International Journal of Agricultural Science, Research and Technology in Extension and Education Systems (IJASRT in EESs)
Available online on: http://ijasrt.iau-shoushtar.ac.ir
ISSN: 2251-7588 Print
ISSN: 2251-7596 Online
2018: 8(1):49-58

Received: 19 June 2017
Reviewed: 4 September 2017
Revised: 10 September 2017
Accepted: 30 September 2017

Analysis Gender Role and Factors Affecting Soil and Water Conservation Adoption in Kersa Districts of Eastern Hararghe Zone, Ethiopia: The Case of Fanya Juu, Soil and Stone Bund Measure

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Abstract

Soil conservation is the only known way to protect the productive land. In countries like Ethiopia, where droughts and floods cause food scarcity problem, soil and water conservation not only increases crop yield, but also prevents further deterioration of land. Soil and water conservation preserve soil moisture and drain water sustainably to avoid soil erosion and depletion of soil nutrients. As such, the main objectives of this study are to analysis factors affecting soil and water conservation adoption and to identify gender role in soil and water conservation practice in the study area. Both primary and secondary data were collected for the study. The data were collected by means of a semi-structured questionnaire during the period of January 20-February 20, 2017.The study implemented binary logit regression model to identify factor affecting adoption of soil and water conservation practice. Binary logit regression estimation also revealed that soil and water conservation practice is significantly influenced by five explanatory variables. Level of formal education, market distance, labor force, slope of the farm land and size of livestock in tropical livestock unit were significant variables which are found to affect the soil and water conservation practice of household in study area. The t-test shows that there is significant difference in formal year of schooling between soil conservation adopter and non-adopter households. Level of education was related with adoption of conservation structures, because literate farmers are in a better position to get information and use it in such a way that it contribute to their best farming practices as well as more concerned about soil and water conservation than illiterate ones. Therefore, designating and implementing adult education should be encouraged by the government. In addition, soil bunds, Fanya juu and stone bunds are the major soil and water conservation measures that are widely implemented by farmers in the area.

Keywords:
Soil and Water Conservation, Adoption, logit regression model

1. Introduction

The economic development of Ethiopia is highly dependent on the performance of its agricultural sector. The dominant economic activity is undertaken by smallholder farm household which are subsistent oriented. Low agricultural productivity due to land degradation mainly accelerated soil erosion is a critical problem throughout Africa, (FAO, 2002). Several studies in Ethiopia have revealed that soil erosion has become an alarming problem Admasu (2005) and Bewket and Teferi (2009) and it is the major factor affecting the sustainability of agricultural production. The loss of soil and essential nutrients due to unsustainable agricultural practices is costing \$139 million or 3-4% of its agricultural GDP, Berry (2009). Similarly, Hurni (1993) estimated, soil loss due to water erosion is about 1493 million Mg per annum. On croplands, average soil loss rates reach 42 t/ha/year or 4 mm of soil depth per annum in the country as a whole. In individual fields however, the rate may reach up to 300 t/ha/year, which is by all measures exceeds the rate of soil formation.

Although estimates of the extent and rate of soil erosion lack consistency, the results of various studies highlight the severity of the problem, Amsalu and De Graaff (2007). According to Wegayehu (2003), among the various forms of land degradation, soil erosion is the most important and an ominous threat to the food security and development prospects of Ethiopia and many other developing countries. Natural resource conservation is absolutely key to the concept of sustainable development, yet environmental pressures continue to increase including soil degradation, water availability, and nutrient cycling. Within natural resource conservation, women play an essential, yet differentiated to men, role, meaning that analysis of gender interactions in relation to environmental management is therefore imperative for sustainable development. Rural women in Ethiopia often face social, cultural and at times legal constraints that limit their capacity to effectively participate in farming, natural resources management and decision-making. Moreover, the traditional role of women puts gender specific constraints on access to resources such as fuel wood, water resources, post-harvest activities, and livestock management (Teshome and Devereux 2005).

Gender division of labor in rural Ethiopia varies in terms of farming systems, cultural settings, location and the different wealth categories (Abera et al. 2006). Gender roles in the country also vary according to ethnicity, income, and status. Moreover, as has already mentioned, Ethiopian women are largely responsible for nearly all reproductive tasks such as fetching fuel wood and water, cooking, washing, cleaning and child care. In most cases, men are the heads of households and are therefore the principal decision-makers in the household although some consultation with women may take place. Njuki et al. (2011) defined gender as 'the socially constructed roles and status of women and men, girls and boys. It is a set of culturally specific characteristics defining the social behavior of women and men, and the relationship between them. Gender roles, status and relations vary according to place (countries, regions, and villages), groups (class, ethnic, religious, caste). Gender is, thus, not about women but about the relationship between women and men.'

Thus, gender relations at the household level play a key role in determining the extent to which men and women interact within a given activities. Gendered patterns of resource allocation quite often imply gender differences in participation as well as in the sharing of benefits based upon participation. Furthermore, women often carry a much heavier work burden then men as they are responsible for housework, childcare, subsistence food production and sometimes also paid employment. In most places, women work longer hours than men, but because their work is within the household it is often not recognized (Momsen, 2004). Gender relations structure men's and women's roles and responsibilities within livelihood practices and adaptive strategies to produce sustainable livelihoods. Rural livelihoods can be considered sustainable when they can, "cope with and recover from stresses and shocks and rural residents can maintain or enhance access to assets while not undermining the natural resource base" (Scoones, 2009).

Gender analysis draws on the understanding that every development situation is unique. No other individual, family, village or nation has the same set of resources to manage with the same people, in the same time frame, or with the same constraints. Women's work and men's work differ from place to place and examining gender roles in each specific development context will help to avoid programme failure. Development initiatives which aim to improve the livelihood of local people must take into account gender based divisions of labor, gender-based access to resources and control over those resources. Otherwise, decisions will be based on mistaken assumptions. Gender- disaggregated information also reveals what rural women and men know and what they need. Women and men are both sources of valuable cultural knowledge and sustainable resource management practices, but each may be knowledgeable about different species and practices, according to their activities.

Generally, women carry out essential tasks in agricultural production and marketing that affect natural resources. They also possess extensive knowledge about the use and conservation of natural resources. Women and men play different social and economic roles in natural resource conservation in the family and the management. Too often, women are excluded from community development activities because their economic roles and the obstacles to their participation are overlooked. To our knowledge, there has no empirical study that considered gender role in soil and water conservation practice on communal and individual farm land the study area in particular. This kind of research is necessary and helps the government or other development agents to design intervention mechanisms and mobilize the local people for more conservation activities. Effective soil and water management practices can improve soil fertility and increase yields in a sustainable way. Therefore, it is important to highlight some of the techniques that conserve soil and water that preserve soil moisture, drain water sustainably to avoid soil erosion and depletion of soil nutrients. So that, the main objectives of this study is to analysis factors affecting soil and water conservation adoption and to identify gender role in soil and water conservation practice in the study area.

2. Materials and methods

Kersa district is located in East Hararghe zone of Oromia Regional State and located at a distance of 44 km from Harar town to the west direction along Addis Ababa- Harar main road. It has a total area of 544.94 Km^2, accounts for 2.23% of the total area of East Hararghe Zone. Geo-graphically, it is situated between $9^0$17`-$9^0$29`N Latitude and $41^0$40'- $41^0$56`E Longitude to the west of Harar town (EHZAO, 2011). Agro-climatically, 20 %, 74% and 6 % of the district is Dega (temperate rainy climate), WoinaDega (tropical rainy climate) and Kolla (tropical arid climate), respectively with an estimated average annual rainfall ranging between 410 to1200 mm, and temperature ranging between 18^0c to 26^0c (EHZAO, 2011). The average family sizes for rural and urban were 4.3 and 4.0 persons, respectively. In addition, the total number of households in the district was 36,698 out of which 87.4% and 12.6% were headed by male and female households, respectively. Agricultural production is the main source of income and employment to the people, which is rain-fed and irrigation-supplemented. The principal agricultural activities in the study area are crop production, which is rain-fed and irrigation-supplemented and livestock rearing. Mixed farming is the dominant farming system in the study area. In the district cereals such as sorghum, maize, barley wheat, pulses such as field peas, oil seeds such as ground nut and linseeds, using irrigation and rain-fed, vegetable production is practiced in the study area. Vegetables such as potato, onion, head cabbage and carrot are cultivated. Stimulants (coffee and khat) and other fruit trees and also grown in the study area.

2.1 Method of data collection and sampling technique

A combination of purposive and random sampling techniques was employed to obtain a sample of respondents for this study. Kersa district was purposively selected for availability for potential soil and water conservation practice in the area. A two-stage random sampling technique was then applied to select sample households. In the first stage, four Kebeles were randomly selected from conservation practicing kebele's of Kersa district. In the second stage, total of 120 soil and water conservation adopters and non-adopters household heads were selected randomly from four kebeles using probability proportional to size. The data were collected by means of a semi-structured questionnaire during the period ofJanuary20-February 20, 2017. The schedule was first pre-tested and, based on the result of the pre-test; some modifications were made to the questionnaire before the execution of the formal survey.

2.2 Method of Data Analysis

Descriptive Analysis

By applying descriptive statistics, one can compare and contrast different categories of sample with respect to the desired characteristics. These include mean, percentage and standard deviation for the soil and water conservation adopter and non-adopter. The statistical significance of the variables was also tested for all variables using chi-square and t-tests.

Econometric model analysis

The logit and probit are the two most commonly used models for assessing the effects of various factors that affect the probability of adoption of a given technology. These models can also provide the predicted probability of adoption. Following Liao (1994), Gujarati (2003) and Aldrich and Nelson (1984) the logistic distribution function for the adoption of soil and water conservation practice is specified as:

$$P_i = \frac{1}{1+e^{-z_i}} = \frac{e^{z_i}}{1+e^{z_i}} \quad (1)$$

(1)

Where, P_i = is the probability of adopting for the i^{th} farmer and it ranges from 0-1.

e^{zi} = stands for the irrational number e to the power of Z_i.

$$Z_i=b_0+b_1X_1+b_2X_2+\ldots+b_nX_n \quad (2)$$

Where, X_1, X_2… $X_n$are explanatory variables.

b_0- is the intercept, b_1, b_2 … b_n are the logit parameters (slopes) of the equation in the model.

The slopes tell how the log-odds ratio in favor of adopting changes as an independent variable changes. The unobservable stimulus index Z_i assumes any values and is actually a linear function of factors influencing adoption decision of soil and water conservation. It is easy to verify that Z_i ranges from -∞ to ∞, P_i ranges between 0 and 1and that P_i is non-linear related to the explanatory variables, thus satisfying two requirements:

$$P_i = 1/ (1 + e^{-(b_0+b_1X_1+b_2X_2+\ldots+b_nx_n)} \quad (3)$$

This means the familiar OLS procedure cannot be used to estimate the parameters. But this problem is more apparent than real because this equation is intrinsically linear. If P_i is the probability of adopting a given soil and water conservation then (1-P_i), the probability of not adopting, can be written as:

$$1-P_i= 1/(1 + e^{Z_i}) \quad (4)$$

Therefore, the odds ratio can be written as:

$$\frac{P_i}{1-P_i}=\frac{1+e^{z_i}}{1+e^{-z_i}}=e^{Z_i} \qquad (5)$$

$\frac{P_i}{1-P_i}$ is simply the odds ratio in favor of adopting soil and water conservation practice. It is the ratio of the probability that the farmer would adopt the soil and water conservation practice to the probability that he/she would not adopt it.Finally, taking the natural log of equation 5, the log of odds ratio can be written as:

$$L_i= \ln\left(\frac{P_i}{1-P_i}\right)=ln(e^{b_i+\sum_{i=1}^{n} b_i X_i}) = Z_i = b_0 + \sum_{i=1}^{n} b_i X_i \qquad (6)$$

Where, L_i is log of the odds ratio in favor of adopting soil and water conservation practice, which isnot only linear in X_i, but also linear in the parameters. Thus, if the stochastic disturbance term,(u_i),is introduced, the logit regression becomes:

$$Z_i=b_0+b_1X_1+b_2X_2+\ldots+b_nX_n+u_i \qquad (7)$$

3. Results and discussion

3.1 Households' demographic and socio-economic characteristics

The mean age of the respondents was 36.5 with the range from 17 to 62 (Table 1). The mean educational level of the sample households was grade 3.4 and about 21.7 per cent of the respondents were capable of reading and writing though they did not attain formal education.

Regarding family member, the family size of the sampled households varies from 2 to 12 with a mean of 6.5 persons. The mean livestock holding of the sampled households in terms of tropical livestock unit (TLU) was 1.63 and the area of cultivated land ranges from 0.1 to 1.4 hectares with an average size of about 0.6 hectares.

Table 1. Socio-economic characteristics of sample respondents

Variables	Means	Min	Max	Std. Dev
Age HH	36.49	17	62	12.31
Education HH	3.36	0	8	2.17
Market distance	7.29	1	20	4.39
Family Size	6.47	2	12	2.54
Labor Force	2.692	1	5	0.99
Farm Size	0.607	0.1	1.4	0.28
Farm Experience	19.65	2	45	9.10
Livestock (TLU)	1.626	0.1	3.8	0.85
Slope of land	0.56	0	1	0.50
Perception of farmers	0.52	0	1	0.50
Access to Extension	0.59	0	1	0.49

Source: Own survey result

Regarding extension service, 59.2 per cent of the total sample households surveyed reported that they have received extension service. The mean distance from the nearest market to the homestead was 7.3 kilometers. Concerning the farmers' experience, the mean farm experience of the farmers was found to be 19.65years which ranges from 2 years to 45 years. Around 55.8 percent of sampled respondents replied that their farm has steep slope which is susceptible to soil erosion in the area.Regarding perception of farmers on existence of soil erosion problem, 47.5 percent of the farmers perceive existence of soil erosion problem.

As mentioned in the methodology, the descriptive parts of the analysis are used to describe characteristics of the sample respondent. Table 2 shows descriptive statistics results of sample household based on adoption of soil and water conservation practice. Education level of sampled respondents is one of the variables that determine technology adoption of farmers. In the study area, the average education level of sampled respondents was around 3.4 in formal years of schooling. On average, sample soil and water conservation adopter have around 4.7 while that of non-adopter have 2.1 in years of formal schooling. The t-test shows that there is significant difference in formal year of schooling between soil conservation adopter and non-adopter households (table 2). The average market distance of all sample respondents was 7km.The average market distance of sample adopter was found to be 5 kilometer while that of non-adopter was 9 kilometer. There is a significant difference in their labor force. The survey results showed that mean difference between conservation adopter and non-adopter was found to be significant at 1% significant level based on economically active member of the family.

3.2 Results of Econometric Models

3.2.1 Factors affecting adoption of soil and water conservation measure

Before analyzing factors affecting adoption of soil and water conservation measure of households, Variance Inflation Factor (VIF) was applied to test for the presence of strong multi collinearity problem among the explanatory variables and no serious problem of multi collinearity was detected from the VIF results. Similarly, heteroscedasticity was tested by using Breusch-Pagen test. This test resulted in rejection of the existence of heteroscedasticity hypothesis as (p= 0.99) using STATA11.2. The pseudo- R^2 indicates how well the repressors' explain the adoption of soil and water conservation practice.

Table 2. Descriptive Statistics Results for Sample Household of Adopter and Non-Adopter

Variables	All sample HH(N=120)		Non-Adopter HH(N=60)		Adopter HH(N=60)		Mean Difference	t-Value
	Mean	SD	Mean	SD	Mean	SD	Mean	
Age HH	36.7	12.7	35.8	12.5	37.5	13.1	1.68	0.72
Education HH	3.35	2.16	2.1	1.3	4.65	2.1	2.58	8.13***
Market distance	7.1	4.61	9.1	4.1	5.1	4.3	3.9	5.1***
Family Size	6.5	2.7	6.6	2.9	6.3	2.4	0.3	0.67
Labor Force	2.7	1	2.4	1	3	1	0.68	3.9***
Farm Size	0.6	0.3	0.5	0.3	0.71	0.51	0.2	4.2***
Farm Experience	19.65	9.1	17.7	8.9	21.6	9	3.8	2.3**
Livestock(TLU)	1.63	0.85	1.2	0.6	2	0.85	0.83	6***

Table 3. Logistic Regression Results for Determinants of Adoption of Soil and Water Conservation

Adoption	Coef.	Odds Ratio	Std. Err.	Z
Age of HH	-0.03	0.97	0.054	-0.56
Gender of HH	0.90	2.45	0.850	1.05
Educ of HH	0.94	2.57	0.262	3.6***
Mrkt Distance	-0.29	0.74	0.103	-2.85***
Family Size	0.02	1.02	0.237	0.08
Labor Force	1.18	3.24	0.405	2.9***
Farm Size	0.31	1.36	1.432	0.21
Slope of land	1.39	4.00	0.808	1.72*
Perception	0.72	2.05	0.845	0.85
Farm Experience	0.09	1.09	0.070	1.29
Livestock(TLU)	1.78	5.92	0.639	2.78***
Access Extension	0.46	1.59	0.848	0.54
Constant	-10.32		3.254	-3.17
Number of obser = 120			LR $Ch^2(12)$ = 112.24	
Pseudo-R^2 = 0.674			Prob> Ch^2 = 000	
Log likelihood = -83.178				

Source: own survey results.*** And * means significant at the 1%, and 10 % probability levels, respectivel

As it was indicated in table 3, the results indicate that soil and water conservation practice is significantly influenced by five explanatory variables. Level of formal education, market distance, labor force, slop of the farm land and size of livestock in tropical livestock unit were significant variables which are found to affect the soil and water conservation practice of household in study area.

The results also revealed that the formal year of schooling was of the variables that found to affect soil and water conservation adoption practice. The variable was significant at less than one percent significance level (<1%) and positively related with soil and water conservation among rural households in the study area. The model result indicated that all other things being kept constant, the odds ratio in favor of showing interest to adopt soil and water conservation practice increases by a factor of 2.57as years of formal schooling increase by one year. That is, respondents with more years of schooling are adopting soil and water conservation practice. This might be due to the fact that educated household heads perceive and are willing to adopt soil and water conservation more than less educated households. This clearly calls the importance of human capital development for implementation of soil conservation practices. This is consistent with the findings of (Tesfaye *et al.* 2013). Level of education was related with adoption of conservation structures, because literate farmers are in a better position to get information and use it in such a way that it contribute to their best farming practicesas well as more concerned about soil and water conservation than illiterate ones. In addition, possible elaboration for this is that education helps the literate household head to access and utilize information from different sources than illiterate household head.

Distance of farmers' residence from the nearby market center also matters in the farmers' adoption of soil and water conservation. Those who are located far away from the market have a negative and significant influence on adoption of soil and water conservation practice. The model results revealed that market distance was found to affect soil and water conservation practice negatively and significantly at one percent significant level. The result also indicated that all other things being kept constant, the odds ratio in favor of adopting soil and water conservation practice decrease by a factor of 0.74 as distance from the nearby market center increase by one kilometer. This may be because of low opportunity cost of labor contribution as a farmer far away from the market center. The shorter the distance to the market, the less time and money is spent on transportation of the farm products that produced from improved soil conservation management. This would motivate farmers to adopt soil and water conservation practice then produces more market oriented products to generate higher income. In turn, proper management of their land would allow them to improve their production system as results of lower transportation cost incentive.

The number of economically active members in the family was found to be positive and significant at 1% significant level with adoption of soil and conservation practice. The model result also revealed that all other things being kept constant, the odds ratio in favor of adopting soil and water conservation practice increases by a factor of 3.24 as the number of economically active member of the farm family increase by one person. This finding is in line with the results reported by Chilot *et al. (*2009). In the farm community soil and water conservation activity requires large number of labor force in rural area. Households that have larger number of working group members were more likely to be included in soil and water conservation practice. The results of logit models shows a positive and statistically significant relationship between soil conservation and use of higher labor, most likely due to the higher level of labor requirement during soil and water conservation activities involved.

The slope of the farmers' land, which represents the degree of steepness of the land, was included in the model as the level of land slope determine the amount of soil erosion in that area. Slope steepness of farm land of the sample respondents was found to affect positively and significantly the households' adoption for soil and water conservation practice at ten percent (10%) significant level. The model result also revealed that all other things being kept constant, the odds ratio in favor of adopting soil and water conservation practice increases by a factor of 4 as the slope of farm land steep. The implication is that the farmer who has a land with steep slope is more likely to understand soil erosion problem and apply conservation structures than the farmer who has flat sloped land. This is consistent with Wagayehu and Lars (2003).The findings show that those farmers with steep land have a positive and significant effect on the probability of adopting soil and water conservation practice. Empirical studies in Ethiopia also reported a positive and significant effect of the slope of a plot on the decision to adopt soil conservation structure(Bekele and Drake, 2003).

Livestock holding of the household refers to the total number of livestock measured in tropical livestock unit (TLU). Livestock is used as a proxy for wealth in farm community. Household those have larger number of livestock in tropical livestock unit and numbers of oxen were more likely to be adopting soil and water conservation. These variables were found to influence the soil and water conservation practice positively and significant at 1 percent significance level. The logit model result also show that all other things being kept constant, the odds ratio in favor of adopting soil and water conservation practice increases by a factor of 5.92 as the number of livestock increase by one in tropical livestock unit. The implication of the result was that livestock are an important source of cash in rural areas to allow purchase of farm inputs that can be used in conservation practice. Farmers who have large number of livestock might consider their asset base as a mechanism of controlling any risk associated with soil erosion problem on their farm land. Given this potential contribution of livestock and oxen to sustainable soil and water conservation practice, it encourages adoption of new technology as well as soil conservation practice. Many previous studies such as Kidane *et al*. (2005) also confirm this result. The number of cattle is attributed to the circumstance that the wealthier farmers take risks by investing and adopting soil conservation technology for improving productivity. Therefore, having a large number of livestock can strengthen farmers' capacity to contribute to the soil and water conservation efforts in the area.

3.2.2 Gender Role and Best Practice on Soil and Water Conservation in the Area

The results of the analysis indicate that female farmers contribute more as their male counterparts in farm activity and soil water conservation. However, despite their significant role in agriculture, the triple roles of female farmers are not well recognized or valued in the study area in particular. The promotion of sustainable agricultural activity including soil and water conservation practice in district requires that the needs of both rural male and female farmers are addressed in a comprehensive manner. Farmers in the study area used improved soil and water conservation methods. The most widely used improved soil conservation technologies were improved soil bund,fanyajuu as follows.

Result revealed that women participate in every aspect of farm activities including soil and water conservation. Survey result (table 4) shows that, out of sample respondents about 59.3 percent of non-adopter and 40.7 percent of adopter replied that women participated in stone and soil transportation during soil bund and stone bund construction. Around 579 percent of non-adopter and 42.1 percent of adopter respondent replied that women participated in stone bund construction activities soil and water conservation.

Table 4. Description of Women Role in Soil Conservation Activities based on Adoption Status

Women activities in SWC		Adoption of soil and water conservation: Non-adopter	Adopter	Total
Stone and soil transportation	% within women activities	59.30	40.70	100.00
	% of Total	13.30	9.20	22.50
Stone bund construction	% within women activities	57.90	42.1	100.00
	% of Total	9.20	6.70	15.80
Food, coffee and Tea preparation	% within women activities	57.10	42.90	100.00
	% of Total	20.00	15.00	35.00
Digging soil with farm implement	% within women activities	31.00	69.00	100.00
	% of Total	7.50	16.70	24.20
Grass planting on top of soil and fanyajuu bund	% within women activities	0.00	100.00	100.00
	% of Total	0.00	2.50	2.50
	% within women activities	50.00	50.00	100.00
	% of Total	50.00	50.00	100.00

Source: Own survey results

Table 5.Gender Role in Soil and Water Conservation Activities as Replied by Sampled Respondents

Activities		**Age group Categories**: Male HH	Female HH	Adult Male	Adult Female	
Digging stone	% within age group	14.30	0.00	20.0	3.30	8.30
	% of Total	4.20	0.00	3.30	0.80	8.30
Digging soil	% within age group	8.60	31.40	0.00	6.70	13.3
	% of Total	2.50	9.20	0.00	1.70	13.3
Soil and stone transportation	% within age group	14.30	17.10	25.0	13.30	16.7
	% of Total	4.20	5.00	4.20	3.30	16.7
Stone and soil bund construction	% within age group	11.40	2.90	5.00	3.30	5.80
	% of Total	3.30	0.80	0.80	0.80	5.80
FanyaJuu bund construction	% within age group	17.10	2.90	10.0	3.30	8.30
	% of Total	5.00	0.80	1.70	0.80	8.30
Food, Coffee, Tea preparation	% within age group	2.90	5.70	0.00	10.0	5.00
	% of Total	0.80	1.70	0.00	2.50	5.00
Animal Feeding	% within age group	17.10	14.30	15.0	23.3	17.5
	% of Total	5.00	4.20	2.50	5.80	17.5
Grass planting on bund	% within age group	5.70	17.10	15.0	23.3	15.0
	% of Total	1.70	5.00	2.50	5.80	15.0
Other conservation activities	% within age group	8.60	8.60	10.0	13.3	10.0
	% of Total	2.50	2.50	1.70	3.30	10.0
	% within age group	100	100	100	100	100
	Total	29.20	29.20	16.7	25.0	100.

In situations where degradation of soil has occurred, methods such as planting trees and grass was done by women while men could be involved in the construction of diverging ditches and so on. During soil and water conservation construction activity, all age group of the community such as male household head, female household head, adult male in the family and adult female were involved. Activity like digging stone, soil and stone transportation, stone and soil bund, fanyajuu bund construction and grass planting on bunds were among conservation activities that were undertaken by different aged group the farm community. Stones were also used to construct contours to regulate the flow of rain water by diverting it down slopes. Mostly construction of contours was done by men while women were responsible for the collection of the stones and soil to the site. Men were also responsible for making bunds and terraces to prevent soil erosion in steep slopes. Women could plant grass to reinforce the terraces. The result revealed that 14.3 percent of sample respondents replied that digging stone for bund construction was done by male household head while 20 percent replied by adult male and 3.3 percent replied as it done by adult female.

Soil bunds, fanyajuu bunds and stone bunds are the major soil and water conservation measures that are widely implemented by farmers. Stone bunds are usually constructed where stones are readily available on or near the field. Stone bunds are stable and durable measures. They can reduce runoff and soil erosion in steeply sloping areas and excess water can pass more easily through stone terraces. In the area male and female group were participating while construction of soil and stone bund. Moreover, construction of stone bund requires a large amount of labor.

Figure 1. Women Role in Stone Bund Construction

Almost all farmers perceived erosion problems while many of them also believed that soil and water conservation measures are profitable. Regarding perception of farmers on existence of soil erosion problem, 47.5 percent of the farmers perceive existence of soil erosion problem. This is consistent with the findings of (Teshome *et al.*, 2013). Figure 1 shows best practice of women participation while construction stone bund in the study area.

Figure 2. Gender Role and Types of Stone Bund in the Area

Soil bunds are embankments made from topsoil along the contour to control erosion (Figure 3). They require less labor for construction compared to stone and Fanyajuu bunds as excavated material from the ditch is placed downhill rather than uphill, as is the case in the construction of Fanyajuu bunds. However, soil bunds require more labor for maintenance than Fanyajuu and stone bunds. The uphill drains of the soil bund are impacted by accumulated soil material and therefore require more labor to regularly excavate the ditches, as farmers need to ensure effective evacuation of excess water in the field. Grass is grown on the riser to stabilize the bunds. Soil bunds can be easily eroded during heavy rainfall in steeply sloping areas unless it stabilized by grass grown on the top of the soil bund.

Figure 3. a Types of soil bund in the area
b Soil bund with plantation coverage

A fanyajuu bund, which is sometimes called a converse terrace, is constructed by digging a ditch and moving the excavated soil upslope to form an embankment to the ditch. The embankment is meant to trap runoff, sediment and nutrients above it, and the ditch is meant to collect any that will overtop the embankment. The ditch is thus providing protection to the part of the field in the down slope. Fanyajuu bunds are made by digging a trench and moving the soil uphill to form an embankment and are thus more labor intensive during construction. They provide an opportunity to grow fodder or grass on the top of bund.

4. Conclusion

Soil conservation is the only known way to protect the productive land. In country like Ethiopia, where droughts and floods cause food scarcity problem, soil and water conservation not only increases crop yield, but also prevents further deterioration of land. Soil and water conservation preserve soil moisture and drain water sustainably to avoid soil erosion and depletion of soil nutrients. So that, the objective of this study is to analysis factors affecting soil and water conservation adoption and to identify gender role in soil and water conservation practice in the study area. Both primary and secondary data were collected for the study. The data were collected by means of a semi-structured questionnaire during the period of January20-February 20/ 2017.

The study implemented binary logit regression model to identify factor affecting adoption of soil and water conservation practice the farmers. Binary logit regression estimation also revealed that soil and water conservation practice is significantly influenced by five explanatory variables. Level of formal education, market distance, labor force, slop of the farm land and size of livestock in tropical livestock unit were significant variables which are found to affect the soil and water conservation practice of household in study area. Level of education was related with adoption of conservation structures, because literate farmers are in a better position to get information and use it in such a way that it contribute to their best farming practices as well as more concerned about soil and water conservation than illiterate ones. Therefore, a way of access to adult education should be designed. In addition, soil bunds, Fanyajuu and stone bunds are the major soil and water conservation measures that are widely implemented by farmers in the area.

The number of economically active members in the family was found to be positive and significant at 1% significant level with adoption of soil and conservation practice. The model result also revealed that all other things being kept constant, the odds ratio in favor of adopting soil and water conservation practice increases by a factor of 3.24 as the number of economically active member of the farm family increase by one person. In the farm community soil and water conservation activity requires large number of labor force in rural area. The results of logit models shows a positive and statistically significant relationship between soil conservation and use of higher labor, most likely due to the higher level of labor requirement during soil and water conservation activities involved.

Household those have larger number of livestock in tropical livestock unit and numbers of oxen were more likely to be adopting soil and water conservation. This variable was found to influence the soil and water conservation practice positively and significant at 1 percent significance level. The result show that all other things being kept constant, the odds ratio in favor of adopting soil and water conservation practice increases by a factor of 5.92 as the number of livestock increase by one in tropical livestock unit. The implication of the result was that livestock are an important source of cash in rural areas to allow purchase of farm inputs that can be used in conservation practice. Farmers who have large number of livestock might consider their asset base as a mechanism of controlling any risk associated with soil erosion problem on their farm land. Given this potential contribution of livestock and oxen to sustainable soil and water conservation practice, it encourages adoption of soil conservation practice. Therefore, it is concluded that different soil and water conservation measures to avert erosion problems should be facilitated by government and non-government organizations. That means development partner should focus on strengthening capacity of household through providing credit facility in the direction of asset building like livestock purchase thought revolve funding system.

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