiopia is low. This is because of factors like fiscal policies and price control of the past governments, strong currency of the country, reform in the economic sector etc. However, the highest rate of inflation (21 percent) in the history of country's economy was recorded in 1991/92 as a result of major drought that hit the agricultural sector and highly reduced production (FAO, 2007). It is because of such hard facts that the government gave focus to the agricultural sector and applied different forms of agricultural extension to support the sector and to push the country forward on the development track. Therefore, it is important to look into overview of the past extension approaches in the country.

2.2. Overview of agricultural extension in Ethiopia

When we look at the history of economic growth and development in general, only very few countries have succeeded sustainable economic growth without priorily or simultaneously developing their agriculture (Birkhaeuser, et al 1991). Therefore, in least developed countries like Ethiopia, improving the performance of the agricultural sector is the best alternative to show the way out of poverty and hunger. Though, there is potentially cultivable land in the low lands of the country, high population growth rate makes the expansion of farmland difficult in the highlands. As a result land size is diminishing from time to time and even there are landless families in the rural Ethiopian highlands nowadays. Degradation that results from intensive cultivation, overgrazing, short or zero fallow periods, cultivation of steep slopes etc. was observed in the country long time ago. These and many other problems necessitate bringing in the idea of agricultural extension in the county to minimize the gap between the demand and supply of food, to reduce the pressure on the natural resources, and to avert land degradation.

Without any doubt, the outward shift in production possibility frontier needs transformation of the agricultural sector by the use of improved agricultural technologies, and interventions like extension to the rural mass (Wale and Yalew, 2007). At least 50 years have been spent since the idea of extension was brought in to the country. However, more has been said than done practically, about the Ethiopian agricultural system in bringing the expected change in the rural communities of the country (EEA, 2006). The performance of the sector is dwindling from time to time. Even though the general production has increased in the recent days, the per-capita production is by far lower than in the 1960s and 1970s. The livelihood of the society is also the best indicator of the performance of the agricultural sector. National and household food security conditions show that a year to year food aid is a must for some 6-7 percent (4-5 million) of the chronically food insecure people and some 8.5-10 percent (6-7 million) people, which are transitionally food insecure, also need food aid during bad seasons (EEA, 2005). In general, since the last two decades, Ethiopian agriculture has been unable to produce enough amounts to support the food demand of the ever growing population (Belay, 2003). In fact drought and some other natural calamities are the primary driving

force for the bad performance as rainfall becomes less predictable and drought becomes more frequent.

The beginning of agricultural extension service and the effort of the government to modernize the agricultural sector dates back to the establishment of the Ministry of Agriculture, the former 'Yersha Mesriabet', in 1908 (EEA, 2006). The mandate of the then Ministry of Agriculture was provision of advice on crop and livestock production, protection of wildlife and forest resources, provision of veterinary services, and at the same time collection of pertinent statistical information. However, since then the Ministry has undergone frequent restructuring and reforming, both in the staff under it and the institutions and programs to be followed. For the past three decades alone, the Ministry of Agriculture has passed through at least ten big restructuring and reforming processes (Ibid, 2006). Under this frequently reformed institution with new programme coming in every time, the approaches followed by the extensionists to reach farmers were also different. As a result different extension programs were following different approaches to reach the farmer. Generally there are many different extension approaches existing today.

2.2.1. Approaches generally existing

Agricultural extension is considered as: a function that can be applied to different areas in the society; a knowledge system whereby research and agricultural education are operating in association within a broader knowledge system; an extended concept in which rural people who depend on primary production, remittances, petty trade and casual works should covered under agricultural and rural extension; and it is also an alternative among different approaches to best suit to the existing social, environmental and economic conditions (Rivera, et al 2001). These authors emphasized that agricultural extension follows many different approaches that can be managed by a variety of institutions under different settings saying that '…no single approach best suits extension development in all circumstances,…just as there is no one single approach that best suits development …otherwise the problem of extension and, for that matter, of development, would have been solved long ago…' p 12

According to Axinn (1988), there are eight main approaches in agricultural extension and their success can be measured by different criteria. These eight approaches are the following;

1. **The general agricultural extension approach**- in which the boost in national production together with the rate at which the recommendations are taken up is considered as a measure of success.
2. **The commodity specialized approach**- whereby the total production in particular crops measures the success of the approach.
3. **The farming system development approach**- measure of success is the degree to which the local farming communities adopt agricultural technologies provided by the programme and for how long they are continuing with the technology in use.
4. **The training and visit (T&V) approach**- increment in production of particular crops covered under the extension programme measures the success of such approaches.
5. **The agricultural extension participatory approach**- here the number of farmers that are actively participating and benefiting from the extension program as well as the long term continuity of the extension organizations at a local level measures the success or failure of the approach.
6. **Educational institution approach**- success is measured by farmers' participation and attendance in agricultural extension services at school.
7. **The project approach**- this comes with short term projects and the measure of success is the change that we can achieve in a short period of time.
8. **The cost sharing approach**- the farmers' willingness to share the cost incurred by the programme individually or through their local institutions measures the degree of success.

When we come to the case of Ethiopia, the above mentioned approaches were applied separately or in combination with one another, under different policy regimes. Therefore, it is better to look into some of the approaches followed in the past to develop the agricultural sector in particular and the country in general.

2.2.2. The approaches followed so far in Ethiopia

Agricultural extension in Ethiopia started during the imperial regime[2]. The base for the commencement of real agricultural extension at that time was the agreement between the US and Ethiopian government signed in 1952 with broad mandate such as; high level manpower training, agricultural extension promotion, and dissemination of research output and scientific information using agricultural extension as a network (Abesha, et al 2000). Of course these ideas were interrelated. During that time the country was without any trained manpower and to fulfill the above objective, the now Haromaya University was established in the same year as the agreement. The collage played a significant role in establishing agricultural extension in the country shouldering national mandate to develop and deliver agricultural extension programmes (Belay, 2003). However, as of August 1963, the mandate for agricultural extension was transferred to the Ministry of Agriculture with the complaint that the college's effort was concentrated to reach only farmers in the vicinity (Ibid, 2003).

Because of the fact that the country's trained manpower, financial and material resources were inadequate to modernize agrarian societies in all corners of the country at a time, the comprehensive package approach was implemented at that time by the imperial government. Chillalo Agricultural Development Unit (CADU) was the first comprehensive package programme, established in 1967 in Arsi region, southern Addis Ababa, with financial aid from the Swedish International Development Authority (SIDA) (Abesha, et al 2000). CADU focused at general socioeconomic development such as integrated planning, market and credit services, mechanization, stabilization of market price, training to local project employees, research related to intermediate agricultural technologies and farm inputs (Belay, 2003). Wolayta Agricultural Development Unit (WADU), that was supported by World Bank, and Arsi Rural Development Unit (ARDU) were some of the comprehensive package approaches followed by the imperial regime (Wale and Yalew, 2007). According to Belay (2003), the approach implemented by the comprehensive package to reach the farmer, especially CADU, was demonstration whereby extension agents and model farmers were demonstrating new agricultural

[2] The regime by king Hile Silassie who ruled Ethiopian between the years 1930-1974

technologies and farmers field days were arranged so that farmers in a nearby area could learn from the demonstration sites. Some farmers in the vicinity were also supplied with improved seeds and fertilizers.

Since the mid 1960s, there were also extensive efforts in research focused on testing fertilizers and key crops in different areas of the country by FAO and the then Imperial Institute of Agricultural Research. This resulted in another approach called Minimum Package Programme (MPP) in 1971 (Keeley and Scoones, 2000). According to these authors, the MPP was applied at different stages (as MPP I and MPP II, of which only MPP I is applied in the imperial period) and tried to link external inputs (fertilizer and seed) to credit facilities with the narrative in favor of Green Revolution elsewhere.

By September 1974, the country entered into a new era as a result of revolution undertaken in the country. The imperial regime was overthrown and the military force took the power. Some drastic changes happened in the country, of which the March 4, 1975 land reform proclamation is the major one. The proclamation banned private ownership of land, prohibited transfer of land through sale or mortgage, declared land distribution to tillers without any compensation to the private owners, and limited the maximum land size that a single family can have to 10 hectares (Belay, 2003, EEA, 2006). Under its third chapter, the proclamation contained the establishment of peasant association as the basic instrument for the implementation of the land reform. A peasant association has to cover an area greater or equal to 800 hectares and 250-270 households as members (Belay, 2003).

Under the military regime, two major extension programmes were applied, the Minimum Package II (MPP II) and the Peasant Agricultural Development Extension Project (PADEP). MPP II was planned to be implemented between the periods 1975-1979, however the political instability in the country did not allow the timely implementation of the program. After the establishment of producers' and service co-operative in 1978, the MPP II was reinitiated in the year 1981 to be implemented between the years 1981-1985 by support from the International Fund for Agricultural Development (IFAD), World

Bank, and by SIDA (EEA, 2006). However, PADEP came in as a result of the shortcomings of MPP II in 1985 that emanate from the limited resource capacity of the country towards developing technology that fit into highly diversified ecological and social setup.

The formulation of PADEP divided the country into different, more or less homogeneous zones, and set different objectives to these different zones. Bases on climate, geographic position, resource endowments, and cropping patterns, the country was divided into eight different agricultural development zones whereby 235 districts (181 cereal producing and 54 coffee producing districts) were selected as surplus producing districts (Belay, 2003). Some of the objectives of PADEP were to boost national food production, to promote cash crop production, to expand cooperatives in rural areas, to create employment opportunities for the rural communities, and also to avert soil loss through erosion. The program's approach to reach the farmer was a modified version of the Training and Visit (T&V) system whereby one DA is assigned to 1300 farmers in contrary to the conventional T&V, which assigns 800 farmers per single DA (EEA, 2006).

The current government, after overthrowing the military regime in 1991, opts for Agricultural Development-Led Industrialization (ADLI) as a general strategy of food security and poverty reduction in the country. To realize the strategy, Participatory Demonstration and Training Extension System (PADETES), was adopted as a national extension system as of 1994/95 (Abesha, et al, 2000). However, the approach followed by PADETES, was first introduced in the country by an NGO called Sasakawa Global 2000 (SG 2000), on 160 farmers in two regional states (Oromiya and South Nations, Nationalities and People-SNNP) in 1993 with farmers' wheat and maize Extension Management Training Plots (EMTPs) (EEA, 2006). According to the same source, SG 2000 came to the farmers with inputs (improved seeds, fertilizers with recommended rate), credit for the purchase of the inputs, training for Development Agents (DAs) and farmers, and serious follow-ups of EMTPs by a nearby DA. As a result, SG 2000 got acceptance and in very short time, other regions (Tigray and Amhara National Regional States) were included and technologies for other crops (teff, and sorghum) together with

maize and wheat, were demonstrated on 1600 farmers by the year 1994. The yields from EMTPs were two to three fold of what has been harvested from the traditional plots. Therefore, PADETES is the result of the success story of EMTPs introduced by SG 2000.

Under the current regime, regional states have got a full responsibility of executing agricultural extension systems while the Ministry of Agriculture, has the mandate of policy formulation, coordination of inter-regional projects and development programmes, provision of training and technical advice to raise the competence of staff at regional level (Abesha, et al 2000). The basic approach is the package approach and there are different packages. Some of the major packages are: extension package that bases on cereal crops, package for high value crops, package for livestock sector, package for soil and water conservation, package for agroforestry, and package for post- harvest technology (Ibid, 2000).

According to Wale and Yalew, (2007), the different approaches were in place to avoid the problem of their predecessor. For example MPPs replaced the comprehensive package programs because the comprehensive package programs were found expensive and not applicable for poor farmers. The MPPs were also found to be in favor of wealthy farmers and replaced by PAPEP. These are more or less the same as contemporary extension programme attempted in the 1960s. However, the newly implemented package programme was designed based on a thorough evaluation of efforts applied in the field of agricultural extension in the country for the past three to four decades. Agricultural extension in Ethiopia faced many problems in the past and it still has many shortcomings. Some of the major problems are indicated below.

2.3. The constraints facing agricultural extension in Ethiopia

A good agricultural extension system accepts and incorporates farmers' traditional knowledge in research processes and sees farmers as partners during decision making. However, in most cases the problem with science in agriculture and extension is that it has a poor understanding of the knowledge from very poor, indigenous rural people. For many scientists, in order to develop those rural people, formal research and extension has to transform their knowledge into another knowledge system, because their knowledge is

considered as unscientific and primitive (Röling and Pretty, 1997). This is true when it comes to the case of agricultural extension in Ethiopia. In most cases, the approach is top-down, whereby technologies are developed somewhere and the farmers are told what to do by the development agents (EEA, 2006; Belay, 2002; Belay, 2003; Abesha, et al 2000; Wale and Yalew, 2007).

Since the beginning, extension service coverage was not properly emphasized and certain groups were more favored than others. In spite of their large number, small holder farmers were not given attention until recent days. Development of big commercial farms and industries have got attention during the imperial regime while the focus was towards cooperatives and big commercial state farms, which consumed about 95 percent of agricultural inputs (fertilizers, pesticides, improved seeds and farm implements), during the military regime (EEA, 2006).

Another shortcoming is from the linkage of extension with research in the country. Under normal conditions, agricultural extension service serves as a farmer organization that expresses the concern and feeling of farmers to the public and conveys information from research institute to farmers and from the farmers back to research institutes (Birkhaeuser, et al 1991). Contrary to this fact, agricultural research in Ethiopia is poorly linked to extension (Belay, 2003; EEA, 2006; Wale and Yalew, 2007) because of the fact that extension and research activities have been carried out under different institutions with zero or minimal coordination between them (Belay, 2002).

According to Birkhaeuser et al (1991), agricultural extension service needs agents for two main activities: in the first place to transfer required information to the farmers and secondly to report the problems faced by the farmers. However, agricultural extension agents in Ethiopia (named as Development Agents), are involved in different activities which are not necessarily related to their normal work such as collection of fertilizer credit, being government spokesmen, or agents for other government bureaus and this will highly affect their relation with the farmers (Belay, 2003). According to the same

source extension coverage in the past followed main roads and only farmers on both sides of all-weather main roads benefited from extension.

Agricultural extension approaches in the past were renewed with no or weak evaluation and monitoring of the systems. Moreover the extensions that were put in place used one-size-fits for all types of extension methods and there is no extension that suits for all categories of adopters (EEA, 2006). To summarize, research process and agricultural extension services in Ethiopia lack preferences, criteria and conditions of the farmers (Wale and Yalew, 2007) and a well articulated national research and extension policy is not yet developed in the country (Demese, 2004 as cited in Wale and Yalew, 2007). In general, all of the above mentioned programs came up with some inputs which are totally or partly external to the traditional farming system. This has an impact on the farming system in general and the diversity of the farmers' crop variety in particular.

2.4. Ethiopia as a center of genetic diversity

Considering the 1920 N.I.Vavilov's concept of gene centers as a point of departure, Ethiopia is considered as one of the eight world's centers where crop plants are highly diverse and also where some of the crops are primarily or secondarily domesticated (Engels and Hawkes, 1991). Because of the fact that today's modern crops are domesticated from their wild relatives, the relative abundance of crop wild relatives is also an indication for the center of diversity. Many wild plants are used as source of food in Ethiopia, especially during drought and normally when there is food shortage between sowing and harvest (Edwards, 1991). Plenty of these plants are used as leafy vegetables followed by edible fruits and shoots or roots (Ibid, 1991).

The natural environment, the farming system, and the active involvement of the farming communities resulted also in endemic crops and high number of farmers' local varieties (landraces) that evolved with very peculiar adaptation characters (Geleta, et al 2002). Highlands of Ethiopia are highly dissected by natural barriers such as mountains (as high as approximately 5000 m.a.s.l) and ravines (sometimes as deep as or deeper than 1300m) where primitive farming systems, conditioned by the purposive farmers selection of crops from multi cultural and multi ethnic societies for millennia, resulted in the endemism of

the crops with special traits (Engels and Hawkes, 1991). When it comes to endemism, Ethiopia has many fully domesticated endemic crops of which 'tef' (*Eragrostis teff*) and *Ensete ventricosum* are the best known ones (Edwards, 1991). Earliness, pest and disease resistance, drought and stress condition resistance, nutritional quality and in general, characteristics useful for low input agriculture are some of the special traits, which are believed to exist in most of the crops grown in the country (Worede, 1991; Worede et al, 2000).

On the one hand transformation of the country's traditional farming system necessitates changing in order to feed the highly growing population; on the other hand there is a need to conserve the crop genetic diversity. These objectives are most of the time challenging for the government and for the concerned organizations. Worede (1991), emphasized this idea indicating there is no part of the country which is free of special crops and/or their wild relatives, and it is a challenge for conservationists who are involved in conserving local varieties and their wild relatives to be used in modern cropping systems. Nowadays many of these crops are lost or threatened because of many reasons. Some of the reasons are indicated below.

2.5. Potential threats of modern agriculture to local crop diversity and the environment

Traditional farming, with farmers long lasting accumulated knowledge and experience to sustain yield in diversified farming conditions basically based on locally available resources, is the unique character of Ethiopian farming systems. Traditional crops and landraces; which are adapted over centuries of farmers' selection to satisfy their changing and dynamic needs, is the foundation for Ethiopian farming (Worede et al 2000). Nevertheless, there is a trend to adopt modern agriculture and unless properly handled, this has a paramount impact on the traditional crops in particular and the environment in general.

2.5.1. Local crop variety loss

Traditional varieties (landraces) are used by subsistence farming, which accounts for 60 percent of agricultural land and supply about 15 to 20 percent of the global food demand. On top of that local varieties are the primary input for plant breeders to come up with

modern varieties which supply the remaining world consumption (Wood and Lennea, 1997). However, the global trend is to opt for few high yielding varieties that can suit for high input agriculture, neglecting the farmers' varieties (landraces) on which human beings depended for millennia (Asfaw, 2000).

When it comes to local crop variety of Ethiopia, most of the existing diversities are under constant threat of being irreversibly lost as a result of replacement of low yielding local landraces by introduced exotic or improved varieties at an alarming rate (Worede, 1991). Moreover, the rate at which the exotic or improved materials are replacing the indigenous local varieties in Ethiopia has not been fully documented and the rates of displacement vary from crop to crop and from region to region (Worede et al 2000). A study by Asfaw (2000), on Ethiopian barley indicates that local barley landraces are replaced by improved cultivars and also by other crops like oats and wheat. Some Ethiopian barley landraces are no longer under cultivation and some of them are kept somewhere (eg. Gaterslben gene bank in Germany), and no more found at the farmers hand or in the country. The author emphasized the loss of endogenous knowledge together with the landraces as the major consequences of the displacement.

Ethiopian farmers play significant role in conserving crop varieties as they control the bulk of genetic resources of the country. Unless circumstances force them, the peasant farmers retain at their hands some seed stock for security reason. Even under serious situations when they are forced to leave their home because of drought or war, they store small amounts of seed to use when they come back. Rock hewn mortars or clay pots that can be sealed and buried in secured places inverted in underground pits, are the basic instruments to conserve these seeds (Worede et al, 2000). Nevertheless, the experience from the recent severe drought revealed that seeds imported as food grain by relief agencies, even pose more serious threat on the diversity of local crops, as farmers have already been forced to eat or sell their own seeds during drought periods (Worede, 1991).

One of the effective strategies to help resource poor farmers who practice low input agriculture under marginal environment is to maintain field level species diversity. In

spite of its importance, on-farm conservation of resources has got very little institutional research attention and it was a topic of past neglect and recent interest (Wood and Lennea, 1997). To this regard Ethiopia has experienced a continuous flow of germplasm out of the country since the European journey of discovery whereby Portuguese were the first beneficiaries followed by Italians, Germans, Russians, and others (Engels and Hawkes, 1991). This has also a contribution to the loss of genetic diversity to the poor farming communities in particular and the country in general. On the other hand, in most cases modern agriculture is followed by use of external farm inputs like fertilizers and pesticides, which also have environmental implication both locally and globally.

2.5.2. Impact of fertilizer and pesticide on the environment and bees

Since the beginning of Green revolution, up to 1996 the use of chemical fertilizer increased at about 20-fold and the annual consumption of pesticides reached 2.5 million tons at a cost of 20 billion US Dollar globally (Pimentel, 1996). If we consider only herbicides alone, their half-life in the surrounding environment can vary and some stay less than a month while the others can stay even more than a year (Freemark and Boutin, 1995). That means, there is a residual effect from both fertilizer and pesticide use.

According to Pimentel (1996), the use of pesticide has an intricate impact on the environment and its inhabitants. In the first place it is fatal to human beings; domestic animals in several millions are poisoned each year; and animal products like milk, meat, egg etc. are contaminated with these chemicals. Secondly, as the pesticides that are applied to crops finally enter into water bodies, they result in contamination of both surface and ground water. The problem is more severe when it comes to ground water because almost half of the world's population depends on wells for their domestic water demand and once ground water is contaminated by pesticides, the chemicals stay for a long period of time. Third, even though pesticides are applied for the purpose of crop protection and to reduce loss from insects and pest attacks, under certain conditions crops can be affected by the use of pesticides that are applied for protection purpose. This is because; at recommended dose, growth, development and yield of some crops can be reduced; crops adjacent to the target crop can be affected form pesticide drift; crop rotations that are sensitive to chemicals can be inhibited or their growth can be hampered

because of the residual effect of pesticide after the target crop growth is over. Finally, the application of some volatile chemicals results in the contamination of the atmosphere.

On the other hand Isherwood (1999), tried to reveal problems related to use of chemical fertilizer on human beings, biodiversity, soils, water, air, and non-renewable resources in general. To look into it very roughly, application of nitrogen containing fertilizers can cause soil acidification and some fertilizers result in the disruption of soil structure. Soil physical properties are also adversely affected when fertilizer use is incorrect or beyond the required. Concentration of nitrates in drinking water has got greater attention because of its impact on human health, and both nitrates and phosphates are the cause of eutrophication of water bodies that hampers fishing, reduces recreational value of water bodies, and affects aquatic ecosystems in general. Volatilization of nitrogen in the form of Ammonia can pollute the atmosphere and later cause destruction of marine waters and natural habitats and acidify soils and lakes.

The other threat from the use of agrochemicals is its impacts on insects, especially honey and wild bees. Honey bees and wild bees play a significant role in pollinating vegetables, fruits and other crops globally and their contribution to global agriculture amounts to several billion dollars every year (Pimentel, 1996). Agricultural intensification and loss of habitat are the major causes to impoverished pollinators and finally reduced crop yield. The problem is even more dangerous when it comes to application of pesticides to treat forest trees (Richards, 2001). Richards also emphasized that genetic modification of crops to resist insect attack has a double effect on pollinator insects. In the first place, insecticidal toxin produced by crops as a result of genetic modification is toxic to pollinators because it is present in the pollen and nectar of flowering plants. Second, modification of crops to resist broad-spectrum herbicides that can destroy the other weeds effectively might remove the habitat and foods of pollinators from the area. Moreover, most insecticides used by farmers to produce crops are toxic to the population of wild and honey bees. Because of heavy application of insecticides on crops, bee keeping by small farmers becomes impossible in some cotton growing areas of Kenya and Tanzania (Bull, 1982; as cited in Pimentel, 1996).

Even though the application of agro-chemicals in developing countries is small as compared to the developed ones, the negative effect is high in developing countries as a result of high level of illiteracy, inadequate enforcement of standards and laws, inadequate safety precautions and safety devices, improper pesticide labeling, and insufficient knowledge base in general.

3. Methodology and settings of the study

3.1. Description of the study area

This study was carried out in Guduru district of East Wollega zone. Recently both the district and East Wollega zone were divided into two for the ease of administration. The study site falls still in Guduru district, while at zone level it belongs to the newly created Horro-Guduru Wollega zone, which is former part of East Wollega zone. Since there is no published resources that can be easily accessed to fully describe Guduru district, information to describe the district was collected from different offices during the data collection and also have been generated from field observation. Of course the information reflects the former levels of administration as the new ones created very recently and have no organized data at their offices. Guduru district is one of the 180 districts in Oromiya regional state, in Eastern Wollega zone. Covering 2474 square kilometers with population density of 63.2 per square kilometer, Guduru district is the third largest district in Eastern Wollega zone with a total population of 151,638 of which only 4.78 percent are urban dwellers, (CSA, 2005, Table B.3). Kombolcha is the administrative capital of Guduru district located at $9^{o}3'$N latitude and $37^{o}28'$E longitude having 4557 total population out of which 2361 are male (Ibid, 2005).

According to the current administrative demarcation, Guduru district is bounded by different administrative levels like region, zone, and districts and its boundary is separated by physical land features, mostly rivers and gorges. The district is bordered by Jimma Rare district to the South, Jimma Horo district to the Southwest, Lake Finchawa to the West, Abay Chomen district to the Northwest, Amhara Regional State (separated by Abay-Blue Nile River) to the North and West Shewa zone (separated by Guder River) to the East (Fig. 1).

The topography is almost flat with three kinds of soil types namely, Eutric Cambisols, Nitosols, and Arenosols dominating the area. Mount Habib, with 2430 meters height, is the peak point in the district. The land use types are; 53.8 % cultivated land, 15.3% of grazing land, though not considered as thick forest 14.3 % of bush cover, and the remaining 16.6% accounts for the mountainous areas, water logged areas, or

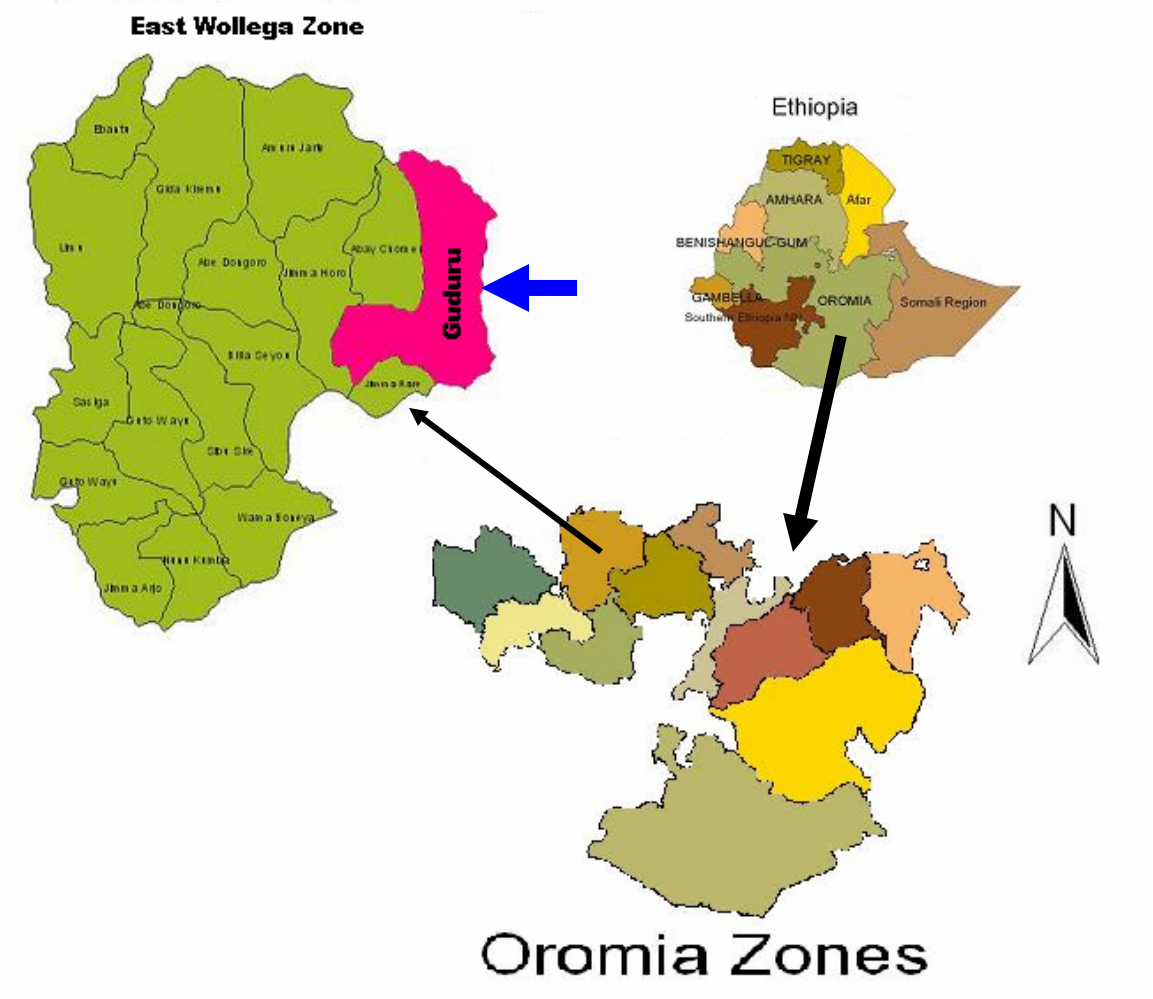

Fig.1 Map of Ethiopia together with Oromiya zones and East Wollega zone indicating the study site.

unusable areas (OSG, n.d). Guduru district is one of the surplus producing areas in the country. There are different types of crops (cereals, pulses and oil crops) growing in the district like; wheat, *teff*, maize, millet, barley, sorghum, horse beans, peas, lentils, niger seeds, and rape seeds; but the three major crops produced in surplus are *teff*, maize and niger seeds[3].

According to the district agriculture office WMQBAG (2007), the district is divided into two agro-ecological zones, locally named *badda-daree* (85%) and *gammoojjii* (15%)-it

[3] http://en.wikipedia.org/wiki/Guduru_(woreda) Wikipedia, the free Encyclopedia

means midland and lowland respectively. The altitude ranges between 1500-2450 m.a.s.l. and receives mean annual rainfall of 1350mm. The rainfall is unimodal in its nature and the main rain rains between June and September. The typical vegetation types in the plateau areas of the district are mainly big trees in a woodland with open canopy and the most common are such as *Cordia africana*(*woddeessa*), *Afrocarpus falcatus* (*Birbirsa*), *Accacia spp. (eg. Laaftoo, Doddota), Ccroton macrostachyus* (*Bakkaniisa*), *Ficus spp.* (e.*g*. *Harbuu, Qilimxoo*, *Qilxuu*), *Ekebergia capensis* (*Soombo*), *Olea europaea subspp. caspidata* (*Ejersa*) *and Prunus africana (Gurraa)*. The plateau areas have a warm temperate climate with moderate temperature and the temperature can drop up to 5^{o}C in the midland areas during (*birraa*) nights and it can rise up to 30^{o}C in the lowlands during (*bona*)[4] days.

3.2. Data collection

The study was based on a household survey, group discussion, and field observation conducted from June to August 2007, for three months. To undertake the study, use of local level administration was a must and the smallest local level administration is Peasant Association (PA), which is locally named as *ganda.*

Representative PAs in the district were selected based on distance from the center of input supply and district extension expert offices. Taking the time and budget necessary for the research in to consideration, six PAs at different distances from the center; two from far, two from middle, and two from near areas to the district center (Kombolcha) were selected. From each PA, 15 households and five beekeepers were interviewed. The selection of the households was based on wealth ranking categories. Three group discussions were held at far, middle and nearest areas with respect to the district center. Female households were also included in group discussions that consist of local elders, religious persons, DAs, and local administrators.

To pinpoint the understanding of extension in the area, farmers were classified in to three wealth categories based on classification criteria that is familiar in the area, as rich, medium and poor farmers, and since it is a mixed type of agriculture whereby crop

[4] Words in brackets are local names of trees and seasons in *Afaan Oromoo* language

production, livestock raring, and bee keeping is going on in the area and the beekeepers are few in number, bee keepers were purposively included in sampling while other farmers were selected randomly at each strata using lottery method. In some case, where the number of beekeepers is more than five, five of them were randomly selected from the list of the beekeepers. Five households from each stratum and 120 farmers in total were interviewed.

To generate both qualitative and quantitative data, farmers of the area were interviewed using a structured questionnaire. The questionnaire for the survey of households include data on household characteristics (e.g age, family size, holding size, rented in and rented out land size); comparison of traditional varieties with improved varieties in terms of labour demand, input and output; improvement in life standards of farmers related to diet, housing, assets such as draft animals, schooling of farmers' children; crop types lost from the area and the situation of beekeeping activity in terms of honey production and quality, bee colonies stability, and others. The data was collected by enumerators (three diploma holders) after they have been given training for two days. The questionnaire was translated into local language, *Afaan Oromoo,* for easy understanding and pre-tested on about 10 farmers who were not considered as respondents in the main survey.

As the study is pioneer to the area, there was a continuous review of literature and collection of secondary data from different organizations including administrative office and bureau of agriculture in the area to enrich the study. Moreover, qualitative and quantitative data was sought from official documents on the area of concern. In depth interviews have been undertaken with different groups of people during group discussion.

3.3. Data analysis

The data collected was coded and filled into Statistical Package for Social Science (SPSS). Depending on the nature of the data, different statistical methods were applied. ANOVA was used to figure out the difference between farmers at different wealth categories and different locations. Pair-wise comparison of T-test was used to look in to the difference in performance of improved and local varieties. Descriptive statistics, such

as mean, frequency, cross-tabulation, and percentage were also used when necessary. The results were presented in tables or graphs as appropriate.

3.4. Scope and limitations of the study

This study basically focussed on the impact of agricultural extension on food crop diversity and livelihood of the farming communities in Guduru district. The intention of this study was to compare the situation prevailing in extension users with that of non-users. However, just because of the fact that all farmers are using chemical fertilizers that are supplied by the district agriculture office for many years, farmers are considering themselves as extension users. Therefore, it is impossible to identify non-users form users of extension from the randomly selected farmers. This study mostly relied on farmers' response, perception and memories for the results presented in the findings and because of the fact that there is no similar kind of study undertaken in the area, it is impossible to validate the findings with some other findings. Besides, the official information at district level is also very sketchy as there is problem of database management and high rate of staff turnover that makes the access for important data very difficult and time taking.

4. Result and discussion

4.1. Basic household characteristics

Farmers were asked basic questions that explain their background in related to age, sex, land holding, education level, family size and so on that have impact to their day to day activity and their living standard.

According to their response to the above question; the respondents are 41.23 years old on average (see table 1) with the minimum as young as 22 years and the maximum as old as 73 years. The most frequently observed age is 35 years (N=12). Only 11.7 percent of the respondents attended secondary school education (9-12 grades). The proportion that attended first cycle (1-4) and first cycle (5-8) are almost equal to 25 percent and 24.1 percent respectively. The rest 39.2 percent can be considered as illiterates except 4.2 percent, who have basic education[5].

The average family size of the respondents in the area is 7.99 with farmers having family size of 8 most frequently observed (N =25). When we look into the national statistics, according to the data from the year 2005/06 by Central Statistics Authority (CSA), excluding pastoralist areas in the country, 2.46 percent of the farming families have only one member, while 20.94 percent have two to three members. Farmers with large families (10 and above) account for 4.48 percent nationally. This is completely the opposite in the study area. While farmers with family size of 3 and below accounts only for 4.2 percent, farmers with large families (10 and above) account for 25.9 percent. However the majority of farmers (69.9) from the study area have family members of four to nine. This is almost similar with the national statistics of the same range that accounts for 72.11 percent (CSA, 2007). Therefore, farmers in the study area have slightly large family size than the national average.

[5] Basic education is what is formally known as *Meserete Timihirt* during Derge regime. It is a strategy set by Derge to eradicate illiteracy whereby high school students, after completion of secondary school, were forced to give national service to teach farmers and the farmers were also forced to attend that education.

Table 1 Basic household characteristic

	N	Minimum	Maximum	Mean	Std. Deviation
Household age	120	22	73	41.23	11.659
Family size of interviewed household	120	2	23	7.99	3.379
Cultivated land size (in Oolma) in the year 1998/99	116	0	32	11.10	6.964

When it comes to holding size, based on data for the year 2007, on average farmers have 11.1 oo*lma*[6] (table 1) land that means about 2.78 hectare. This is definitely above the national average holding size (1.2 hectare) for the main season[7] growers.

To identify whether there is flow of people from other areas, to the study area, a question that identifies how long the respondents stayed in the area was asked and this value is compared with the age of the respondents. The intension is that for respondents whose age is different from the residence time, because of different reasons the farmer is not native to that area. Their age is different from their residence time only for 17.5 percent of the surveyed households while it is similar for the majority. That means movement of people from one locality to the other is not as such significant. The primary reason for the movement is in search for farm land. In the old days, when people didn't have farm land in their home area, they traveled far to look for unoccupied land to permanently reside and cultivate. But this is no more practiced as there is no unoccupied land in the area. The other reason may be due to intermarriage where again farmland size plays decisive role. According to the elders in the area, when a boy marries to a girl, whose family have excess farm land, contrary to what is normal, they move together to the girl's family area. Then the boy who is going to be the family leader becomes newcomer to the area. Such movements are within the district boundary and there is no as such significant movement which crosses the border of administrative boundaries. It is better to call it re-arrangement than migration.

[6] *Oolma* is Afan Oromo language and it is well common traditional measurement of farm land in the study area. It is approximately equals to 0.25 hectare

[7] In Ethiopia the main rainy season is mostly the rain from June through July to September. But mostly it begin early and last until the beginning of October in the study area.

4.2. Benefit of extension to the farming society.

4.2.1 Extension and land productivity (benefit related to input and output relations)

It is obvious that the use of improved seeds together with fertilizers can increase yield. Pair wise T-test comparison of yield under local and improved varieties of maize and wheat shows that the yield from improved variety of maize ($t = 41$, $P < 0.001$) and wheat ($t = 13.32$, $P < 0.001$) is significantly higher than local varieties. On the other hand the amount of seed required for improved maize is significantly lower ($t = 13.94$, $P < 0.001$) than what is required for local variety. However, the amount of seed required for improved and local variety of wheat has no significant difference ($t = 0.41$, $P = 0.68$). Together with this, other important input output comparisons of the traditional versus the improved varieties of maize and wheat are presented in table 2. Both the increase in yield and reduction in amount of seed required per unit of land play significant role in determining the living condition of agrarian communities.

Table 2 Paired samples t-test for important input and output parameters

		Paired Differences			t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	The Number of plows needed by local Maize variety - The Number of plow needed to Improved Maize variety	-1.852	1.320	.123	-15.053	114	.000
Pair 2	The Number of Plows needed by Local Wheat Variety - The Number of Plow needed by Improved Wheat Variety	-1.961	1.226	.121	-16.151	101	.000
Pair 3	The Amount of seed Required for Local Maize Variety per ha (kg) - The Amount of seed Required for Improved Maize Variety per ha (kg)	25.026	19.252	1.795	13.940	114	.000
Pair 4	The Amount of seed Required for Local Wheat Variety per ha (kg) - The Amount of seed Required for Improved Wheat Variety per ha (kg)	-2.078	47.328	4.989	-.416	89	.678
Pair 5	The Amount of Urea Fertilizer Required for Local Maize Variety pre ha (kg) - The Amount of Urea Fertilizer Required for Improved Maize Variety pre ha (kg)	-196.667	10.589	.992	-198.310	113	.000
Pair 6	The Amount of Urea Fertilizer Required for Local Wheat Variety pre ha (kg) - The Amount of Urea Fertilizer Required for Improved Wheat Variety pre ha (kg)	-79.116	40.688	4.175	-18.952	94	.000
Pair 7	The Amount of DAP Fertilizer Required for Local Maize Variety pre ha (kg) - The Amount of DAP Fertilizer Required for Improved Maize Variety pre ha (kg)	-92.211	18.402	1.724	-53.501	113	.000
Pair 8	The Amount of DAP Fertilizer Required for Local Wheat Variety pre ha (kg) - The Amount of DAP Fertilizer Required for Improved Wheat Variety pre ha (kg)	-81.739	39.918	3.722	-21.959	114	.000
Pair 9	Yield of Local Maize Variety Per ha (qu) - Yield of Improved Maize Variety Per ha (qu)	-42.286	8.424	1.007	-41.999	69	.000
Pair 10	Yield of Local Wheat Variety Per ha (qu) - Yield of Improved Wheat Variety Per ha (qu)	-17.885	9.683	1.343	-13.320	51	.000

On the other hand, as it is indicated in table 2 above, the number of plows required and fertilizer requirement (both urea and DAP) are significantly different indicating that the improved varieties require higher number of plows and more fertilizer. As compared to the improved varieties, average fertilizer use for farmer's varieties is very minimal. That means in most cases farmers grow their local seeds without fertilizers. In the study area farmers use on average 3.3 kg and 21.2 kg of urea fertilizer per hectare for local maize and wheat respectively. DAP fertilizer requirement is also small, 7.79 and 17.46 kg per hectare on average for maize and wheat respectively (refer appendix 1). The small amount of fertilizer used for local varieties is because farmers use traditional fertility management systems for their local varieties (figure 6.a).

The fertilizer application rate for improved varieties of maize is all the same across all the farmers and it is 200 kg of urea and 100 kg of DAP per hectare. This is the application rate recommended by the DAs in the area. Farmers also indicated that extension farming is more labour demanding compared to traditional farming (Table 3). Therefore, with the projected increase in the price of fertilizer both at local and international market, the benefit that farmers gain from increase in production of improved varieties, may be reversed. Because, in addition to the high labour demand of improved varieties, the trend in Ethiopia is that farmers will be forced to sell much of the products to pay back fertilizer loan immediately after harvest (Abesha et al 2000) with very low price during post harvest time (EEA, 2006). This is because farmers receive crop-based extension packages on credit bases from local banks.

Table 3 The comparative labour demand of extension based and traditional farming

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extension based farming is more labour demanding	85	70.8	70.8	70.8
	Traditional farming is more labour demanding	34	28.3	28.3	99.2
	Both are the same	1	.8	.8	100.0
	Total	120	100.0	100.0	

4.2.2 Benefits related to asset formation and living conditions

Animals that can be used for draft power play a significant role in determining the living conditions of farmers in the study area. One way ANOVA shows that there is significant difference ($F = 14.657$, $P < 0.001$) between the number of pairs of oxen farmers have today as compared to five and ten years ago. As it is indicated in figure 2 , even though the deviation from the mean is almost the same, there is a clear increment in the number of pairs of oxen farmers have now compared to five or ten years ago.

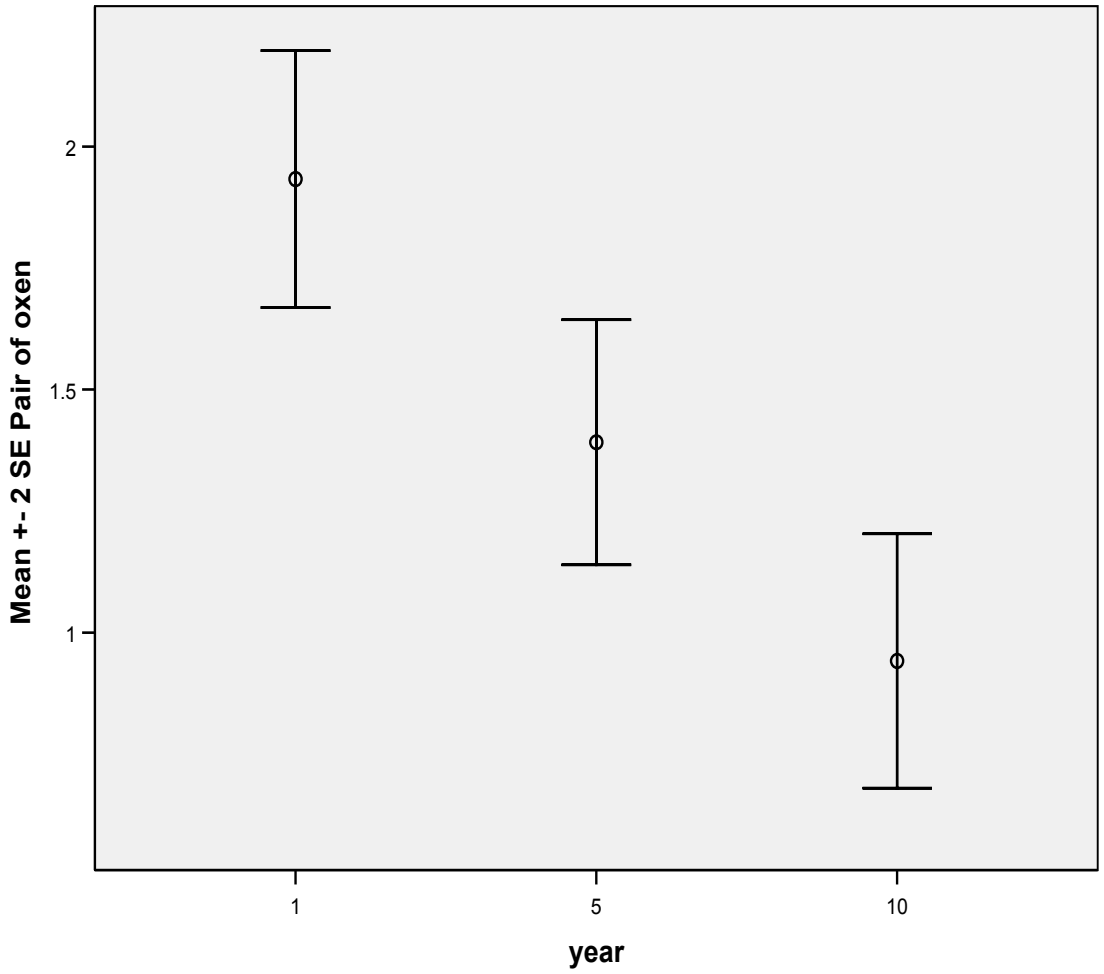

Figure2. The mean and deviation from the mean of pairs of oxen farmers have today[8], five and ten years ago.

[8] Today is indicated as year one and year 5 and 10 are counted back from today in such type of analysis for the ease of analysis and presentation

To know the housing condition of farmers, farmers were asked the type of house they are living in today. Moving from grass covered roof to corrugated iron roof is considered to be the result of betterment in living condition. As a result, 92.5 percent of the farmers in the study area are living in houses with roof made of corrugated iron. However there was a dichotomy among farmers during group discussion on the idea of having iron roofed house as an indicator of living condition. Some farmers justify that having iron roofed house is the result of improved economic status while the others say that it is not because of improvement, rather enforcement to have it. The reason they gave was that in areas where grass was used for roof coverage, the land is already cultivated or overgrazed and there is no more grass that is enough to cover roof as it used to be in the old days.

Considering children attending school as indicator for economic status and future investment at the same time, farmers in the study area were also asked the number of children they have at school now to compare it with that of five and ten years ago. As it is indicated in figure 3, the number of children attending school now is increasing as compared to the past five or ten years.

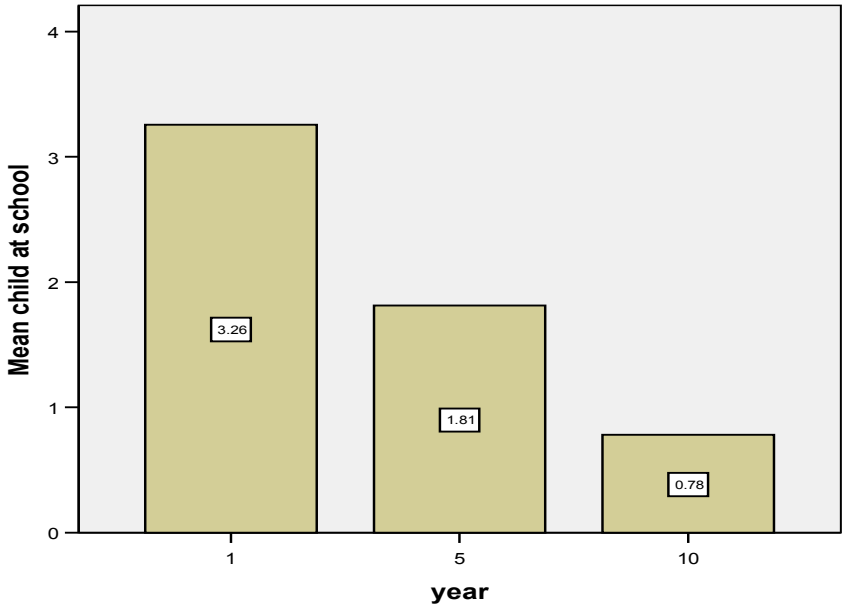

Figure 3 Children at school now compared to five and ten years ago

Information from CSA (2007) shows that, when compared to that of 2000/01, education enrolment has been increased in the country in general. According to the same source, if

we take government schools alone, number of schools grew from 11,600 in 2000/01 to 17, 642 in 2006/07 while the number of teachers teaching in government schools elevated from 126,719 to 197,657, the number of students grew from 7,571,436 to 12,642,998 between the same years indicated above. Accessibility of school in a nearby area, increase in the number of children within school age, policy direction of the country and other factors can contribute to increase in the number of students attending school. However, the study by Woldehanna et al (2004) on the determinants of poor households to send their children to school in Ethiopia indicated that among the other factors, it is the wealth status of the household that primarily determines whether to send their children to school or not. That means anything that can contribute to the betterment of the wealth status of poor society can contribute to school enrolment.

If we consider the number of meals farmers have per day as an indicator of betterment, while the proportion of farmers having meal three times a day were only 4.2 and 6.7 percent ten and five years ago respectively, this proportion is significantly increased to 59.2 percent recently. The proportion of farmers who can afford to pay for health centers that are found in the local area is 83.3 percent. The rest can not afford the payment. When we compare their ability for those who can afford, their ability has improved for 80 percent and declined only for 4 percent of the farmers. However, for 16 percent, there is no change on their ability to pay for health centers in their vicinity (appendix 2). This shows that the majority can afford to pay to be treated when they get sick and there is an increase in their ability.

Even though, increase in productivity from agriculture as a result of application of extension can buffer the capacity of farmers to pay for treatment of infectious deceases, they can be a potential threat for the health of agrarian community. If we take pesticide alone, according to Eddleston et al (2002), in some developing countries, deaths because of pesticide poisoning are even greater than that of infectious diseases. Farmers in the study area can experience such problems, because as a result of extension, the production of maize is highly increased in the area and maize is one of the highly susceptible crops to post harvest pests. To prevent pest attack, different pesticides, especially malathion, is

applied by the farmers sometimes without following the recommended dose. Therefore farmers can be poisoned during application or after application when they consume pesticide treated grains.

4.2.3. Benefits related to infrastructure, training and credit services

When agricultural extension is in place in one area, more or less there are some basic elements that come together for agricultural development. Some of these are marketing, agricultural credits, and extension advices (Belay, 2003). Such elements of agricultural extension directly or indirectly benefit the local communities. Accordingly, almost all farmers agree that extension offers benefit to the farmers with highest rating for input supply as benefit of extension (92.4 percent agreement to 7.6 percent disagreement). Benefit of extension in the form of credit supply was rated in the second place (74.8 percent agreement to 25.2 percent disagreement). On the other hand, it is impossible whether to regard market access and new road construction as a benefit of extension or not as the proportion of farmers that agree and disagree is almost the same (appendix 3).

According to Carlsson et al (2005), improved seeds and artificial fertilizer are the highly adopted inputs by the Ethiopian farmers for the past decades. In the study area, chemical fertilizers and improved seeds are obtained by the farmers on credit bases that will be returned in short term. The credit is given to the farmers under institutional collateral agreement where these institutions are involved in the delivery and pay back of the loan. In most cases DAs and the district officials are involved in such activities. Until recent day, if there is fertilizer, there is also credit for the farmers to be paid back the next harvest season. This might be the reason why farmers rate input supply followed by credit service as the most important benefits of extension in the area.

However, the agriculture bureau at district level has a plan to remove these input credits gradually and the first step trial was going on while this study was under taken. Farmers were selected to pay in cash the price of fertilizer and improved seeds for the production that is going to be harvested the coming year (2007/08). Nevertheless, farmers were complaining because of two main reasons. In the first place, it is only some potential farmers who are forced to pay in cash; others are getting it by credit. These selected

farmers were putting the transparency and selection criteria under question. In the second place, it is double payment in a single year for these selected farmers as they have already paid the credit from the last year and are unexpectedly forced to buy in cash for the next year.

Almost all farmers (97.5 percent) agree that there is a new way of farming in the study area following the introduction of extension. Primarily the way farmers sow their crops is different. Especially for maize, broadcasting (the traditional way of planting maize seed) is completely replaced by row planting. No farmer in the study is broadcasting maize seed on his farm now as he did before (see figure 6.d). Farmers also explained that though the use of DAP fertilizer has a long history, use of urea as a fertilizer is a new idea that resulted from the introduction of extension in the area.

4.3. Impact of extension as a function of wealth and distance from the center

4.3.1 Wealth as a factor that can be affected by extension.

It is true that small-scale farmers do not want to take risk because of many reasons. As a result, it is farmers who have capital and resources relatively, who can take more easily the advantage of new technologies. If we take the case of SG-2000 as an example, they were supplying model farmers who can allot half a hectare of land (that were called EMTPs), with the necessary extension packages, supervision and credit cervices. However, the majorities of poor farmer have holding size less than the required or are totally landless.

In Ethiopia, holding size is among the most crucial assets that determine the wealth status of farmers. For example, a study by Zegeye, et al (2001), on the adoption of improved wheat varieties in Northwestern Ethiopia, indicates that land holding size can affect rate of adoption. Considering the year 1998/99 (E.C), if we compare the holding size difference among the surveyed households, there is a significant difference in holding size ($F = 37.51$, $P < 0.001$) between the farmers. The comparison of the means between rich, medium and poor revealed there is also difference between the three groups at 5 percent level of significance. The average holding size, rented in and out land size and

the amount of land farmers kept aside for grazing from their own land (irrespective of the communal grazing land) are indicated in figure 4 bellow.

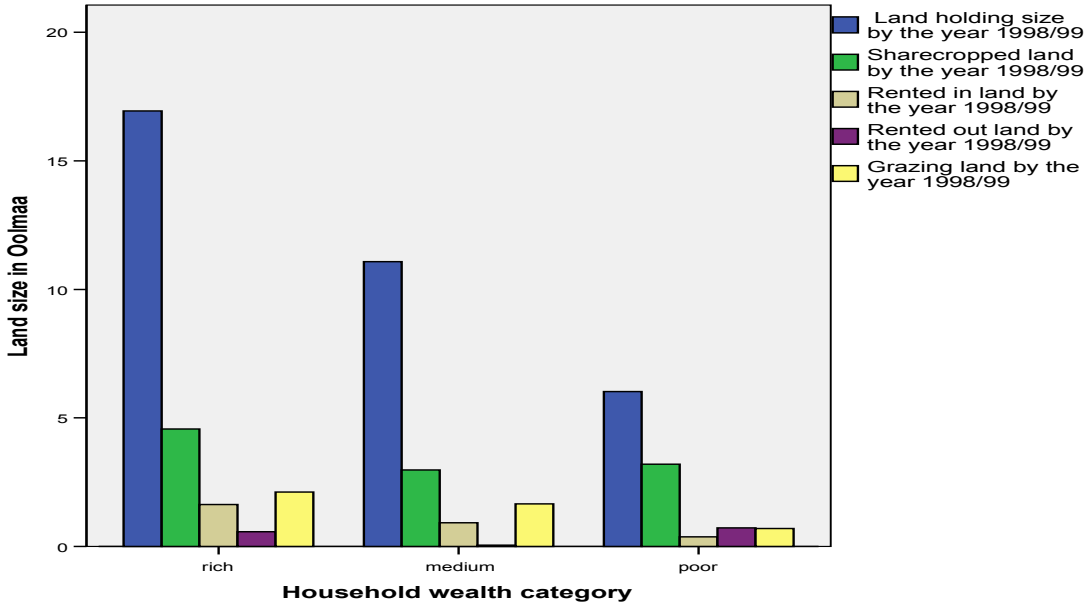

Fig 4. Mean holding size together with mean share cropped, rented in and out, and grazing land

As it is indicated in figure 4, the poor have small holding size compared to the rich and the medium groups. Their ability to rent in cultivable land is also very minimal. However, the average land size rented out by the poor is slightly higher than the rich while the medium groups have no land to rent out. This is because; the wealthier groups have excess land that can be rented out while the poor have no capacity to till their land. The medium groups have the capacity to till their land but have no excess to rent out. The poor rented out their land for many reasons. The most dominant constraint of the poor is draft animal (ox). There is also constraint of capital for fertilizer and seed purchase.

On the other hand, there is no significant difference among the wealth categories on the size of land under share cropping ($F = 1.364$, $P = 0.26$). There are mostly two contrasting reasons why the poor and the rich groups opt for share cropping. The probable reason from the wealthier groups is that if they have excess land but limited draft animals, they

give their land to share croppers who can plow and share the grain with them. Nevertheless, if they have more draft animals, they go in search of extra land. The reason from the poor side is that in the first place they have limited land or don't have land to till at all. In that case, if they have draft animals, they try to search for share cropping. However, if they don't have any draft animal, but a small amount of land, then they give the land to a share cropper so that he can till and share the grain with them. The basic difference between the poor and the rich related to share cropping could be that the rich opt for share cropping as an extra benefit while the poor is forced by shortage of either land or draft animal. Therefore, in relation to holding size, the wealthier groups in the study area are better-off as compared to the medium or the poor groups. This may increase their ability to accept new technologies that can later accelerate their ability as compared to the others.

Table 4. LSD test for multiple comparisons of number of pairs of oxen farmers have at different time

Dependent Variable	(I) wealth category	(J) wealth category	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Pairs of oxen farmers have now	rich	medium	1.284(*)	.261	.000	.77	1.80
		poor	2.211(*)	.261	.000	1.69	2.73
	medium	rich	-1.284(*)	.261	.000	-1.80	-.77
		poor	.927(*)	.248	.000	.43	1.42
	poor	rich	-2.211(*)	.261	.000	-2.73	-1.69
		medium	-.927(*)	.248	.000	-1.42	-.43
Pairs of oxen farmers had five years ago	rich	medium	1.100(*)	.271	.000	.56	1.64
		poor	1.866(*)	.270	.000	1.33	2.40
	medium	rich	-1.100(*)	.271	.000	-1.64	-.56
		poor	.766(*)	.259	.004	.25	1.28
	poor	rich	-1.866(*)	.270	.000	-2.40	-1.33
		medium	-.766(*)	.259	.004	-1.28	-.25
Pair of oxen farmers had ten years ago	rich	medium	.715(*)	.310	.023	.10	1.33
		poor	1.496(*)	.308	.000	.89	2.11
	medium	rich	-.715(*)	.310	.023	-1.33	-.10
		poor	.782(*)	.296	.009	.20	1.37
	poor	rich	-1.496(*)	.308	.000	-2.11	-.89
		medium	-.782(*)	.296	.009	-1.37	-.20

* The mean difference is significant at the .05 level.

Multiple comparisons of means of pair of oxen farmers have at different time periods indicate that there is significant difference between the rich, medium, and poor farmers of

the study area at current time, five and ten years ago. However, if we look at the mean difference between the rich, medium and poor farmers, the difference is getting larger and larger at present compared to the difference ten years ago (table 4), clearly indicating that the rich group have more draft animals as compared to the poor.

If we take difference in the number of students attending school as a factor, ANOVA shows that, there is significant difference between students attending school among the rich, medium and poor class of the society now ($F = 12.994$, $P < 0.001$), five years ago ($F = 13.237$, $P< 0{,}001$), and ten years ago ($F = 7.136$, $P = 0.001$). Multiple comparisons of the means also indicate that there is significant difference between the means now and five years ago between the three wealth classes. Ten years ago, there was significant difference between the rich and medium, the rich and poor. However, there was no significant difference between the medium and the poor classes. This means that the medium class shows improvement compared to ten years ago. When we look at the mean difference between the rich and the medium class, the gap is also declining. But for the poor, in addition to the creation of significant difference between the medium now and five years ago, their mean difference compared to the rich is increasing from time to time (see appendix 4 and fig.5). That means, even though under certain condition, because of limited knowledge and some other factors, the poor have comparable or even higher family size compared to the other groups, their children are not attending school with equally high numbers as the rich or the medium groups.

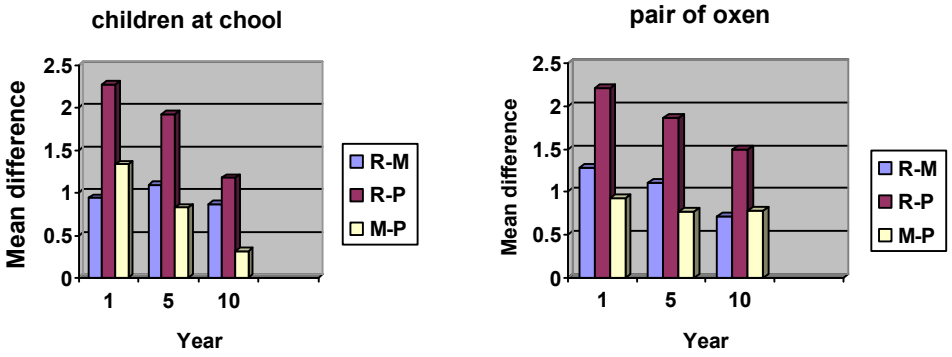

Fig.5 Mean difference of children at school and draft animals at different time

As it is indicated in figure 5 above, in both mean difference of number of children attending school and draft animals that farmers have, the gap between rich and medium class (R-M) is a little bit increasing for draft animals while it is almost similar for the number of children attending school. The mean difference between the medium and poor (M-P) is not as such large for draft animals between the years, but is increasing for children attending school. However, the mean difference between the rich and the poor (R-P) is big in the first place and is getting larger and larger for both children attending school and number of draft animals the farmers have.

If we consider the number of meals farmers have a day as an indicator, ten years ago, majority of the farmers (80.8%) had two meals a day. But if we look into the extreme sides (once or three times a day), out of the farmers who have only one meal a day, the rich classes are less than the poor proportionally (33% and 44% respectively). But no rich was be able to have three meals a day while 7% of the poor and 4.8% of the medium groups could. Five years ago, still the majority (88.3%) had two meals a day. Generally, this is an improvement as compared to the past. However, there is disparity between the groups. There is a total shift for the rich towards two meals and above while the poor class is declining. Among the farmers who have only one meal a day, the proportion of the poor class increased from 44% to 83% while the proportion of poor among those having three times a day declined from 60% to 37.5%. At present all people have the potential to have two meals or more. But out of the rich groups, 28.8% have twice a day, while 71.4% of the rich class can have three times a day. For the farmers who have two meals a day, the proportion is 20.4%, 36.7%, and 42.9% for the rich, medium and poor classes respectively, while for the farmers who can have three times a day, the proportion is 35.2, 33.8, and 31% for the rich, medium and poor classes respectively (see appendix 5). This means that diet wise also, the poor are not in an equal track as compared to the others.

One way or the other, the above mentioned results indicate that there is disparity between groups and the poor groups are lagging behind the other groups. Of course the causes are

many, intricate, and can't be separated easily. But benefits from extension are potential contributors.

Table 5. Farmers view of beneficiaries and non-beneficiaries of extension activities in the area.

5.1. Views of farmers to identify beneficiaries of extension

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Wealthy groups	39	32.5	33.1	33.1
	Wealthy and elite groups	49	40.8	41.5	74.6
	Farmers with excess land	5	4.2	4.2	78.8
	Farmers who are not resistant to technology	25	20.8	21.2	100.0
	Total	118	98.3	100.0	
Missing	Not applicable	2	1.7		
Total		120	100.0		

5.2. Views of farmers to identify non-beneficiaries of extension

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	The poor	90	75.0	76.9	76.9
	Landless farmers	3	2.5	2.6	79.5
	Technology resistant farmers	24	20.0	20.5	100.0
	Total	117	97.5	100.0	
Missing	Not applicable	3	2.5		
Total		120	100.0		

A large majority of farmers in the study area (98.3%) agree that there is wealth difference among the farmers because of extension. As it is indicated in table 5, according to response of farmers, wealthy and elite farmers were the beneficiaries while the poor were the losers. The favor of extension activities towards the wealthy class in Ethiopia during the past time was also indicated as a reason for the revision of extension approaches in the country (Belay, 2003). Still the fairness and equal coverage of the current extension activity in the study area will be suspicious if the gap between the rich and the poor will continue to increase in the future.

4.3.2. Distance as a factor that can affect benefit from extension

It was hypothesized that distance from the district center, and from all weather roads have impact on the supply of inputs and advice to the farmers, whereby farmers near to the center can benefit more than those at far distance. On average farmers that were found at far distance travel 24.3 km to reach the center of the district while they are 9.38 km away from all weather roads. On the other hand, farmers in the nearest PAs (*Guutoo Abbaayi* and *Guddannee sirbaa*) are only 2.23 km on average from both all weather road and from the district center. Farmers that were identified as mid distance are 11.15 km away from the district center and 5.55 km from all weather roads on average. But the data for this study was collected during the main rainy season in the area and because of inaccessibility; very remote areas were not included in this study.

Considering that the residence place of the farmers can not vary over time (ignoring time impact), ANOVA for the current data of land size, pairs of oxen and children at school give no significant differences at 5 % level. However, there is significant difference for mean of input price of wheat seeds and output price of maize among the different locations in the study area (see appendix 6). Maize and wheat are selected because intervention of extension is only on these crops, especially maize.

Multiple comparisons of variables that were statistically significant shows that for fertilizer (both DAP and urea), the price in the year 1998/99 (E.C) is significantly lower at the center compared to the middle and far distances, while price of fertilizer type DAP has no significant difference between middle distance and far distance from the center. Price of fertilizer type urea is significantly lower at far distance compared to middle distances. Price of improved maize seed is similar at all distances ($F = 2.153$, $P = 0.121$). Nevertheless, price of improved wheat is significantly lower at center compared to middle distance but has no difference when compared to far distance (appendix 6).

Multiple comparison for grain prices (maize and wheat) shows that the price of wheat has no significant difference at different location while maize price is significantly lower at the middle distances from the center compared to the near and far distances. There is no

significant difference between the near and far distances on the price of maize per quintal[9] (appendix 6).

Table 6. The number of corrugated iron sheets on farmers' house

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	363.198	2	181.599	1.397	.252
Within Groups	14040.693	108	130.006		
Total	14403.892	110			

If we consider housing of the farmers as an indicator, the majority are living in house whose roofs are made of iron sheet. With mean value of 57.59, 57.56, and 53.76 sheets at the district center, middle and far areas respectively, ANOVA of the number of iron sheet of farmers' house roofs have no significant difference at different locations (table 6). The number of iron sheets for roof cover, which determines the size of the house, is considered as an indicator of the living condition in the area. This is because as the number of sheets increases, the cost for construction increases and the poor can not afford to construct such big houses.

Distance to development center was found to have no impact on the adoption of improved wheat variety in Northwestern Ethiopia (Zegeye, et al 2001). Similarly the impact of distance is not strong on the variables affecting the living condition of farmers of the study area, except for inputs. However, in relation to price of inputs, the result needs further investigation to clarify the ambiguity, because farmers at far distances are at better condition compared to those at middle distances regarding the above mentioned price of grain and fertilizer. But the probable reason for this finding is that, even though they are at far distance when compared to the center of the district, they are more close to the main road to the capital of the country (Addis Ababa). Even farmers near the center are far when measured against this main road. The other all weather roads are the ways to be connected to this main road. Therefore, there might be benefits related to this main road to the center of the country.

[9] Quintal (qt) is mostly used to measure grain yield and inputs like fertilizer in the area and it is equivalent to 100 kg.

4.4. Impact of extension on the diversity of local maize and wheat varieties

It is obvious that human beings are rational and want to maximize their benefit. Under conditions whereby the output of improved varieties is by far larger than that of local varieties, there is no question that farmers will opt for the improved varieties. The gradual replacement of local varieties can cause erosion of local varieties. The impact is worst when there are neither in-situ nor ex-situ conservation activities. Even in the presence of well functioning ex-situ conservation, on-farm conservation is very important as it serves the local communities in the first place and keeps the dynamism of the varieties in track with the change in the cropping pattern, the environment and others (Wood and Lennea, 1997).

The intention here was to analyze whether there is replacement of farmers' local varieties by improved varieties in the study area. Attention was given to maize and wheat because of their wide coverage under extension services. The study by Hunduma (2006), under the same environment and social set-up in adjacent Zone (Gindeberet, West central Ethiopia) shows that even though majority of farmers are growing both local and improved varieties in general, 94.6 % of wheat growers sow only improved varieties of wheat. This author also emphasized that the land size allotted for improved wheat is significantly higher than that of local varieties. Even though this study is not intended to identify the land size and coverage of improved versus local varieties, farmers identified the crop varieties listed in table 7 as lost from the study area.

Table 7. Lost maize and wheat varieties together with other crops as identified by the local farmers

Crop type	Local name of farmers Variety	Description
Maize	*Boqqolloo haadha*	
	Feeshoo	
	Gaarman	
	Amaarikaanii	
Wheat	*Qamadii biilaa*	
	Qomixee	
Other crops	*Xaafii maanyaa*	*Teff* variety
	Feeshoo	*Teff* variety
	Muriyyii eegee jaldeessaa	*Teff* varity
	Caxee	Sorghum variety
	Daagujjaa	Finger millet
	Garbuu gurraacha/goronjii	Barley variety
	Samareeta	Barley variety
	Suufii	Sunflower

In addition to the above mentioned lost crop varieties, farmers also indicated during group discussions that very many varieties only exist on the hand of a few farmers and there is serious threat of loss to these varieties from the area.

Introduction of extension in a given area is not the only reason that local varieties of crops are lost from the area. Change in farming system, climate change, decline in soil fertility, change in taste and preference of farming communities etc. can contribute to crop loss. As it is indicated in table 7, the loss of other crops, apart from wheat and maize, is the witness for this because the interference of extension in other crop types is very minimal. However, extension expansion is one potential contributor for the loss of crop variety as low yielding crops, but with very unique special traits, will be swept out of the locality.

Views of farmers in relation to this issue is that all farmers (100%) agree that it is important to conserve local crop varieties with the majorities of them indicating that the trend in use of local crop varieties is declining as compared to the past (table 8.2). Even though a considerable number of farmers gave different reasons as to why farmers are

losing their varieties, 51.5 % of the interviewed farmers point out that the expansion of the use of improved varieties is the main reason. This reason has the highest percentage among reasons given by the farmers (table 8.1).

Table 8 Trend of use of local varieties and farmers' reason for the loss of crop varieties in Guduru

8.1 Reason of crop variety loss form farmers side

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Climate change	2	1.7	2.0	2.0
	Low yield	7	5.8	6.9	8.9
	Easily affected by birds	1	.8	1.0	9.9
	Replaced by improved variety	52	43.3	51.5	61.4
	Combination of the above	39	32.5	38.6	100.0
	Total	101	84.2	100.0	
Missing	No answer	19	15.8		
Total		120	100.0		

8.2 The trend of use of Local Crop Variety as Compared to the past

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	It is the same as the past	6	5.0	5.0	5.0
	Increasing as compared to the past	14	11.7	11.7	16.7
	Decreasing as compared to the past	95	79.2	79.2	95.8
	Don't know	5	4.2	4.2	100.0
	Total	120	100.0	100.0	

When we look into the influence of extension on maize, maize was the crop type grown in the homesteads in the old days when farmers were using only local varieties. There is no chemical fertilization required and farmers use traditional fertilization whereby livestock manure plays a significant role. Cattle are kept in a rectangular barn which is made of wood in such a way that each side of the rectangle can easily be removed and re-constructed in a row keeping the rectangular pattern. The barn rotates in three to five days intervals, depending on labour availability in the family. By doing so on a large area, the land will be covered by manure during dry season. Farmers plow bit by bit to mix the animal feces and urine in the rectangular plots to reduce the loss of nitrogen to the atmosphere (fig 6.a), and finally it will be mixed together to sow local maize during rainy season.

a) Traditional fertility management

b) Fine seedbed for wheat growth

c) Sediment transport (threat of erosion)

d) Maze planted in row (recently introduced way of sowing maize)

Fig 6. Traditional fertility management, Seedbed preparation, soil erosion and row planting, in Guduru district (Photo: Gizachew Kebede, June 2007).

However, nowadays improved maize can be planted everywhere, whether far or near to the homestead, with blankly recommended rates of both urea and DAP fertilizers. It is a must to use chemical fertilizer to grow both improved maize and wheat varieties. Therefore, maize is competing with other field crops and local maize varieties at the same time as it can be grown away from homestead. According to farmers of the area, what is very unique to wheat is that it was not common to plant the local varieties of it in larger quantities before the introduction of improved varieties of wheat. Similar to emmer wheat

and *qamandii gurraattii* grown in Gindeberet, West shewa zone (Hunduma, 2006), farmers varietes of wheat like *Xamajaa, Zamboolee, Qamadii dheeraa,* and *Qamadii gabaaba*[10] together with those mentioned as lost ones, need big or branched trees to be grown as they require shade. They were also grown only in small quantity for social value, best quality bread, medicinal, and generally for consumption purpose. Recently, improved varieties of wheat are grown in large amounts both for consumption and market. These improved wheat varieties need fine seedbed and large areas as compared to local wheat varieties (figure 6.b).

Fine seedbed can contribute to soil erosion as frequently cultivated soils can be removed easily by running water. There is a sign of severe erosion on the farm lands that need immediate measure (figure 6.c); otherwise the result will be severe soil degradation to a point of zero productivity. It is known that the nature of rain in most parts of Ethiopia is with high intensity and short duration resulting in removal of high amount of sediment and formation of gullies if conditions for erosion are fulfilled. In addition wheat is planted during peak time of the rain, which aggravates the problem. This is purely the result of extension in the study area, because there was no local variety of wheat that could be cultivated far from homestead and in large amounts. On the other side improved wheat is competing for farm land and when farmers, especially those who have shortage of land, produce wheat, then definitely the size of land allotted for other crops will be reduced or they never grow the local varieties at all. Therefore the impact of extension is direct replacement of the local varieties by improved varieties, for crop types that are under extension, and competition for farm land for crop types that are not under extension coverage.

It was revealed during group discussion that there are farmers who really understood the severity of the problem and are trying to conserve some local crop varieties. The method they apply is to have a small amount of seeds of the threatened local crop variety at hand and to plant it on a small piece of land in a nearby area to their home or in their compound to harvest it again purely for conservation purposes. However, such trials were

[10] Local variety names by the local name, in *Afaan Oromo* language

not working for all kinds of crops. The farmers explained that the barley variety *samareeta* is impossible to conserve in such a way as birds affect it and totally eliminate it when it gets ripened as the plot size declines. For some crops that can easily be affected by pests, the problem is the same, as the pressure increases when the amount of the grain stored is reduced or as they have to be planted every year, which is impossible for many farmers due to many reasons.

4.5. Degree of agricultural input use and its impact

4.5.1. Trend of input use

Many studies show that adoption of agricultural inputs, by any measurement, is low in Ethiopia as compared to developed countries and some Asian and sub-Saharan African countries (eg. Belay 2003, EEA 2006). However, as compared to the situation in the 1980s and 1990s, fertilizer use is highly increasing. According to a comparative study by Jayne et al. (2003) among sub-Saharan African countries who were consuming more than 10,000 tons of fertilizer in the 1990s, Ethiopia was grouped among those whose consumption rate per hectare increased by 45% or more. This study indicated that between the years 1980-89 fertilizer application rates was 3.87kg per hectare. This figure was increased to 8.41 kg per hectare between 1990-1995 and further increased to 15.11 kg per hectare between the years 1996-2000.

There is no adoption problem of fertilizer among farmers of Guduru. They were applying DAP fertilizer on their farmland, especially for *teff* production, for a long time. Following the introduction of improved maize and wheat, the use of urea is also becoming popular. The farmers also more or less follow the recommended rate of fertilizer application. As an example, if we look into the response of farmers for the rate of fertilizer application for maize, the most popular and accepted crop type in the effort of improved seed expansion, the mean farmers application rate of urea and DAP is 200 and 100 kg per hectare respectively with zero standard deviation. This is exactly the same as the recommended rate of SG-2000, which is 100kg and 50 kg of urea and DAP per plot[11].

[11] Extension Management Training Plots (EMTPs) introduced by SG-2000 are simply called plots and are half a hectare in size.

That means all farmers are applying urea and DAP fertilizers at the same rate on improved type of maize.

A current problem in the area is the supply side. As it was indicated by Simane (2004), much of the agricultural inputs imported and distributed are supply driven, without giving due consideration to the demand from the farmers' side. As a result farmers in the study area were complaining about the lack of timely supply and insufficient amount of inputs such as fertilizer, improved seeds, pesticides etc. The farmers also complained about the quality of improved seeds. As a result of exponential increase of the number of extension users, the quality of improved seeds, especially maize, is declining from time to time and farmers are not getting the amount they want to buy from seed suppliers.

Agricultural inputs for the farmers are supplied by different groups, such as the district agricultural bureau, district extension office, Haragu farmers' cooperative union and others in the study area. Private traders also have a paramount share in distributing inputs. Leaving the others aside, because of lack of reliable data, if we look into the trend of input supply by Haragu farmers' cooperative union for Guduru district, the trend is increasing between 1994/95-1998/99 (E.C) for both fertilizer and herbicide use (fig.7).

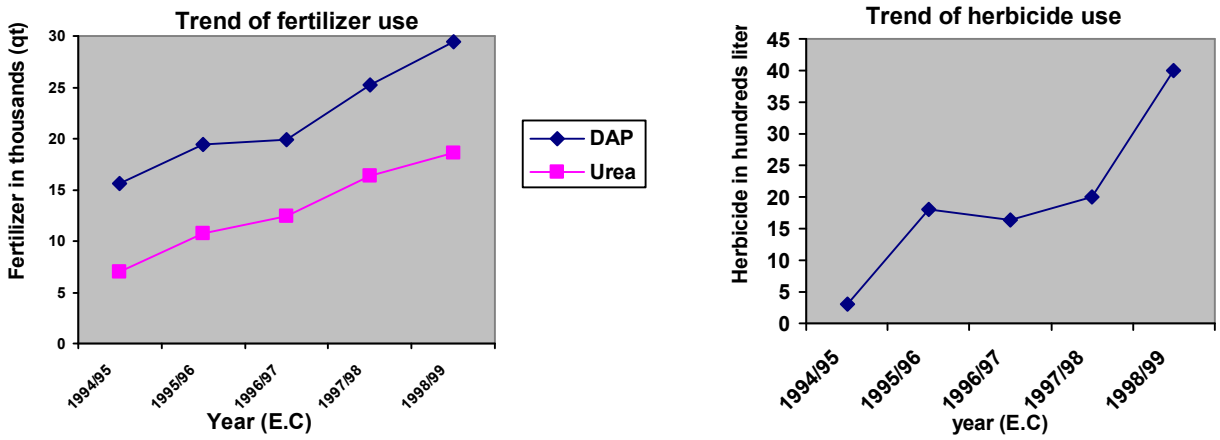

Fig.7 Fertilizer and herbicide use trends in Guduru district. (Source: Haragu farmers' cooperative union).

Fertilizer DAP is more consumed as compared to urea and the increase in herbicide use is more sharp as compared to fertilizer use. Figure 7 underestimates what is really consumed in the district. For much of the supply from the district, there is no organized data and it is not possible to get the data for what private traders are supplying. For pesticides, including herbicides and pre and post-harvest insecticides, private traders take the largest share of the supply, which is impossible to trace back. Contrary to what is observed in most parts of the country farmers are willing to adopt different inputs and, as indicated above, the trend is increasing from time to time.

What is very surprising is that in such a high potential area, there is no any demonstration site from any of the research institutions in the country and inputs are applied based on the recommended rate developed somewhere else in the country. This can create problems, especially in a community that does not have enough knowledge as to when, where, and how to use it. Even though the amount used so far in the country is not a potential threat to the environment, this study has tried to identify any impact from herbicide use on bee keepers, as health of insects such as bees can indicate the health of the environment.

4.5.2. Input use and its implication on the environment

Assessing the impact of the environment is very broad in scope as the functions and dimensions of the environment are so many. Impact from agricultural inputs to the environment is more difficult to assess because, it is impossible to identify the source. Furthermore it requires soil analysis, water and air quality analysis that involve instruments, resource and time, which is beyond the scope of this research. Moreover, components of the environment are interlinked and it is impossible to generalize by looking into one of it independently. To have a look into one simple aspect, honey bees, which some of the farmers in the study area are keeping as a source of income, were chosen to see if farmers recognized the impact of introduced use of herbicides on bees and honey production.

Contrary to their traditional weed control method (hand weeding), majority of farmers (81.4%) are using herbicide at present to control weed. Their annual consumption varies

from 1 to 5 liter. Only 18.6% are not using herbicide as weed control. Farmers who are engaged in beekeeping responded that both honey quality and production is declining as compared to the past (appendix 7) and currently farmers are collecting on average 6.43 kg and 2.2 kg of honey and wax per hive respectively. This amount of honey is less than what was observed in northern part of Ethiopia (Assres, 2002).

Number of bee colonies farmers have at different periods of time indicates that there is significant difference among the years, currently, five or ten years ago ($F = 7.181$, $P = 0.001$). The comparative analysis between the means also shows bee colonies that farmers have at the current period of time is significantly higher than that they had five or ten years ago. However, there is no significant difference between what they had five and ten years ago (Table. 9).

Table 9. Multiple Comparisons of bee colonies farmers have at different time

(I) year	(J) year	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1(a)	5(b)	11.857(*)	4.837	.016	2.23	21.48
	10(c)	18.036(*)	4.837	.000	8.41	27.66
5	1	-11.857(*)	4.837	.016	-21.48	-2.23
	10(c)	6.179	4.837	.205	-3.45	15.80
10	1	-18.036(*)	4.837	.000	-27.66	-8.41
	5(b)	-6.179	4.837	.205	-15.80	3.45

* The mean difference is significant at the .05 level.
a Bee colonies at current time
b Bee colonies farmers had five years ago
c Bee colonies farmers had ten years ago

On the other hand, when we look into the average number of bee colonies farmers caught with that of colonies transferred to next year for the past five years, bee colonies transferred to next year are much lower than those farmers caught every year (appendix 8). All beekeepers also agree that the bees leave their hive more frequently at present time when compared to the past time. They gave three reasons as to why bees leave their hive frequently; lack of pollen as a result of deforestation and low flower availability, herbicide use, and attack from ants and beetles. While 53.6% of bee keepers identified lack of pollen as a primary reason, 35.7% gave a combination of the three reasons. But only 7.1% rate use of herbicide as the main cause of bees to leave their hive.

The reason why bee stability in hive was selected as an evaluation criteria is that majority of farmers are using traditional ways of bee colony collection whereby farmers put empty hives on big trees so that bees can enter into hives during peak flowering time. Otherwise the farmers have very limited knowledge, if any, of managing the queen in the hive. If conditions are not conducive in that vicinity, the bee colony will migrate to another area. There is movement of bee colonies during flowering time, when there is high rate of queen breeding in hives as farmers' ability to manage queen breeding in their hives is also very minimal. They can easily catch these colonies by putting empty hives on trees or big towers constructed for high voltage electricity transmission. However, the bee colonies will stay in the hive to produce honey for the next season, if and only if the condition in the prevailing environment is suitable for the colony. But as indicated above their stability is low as compared to those caught.

Even though use of herbicides is not considered as the main reason of bees' instability, farmers understand the side effect of herbicide use and almost all bee keepers (96.3%) replied that the use of herbicide has impact on bees. According to the farmers, forager bees are the victims of use of pesticides as they move around in search of pollen. Human intervention might be the reason why honey production is high in the enclosure area of Tigray, northern part of Ethiopia (Assress, 2002), compared to non-enclosed areas. Assress (2002) also indicated that honey production is an environmentally friendly activity and the increased production in enclosed areas is an incentive to farmers to rehabilitate degraded environments. Therefore, beekeeping activities can give a rough insight to environmental conditions like degradation and deforestation.

In the study area, beekeeping is not the major activity of farmers; rather it is a means of diversification of livelihoods for some farmers. Their main occupation is farming and use of agricultural input is a must to increase production. Though the trend in consumption of herbicides is increasing in the study area, at a current condition, its impact is not significant on beekeeping as herbicide use is still modest and colony size is increasing from time to time.

5. Conclusion

Agricultural extension could be one tool in attaining the millennium development goal related to the reduction of extreme poverty and hunger in developing countries like Ethiopia. Though the idea was introduced long time ago, it is recently that extension has got attention to address the issue of small-scale farmers in Ethiopia. This study commences to look into the impact of extension on the livelihood and farmers' variety of food crops.

Generally, compared to the past five and ten years, farmers in Guduru district are in a better condition now. They have more draft animals than before, the majorities are able to have three meals a day, and most of them can afford the payment for the clinic in their nearest town or village when they get sick. Compared to the past, more children of the farming communities are attending school now. This is really an improvement in mentality, economy and also it is a future investment in a society with high level of illiteracy. Housing of the farmers is also getting improved. There is a massive shift towards iron roofed house. No question that extension has contributed in improving the livelihood of farmers in Guduru.

However, it seems that extension is not equally benefiting the farming communities in the study area. There is a difference among the farmers whereby those considered as rich groups of the society benefit more from extension as compared to those considered as poor. The rich have more draft animals than the poor; more children from the wealthy families are attending school than the poor families; and the rich have big houses as compared to the poor. The difference between the rich and the poor in terms of draft animal and children attending school is getting larger from time to time. Contrary to wealth difference, the impact of distance from the center of the district is insignificant. Except for some inputs and outputs, farmers at different locations have the same access or at the same level for many livelihood indicators such as housing, diet, schooling, and assets like draft animals.

Increasing productivity and conserving resources are two contrasting activities. Maintaining trade-off between these activities is a must if we really want a sustainable development in agricultural sector. Many local varieties were lost from Guduru district that witnesses the negative impact of extension on local varieties. Of course expansion of extension is not the only reason why local varieties can be lost from a given locality. However, the responses from the farmers in Guduru reveal that expansion of extension has a double effect on the use and conservation of local cultivars. In the first place farmers are attracted by increased production of improved varieties and replace their local varieties by the improved varieties of the same crop. Secondly, the massive production of improved varieties will compete for land with other crop types, especially for the majority of poor farmers with very small holding size prevailing in highly populated areas of Ethiopia like Guduru.

Trend of input use in the area is increasing from time to time. Farmers apply both urea and DAP fertilizers on their farm with improved varieties consuming the largest share compared to the local varieties. It is more common to apply commercial fertilizer for growing different varieties of *Teff* compared to other local crop types and it is exercised for many years in the study area. Herbicide is also replacing traditional ways of weed control. The trend in herbicide use is sharper when compared to the increase in fertilizer use in the study area. However, currently it is not at a level to hamper honey production and affect bee colonies as beekeepers have more bee colonies now than before.

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Appendixes:

Appendix 1.

Paired samples statistics for pair wise T-test

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Number of plow needed to local maize variety	4.48	115	1.245	.116
	Number of plow needed to improved maize variety	6.33	115	1.153	.107
Pair 2	Number of plow needed to local wheat variety	5.28	102	1.214	.120
	Number of plow needed to improved wheat variety	7.25	102	1.029	.102
Pair 3	Amount of seed required for local maize variety per ha (kg)	50.03	115	19.252	1.795
	Amount of seed required for improved maize variety per ha (kg)	25.00	115	.000	.000
Pair 4	Amount of seed required for local wheat variety per ha (kg)	143.73	90	47.762	5.035
	Amount of seed required for improved wheat variety per ha (kg)	145.81	90	18.049	1.903
Pair 5	Amount of Urea fertilizer required for local maize variety pre ha (kg)	3.33	114	10.589	.992
	Amount of Urea fertilizer required for improved maize variety pre ha (kg)	200.00	114	.000	.000
Pair 6	Amount of Urea fertilizer required for local wheat variety pre ha (kg)	21.22	95	41.327	4.240
	Amount of Urea fertilizer required for improved wheat variety pre ha (kg)	100.34	95	1.993	.204
Pair 7	Amount of DAP fertilizer required for local maize variety pre ha (kg)	7.79	114	18.402	1.724
	Amount of DAP fertilizer required for improved maize variety pre ha (kg)	100.00	114	.000	.000
Pair 8	Amount of DAP fertilizer required for local wheat variety pre ha (kg)	17.46	115	38.229	3.565
	Amount of DAP fertilizer required for improved wheat variety pre ha (kg)	99.20	115	13.242	1.235
Pair 9	Yield of local maize variety per ha (qu)	14.23	70	4.651	.556
	Yield of improved maize variety per ha (qu)	56.51	70	8.949	1.070
Pair 10	Yield of local wheat variety per ha (qu)	13.73	52	6.920	.960
	Yield of improved wheat variety per ha (qu)	31.62	52	6.517	.904

Appendix 2

Health access and number of meal per day

2.a The ability of the farmer to access health centers when they get sick

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, I can afford	100	83.3	83.3	83.3
	No, I can't afford	20	16.7	16.7	100.0
	Total	120	100.0	100.0	

2.b Comparison of the ability of farmers to health access

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Increasing as compared to the past	80	66.7	80.0	80.0
	No change as compared to the past	16	13.3	16.0	96.0
	Decreasing as compared to the past	4	3.3	4.0	100.0
	Total	100	83.3	100.0	
Missing	Not applicable	20	16.7		
Total		120	100.0		

2.c The number of meal the farmer is having now Per day

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	49	40.8	40.8	40.8
	3	71	59.2	59.2	100.0
	Total	120	100.0	100.0	

2.d The number of meal the farmer was having five years ago

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	6	5.0	5.0	5.0
	2	106	88.3	88.3	93.3
	3	8	6.7	6.7	100.0
	Total	120	100.0	100.0	

2.e The number of meal the farmer was having ten years ago

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	18	15.0	15.0	15.0
	2	97	80.8	80.8	95.8
	3	5	4.2	4.2	100.0
	Total	120	100.0	100.0	

Appendix 3

Benefit of extension in different forms

3.a Benefits of extension service to the farmers in general

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	118	98.3	99.2	99.2
	No	1	.8	.8	100.0
	Total	119	99.2	100.0	
Missing	9	1	.8		
Total		120	100.0		

3.b Benefit of extension service in the form of new road construction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	61	50.8	51.3	51.3
	No	58	48.3	48.7	100.0
	Total	119	99.2	100.0	
Missing	9	1	.8		
Total		120	100.0		

3.c Benefits of extension service in the form of credit services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	89	74.2	74.8	74.8
	No	30	25.0	25.2	100.0
	Total	119	99.2	100.0	
Missing	9	1	.8		
Total		120	100.0		

3.d Benefits of extension service in the form of agricultural inputs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	110	91.7	92.4	92.4
	No	9	7.5	7.6	100.0
	Total	119	99.2	100.0	
Missing	9	1	.8		
Total		120	100.0		

3.e Benefits of extension service in the form of suitable market

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	60	50.0	50.4	50.4
	No	59	49.2	49.6	100.0
	Total	119	99.2	100.0	
Missing	9	1	.8		
Total		120	100.0		

Appendix 4

ANOVA for number of students attending school at different time

4.a. Descriptives statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
						Lower Bound	Upper Bound		
Children at School now	rich	33	4.27	1.807	.315	3.63	4.91	1	8
	medium	39	3.33	2.030	.325	2.68	3.99	1	10
	poor	29	2.00	1.225	.227	1.53	2.47	0	6
	Total	101	3.26	1.958	.195	2.87	3.64	0	10
Children at School Five Years ago	rich	33	2.79	1.635	.285	2.21	3.37	0	6
	medium	39	1.69	1.575	.252	1.18	2.20	0	6
	poor	29	.86	1.125	.209	.43	1.29	0	4
	Total	101	1.81	1.654	.165	1.49	2.14	0	6
Children at School Ten Years ago	rich	33	1.45	1.734	.302	.84	2.07	0	6
	medium	39	.59	1.117	.179	.23	.95	0	5
	poor	29	.28	.841	.156	-.04	.60	0	4
	Total	101	.78	1.368	.136	.51	1.05	0	6

4.b LSD Multiple comparisons

Dependent Variable	(I) wealth category	(J) wealth category	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Children at School now	rich	medium	.939(*)	.416	.026	.11	1.77
		poor	2.273(*)	.448	.000	1.38	3.16
	medium	rich	-.939(*)	.416	.026	-1.77	-.11
		poor	1.333(*)	.431	.003	.48	2.19
	poor	rich	-2.273(*)	.448	.000	-3.16	-1.38
		medium	-1.333(*)	.431	.003	-2.19	-.48
Children at School Five Years ago	rich	medium	1.096(*)	.351	.002	.40	1.79
		poor	1.926(*)	.377	.000	1.18	2.67
	medium	rich	-1.096(*)	.351	.002	-1.79	-.40
		poor	.830(*)	.363	.024	.11	1.55
	poor	rich	-1.926(*)	.377	.000	-2.67	-1.18
		medium	-.830(*)	.363	.024	-1.55	-.11
Children at School Ten Years ago	rich	medium	.865(*)	.305	.006	.26	1.47
		poor	1.179(*)	.329	.001	.53	1.83
	medium	rich	-.865(*)	.305	.006	-1.47	-.26
		poor	.314	.317	.324	-.31	.94
	poor	rich	-1.179(*)	.329	.001	-1.83	-.53
		medium	-.314	.317	.324	-.94	.31

* The mean difference is significant at the .05 level.

Appendix 5

Crosstabulation of number of meals farmers have with wealth category at different time

5.a. Wealth category * Number of meal farmers have now per day

			Number of meal the Farmer is having now Per day		Total
			2	3	
wealth category	rich	Count	10	25	35
		% within wealth category	28.6%	71.4%	100.0%
		% within meal Number	20.4%	35.2%	29.2%
	medium	Count	18	24	42
		% within wealth category	42.9%	57.1%	100.0%
		% within meal Number	36.7%	33.8%	35.0%
	poor	Count	21	22	43
		% within wealth category	48.8%	51.2%	100.0%
		% within meal Number	42.9%	31.0%	35.8%
Total		Count	49	71	120
		% within wealth category	40.8%	59.2%	100.0%
		% within meal Number	100.0%	100.0%	100.0%

5.b. Wealth category * Number of meals farmer had five years ago

			The Number of meal the Farmer was having Five Years ago			Total
			1	2	3	
wealth category	rich	Count	0	34	1	35
		% within wealth category	.0%	97.1%	2.9%	100.0%
		% within meal Number	.0%	32.1%	12.5%	29.2%
	medium	Count	1	37	4	42
		% within wealth category	2.4%	88.1%	9.5%	100.0%
		% within meal Number	16.7%	34.9%	50.0%	35.0%
	poor	Count	5	35	3	43
		% within wealth category	11.6%	81.4%	7.0%	100.0%
		% within meal Number	83.3%	33.0%	37.5%	35.8%
Total		Count	6	106	8	120
		% within wealth category	5.0%	88.3%	6.7%	100.0%
		% within meal Number	100.0%	100.0%	100.0%	100.0%

5.c Wealth category * Number of meals farmer had ten years ago

			The Number of meal the Farmer was having Ten Years ago			Total
			1	2	3	
wealth category	rich	Count	6	29	0	35
		% within wealth category	17.1%	82.9%	.0%	100.0%
		% within meal Number	33.3%	29.9%	.0%	29.2%
	medium	Count	4	36	2	42
		% within wealth category	9.5%	85.7%	4.8%	100.0%
		% within meal Number	22.2%	37.1%	40.0%	35.0%
	poor	Count	8	32	3	43
		% within wealth category	18.6%	74.4%	7.0%	100.0%
		% within meal Number	44.4%	33.0%	60.0%	35.8%
Total		Count	18	97	5	120
		% within wealth category	15.0%	80.8%	4.2%	100.0%
		% within meal Number	100.0%	100.0%	100.0%	100.0%

Appendix 6

6.a. ANOVA table for some important parameters to compare the impact of distance

		Sum of Squares	df	Mean Square	F	Sig.
Cultivated land size in the Year 1998/99 (a)	Between Groups	245.753	2	122.876	2.524	.085
	Within Groups	5500.247	113	48.675		
	Total	5746.000	115			
Pair of Oxen The Farmer have Now	Between Groups	13.102	2	6.551	2.351	.059
	Within Groups	220.898	113	1.955		
	Total	234.000	115			
Children at School now	Between Groups	5.331	2	2.666	.691	.503
	Within Groups	377.976	98	3.857		
	Total	383.307	100			
The price of fertilizer urea in the year 1998/99 per 50 kg	Between Groups	1603.836	2	801.918	8.924	.000
	Within Groups	10423.442	116	89.857		
	Total	12027.277	118			
The price of fertilizer DAP in the year 1998/99 per 50 kg	Between Groups	1792.790	2	896.395	55.467	.000
	Within Groups	1874.672	116	16.161		
	Total	3667.462	118			
The price of improved maize seed in the year 1998/99 per plot	Between Groups	587.220	2	293.610	2.153	.121
	Within Groups	15545.105	114	136.361		
	Total	16132.325	116			
The price of improved wheat seed in the year 1998/99 per plot	Between Groups	7740.218	2	3870.109	5.862	.004
	Within Groups	70639.100	107	660.179		
	Total	78379.318	109			
The price of maize in the year 1998/99 per quintal	Between Groups	1188.965	2	594.482	11.086	.000
	Within Groups	6059.544	113	53.624		
	Total	7248.509	115			
The price of wheat in the year 1998/99 per quintal	Between Groups	1152.330	2	576.165	2.670	.074
	Within Groups	24381.119	113	215.762		
	Total	25533.448	115			

a. Years in such calculations are in Ethiopian Calendar

6.b. LSD Multiple cmparison for parameters that were significant in ANOVA

Dependent Variable	(I) Location	(J) Location	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
The price of fertilizer urea in the year 1998/99 per 50 kg	Near	Middle	-9.008(*)	2.133	.000	-13.23	-4.78
		Far	-4.675(*)	2.120	.029	-8.87	-.48
	Middle	Near	9.008(*)	2.133	.000	4.78	13.23
		Far	4.333(*)	2.133	.045	.11	8.56
	Far	Near	4.675(*)	2.120	.029	.48	8.87
		Middle	-4.333(*)	2.133	.045	-8.56	-.11
The price of fertilizer DAP in the year 1998/99 per 50 kg	Near	Middle	-7.793(*)	.905	.000	-9.58	-6.00
		Far	-8.575(*)	.899	.000	-10.36	-6.79
	Middle	Near	7.793(*)	.905	.000	6.00	9.58
		Far	-.782	.905	.389	-2.57	1.01
	Far	Near	8.575(*)	.899	.000	6.79	10.36
		Middle	.782	.905	.389	-1.01	2.57
The price of improved wheat seed in the year 1998/99 per plot	Near	Middle	-18.200(*)	6.206	.004	5.90	30.50
		Far	-1.200	5.745	.835	-12.59	10.19
	Middle	Near	18.200(*)	6.206	.004	-30.50	-5.90
		Far	-19.400(*)	6.206	.002	-31.70	-7.10
	Far	Near	1.200	5.745	.835	-10.19	12.59
		Middle	19.400(*)	6.206	.002	7.10	31.70
The price of maize in the year 1998/99 per quintal	Near	Middle	6.914(*)	1.681	.000	3.58	10.24
		Far	.090	1.648	.957	-3.18	3.35
	Middle	Near	-6.914(*)	1.681	.000	-10.24	-3.58
		Far	-6.824(*)	1.670	.000	-10.13	-3.52
	Far	Near	-.090	1.648	.957	-3.35	3.18
		Middle	6.824(*)	1.670	.000	3.52	10.13

* The mean difference is significant at the .05 level.

Appendix 7

Comparison of honey quality and production

7.a. Honey quality as compared to the past

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Increasing	1	.8	3.6	3.6
	It is almost comparable	5	4.2	17.9	21.4
	Decreasing now a days	22	18.3	78.6	100.0
	Total	28	23.3	100.0	
Missing	not applicable	92	76.7		
Total		120	100.0		

7.b. Honey production as compared to the past

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	It is almost comparable	2	1.7	7.1	7.1
	Decreasing now a days	26	21.7	92.9	100.0
	Total	28	23.3	100.0	
Missing	not applicable	92	76.7		
Total		120	100.0		

Appendix 8

Average number of bee colonies caught with that of transferred to next year

	N	Min.	Max.	Mean	Std. Deviation
Bee colonies caught in the year 1995	26	0	30	10.12	7.906
Bee colonies caught in the year 1996	26	0	30	11.96	9.241
Bee colonies caught in the year 1997	26	2	50	13.46	12.535
Bee colonies caught in the year 1998	26	3	80	17.81	18.830
Bee colonies caught in the year 1999	26	2	80	18.42	21.229
Bee colonies transferred to the next year 1995	26	0	10	4.62	3.312
Bee colonies transferred to the next year 1996	26	0	15	5.42	4.139
Bee colonies transferred to the next year 1997	26	0	20	5.81	5.382
Bee colonies transferred to the next year 1998	26	0	40	8.00	8.832
Bee colonies transferred to the next year 1999	26	0	40	8.23	9.509

Appendix 9

Questionnaire

I. General information

1. Name of peasant association _____
2. Name of village _____
3. Distance from the center of the district (in hrs)_____
4. Walking distance to the nearest all weather road (in minutes)_____
5. Name of enumerator _____
6. Date of interview_____

II. Characteristics of household

1. Can you provide me the following information please?

Household code	Sex	Age	Total No of HH members	Marital status	Education	Religion	Engagement in agriculture

2. The house hold is: (1) Male headed (2) Female headed
3. How long you lived in here?
4. What are the sources of the household income? 1) crop sale 2) livestock sale 3) Both crop and live stock sale 4) casual work 5) off farm activity 6) others (specify)_____
5. Do you possess land? Yes/ no
6. If yes, what is the size of your land holdings in '*olmaa*' (1 *olmaa* = ¼ ha)

Type of land use	Farm size in '*olmaa'*			
	1995/96	1996/97	1997/98	1998/99
Cultivated land				
Share cropped				
Rented in				
Rented out				

Grazing				
Fallow				
Others				

7. Do you own livestock? Yes/ no
8. If yes, can you mention some of them?

Livestock type		Number	purpose
Cattle	Oxen/bulls		
	Cows		
	Heifers		
	Calves		
Shots	Sheep		
	Goats		
Equines	Horses		
	Mules		
	Donkeys		
Poultry			

9. Do you have any external support from some one not engaged in agriculture? Yes/no
10. If yes, what is his/her engagement? 1) Government employee 2) business man 3) Living outside of the country 4) other (specify)_____

III. Benefit of extension to the farmers

1. When did extension practices start in this area?
2. When did you start to be a member of extension service?
3. Who encouraged you to participate in it? 1) former members in your area 2) self initiation 3) Development workers in the area 4) Mass media 5) Local level administrators 6) others (specify)

4. What new intervention did you observe following the introduction of extension practices? 1) Road construction 2) credit facility 3) Input supply facility 4) market access 5) others (specify)_____
5. What special services are given to extension members as compared to other farmers in this area?

A. Training B. Credit C. Advice D. Input supply E. Others, specify----------

6. How do you evaluate the farming guided by extension as compared to the traditional one?

Inputs and outputs per '*oolmaa'*		Traditional farming / local variety seeds			Extension farming/ improved seeds		
Crop type		maize	wheat	teff	maize	wheat	teff
No of plowing needed							
Seed required (in kg)							
Fertilizer (in kg)	Urea						
	DAP						
Pesticides (in liter)							
Yield (in quintal)							

7. How many pairs of oxen do you have? 1) now 2) five years ago 3) ten years ago
8. Do you have children at school?
9. If yes, How many? 1) now 2) five years ago 3) ten years ago
10. Can you afford school fees? 1) now 2) five years ago 3) ten years ago
11. The quality of house you are living in is? 1) the roof is covered with grass 2) roof is corrugated iron
12. If you are living in house made of iron sheet, what is the number of iron sheet? __
13. Can you afford to get health service if you or your family is getting sick?
14. If your answer is yes, as compared to the past time, is your potential 1) getting improved 3) no change 4) declining
15. How many meals do you have a day? 1) Now 2) five years ago 3) ten years ago
16. How is the quality of food you are eating? 1) getting improved 2) the same as before 3) declining
17. Have you started some saving activities?

18. If yes, in what form? 1) Crops for saving 2) livestock assets 3) cash saving 4) future investment 5) others (specify)_____
19. Is there any kind of training that is given to the farmers and that you have attended? _____
20. If yes, what was the training all about? _____
21. Is there any new way of farming that is introduced in the area following extension?_____
22. In which case do you apply more labour? 1) traditional farming, 2) extension farming, 3) both are the same

IV. Effects of extension on local variety

Below are questions regarding some crop varieties that you might know. These varieties include those which used to be used by you, your neighbor, your parents, your relatives or other people in the locality. The questions concern your knowledge of the different desirable and undesirable characteristics associated with them.

1. How many varieties of maize did you know in this area?

Local name of variety	Desirable characteristics (code A)	Undesirable characteristics (code B)	Use value (code C)	Other features
1.				
2.				
3.				
4.				

Code A: I) Agronomic characteristics: *1. disease resistant, 2. pest resistant, 3. frost resistant, 4. Early maturity, 5. Short growing period, 6. others (specify)_____*

II) Storage behavior: *1. good germinating ability (low dormancy), 2. Good seed quality, 3. Not susceptible to pest,* ***III) Other preferences:*** *1. Easy for cooking, 2. Long shelf life as grain, 3. Good shelf life as flour, 4. Taste preference, 5. Stability of flour/dough, 6. Marketability, 7. Volume of flour per kg of grain, 8. Ohers*

Code B: 1. perform less with fertilizer compared to improved varies and thus was substituted for by improved varieties, 2. Low disease resistant, 3. Low frost tolerant, 4. Low performance value, 5. Others.

Code C: 1. Sale, 2. Consumption, 3. Planting (seed for next season)

2. Out of these how many of them are growing now in the area/on your farm?
3. How many varieties of wheat did you know in this area?

Local name of variety	Desirable characteristics (code A)	Undesirable characteristics (code B)	Use value (code C)	Other features
1.				
2.				
3.				
4.				
5.				

4. How many of the above variety are growing in the area now?

5. How many variety of '*teff*' did you know in this area?

Local name of variety	Desirable characteristics (code A)	Undesirable characteristics (code B)	Use value (code C)	Other features
1.				
2.				
3.				
4.				
5.				

6. How many of the above variety are growing in the area now? _____

7. Do you know crop variety, other than the above mentioned, that are lost from this area? _____

8. If yes, what do you think is the main reason for their loss? 1) Climatic change, 2) Change of preference, 3) Low productivity, 4) Low pest resistance, 5) low frost tolerance, 6) low flour yield, 7) Low bird resistance, 8) low disease tolerance, 9) introduction of improved variety, 10) Change in the farming system of the area, 11) Mention if there is other reason_____

9. Is there any organization, governmental or non-governmental, that is working on genetic conservation in this area?

10. Is the use of local varieties declining or increasing in your area? 1) There is no change 2) Increasing 3) Declining 4) Unknown.
11. Do you think that the local variety is important to you and for your society?
12. Have you tried to conserve the local variety at your land?
13. If yes, what is you method of conservation?
14. How much percent of your seed source is from the government? 1) Almost all 2) half of it, 3) a quarter of it, 4) almost none
15. If your seed source is from the extension office, what do you do when there is shortage, delay, or no delivery of seeds? _____

V) Impact of inputs used on bee keeping

1. Do you have bee hive?
2. When did you start keeping bee colony?
3. How many bee colonies do you have? 1) Now 2) Five years ago 3) Ten years ago
4. How many bee colonies can you catch every year?

Year (E.C)	1995	1996	1997	1998	1999
Collected					
Survived to the next year					

5. How many kg of honey can you collect per hive? _____ In total?_____
6. How many kg of wax can you collect per hive? _____ In total?_____
7. How is the honey quality as compared to the past? 1) high 2) the same 3) less
8. How is the honey production as compared to the past? 1) increasing 2) comparable to the past 3) declining
9. How is the condition of bee colonies leaving bee hive? 1) Frequent 2) Stable
10. If frequent, what do you think the main cause that forces the bee colony to leave the hive? _____
11. As a farmer, how many liters of herbicides do you use every year? _____
12. Do you think use of herbicides can affect bee production? Yes/ no
13. If your answer is yes, how? _____

14. Do you have access to modern bee hives? Yes/ No
15. If yes, who provides you with modern bee hives? 1) agricultural experts 2) NGOs 3) individuals in the area 4) others (specify)_____

VI) Farmers perceptions

1. Do you think that extension is important to the farmers of the area? _____
2. Can you compare the inputs cost and yield price for the past four years at the easily accessible market place?

Items		Price			
		1995/96	1996/97	1997/98	1998/99
Fertilizer (per 50 Kg)	Urea				
	DAP				
Improved seeds (kg)	- maize				
	- wheat				
	- teff				
Herbicides (per liter)					
Maize (per quintal)					
Wheat (per quintal)					
Teff (per quintal)					

3. How is the access to extension services? 1) accessed easily by those who are near to the center 2) accessed by the rich 3) accessed by elite groups 4) every body can access it
4. Is there wealth difference in the society due to the introduction of extension?
    a. If yes, who are the beneficiaries? _____
    b. Who are the losers? _____
5. Do you face any market problem or reduction in price of crops? Yes/ no
6. Do you think that it is due to extension? If yes, how?

7. If yes, what is the lowest price you observed? And in which year and month?

Crop type	year	Lowest price (per quintal	Production cost (per quintal)
Maze			
Wheat			
Teff			

8. How was the above problem solved? 1) Government interference 2) market clear out it self 3) the problem is still existing 4) others (specify)_____
9. Do you think the assistance given to you from expertise is enough and on time? Yes/ no
10. If no, what additional support do you need from them?_____
11. How often does the expertise from district or DAs visit you? 1) Regularly at any time I need assistance 2) once a week 3) twice a week 4) once a month 5) twice a month 6) irregular and can not be specified
12. Are the farmers in this area participating in extension agriculture willingly? Yes/no
13. If no, what is the instrument used by implementers to convince the farmer to be a member of extension? _____
14. Would you continue to apply high yielding varieties and use of fertilizer and pesticides without the involvement of any external supporters? Yes/ no
15. If no, what is your reason of withdrawal? _____
16. Finally, do you have any more points to add or to comment on? _____

_____

_____

_____

_____

_____