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Agricultural Modernization, Extension and Peoples' Perception in Gamo Highlands: Southwest Ethiopia

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Abstract

As common in most rural areas of Ethiopia, the prevailing farming system in Gamo highlands is largely dominated by small scale and still predominant subsistence agriculture with traditional production systems. However, the recent development to introduce modern agricultural technologies and inputs need attention. The objective of this study is to investigate the extent of agricultural modernization and people's responses to the modern agricultural technologies and inputs in Gamo highlands. Data were collected from 193 sample households taken from three peasant associations. A detailed structured household survey and a wide range of participatory rural appraisal (PRA) were used to collect data. Descriptive statistics as well as ground theory analysis were employed to analyze the data. Results confirm that though chemical fertilizers, improved livestock and crop varieties, conventional soil conservation and fertility management techniques were introduced to the Gamo Highlands, its influence to change the agricultural systems is still at initial stage. Farmers at dega and woynadega prefer indigenous soil conservation structure (keela) to conventional ones to protect their soil from erosion. Generally, chemical fertilizers and maize are well adopted at low lands. Lack of budget, low infrastructure, high turnover of extension workers and low commitment of responsible bodies were the factors affecting the expansion of extension services.

Key words: *Modern agriculture, agricultural inputs, extension, Highland*

1. Introduction

Warren (1991) indicates that modern knowledge is the international knowledge systems generated through the global network of formal educational establishment. In other words modern knowledge systems are those developed through research finding, or laboratory experiment results in contrast to indigenes knowledge systems, which are the result of trial and error.

Based on several research reports, Pretty, et al. (2001) documented the environmental and human impacts of modern agriculture. (1) Contamination of water and harming wildlife and human health by pesticides; (2) contamination of water by nitrate and phosphate from fertilizers, results in algal blooms, deoxygenating and fish deaths; (3) Flooding and damage to housing and natural resources by soil erosion distracting erosion watercourses and run-offs; and (4) Methane, nitrous oxide and ammonia derived from livestock, their manures and fertilizers which causes contamination of the atmospheric environment. They also summarized the social impacts of modern agriculture that resulted in minimizing the number of farms that are larger in size and also

abandonment of land in some areas in Europe which brought a decline in the number of people employed in agriculture. Fewer farms, fewer jobs and larger-scale farming have also played a role in the rise of rural poverty and economic disadvantage (Pretty et al., 2001).

In the struggle to improve the livelihoods of rural poor in developing countries, supporting the agricultural system with modern agricultural technologies is the intention of governments. So far, several approaches have been developed to disseminate the research results and new technologies in to the farming systems of the traditional societies that are struggling to survive, basically, depending on their own agricultural knowledge.

The activities of various research establishments in Ethiopia including those in agricultural education over the past 50 years have resulted in the development of substantial number of improved agricultural technologies but the impact of these technologies on enhancing production has not been satisfactory (Aklilu, 2006). The main reasons for this are related to the inadequate application of the technologies due to several factors. The most important of which includes insufficient supply of the developed technologies to farmers because of limited capacity of technological multiplication and distribution mechanisms. Inadequate effort to develop specific technologies that suite to the needs and circumstances of farmers in a specific context, particularly in less favorable production environment resulted farmers' reluctance to the adoption of the new technology (Woldeamlak, 2007).

Ethiopian agricultural extension service was started in 1952 by the assistance of the United States Point Four program at the Agricultural and Mechanical College of Alemaya. At its initial stage, it passed through several structural and organizational challenges to show some bright spots in the agricultural systems today. The extension services of the time and to the start of 1970s were limited to providing advice on production techniques (Stommes and seleshi, 1978a) and supplying an integrated minimum package of services to the farming households through the 'model farmers approach' (Stommes and seleshi, 1978b). This was to support the adoption of extension services.

Today, one of the top priorities of Ethiopia in achieving the millennium development goals is making rural households food self-sufficient. Since 1991, the country has introduced new national economic strategy known as Agriculture Development Led Industrialization (ADLI) to accelerate agricultural growth that help achieve food security within short period of time (Amdissa, 2006). Big emphasis was given in 1990s to generate a more supportive macroeconomic framework, liberalize markets for agricultural products and promote the intensification of production of food staples through the use of modern inputs (Sprielman, et al., 2010). Of course, it is not a simple task to transform the lives of millions of rural households, which accounts for 84% of the total population and 90% of the poor engaged in traditional subsistence farming.

In Ethiopia, pathways of agricultural technology transfer that have been applied so far are pre-extension demonstration, popularization, on-farm verification and training of farmers. However, gaps have been observed in different parts of the country indicating lack of efficiency in agricultural technology dissemination pathways (Agajie, et al., 2007) and inaccessibility of generated technologies.

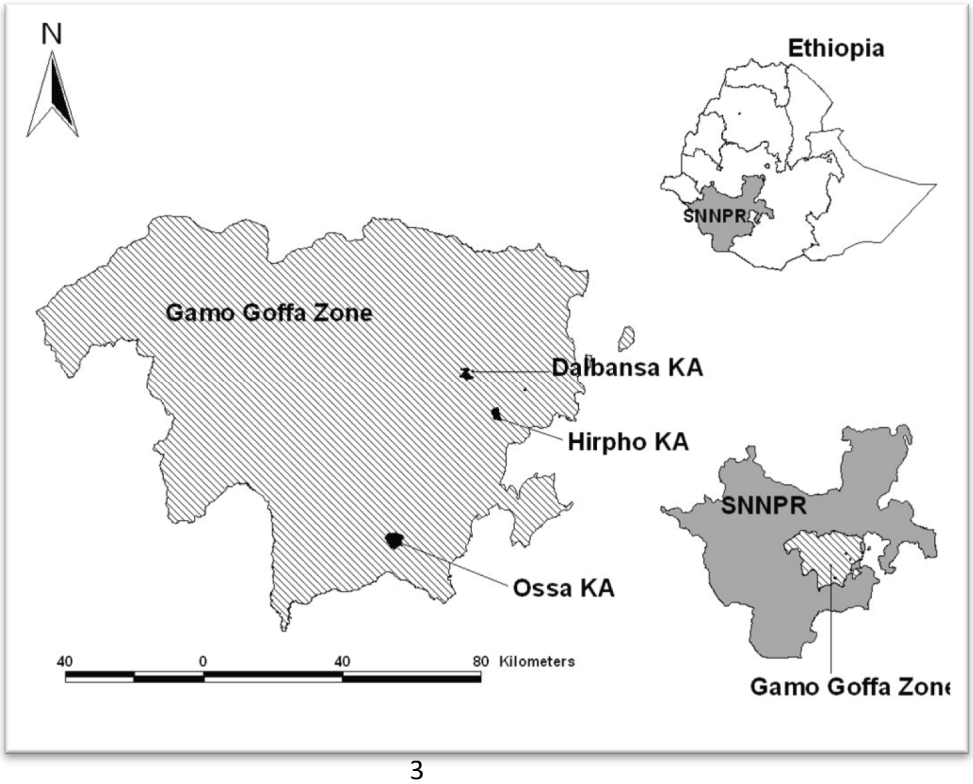
Several agricultural technologies such as improved agricultural implements (Tilahun, et al., 2004), integrated pest management (Kindu, et al., 2004), plant breading (Gemechu, et al., 2004) and more others were developed and implemented in different parts of Ethiopia. In fact, continuous supply of options of technologies to be tested with farmers' intensive involvement mostly not to generate technologies, but rather technology verification and adaptation trials are carried out on already generated technologies (Tilahun, et al., 2004). Unluckily, the technologies introduced to Gamo Highlands are restricted to the distribution of chemical fertilizers, improved varieties and conventional soil conservation and fertility management techniques.

2. Materials and Methods

Sampling and Data Collection

Multi-stage sampling stage was followed to select study population. To do this all rural peasant administrations locally known as *Kebele* Administrations (KAs) that fall within the defined territory of Gamo highlands were classified into three stratums, namely, *Dega* (a local term which refers to altitude above 2200 meters above sea level), *woyna dega* (1300 - 2200 meters above sea level) and *qolla* (1300 – 500 meters above sea level). One KA was randomly selected from each agro-climatic zone.

Figure 1 Location of Study Kebele Administrations (KAs)



Finally, households of selected KPAs were ranked into three wealth categories (rich, middle, poor) and 20 % of each category was taken by using random numbers table. The total sample size was 193 households. Figure 1 shows location of Gamo highlands within which three KAs were located in three agro-climatic zones.

Open and close-ended questionnaire were administered to generate information which include data on identification of household members, demographic characteristics and behavior of study households; data on socio-economic characteristics; data on household resources; soil conservation methods, production systems, crop and livestock production, modern agricultural technologies and inputs applied. Moreover, participant observation was conducted to obtain data on the day-to-day activities related to agricultural production including, mainly modern ways of soil conservation, use of chemical fertilizers on different crops, ways of cultivation and fertility management systems.

Focus group discussions were conducted by organizing three groups at each KAs at different seasons. One group discussion was conducted at harvesting season and the other was at food shortage season. There were five members in each group consisting of household heads, as much as possible, from three wealth groups. One mixed community group (Ellis and Tasew, 2004) was organized per KA consisting of 12 members that enabled the researcher to triangulate the information and access a broad range of knowledge about one issue. Simple random sampling was applied to select the group members. Finally, Participatory wealth ranking was used to categorise the community into three wealth group based on Grandin's wealth ranking methodology (Grandin, 1988 cited in Ellis and Tasew, 2004). In the process, 6 reliable key informants were selected purposely to list household names in the community. The key informant group was allowed to set criteria, to place the household in to one of the three terms used in this research: Poor, meddle and rich.

Methods of Data Analysis: Qualitative data of this study was analysed by means of 'interpretative analyses' (Kitchin and Tate, 2000). Verbal responses, discussion results and observation memos were transcribed. While transcribing interviews, ideas and memos relating to the transcription about the data was jotted down. The data was annotated immediately while both the interview and transcriptions are still fresh in mind. Participatory maps, diagrams, sketches of the local people and photographs were coded and categorized based on issue it represents. Depending on the relationship, the sorted and categorized data was linked and connected. Data collected from household surveys was sorted and quantified for triangulation. As such, descriptive analysis such as frequency tables and measures of central tendency are selected to be used in the analysis of this part.

3. Results and Discussion

The intensive farming system of the country that farm households have managed to produce out of small plot of land by employing indigenous farming methods with low inputs have become increasingly inadequate to provide food security to the rapidly growing population of rural household. In order to open up pathway to get out of the poverty and food insecurity traps, the government, therefore, implemented a wide range of agricultural

extension programs and natural resource management activities all over the country. Three extension workers or development agents with a focus area of crop production, animal health and natural resource conservation were assigned in each KA to assist farmers in the implementation of modern agricultural inputs especially chemical fertilizer, improved seeds and water and soil conservation practices.

Chemical Fertilizers

Chemical fertilizers are supplied to Ethiopian smallholding farmers through government-run extension and input supply channel that functions with supervision from the regional agriculture and rural development bureau. District agricultural and rural development office looks closely the distribution and implementation of chemical fertilizers by each farm households. The regional authorities play a significant role in facilitating credits from regional credit organizations. At the bottom of the structure (*kebele* level), DAs are responsible to distribute chemical fertilizers and monitor the practical activities at household's field level. The intention of the government here, as stated earlier, is to persuade every farmer to use chemical fertilizers at the main cropping season. Furthermore, DAs and section heads of the Agriculture and Rural Development Office (ARDO) participate during the cropping season to convince farm households to apply chemical fertilizer.

Table 1 depicts that all the surveyed farm households are well aware of the application of chemical fertilizers for all annual crops. However, the implementation in reality is different from what farmers have learned, that is, due to lack of confidence on chemical fertilizer, farmers experiment by combining chemical fertilizer with that of manure, which they come out with the conclusion that the combination will keep the soil from damage, and there is some improvement in yield. The general perception of farmers at *dega* agro-climate was the damage that chemical fertilizers may cause on the soil. A discussion with farm households reveals that farmers still strongly argue against chemical fertilizers not only because of its increasing price but also, due to their wrong perception, that is the damage it causes on soil. All farmers conclude that the soil is never being productive after the soil adapts the chemical fertilizer. This forced a considerable number of farmers (28% and 22% at Dalbansa and Hirpho respectively) to combine chemical fertilizers with that of manure, which they think, will balance the negative impact of chemical fertilizers on the soil.

As to the advantages of chemical fertilizers, farmers at Dalbansa and Hirpho have two contradicting ideas. On the one hand, they are discontented with the yield increase compared with the cost of fertilizers. On the other hand, they are pleased that chemical fertilizers are easy to apply on farm plots far away from home and on sloppy ones where transporting manure is difficult.

At Ossa, the perception of farmers towards chemical fertilizers is different from households at Dalbansa and Hirpho due to less attention given to manure in this lowland area and 60% of the studied households in this *kebele* have come out with production improvement. Moreover, about 77% of the sample farm households at

Ossa were happy with the chemical fertilizers they obtained and the process of provision, although they have some discontent with the time of provision. Farmers reported that it was not the problem of chemical fertilizers but their poor application and excess, scarcity or irregularity of rain that are responsible for the decline of production and the resultant food shortage.

As stated earlier regarding reasons for reluctance to apply chemical fertilizers, price appears to be one of the major causes of farmer's reluctance to use more chemical fertilizers. According to farmers, though there are some improvements recorded, the production change is not as expected, particularly at *dega* and *woynadega kebeles* but the price of chemical fertilizer was too high for majority including the average households. Table 2 depicts that more than 86% of the farmers from all agro-climate worried about the increasing price of fertilizer. Therefore, farmers at Dalbansa (96.2%) and Hirpho (92.6%) conclude that the application of chemical fertilizers did not bring the expected production boom.

Table 2. Distribution of Respondents by Reasons for low attitude towards chemical

Fertilizers (multiple responses are Possible)

Reasons	*Dalbansa*	*Hirpho*	*Ossa*
High and rising price	52 (100)	61 (89.7)	58 (79.5)
Distance of farm plots from home	3 (5.8)	-	--
It's labour intensiveness	33 (63.5)	46 (67.6)	5 (6.8)
No improvement in production	50 (96.2)	63(92.6)	3 (4.1)

Source: Field Study, 2012

During focus group discussion, farmers at Ossa tried to demonstrate the application of chemical fertilizers on maize and *tef.* In this case, it gives confidence to say that farmers have enough knowledge to use chemical fertilizer. However, the short planting season force farmers to ignore the proper application and simply saw it with the maize or *tef* seeds because of labour intensiveness of the modern mechanisms.

Improved Varieties

One of the basic characterizations of modern agriculture is dissemination of genetically modified seed varieties, which often erode agricultural diversification avoiding different varieties of animal and plant in to a single high yielding species (Altieri, 2002). However, densely populated developing countries like Ethiopia highly need high yield varieties to become self-sufficient in food. The threat arises from small holders' predominantly depend on rain fed agriculture that may result in failure in case of rainfall variability. So far, a wide range of improved productive livestock varieties, high yield cereals, vegetables, fruits, and other commercial plant varieties were distributed at different times to different agro-climatic zones of the country. [

Introduced Livestock Varieties

As indicated in Chapter 4, livestock are the backbone of the agricultural systems in Gamo Highlands. Improving this sector will have a big impact on the livelihood of the rural community and this has practically been seen in some parts of Gamo Highlands. In Chencha district, for example, highly productive cattle are well adopted within and around the town. Nowadays, milk and milk products are sold from Chencha to nearby towns of Arbaminch improving the livelihoods of households in the town and around. more appreciable progress has been observed in and immediate surrounding *kebeles* in terms of cattle artificial insemination although insemination stations declined in the *woreda* from 18 to 5 within the last five years with lack of trained human power, high turnover and budget scarcities are the problems stated in this case. The HF Jercy and Holstein Friesian are the two major introduced cattle species in the area. Other than this, documents of Chencha *woreda* ARDO indicates that about 20,000 highly productive sheep varieties were introduced to Chencha *woreda* and distributed to farm household in and around Chencha town which seems to dominate the existing sheep varieties in the target area. However, the progress that have been achieved along Chencha town and its immediate surrounding *kebeles* is not expanded to the far rural farm households due to several factors such as budget scarcity, lack of transportation (fuel), limitation of infrastructure, absence of professionals, shortage of refrigerators and lack of commitment of officials and professionals.

As far as Dita and Bonke districts are concerned, artificial inseminations are widely used in order to strengthen the percentage of new varieties, which are effective in terms of productivity.. This is largely because as professionals searching for further educational access and other benefits around are transferred to these districts, they are better equipped with human and material resources to expand technological inputs. However, the progress in bringing the technology itself into the districts is slow. Some achievements that have been observed in Chencha town and its surround *kebele*s are not seen in Gerese and Zada (district centers) towns although religious organizations[1] and World Vision Ethiopia (NGO) played undeniable role in early introduction and expansion of improved cattle and fruit varieties in Chencha.

Vegetable and Fruits

The production and marketing of vegetables and fruits are good economic strategies, as they are better in terms of price than cereals. However, subsistence farmers in Ethiopia are in favour of cereals than vegetables and fruits, this is partially because vegetables and fruits need the knowledge of market conditions, which farmers do not have (Sørenson, et al., 2004). It is therefore, very important to help farmers to develop market strategies to select crops which can easily transported, high market value, and can be produced in a very small plot of land.

Those farmers who started such practice can be taken as a model for others who are in between cereal culture and the marketable vegetable and fruit crops as the return should attract many to change their mind.

Vegetables and fruits bring high amount of income especially in the areas of high population densities and small landholdings because much can be produced within small plot of land. It can be taken in some areas as a means to improve food security through diversified income. In light of this, Gamo Highland is one of highly densely populated areas of the country where farmland is getting to be a scare resource. In such areas it is advisable to introduce high yielding vegetable and fruit varieties. One of the factors for less attention to vegetable and fruits was none availability of vegetables in the regular consumption list of the rural communities of Gamo Highlands. There are very few indigenous vegetable varieties. Very commonly cabbage, garlic and onion are produced as a spice to be eaten with all other staples. There are no fruits known to the *dega* agro-climate, while *woynadega* and *qolla* agro-climate produce some varieties in small amounts. Thanks to catholic and protestant missionaries, new varieties of vegetables and fruits were introduced to Gamo Highlands. As to the vegetables, up to the near past people from urban and rural areas purchase varieties of vegetable seeds from catholic missionaries near Chencha town which helped farm households around Chencha town to increase their income.

At Hirpho, farmers produce varieties of vegetables which are new for the tradition and customs of the area or which are not known in the area before. What makes production of varieties of vegetables, fruits and other small root crops different in this *kebele* is that farmers produce more than four edible varieties on a very small piece of land in a combination. Some of the introduced vegetables and/or fruits are not available in the food items lists consumed in the area. They are produced for market purpose. Farmers brought the seeds of these food items from individual shop in Chencha town purchasing individually or in group.

One of the successful fruits introduced to some parts of Gamo highlands is Apple. It was introduced to Chencha some 40 years ago. It took more than two decades to be adopted and be known by local communities. Nowadays apple seedlings were widely produced by local farmers and distributed to other parts of Ethiopia. Similarly, apple Gamo Highland is well-known for its apple fruit production in the country. However, farmers' resistance to purchase apple seedling (one seedling costs 45 ET Birr at the time of survey), was the major bottleneck of the dissemination process.

Improved Crop Seeds

Most districts of Gamo Highland are still under serious food insecurity problems; primarily because of high population density and land scarcity that need fast and systematic intervention interims of improving basic staple crop units. Major indigenous crops of Gamo Highland namely barley, wheat and maize are under pressure by newly arrived high yielding varieties particularly wheat, maize and potato. Trainings on the

cultivation steps for introduced major crop varieties took place at different levels to include all farm households. Hence, almost all farmers at Hirpho (89%) and Dalbansa (93%) were advised to sow high yielding wheat varieties for 2011 growing season. DAs in each *kebele* were seriously following the application of necessary inputs particularly chemical fertilizers and land preparation. Poor fertilizer applications combined with bad weather resulted in crop failure of 86% for the farmers' at Dalbansa. At Ossa, new and high yield disease resistant maize varieties (DH-1400) exclusively dominate the farm fields and obtained farmers acceptance and were adopted successfully. According to respondents of this *kebele,* DH-1400 is highly productive if there is optimum rainfall. However, some times the amount of rainfall is excessive that turns the maize field in to swampy. Generally, farmers at Ossa are happy with the maize seed and chemical fertilizer. The major problem of production here is bad weather accompanied by its variability, which kept majority (72.6%) to face seasonal food shortage.

Modern Cultivation Methods

One component of extension that was implemented together with modern inputs was cultivation systems. Farmers were trained and continuously advised by DAs to follow the procedures of modern methods of cultivation. Previous rural development programs and agricultural research have given less emphasis to the needs and on-farm production problems facing the small-scale producers. More important, the accessibility of small farmers to improved production technology (including improved seeds, fertilizers, irrigation facilities, herbicides, etc.) and capital is very limited (Abeje, 2008). This in partial contributed to low productivity that was the result of low utilization of modern inputs. On the other hand, traditional farming with practical farming experiences contributed a great deal for generations in feeding the population and keeping the environment safe but nowadays this system with limited resource and low input faced considerable challenges in feeding rapidly growing population. Therefore, it is not only an obligatory to introduce modern inputs into the agricultural system but also to change the methods of cultivation.

Cognizant to this, attempt has been made in Ethiopia to introduce modern mechanized farming system since mid-1960s (Stommes and Silleshi, 1987a). The mechanization process having a great deal of problems, which are not important to mention here, could not show progress although it indicated the possibilities of modernizations (Dessalegn, 2009). A wide range of modern ideas and agricultural research result have been coming from recognized institutions to enhance production and hence to improve the life of rural poor household.

It is equally important to note that, Gamo Highlands are characterized by indigenous agricultural systems dominated by age-old cultivation methods and other techniques from sowing, harvesting to storing. The landform itself has its own contribution to be added up in preventing the construction of infrastructures such as road etc. that are primary to modern ideas to flow in. Nonetheless, having the existing situation not improved

very well, progress has been observed in terms of introducing cultivation mechanisms where respondents in all sites witnessed their awareness on improved cultivation, weeding, harvesting and storing agricultural products.

According to discussions, farmers were conscious enough about the change that would have come if the steps had been carefully followed. However, according to discussions with farm households, there are clear bottlenecks of adoption. First, the technology farmers learned was labour intensive and time consuming compared to that of the indigenous one, people are still using oxen as the only means of plowing. Secondly, the sowing period is very short as the rain may stop before sowing all the plots. Moreover, the soil is very hard for the oxen to plow before the rain drops; too heavy sunshine that makes the land very hard for oxen to pull. Finally, lack of time to plough the land three times are some of the major problems stated.

At Dalbansa and Hirpho, DAs invest much of their time on awareness creation of farmers to implement the package of improved technologies particularly improved seed, chemical fertilizer, cultivation systems and soil fertility management practices. All farmers of the study area were well aware of the steps of cultivations of wheat (improved seed that have been introduced to the area so far) and potato by applying chemical fertilizers. Slightly more than 85% of the total studied households of *dega* and *woynadega* apply chemical fertilizers to wheat seeds they obtained while the remaining ones use chemical fertilizers in potato fields. This helped farmers to evaluate the gains from using improved technologies (Mengisteab, 2005) which has significant impact on adoption of this package.

Conventional Soil Conservation Measures

Soil erosion has been recognized to be a serious problem in Ethiopian high lands since early 1970s followed by the deadly famine of the time (World Bank, 2007). Conservation projects have been extensively carried out under the support of the World Food Program's food-for-work scheme focusing on the introduction of modern soil and water conservation technology instructions for resource-poor farmers. Considerable efforts have been made since then to minimize further degradation and restore degraded environments. Remnants of some land covers and soil conservation structures indicate that large number of farmers were mobilized through their peasant association during the 1970s and 1980s focusing on physical soil and water conservation measures at communal areas and afforestation of hillsides. The labour force farmers contribute to the rehabilitation program was based on food- for- work and/or through threatening farmers to stop providing any service from the government (Woldeamlak, 2007). The conventional soil conservation measures introduced during the time were considered effective. However, farmers were discontented with the introduced conservation measure, which did not address their needs and priorities; and stopped immediately after the food - for - work was discontinued and the threat was withdrawn with the government change (Dessalegn, 2009; Woldeamlak, 2007, Aklilu, 2006).

Conventional soil conservation measures have been re-introduced since 1990s as a component of agricultural extension package. Most recently, farmers were organized in small units (5:1, that is five households having one leader) in their locality and encouraged to spend three days per week in conservation engagements. The contribution of labour force by farmers in this case is responded in two forms. Firstly, poor farm households were included into PSNP and paid monthly cash for five years until they are fit to graduate completing their poverty class and enter into self-sufficient class. Secondly, medium and better-off families were provoked to provide labour from their family just for the local, regional or national development. With this concept in mind, farmers have been motivated to implement the conservation programs, which are planned to be implemented at selected sloppy farm or non-farm communal and private farmlands.

A range of conservation practices, which include stone terraces, *funya juu,* soil bunds, waterways and area closures, have been introduced into individual and communal lands at massive scales throughout the districts under strudy. However, the trend so far shows a limited success in addressing the problem (Aklilu, 2006). Farmers of the study area are seem to be not willing to participate on the construction of the *fanyajuu* bunds on their plot due to the fact that *fanyajuu* structures occupy much space or not designed to suit local farming situation. More importantly, the structure also do not outfit the free grazing system since it can be easily damaged by livestock after harvest and its maintenance will demand additional labour of the household.

On the other hand, **stone bund** with its modified form is the most preferred soil conservation structure by the farmers of *dega* and *Woynadega* agro-climate. Nonetheless, there are very few or no new structure construction observed over the *kebeles* covered by this study, rather, a wide range of maintenance work was employed during the survey period using more of indigenous techniques. Down slope cultivation combined with small landslides caused by heavy rain during the summer season are the major factors attributed to the damage of stone bunds. The maintenance of stone bund still follow traditional model due to lack of measuring instruments, lack of skill and little awareness about the difference between the existing and introduced technologies.

Cutoff-drains are the appropriate conservation measures already in use in the plain fields of Ossa. The physical set-up of the land forced farm households to develop mechanism to drain water from their maize field. Like stone bund in higher and sloppy grounds, cut-off-drains are widely practiced in this lowland. It is also important to note that, introduction of new conservation technologies is observed to be weak in terms of avoiding excess water, which is the main problem of farmers in this *kebele*. As observed, farmers have still been struggling with their traditional methods by constructing small traditional waterways across the farm to draw water away from their plots. Hence, much work is expected to be done by DAs to create a range of awareness in implementing new conservation technologies to protect crops from damage by water logging.

Waterways, on the other hand, are structures constructed to accommodate run-off from sloppy ground and cut-off drain of several plots to safe-pass-way to the streams. Hence, about 82.2% and 22% of the respondents at Ossa and Hirpho respectively have waterways along the edge of their farm plot. According to the group discussion, there is no new construction of waterways but the existing structures are maintained by cleaning silt and grasses stored at different time. Every farmer is responsible to keep waterways from damage due to the fact that consequences may result in flooding and the major limitation of this structure is increase in the volume of water as it crosses a couple of crop fields until it joins bigger waterway or small stream.

planting trees is one of the best ways of conventional soil conservation measures at the tip of farm plots. Demonstration sites at Ossa and Dalbansa grew thousands of seedlings as one of the main component of their engagement. Exogenous tree species dominate the seedlings at both stations. However, recent strong agitations by environmental activists and NGOs gained a great deal of attention and turned district agricultural officials to revise their way of natural resource management plan and initialized the distribution of indigenous trees and grass varieties to farmers. The seedlings were distributed free of charge for farm households to be planted along the edge of their farm plots. The plantation is more pronounced at Hirpho to the extent that every farm household has a number of different types of indigenous as well as exogenous tree species to exploit multiple importance of trees: firewood, construction purpose, soil and water conservation, mulching and source of cash in different forms to mention few.

Check Dams: structures built across gullies to slowdown the speed of run-off and the deepening of gullies by constructing checkpoints. They are constructed from stone and wood so that water can pass safely and slowly. Micro-dam construction was strong at affected areas of bare lands and some roadsides by PSNP beneficiaries. Only 14.7 studied households at Hirpho were interested in check dam construction, while farmers at the other sample *kebeles* were in favour of the other conservation structures. This finding supports a study by Yechale (2011) which concluded that only 10% of the interviewed farmers were interested in constructing check dams.

According to my observation and farmers account, there are two paths of technology transfer. The first is by providing short trainings to farmers through extension workers (DAs) at demonstration sites. Trainings supported by demonstrations were regular activities on farmer's plot and demonstration sites. Mostly, trainings focus on proper land preparation, planting seeds on rows and applying chemical fertilizers on wheat and potato at *dega and woynadega,* and maize at *qolla*. All studied farm households have a good knowledge of the aforementioned agricultural activities. However, crops at every farm plots were cultivated as usual on traditional form, rather than the way farmers learned. Reasons forwarded by farmers on this issue were related to time and labour intensive character the technologies as the weather variability does not allow farmers to have time for the purpose.

The second is by convincing farmers to apply chemical fertilizers at least on improved seeds and participate on conservation structures. Chemical fertilizers are must to all individual community members registered as household head. However, all stated factors were pushed aside and contributed to improper and/or none application of fertilizers. In addition to PSNP beneficiaries who are the regular workers of conservation structures at least three times a week, it is an obligation for each household in a *kebele* to send one member to participate in conservation work. Participant farmers appreciate all the conservation activity when I asked them accompanied by DAs.

4. Conclusion

Modern agriculture had changed and has been changing most of the developing countries of Asia and Latin America in filling the food gap they face. It was also introduced to Africa by the colonial invaders in the form of plantation agriculture and took several decades to be adopted by local farmers even after independence. Majority of poor farmers are still at the stage of traditional agricultural practices using local inputs and indigenous varieties.

Ethiopia started modern agriculture in 1950s by introducing agricultural extension service assisted by Americans, Swedish and later by World Bank. Through its long journey to the present, agricultural extension had failed at some point and showed achievement at the other. The major areas of focus of agricultural extension were introduction and distribution of chemical fertilizer, improved seed and training services.

In addition to chemical fertilizers and improved seed distribution, vegetable and fruit varieties, improved livestock varieties and modern cultivation mechanisms were widely introduced to the Gamo Highlands. Achievements have been recorded in livestock varieties and apple fruit and seedlings in Chencha district particularly in Chencha town and immediate surrounding rural *kebeles*. Although World Vision Ethiopia (NGO) has been playing significant role in the dissemination of apple to all farmers in Chencha district, it was not widely adopted by farmers some distance away from Chencha town. This is partially because, poor farmers sale the apple seedlings provided by World Vision Ethiopia and use the money for other purposes. Cattle are also effective at Chencha town. Nevertheless, farmers in rural *kebeles* did not give attention for these varieties because of scarcity of additional fodder, open grazing area and children to look after livestock. On the other hand, few varieties of vegetables such as head cabbage, onion, carrot, and beetroot are introduced to Hirpho by farmers themselves through purchasing the seeds from private shops, which can be taken as good practice. Varieties of scientifically approved seeds such as maize, wheat and potato are extensively distributed at different times. Maize (Dh-1400) at Ossa and potato at Dalbansa and Hirpho are the only introduced crop varieties that are adopted and successfully replaced the local varieties. Almost all farmers were aware of modern farm inputs at least how to use it. Nevertheless, only Ossa farmers utilize these inputs, particularly chemical fertilizers effectively.

Conventional soil conservation measures were also introduced to the Gamo Highlands as part of extension package. Although indigenous soil conservation structures dominate at individual plots, modern structures such as *fanyajuu*, stone bund and cut-off-drains were observed at communal land and at some farmlands. It is the work of PSNP beneficiaries whose program was to spend two days per week working at such activities.

Generally, despite the severity of soil erosion in Ethiopia, conservation efforts have been started since 1980s and with the coming to power of the current government, it has received policy attention. More recently, wide range of conservation practices were declared to be implemented onto individual and communal lands at massive scales throughout the Gamo Highlands hoping that soil and water conservation will enable poor households to produce more from their small farmland. The massive community labour almost covered areas that are susceptible to erosion at Dalbansa and Hirpho.

Finally, when it comes to acceptance and continued use of modern agricultural technologies and inputs, two factors appeared to be primary to affect. First, the involvement of male household members at off-farm activity especially weaving that may avoid the participation of farmers in any extension training or discussions. Secondly, advantages of the new technology or input over the existing practice in terms of productivity, price, labour cost/intensiveness, access and awareness. There is better acceptance and continued use of chemical fertilizer at Ossa (*qolla*) than Dalbansa and Hirpho (*dega* and *woynadega*). Generally, the technology transfer system itself does not consider farmers' interests, which resulted in low acceptance and continued use of technologies.

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