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ASSESSING THE EFFECT OF LAND DEGRADATION ON FARMER'S LIVELIHOOD OPTIONS CHOKE MOUNTAIN

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ABSTRACT
This study tried to assess the effect of land degradation on farmer's livelihood options in Sinan Woreda, East Gojam zone, Ethiopia. Land degradation particularly in the study area and generally in Ethiopia highlands has been a concern for many years and these consisted fundamental bases of rural livelihood problem. The objective of this study was to explore the existing farmers' livelihood options in the study area. In recent years more holistic land degradation problems have been promoted with different scholars where its impact is yet to be seen on farmers' livelihood options. The research design was focused on cross sectional survey and multistage sampling methods would be used to select the study area and sample size. The primary data was collected through dispensing research questionnaires for land degradation and farmers livelihood options. The study was based on the data collected from 187 households. The collected data were analyzed through descriptive and econometric analysis. The descriptive analyses concluded the livelihood options that farmers use to survive the problem of land degradation. The descriptive result shows that 59.4 percent of the total household revealed that agro-forestry product especially apple fruit plays an important role in farmers livelihood. The farm practices in the study area were an important source of income for farmer's livelihood. The result of econometrics model (Multinomial Logit model) shows that education has a positive and significant impact at the confidence level of 0.07% (0.0475 of marginal effect) with relation to the livelihood option (income source). Agro-forestry was one of the most important variables that impacted farmers' livelihood options positively and significantly sway natural resource utilization, and involving in different livelihood option. It is generalized that the facts from land degradation have impact on key livelihood resources and the area is vulnerable to climate change.

1. INTRODUCTION

The term 'land' includes renewable natural resources, i.e. soils, water, vegetation and wildlife, in their terrestrial ecosystems. Land degradation (LD), in turn, includes all processes that diminish the capacity of land resources to perform essential functions and services in these ecological units.(Millennium Ecosystem

Assessment MA, 2005).

In the Ethiopian mountains, soil degradation due to water erosion remains a major threat to sustained agricultural production, as soils on slopes are washed away within a few human generations of land use. Both soil erosion models (Kaltenrieder, 2007) and field observations confirm the importance of vegetation cover or alternatively, structural measures such as soil or stone bunds for protecting the soil against degradation. Besides, soil management measures have the potential to considerably improve agricultural production (Amare Bantider, 2007; Birru Yitaferu 2007).

LD affects a large number of people over a significant proportion of the earth's surface which has led to extreme poverty and hunger. Main well around the world, land degradation can be viewed as any change or disturbance to land perceived to be unwanted that affects human activities like agriculture and settlements (Eswaran, *et al*., 2001).

Land degradation in the Ethiopian highlands (i.e. areas above 1500 m.a.s.l.) has been a concern for many years. Soil erosion, nutrient depletion and deforestation are common, but little has been done to determine their impact on productivity. Sometimes, but theatrical occasions, land degradation pushes population displacement and hundreds of thousands hectares of land have to be abandoned each year for being too degraded for cultivation or even grazing (Taddese G, 2001).

A short-term increase in agricultural production often obtained through increased pressure on the land. In the northern part Ethiopia, huge efforts are undertaken to restore the land. However, the overall productivity of such areas is often perceived to be so spectacularly damaged by human impact that recovery is deemed impossible. However, several impact studies have demonstrated that investments in tropical mountains do pay off in economic terms (Holden et al., 2005).

The wide studies on the landscape are beyond the scale of experimental plots and represent necessarily the 'real world'. Similarly, in northern Ethiopia, reforestation of the uplands has not only benefits for in situ soil conservation and regeneration (Nyssen et al. 2008).The biodiversity in the high geographic region is highly threatened, the vegetation cover and the soil are degraded and the fertility is depleted today grazing land scarcity and reducing water quality because of long history of human settlement and the ever-mounting population pressure. There is also abject poverty and the opportunities for alternative livelihoods are in a continuous down ward spiral (Belay, 2007).According Genanew and Alemu (2012) studies the Choke Mountains are painstaking as one of the East African Afro Mountain Biodiversity hot spots. However, the biodiversity in this geographic region is highly threatened; the vegetation cover and the soil are degraded. Due to important altitudinal gradients, mountain region receives a lot attention. Mountain agriculture systems are vulnerable to environmental change (Becker and Bugmann, 2001).

1.2 Statement of the problem

The deterioration in land qualities affects the way in which smallholder farmers make a living(R&AWG, 2004). Some researchers have been devoted to restore barren land and improve uplands communities' livelihoods. At the same time, research has devoted much attention to upward soil conservation and sustainable land management practices. Despite, of technically promising results, very few of them have been adopted by farmers. Burton (1997) stresses that societies and groups within society that are dependent on natural resources for their livelihoods are considered to be vulnerable unless sustainable options and community-based developments are in place.

LD is increasing in severity and extent in many parts of the world, with more than 20% of all cultivated areas, 30% of forests, and 10% of grasslands undergoing degradation. Millions of hectares of land per year are being degraded in all climatic regions. Likely 2.6 billion people are affected by land degradation and desertification in more than a hundred countries, influencing over 33% of the earth´s land surface. (Wezel

et al 2002).

The mountain ecosystem is still threatened by the rapidly growing population and increased demand for the mountain resources (Festus K B, 2012). Stagnating or declining food crop and livestock production, natural resources degradation, and poverty are interrelated problems in less favored areas, such as the Northern Highlands of Ethiopia including the study area (Berry, 2003).

In Sinan *Woreda* which was known by land degradation problems in the past, many people live in conditions of chronic harm with the absence of alternative options for their livelihood. As Assefa A., (2011) ensured that the Choke Mountain farming community has Prevalence of human, animal and plant diseases that were uncommon in the area became common. Assefa A. (2011) and Assefa D. (2009), give details on land degradation and soil and water conservation practice in highland of Ethiopia and they elucidated the extent and severity of the problem of land degradation spatial variations. But they did not find out the impact of land degradation on farmers livelihood options.

Soil and water conservation have been widely studied with many scholars in the study area. But, the problem is still affecting the livelihoods of households in rural parts of Ethiopia and the life of society is supposed to be rushed and hectic. To improve the land degradation farmer's participation in different livelihood options and keep environment sustainably, action was taken by community and government single-handedly is not enough, unless research like this conducted. As a result, my primary concern here is to seek out the farmer's livelihood option associated with land degradation which is the current and global problem that affects small farming households of the study area. Therefore, this research attempts to fill the above-mentioned research gap and also, the insights will provide bases for future intervention policy.

1.3 OBJECTIVE OF THE STUDY

- The objective of the study was to explore the effect of land degradation on existing farmers' livelihood options in Sian Woreda.

2. LITERATURE REVIEW

2.1 Ethiopia highland and land degradation

About 50 percent of Ethiopia can be defined as mountainous and highland areas include about 90% of its arable lands and are occupied by 90 percent of the human population and 60 percent of all livestock (Hurni, et al., 2010).Throughout the 20th century Land degradation, a decline in land quality caused by human activities, has been a major global issue and will remain high on the international agenda in the 21st century and People can be a major asset in reversing a trend towards degradation. Land degradation for land users and people who rely on their living on the products from a healthy landscape in the highland area of Ethiopia is core problem for their livelihood (Berry 2003).

2.2 Agriculture and land degradation in the highland area of Ethiopia

Agriculture within the Choke Mountain watersheds is various, and characterized as crop-livestock mixed systems, practiced by freelance farmers on tiny plots. Choke Mountain watershed farms average 0.5 hectares in size, and farmers within the cereal production zone cultivate maize, and wheat, supplemented by barley and potato for home or native consumption. Animals embody cows, oxen, sheep, and horses (Simane, et al, 2012). It involves natural processes that often need fastened proportions of nutrients, temperatures, precipitation, and it's a lot of vital for economic activities like manufacturing food and fiber necessary to sustain human life (Vuren, 2009).

Even though agricultural land may be a basic base for rural keep it's a scarce resource within the highland of Ethiopia. However, its property use is extremely affected among alternative factors by bio-physical and institutional aspects of land (Teshome et al, 2016). The living conditions of the agricultural poor in Ethiopian highlands are worsening owing to low agricultural productivity caused by increasing

deterioration of the standard and amount of agricultural natural resources (Anley et al. 2007).

The reduced yield, amendment in land use, and alter in crops, abandonment of fields, and altered stock mixes and patterns of grazing jointly justify land degradation. Land degradation issues cause to loss of natural Capital, the worth to society of land, water, plant, and animal resources (Berry et. al 2003). There area unit various factors behind the low agricultural productivity in Abyssinia. Among others, perennial drought, erratic rain, pests, tenure insecurity, population pressure, wearing away, overgrazing, deforestation, lack of economical rural organizations and weak institutional support area unit usually cited (Beshah 2003).

Degradation ensuing from wearing away and nutrient depletion is one in all the foremost difficult environmental issues within the highland agricultural systems of Abyssinia. The compound piece of land, the in-depth areas with slopes higher than Sixteen Personality Factor Questionnaire, and therefore the high intensity of rain result in accelerated wearing away once deforestation happens (Sahlemedhin 2000). Land degradation and agriculture have robust relations on farmer's keep as a result of food production and every one performance of major rural individuals targeted ashore. Students discovered

that within the developing world as a result of agriculture contributory twenty-nine % of developing countries' gross domestic product and sixty-five % of developing countries' populations (Campbell et al, 2011).

2.3 Empirical evidence/review

The land quality of Ethiopia has been deterioration over the past decades. High level of demand pressure exert on resources could experience decline the cover forest Most people of Ethiopia are linked to agriculture for their livelihood. More than 83% people are dependent on farming (Evans, 2012).

In the unreserved environment the natural base will deteriorate in quality and quantity. In the case of most Africa, absence of sufficient fertilizer can decline soil productivities and environmental change (Barbier 2000). The poor rural communities prefer to adapt to land degradation by making the most of common property resources (Scherr 2000).

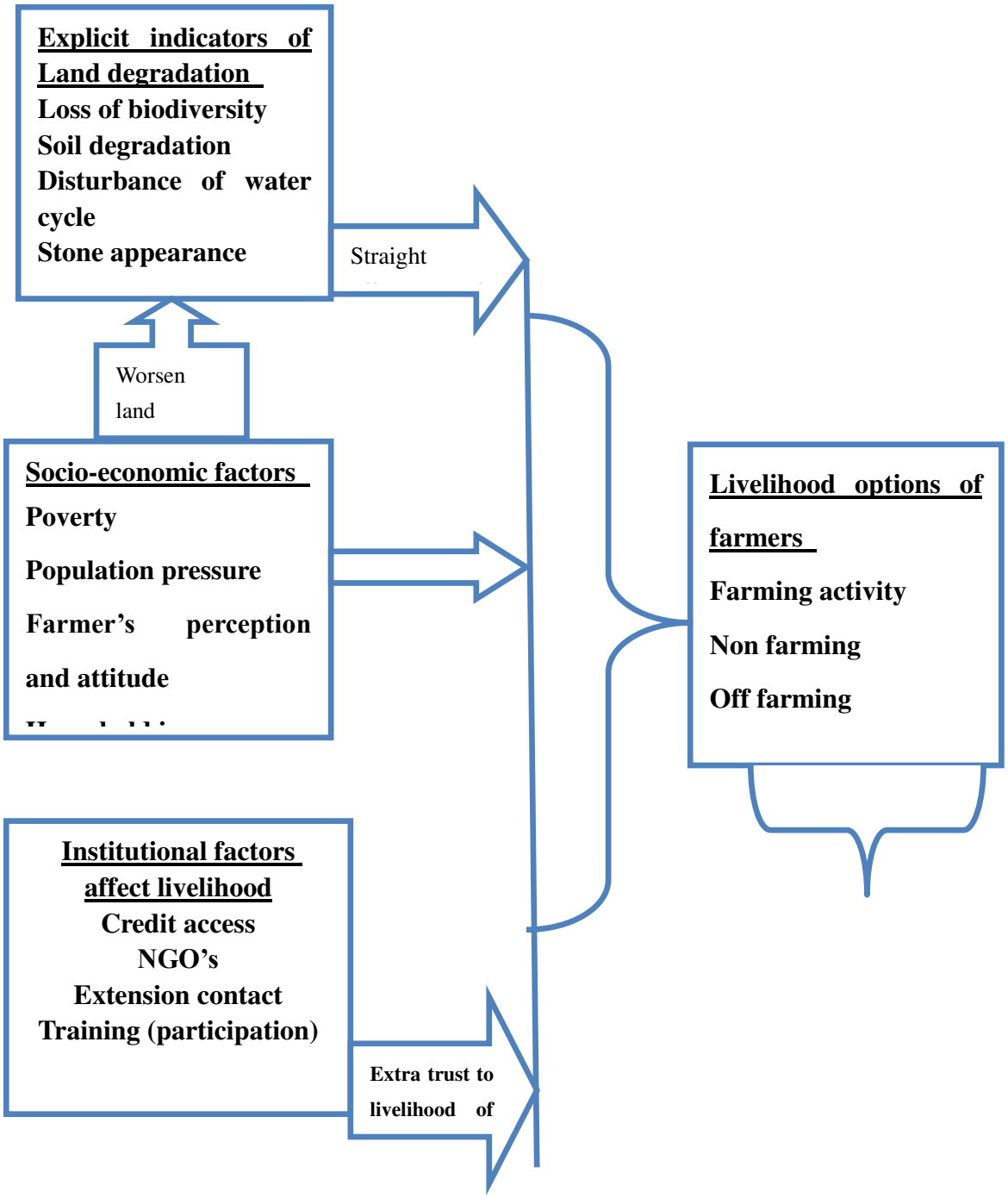
Shiferaw and Bantilan (2004) depict that livelihoods are both sustainable and lead to sustainable resource use. Similarly, Ngugi and Nyariki (2005) divide livelihoods into sustainable, regenerative or non-extractive, and unsustainable and extractive. Unplanned and extractive activities lead to worsening of poverty and declining yields.

Even if many studies indicate the cost of degradation, their findings tend to differ due to methodological differences and different underlying assumptions. Yesuf et al. (2005) state that the annual cost stemming from land degradation ranges between 2% to 6.75% of agricultural GDP. In Ethiopia due to land degradation escorts to food insecurity which is a substantial problem (Ehui and Pender 2005). Evans (2012) allude to crop dependent farmers in the highlands (where 90% of the agricultural land can be found) to be one of the groups most at risk of food insecurity.

2.4 Conceptual framework

The conceptual framework developed here captures inter temporal decision problems across alternative livelihood options. Enabling policies, access to markets and institutional arrangements, create incentives to invest in options that expand future production and consumption possibilities (Evans, 2012). Different form livelihood adaptation and their upshot on agriculture land-use change largely emphasized description of change patterns to local community socio-economic conditions (Elgin, 2014).

Biophysical and conducive socio-economic conditions create the potential for strong linking the farmers' livelihood-land degradation nexus and how the downward spiral can be avoided (Evans, 2012).



Source; own design from literature 2018

Figure 1 Conceptual framework for land degradation and farmers livelihood option in Choke Mountain. Explanatory variables only on biophysical research

3. RESEARCH METHODOLOGY

3.1 Description of the study area

The study site, Choke Mountain Watershed, is located approximately between coordinate 10°33'06" to 10°50'24" North latitude and 37°42'36" to 37°58'24" East longitude. Topographically, the watershed lies in the altitudes range of 3000 to 4413 m.a.s.l. The Choke Mountain watershed is found entirely in Eastern Gojam Zone of six Woreda such as; Bibugn, Debay Tilatgin, Gozamen, Hulet Eju Enssie, Machakel, and

Sinan (Bewket, 2010).

Sinan Woreda is located in East Gojam Administrative zone, which is one of the 11 Zones (including Bahir Dar special Zone), found in Amhara National Regional State (ANRS). The Woreda town is located 27km north of Debre-Markos town. It has by now 16 rural Kebeles and 3 Kebeles towns. It has a total area of about 41134 ha of which 75% is dega, 23% is weyna dega and 2 % is wurich with an average rainfall of 900-1800 mm per annum. The area is highly degraded and the fertility status of the soil is very poor. Most of the soil conservation measures could not sustain and are now devastated (SWARDO, 2018).

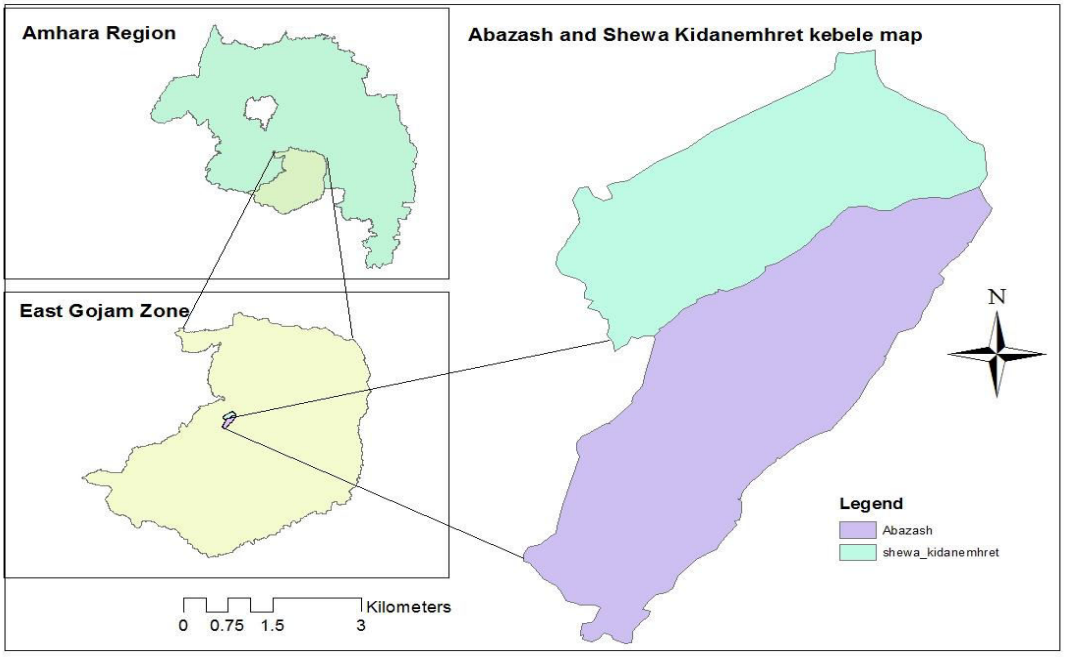


Figure 2 Map of the study area

3.2 Farming experience, forest and agro forestry

The farming system in the district is mixed crop and livestock where by crops contribute a larger share to the farmers' income wheat, barley, potato and local oat or Engdo are major crops sown in the area. In addition to crop production, livestock production is also common in the area.

The forest mostly natural and gave different services for dwellers. The amount of land which is covered by forest is 4,232.79 hectares. Some of forests are Indigenous and man-made plant especially Asta (Erica arboria), Amega, kega, Anfar, Kerkeha (Bamboo), Wolkefa, Tid (Acacia), and Bahirzaf (Eucalyptus). There is also fruit-based agro forestry in the study area such as apple, avocado kock and so on (SWARDO, 2018).

3.3 Research design, target population and sampling procedures

The research design is focused on cross-sectional survey. It assessed the large activities in one attempt (Assefa A., 2011). Given limited time and resources for study, cross-sectional survey was desirable to get insight into the existing livelihood situation of smallholder farmers across the study area (Stern et al, 2004). In addition, the study employed both quantitative and qualitative research methods.

Target populations are a number of population in two Kebeles' because they represent the district population characteristics (Shewa Kidanemihret, male = 820 female= 109 total= 929 and Abazash male=1196, female=96, total=1292) total =2221 which is 205 were female-headed from Sinan Woreda and

the method used for sampling process would multistage sampling and simple random sampling procedures. A simple random sampling method will used to select farmers with equal chance. The Kebeles from the study Woreda will purposively selected based on, natural resource scarcity, conflict, degradation and proximity to forest resources.

Table 2 distribution of sample respondents from to Kebeles (household head)

Peasant association /Kebeles	Total household			Sample household		
	Male	Female	Total	Male	Female	Total
Abazash	1196	96	1292	101	8	109
Shewa Kidanemihret	820	109	929	69	9	78

Source; own survey data, 2018

According to Yamane (1967) sample determination of simplified formula for proportions would be used to calculate the sample size with different levels of precisions. The formula:

$n= N/1+N(e)^2$

Where; n= the required sample size

N= population size

e=allowable error expressed in decimal (level of precision) ±7.

$n=2221/1+2221(0.07)^2$

Finally a total of **187** sampled household was selected through proportional probability sampling method from every two Kebeles.

3.4 Data type and methods of data collection

The research used both primary and secondary data sources. Primary data would generate through questionnaires interview, filed observation and transect walk or photograph. Whereas secondary data was collected from the internet, research journals, document files, different reports and proceedings and books. The researcher would use different methods for relevant data collection such as household survey, observation, photograph, and review documents. Detailed information was derived through survey from sampled households. Semi-structured interview questionnaires were prepared to collect qualitative data on main specific issues land degradation, farmers' livelihood and institutional factors toward land degradation impacted on farmers' livelihood.

3.6 METHOD OF DATA ANALYSIS AND PRESENTATION

3.6.1. Descriptive data analysis

Descriptive statistics such as mean, percentages and frequency were employed to analyze the quantitative data. Pie chart, graph, minimum and maximum whereas measurement of dispersion such as standard deviation and inferential statistics consists of the chi-squares was used. Qualitative data obtained using a semi-structured questionnaire; interview, observations and document analysis were analyzed qualitatively using appropriate words. Explanation and description of different qualitative information would make as deemed necessary.

3.7 Model specification

For econometric analysis, statistical package for social science (SPSS 16) was the method used to analyze the data for the study. When there is a dependent variable with more than two alternatives among which the decision-maker has to choose the appropriate econometric model would be multinomial Logit regression model. Regard estimates the effect of explanatory variables on the dependent variable involving multiple choices with unordered response categories (Greene, 2000). **Multinomial Logit analysis (MLA)** exhibits advanced ability to predict livelihood diversification and picking up the differences between the livelihoods strategies of rural households (Chan, 2005). It is the most frequently used model for nominal

outcomes that are often used when a dependent variable has more than two choices. In this study therefore, a multinomial Logit model specification was employed. This model makes it possible to analyze factors influencing households' choices of livelihood strategies in the context of multiple-choices. Following Green (2000) the Multinomial Logit Model for a multiple choice problem is specified as follows:-

$$pij = \frac{e^{xi\,\beta j}}{\sum_{i=1}^{j=n} e^{xi\,\beta j}} \quad , \quad \text{J=1…n---------- (1)}$$

Where;

Pij = the probability representing the i[th] respondent's chance of falling into category j or (it is the probability of household I's choice of the livelihood strategies from category j),

Xi = is predictors of response probabilities;

e =is the natural base of logarithms; and

Bj = are the parameters to be estimated.

The estimated equations provide a set of probabilities for the j + 1 choice for a decision maker with xi characteristics. For identification of the model, we need to conveniently normalize by assuming β0 =0 (Greene, 2000). Therefore, the probabilities are given by:

$$PROP.(yi = j/Xi) = pij = \frac{e^{xi\,\beta j}}{\sum_{j=2}^{j} e^{xi\,\beta j}}, \quad \text{for j>1---------- (2)}$$

$$prop.\left(yi = \frac{1}{xi}\right) = pi1 = \frac{1}{1+\sum_{j=2}^{j} e^{xi\,\beta j}} \quad \text{---------- (3)}$$

The marginal effects (δij) of the characteristics on the probabilities are specified as:

$$\boldsymbol{\delta ij = \frac{\partial pij}{xi} = pij[\beta j - \sum_{j=0}^{j} pij\beta j] = pij[\beta j - \beta]} \quad \text{---------- (4)}$$

Y=Bo+B1X1+B2X2+B3X3+----------+BiXi + Ei---------- (5)

Where **Y**= the probability of household option (dependent variable), **Bo=** intercept, **Bi** = slope parameter which measures the independent variables **Xi**.

3.8 DEFINITION OF VARIABLES AND EXPECTED HYPOTHESES

3.8.1 Dependent variable

The dependent variable of this study is farmer's livelihood option which is affected by Land degradation and institutional factors. In this research, Farmers livelihood options can measure depend on the accessibility of family income source and their assets. Where the farmers of the study area would get their income to survive and the resource/assets like land, cattle, and small ruminants could determine the character of livelihood system of the household.

3.8.2 Independent variables

The expected independent variables are:-

Sex, it is sex of respondents (male or female). It is a dummy variable. Due to many socio-cultural values and norms, males have freedom of mobility and participation in different extension programs. Individual land is the land used for agricultural purposes with high scarcity there was a difference in sex by practicing soil and water conservation measures (Belay, 1992).

Age, it is number of year of the respondents which is a categorical variable. Green (1987) found that age was positively related to adoption, but negatively related to a farmer's perception of the extent of land degradation.

Education, It is a categorical variable and measured in the highest level of schooling which means the class that the respondent end. It enables farmers to tackle land degradation using various ways of soil

conservation practices and they have alternative livelihood options (Shibru, 2003).

Household size, it is a categorical variable. The household size is one of the determinant factors which affects soil and water conservation practices (Zenebe a. 2015)

Agro-forestry, it can incorporate within a farming system and farmers' livelihood option by planting them around the home garden, where trees are deliberately integrated with crops or animals or both to exploit expected positive interactions between the trees and other land uses, and it has significant effect (Melaku W., 2000).

Fruit tree species in agro forestry systems can bring significant health, environmental and economic benefits for smallholder farmers, particularly in the face of climate change. These pressures are less evident in the expanding markets for indigenous fruit and derived products, making indigenous fruits more suitable for smallholder farmers in developing countries (Poole 2004).

Land size, land size is one of the holding lands of the respondents. It is a continuous variable and it measures in hectare. Land size and practices of soil conservation measures have strong relationship. Farmers perceived to reject soil conservation methods because of more than half of the farmers have land not sufficient consider this as major reason to reject conservation practices and lead to chronic land degradation. The most important reason is small size of their land which they believe that establishing conservation methods on small land is not advisable. This intention of farmers was realized by the finding of (Assefa D, 2009).

Livestock ownership, Livestock density and grazing patterns lead to overgrazing, which is one of the major causes of land degradation. It is categorical variables and it has significant influence on dependent variables. Greater number of livestock can changes the livelihood systems of the farmers with controlled browsing of trees and shrubs (EPA, 2005).

Extension contact, as Stringer et al., 2007 state the number of encircling of contacts per year that the household head made with extension agent would show technical change and environmental problems are typically complex, uncertain, and multi-scale and affect multiple actors and agencies.

Credit access; Farmers who have admittance to credit can minimize their financial constraints and expand their income source and tried to farm exit according to their capacity to take credit. Many efforts have been achieved and a continuous search for sustainable intervention through credit scheme is being introduced to enhance the living conditions and quality of community farmers in rural communities (World Bank, 2008).

Farm experience; most of the rural household are poor and are commencement to diversify their livelihood into off farm and nonfarm activities as a relevant source of household income (Arbuckle et al., 2014).

4. RESULT AND DISCUSSION

4.1 Descriptive analysis

As revealed below **table 2** sex of household is one of the most important variables that are expected to influence natural resource utilization, management and conflict provoking. The high percentages (90.9%) of the respondents from the two Kebeles were male. This show most of the households were headed by a male. As revealed in the table above the majority of the sample respondent was under the age category of 40-55 counted 64.2 percent of total sample respondents. The respondent's average age is 47.5 years. Generally, more than 85 percent of sample household was under the productive age group. As to other explanatory variable Education is one of the key determinants of structural change in agriculture and dimension of farmers' livelihood and land degradation. As indicated by education qualification data, 46 percent of interviewed respondents could uneducated (i.e. none education). Since insufficient education level boosts the interest of small scale farmers' imprudent use of land. Scholars put their idea on the relation between education and livelihood. For instance Watts, 2009 indicates that Education can have two

opposing effects on livelihood transition of farm households.

The majority of the households have a family size of 4-6 tally 58.3 percent of the sample respondents. This show that the number of family in a household is means of a potential supply of works such as Children may take over farm responsibilities from their parents as successors. Increase number of family provides support to households in a variety of productive activities (both farm and off-farm work) (Glauben et al., 2006).

As well as land is a base for those who depend on their livelihood on agriculture. A high number of respondents had their own land and 49.7 percent of respondents would hold between 0.5-1.5 hector. **But more than half of them have holdings less than 1.5 hectare. Thus; most of them are small-scale farmers. The m**ajority of respondent participated in apple fruit production which accounted 59.4 percent of the total household. As the report of respondents, it has great impact on economic variability of households since its product sell in high price and it becomes environmentally friends to the study area. Products from the agro-forestry tree serves as a source of income and revenue to the households. This shows that a new livelihood option comes into view which is practice currently due to the existence of land degradation problem. The study of Thorlakson and Neufeldt (2012) shows Agro forestry builds livelihood resilience to the impacts of land degradation and climate change for smallholder farmers. From the descriptive analysis, an extension service is important with farmers to land productivity and improve livelihood options of household in the study area.

Respondents with the least number of years (10) living in the area recognized that there had been environmental changes, gaining an indication of serious land degradation in the area. About 62.6 percent of households responded that when the farming years increase the implementation of soil conservation measures are certainly increased as well. The majority of the household was still on-farm activities to probing their income But 15.5 percent of the respondents were slot in all income sources. Then the researcher concludes that households in the study villages engage in farm, off-farm and non-farm activities. Livestock is the major resource base up on which the livelihoods of local households are dependent in the study area. Around 52.3 percent of household respondents had 11-20 cumulative livestock's. The interviewed farmers reported that they sell livestock to pay government tax and for other social obligations, sell to purchase food and to purchase input. Heffernan and Misturelli (2000) in Kenya provided evidence of the major importance of livestock keeping in household economic security.

4.2 Econometric analysis

As shown from the table below some explanatory variables significantly influenced by different livelihood income sources. Income sources were determining livelihood option of farmers. Some variables might be significant and insignificant to affect the selection of income sources.

Table 2 descriptive statistical analysis

variable name	Category	Frequency	Percent	Valid Percent	variable name	category	Frequency	Percent	Valid Percent
SEXRSNDT	Female	17	9.1	9.1	HHLIVLHODINCOMSOURC	farm income	81	43.3	43.3
	Male	170	90.9	90.9		off farm income	36	19.3	19.3
	Total	187	100	100		Non-farm income	41	21.9	21.9
AGERSNDT	24-39	41	21.9	21.9		all source income	29	15.5	15.5
	40-55	120	64.2	64.2		Total	187	100	100
	56-71	26	13.9	13.9	LIVSTOK	1-10	80	42.8	42.8
	Total	187	100	100		11-20	98	52.4	52.4
EDUCLEVL	None	86	46	46		21-30	9	4.8	4.8
	read and write	65	34.8	34.8		Total	187	100	100
	8-Jan	21	11.2	11.2	AGROFORESTRY	Apple	111	59.4	59.4
	10-Sep	11	5.9	5.9		Cock	37	19.8	19.8
	12-Nov	4	2.1	2.1		Sherifa	20	10.7	10.7
	Total	187	100	100		Other	19	10.2	10.2
HHZE	1-3	47	25.1	25.1		Total	187	100	100
	4-6	109	58.3	58.3	CREDITACCSEE	Yes	135	72.2	72.2
	7-9	27	14.4	14.4		No	52	27.8	27.8
	10-12	4	2.1	2.1		Total	187	100	100
	Total	187	100	100	EXTENSIONCONTACT	Yes	106	56.7	56.7
LANDSIZE	<0.5	33	17.6	17.6		No	81	43.3	43.3
	0.51-1.5	93	49.7	49.7		Total	187	100	100
	0.51-2.5	37	19.8	19.8	FARMEXPERIENCE	below 25	56	29.9	29.9
	>2.5	24	12.8	12.8		26-41	117	62.6	62.6
	Total	187	100	100		42-57	14	7.5	7.5
						Total	187	100	100

The **table 3** above show that off-farm livelihood diversification would affect from **sex** (SEXRSNDT) negatively and significantly. This indicates that females are mostly involved in off farm activities and they are responsible for home management. From the model analysis young **age** (AGERSNDT) households were followed different livelihood sources of income and it has negative coefficient and significant influence on farm and non farm income source of livelihood. As the analysis of the model show that at the 7% of provability level **education** (EDUCLEVL) had positive relationship and significantly affected the household income source diversification (i.e. in all sources of income).

The income sources of households who have more **livestock's** (LIVSTOK) were preferred to sloppy on off farm and nonfarm activities. It has a negative and significant influence on livelihood income sources. Respondents who have more animals concern to create advanced occasions. **Land size** (LANDSIZE) is another explanatory variable that has positive and significantly affects livelihood income source diversification which revealed that respondents who have large land size can involve in different income sources to win their livelihood. In this analysis **Agro-forestry** (AGROFORESTRY) has positive relationship and significantly affected the farmer's livelihood income source variation. Currently the highland area focuses on the fruit tree production and it creates superior opportunities to engage in non-farming activities mainly Apple which helps respondents to market profit. Yishak G. et al (2014) ensured that agro forestry plays importantly for the diversification of farmer's income sources.

Table 3 econometric analysis of multinomial Logit model

Source: subtracted from own survey data, 2018. ***, **, and * stand for significant at 7% and 10%

Variable name	Households' livelihood income source								
	Farm and non-farm			Farm and off-farm			Farm, non-farm and off-farm		
	Coefficient	**P-value**	**Marginal effect**	**Coefficient**	**P-value**	**Marginal effect**	**Coefficient**	**P-value**	**Marginal effect**
SEXRSNDT	-0.2164	0.328	-0.0365	-1.843	0.010***	-0.0403	-1.125	0.035	-0.0226
AGERSNDT	-0.0279	0.076*	-0.0078	-0.0101	0.435	-0.00003	-0.0205	0.313	-0.00014
EDUCLEVL	0.1551	0.000***	0.0475	0.1002	0.030**	0.0015	0.1505	0.002**	0.00183
HHZE	-0.0751	0.11	-0.0304	-0.1542	0.13	-0.0031	-0.0134	0.830	0.0013
AGROFORESTRY	1.8873	0.000***	0.5057	0.1866	0.751	-0.0346	1.016	0.153	-0.0167
LANDSIZE	-1.542	0.010***	-0.2475	-1.237	0.058*	-0.0136	-1.583	0.072*	-0.02523
LIVSTOK	-0.3822	0.000***	-0.1012	-1.136	0.000***	-0.0107	-0.7554	0.002***	-0.0123
EXTENSIONCONTACT	0.0016	0.755	0.0012	0.0207	0.277	0.0091	0.0034	0.757	-0.0011
CREDITACCSEE	0.0418	0.525	0.0203	0.2344	0.462	0.0036	1.161	0.101	0.0116
FARMEXPERIENCE	2.8874	0.000***	0.5057	0.1766	0.651	-0.0235	1.017	0.263	-0.0167
		No. of obs.	187						
		LR chi2(57)	235.13						
		Prob > chi2	0.0000***						
		Pseudo R2	0.2700						

4.5.1 PARAMETER ESTIMATION OF INDEPENDENT VARIABLES

Table 4 parameter estimate of independent variables

Independent Variables	Coefficient	Std. Error	Wald	Df	Sig.	93% Confidence Interval for Exp(B)	
						Lower Bound	Upper Bound
SEXRSNDT	-2.11	0.688	9.412	1	0.01	0	28.659
AGERSNDT	-1.581	0.627	6.356	1	0.258	0.066	0.641
EDUCLEVL	0.426	2.423	0	1	0.10	0.855	0
AGROFORESTRY	0.864	0.81	1.138	1	0.00	0	10.293
CREDITACCSEE	0.158	0.624	0.064	1	0.8	0.378	3.629
EXTENSIONCONTACT	0.397	0.445	0.795	1	0.002	0.002	3.334
HHLIVLHODINCOMSOURC	2.657	0.864	9.448	1	0.002	2.976	68.228
LIVSTOK	0.933	5.814	0	1	0.00	0	0
LANDSIZE	6.217	1.113	0	1	0.1	0	0
FARMEXPERIENCE	3.531	0.635	5.781	1	0.001	0.451	17.123

Source, own survey data 2018

The results in table 4 show that sex of respondents with a coefficient of 2.110 and Wald

statistics of 9.412) gender influence livelihood option negatively, age of respondents (AGEDEDENT with coefficient of -1.581 and Wald statistics of 6.356, which show that being male and/or female can reduce the livelihood diversification in 1.581. the extension contact with coefficient 0.397 and Wald statistic 0.795 have 0.002 significant level of <p=0.07 in explaining the increase in extension service can improve the livelihood of farmers. The practice of extension agents could change the livelihood option of farmers in 0.397. The result in table – revealed that the effect of income source (HHLIVLHODINCOMSOURC) with coefficient 2.657, Wald statistics of 9.448 and has a significant effect on farmers livelihood. It was concluded that many branches of income source could improve the livelihood of households.

5: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The concluding points stated in this section are based on the findings made with different income source categories of household farmers in terms of their livelihoods.

The findings of this study revealed that the majority of the respondents were male-headed. Regarding age more than 85% of household respondents were found in working-age group. It affects the livelihood income source negatively (-1.581) and insignificantly.

A high number of respondents had their own land and 49.7 percent of respondents would hold between 0.5-1.5 hector. **Thus; most of them are small-scale farmers.** Data from the surveys and household interviews provide evidence for how agro-forestry builds farmers' livelihood and the tree mitigates the land problems. The 64.71 percent of the total household participated in apple fruit production.

Frequent extension services were important with farmers to land productivity and improve livelihood options of households in the study area. The majority of the household in the study area were participating on-farm activities to probing their income.

Livestock is an important source of income for farmers and respondents perceived that farmer's livelihood would affect by land degradation in the study area.

5.2 Recommendation

Based on the finding of the study the following practical recommendations are pinpointed.

Since more than 85.16% of respondents ensured that land degradation in the study area was a serious problem, the Local governments should work harder to implement appropriately existing land use policy, regulation and directives to focus on out off land.

The development agents in respective *Kebeles* should provide farmers with training and up-to-date information on climate, slope, soil erosion, conservation measures, and land management as a whole and livelihood extension will be necessary for the study area households

Further studies should be made to get more information about the soil fertility status of

the cultivated land and other related impacts on the dwellers on the study catchment and farmers' livelihood.

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