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Research article

Determinants of Farmers' Perception of soil and water Conservation Practices on Cultivated Land in Ankesha District, Ethiopia

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Abstract

Soil erosion on cultivated land constitutes a threat to the livelihood of rural households in Ethiopia. Although it is recognized that soil water conservation (SWC) practices can sustainably contribute to reversing land degradation, the performance conservation practices in most Third World countries have generally been unsatisfactory in terms of success and sustained use by smallholder farmers. Past efforts at soil and water conservation did not bring about significant results mainly due to the top-down approach that has gave little attention to the perception of farmers. Understanding farmers' perception of soil erosion problem and involving them in decision making to conserve natural resources generally and soil and water particularly will play a great role to ensure sustainable development of one country. This paper examined farmers' perception of soil and water conservation practices on cultivated land in Ankesha Woreda, Ethiopia. The primary data were collected from 149 sample households selected, from Huletu Chaja and Sostu Gimjabet Kebeles, through systematic random sampling technique. Logistic regression analysis has been employed to separate the major factors influencing farmers' perception of soil and water conservation practices. The result indicates that 50.4% percent of the farmers perceived soil erosion on cultivated land can be controlled through different traditional and improved conservation measures. However, nearly half percent of respondents perceived that controlling soil erosion is difficult. Educational level of the household head; land insecurity, extension contact; and slope of the plot, distance of the plot from residence and plot size are the most important determinants of farmers' perception of conservation practices. The implication is that taking these factors into account while planning soil conservation measures will enhance farmers' commitment to soil and water conservation.

Key words: Cultivated Land, Soil Erosion, Conservation Practices, Farmers' Perception, Logistic Regression,

1. Introduction

Climate change, in combination with the expanding human population, presents a food security worldwide challenge. Population growth and the dynamics of climate change exacerbates desertification, deforestation, erosion, degradation, and depletion of water resources (Bangizi, 2012). Smallholder farmers in Ethiopia whose livelihoods entirely depend on rain-fed agriculture are highly vulnerable to these problems. The agricultural sector plays a dominant role in Ethiopian economy, contributing to nearly 50 percent of the GDP and provides employment for over 80 percent of the labor force and which accounts for a little over (FAO, 1986). In fact, agriculture in Ethiopia is not only an economic activity but also a way of life for which agricultural land is an indispensable resource upon which the welfare of the society is built. The livelihood of the vast majority of the population depends directly or indirectly on this sector. Needless to mention, such dependence obviously leads to increased land degradation (Gould *et al*, 1989). FAO (2000) estimated that some 50% of the highlands are significantly eroded, of which 25% are seriously eroded, and 4% have reached at a point of no return. The area of cropland that constitutes 13% of Ethiopia's land mass is the leading region of soil loss, with an average erosion of 42 ton ha^{-1}. The problems of land degradation and low agricultural productivity, which results in food insecurity and poverty, are particularly severe in the rural highlands of Ethiopia that constitute 95% of the cultivable area in the country and that support 88% of the human and 75% of the livestock population (Holden *et al*., 2005).

Farmers' perception of soil erosion plays a key role in their decision making on land use and management practices. Different farmers may have different attitudes towards soil conservation. Farmers' perception affect the selection and continued use of soil conservation practices (Bandara, 2008). Sometimes farmers who have good attitudes also may not practice soil conservation at a good level due to other factors influencing their practices. However, agricultural planners and scientists forget that farmers, best understand their own lands and objectives (Taangahar *et al*, 2011). While national policy and top down agricultural development strategies have their place, these may only be implemented through the active participation of farmers. It is the farmers who mobilize their resources and take risks, to assist their crops overcome soil constraints on productivity. Many farmers are aware of land degradation, but their priorities are food production and income generation during the current or next cropping cycle, rather than in the more distant future (Taangahar *et al*, 2011).

Perception of soil degradation factors and how to prevent them is a necessary condition for farmers' to investment in conservation technologies. Insufficient attention has been given to examining local-level factors, like socioeconomic, institutional, and biophysical, affecting perception of farmers about their participation in SWC activities (Stahl, 1990; Million, 1996; and Azene, 1997). According to Amarasekara *et al*. (2009), and Ulimwengu and Sanyal (2011), willingness to invest in soil conservation measures increases with farm income, level of awareness and ownership security of land. Thus, appropriate understanding of these factors would assist in the formulation and implementation of the policy interventions designed to induce voluntary continued use of SWC measures. Therefore, the main objective of this study was to investigate the major determinants of perception of farmers on soil and water conservation practices on cultivated land in Ankesha District.

2. Materials and Methods

2.1 Study Area

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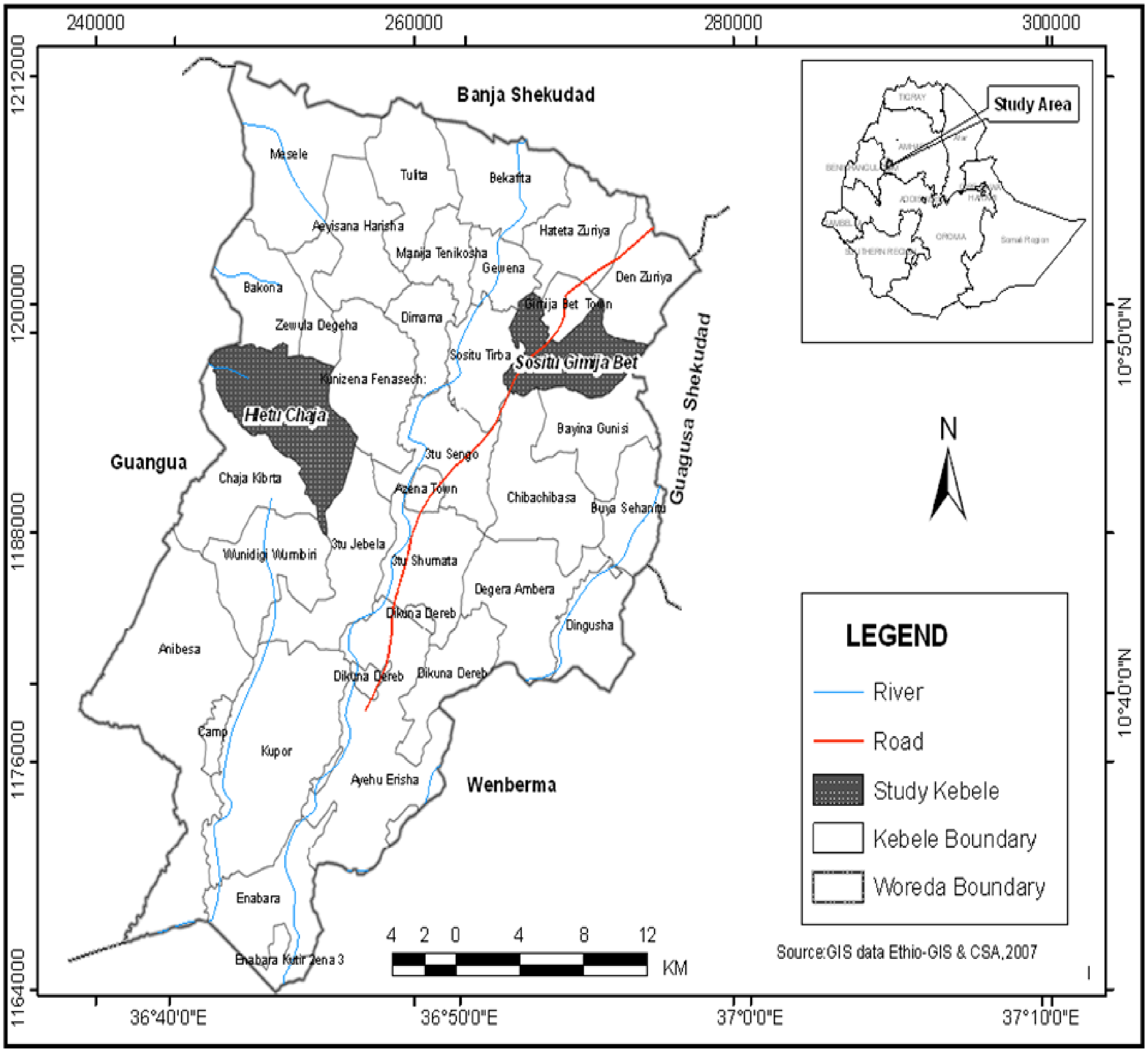

Figure 1. Location map of the study area, Ethiopia

The district is located in the North-Western part of Ethiopian, approximately 480 km north-west of Addis Ababa, the capital city and 140 km south-west of Bahir Dar, capital of the region. Geographically its absolute location extends between the coordinates of 10°31’46’’ and 10°41’32’’ North latitude and 36°36’18’’ and 36°59’33’’ East longitude. The total area of the district is estimated to be nearly 986.37 km^2. A triangle-shaped district in the Awi Zone, Ankesha is bordered on the south by Mirab Gojjam, on the west by Guangua, on the north by Banja shekudad and on the east by Guagusa shekudad (see Figure1 below). The district has an elevation varying from 1800 to 2800 masl. The major relief features of the district include mountains, undulating plains, hilly and gullies and valleys. The three dominant soil types of district are nitosol, fluvisols (at gentler slopes and river banks) and vertisols, locally, *walhi* (covers the major lower slope positions of the area. Varied topography of the area resulted in diverse climatic patterns. The resulting weather pattern provides the highlands with most of its rainfall during a period that generally lasts from mid-June to mid-September. The earliest written records and oral sources gave us image of a well-managed and dense vegetation cover in district. But land pressure and deforestation has now resulted in replacement by bush and grassland. A few remnants of the natural vegetation can be found in church compounds, sacred places and along stream banks.

2.2 Sample size determination

Two stage sampling techniques were applied to select the sample households. In the first stage, a purposive sampling method was employed to identify representative kebeles from the district. From the total of 29 rural kebeles, two were selected purposively by considering topography, severity of soil erosion problem, and agro-ecology. Next, lists of households in each kebele were obtained from the respective offices of development agents. With the lists, a systematic random sampling procedure was used to select a total of 149 sample households.

2.3 Data collection

The major source of data was a formal household survey. A structured questionnaire was used for the field interviews. The questionnaire, with close and open ended type, was pre-tested by administering it to selected respondents. On the basis of the results obtained from the pre-test, necessary modifications were made on the questionnaire. On-site discussion with individual farmers and field observation were also other methods of data collection.

2.4 Data analysis

The study employed both descriptive statistics and econometric methods to analyze the data collected from the sample respondents. To run statistical analysis, data were coded and entered in to a computer program known as statistical package for social studies (SPSS) version 15 software packages.

2.5 Empirical Model and Identification of Variables

Logistic regression is a widely applied statistical tool to study farmers' perception conservation technologies (Shiferaw, 1998; Neupane *et al.*, 2002). Logistic regression allows predicting a discrete outcome from a set of variables that may be continuous, discrete, and dichotomous or a combination of them. The dependent variable, (i.e., perception of soil and water conservation practices) is dichotomous discrete variable that is generated from the questionnaire survey as a binary response, and the independent variables are a mixture of discrete and continuous. Following the methods of used by Abera (2003) and Mekuria (2005), the logistic regression model characterizing perception of the sample households is specified as:

$$P_i = F(\alpha + \beta X_i) = \frac{1}{1 + e^{-(\alpha + \beta X_i)}}$$

Where *i* denotes the i^{th} observation in the sample; Pi is the probability that an individual will make a certain choice given X_i; e is the base of natural logarithms and approximately equal to 2.718; X_i is a vector of exogenous; variables

α and β are parameters of the model, β_1, β_2……, β_k are the coefficients associated with each explanatory variables X_1, X2, …, X_n. The above function can be rewritten as:

$$\ln [P /(1 - P)] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k$$

Where the quantity *P/ (1-P)* is the odds (likelihoods); $\beta 0$ is the intercept; $\beta 1$, β_2 … and β_k are coefficients of the associated independent variables of X_1, X_2…and Xk. It should be noted that the estimated coefficients reflect the effect of individual explanatory variables on its log of odds {ln[P/(1- P)]}.

The independent variables of the study are those which are expected to have association with farmers' perception of soil erosion and conservation practices. More precisely, the findings of past studies on the farmers' perception, the existing theoretical explanations, and the researcher's knowledge of the farming systems of the study area were used to select explanatory variables. The definition and units of measurement of the dependent and explanatory variables used in the logistic regression model is presented in Table 1.

Table 1: Definitions and units of measurement of variables included in the model *(n=149)*

Variables	Variable Code	Variable type	Unit of Measurement
Dependent			
Perception of SWC	PERCON	Dummy	1 if the perceives erosion can be controlled; 0 otherwise
Explanatory variables			
Age of household head	AGE	Continuous	Measured in years
Area managed by single farmer	PLOTSIZE	Continuous	Measured in hectare
Family size of household head	FAMSIZE	Continuous	Measured in Number
Individuals engaged in off-farm labor	OFFARMLA	Continuous	Measured in Number
Average Plot distance from the residence	PLOTDIST	Continuous	Measured in walking minutes
Sex of the house hold	SEX	Dummy	1 if male, 0 if female
Educational level of household	EDUCA	Dummy	1 if literate; 0 otherwise
Extension contact	EXTEN	Dummy	1 if the farmer get extension service; 0 otherwise
Slope of plots	SLOPE	Dummy	1 if steep slope; 0 otherwise
Plot owner type	PLOTOWN	Dummy	1 if the plot is owned by household head; 0 otherwise
Farming experience	EXPER	Dummy	1 if the farmer is currently doing SWC works and/or has previous experience; 0 otherwise
Land security	TENURE	Dummy	1 if the farmer considered tenure 0 otherwise
Training of household head	TRAIN	Dummy	1 if the farmer has been trained in soil erosion and related issues; 0 otherwise

3. Results and Discussion

The result show that 57% of the respondents of respondents believe soil erosion can be controlled. Hence, unwillingness of the farmers to participate in the soil and water conservation activities cannot be explained by a lack of awareness about the problem. Awareness of soil erosion problems and willingness to conserve alone may not necessarily lead farmers to take actions against the problem. Their actions and capacity might be constrained by various socioeconomic and biophysical factors. The idea of soil conservation is not new to farmers of the study area as many traditionally implemented techniques in various parts of the district would indicate.

Logistic regression model was used to analyze determinants of farmers' perception of soil conservation practices. The success of the overall prediction by the regression model indicate that the variables sufficiently explained the perception of farmers on conservation practices, and there is a strong association between the perception and the group of the explanatory variables (R^2 = 0.702). A positive estimated coefficient in the model implies increase in the farmers' perception of soil erosion and conservation practices with increased in the value of the explanatory variable. Whereas negative estimated coefficient in the model implies decreasing perception with increase in the value of the explanatory variable.

Table 2: Logistic regression result for perception of soil conservation practices

Dependent variable: PERCON	Coefficient	Std. Error	Odds ratio
Explanatory variables			
SEX	0.325	1.028	0.723
AGE	-0.560*	0.221	0.571
EDUCAT	0.857**	0.094	2.355
EXPER	0.687**	0.021	1.987
FAMSIZE	0.788*	0.131	2.200
OFFARMLA	-0.433*	0.062	0.587
PLOTOWN	0.933*	0.301	2.542
PLOTDIST	0.761*	0.074	5.280
PLOTSIZE	0.634**	0.037	0.531
SLOPE	-0.885*	0.247	0.413
TENURE	0.712*	0.141	2.538
EXTEN	0.508*	0.117	1.662
TRAIN	0.986*	0.388	2.682
Model Chi-square	102.280		
Log likelihood function	81.165		
Nagelkerke (R^2)	0.702		
Number of observation	149		

***, * Significant at 0.1 and 0.05 probability levels, respectively.*

The result show that age of the household head (AGE) has negative influence conservation activity. A unit increase in age of HH head decreases the farmers' perception of being involved in soil and water conservation activities by 0.56 (Table 2). This could suggest that younger farmers are more likely to have longer planning perspective to justify investments in technologies whose benefits are realized over time. This result is inconsistent with the finding by Fikru (2009) who found that younger farmers do not expend more effort on soil and water conservation measures compared to older ones, which was motivated by the view that older farmers have experience. Education of the head of the household (EDUCAT) significantly and positively determined farmers' perception of soil and water conservation practices. Possible explanation is that educated farmers tend to be better at recognizing the risks associated with soil erosion and hence tend to spend more time and money on soil conservation. This is because literate farmers often serve as contact farmers for extension agents in disseminating information about agricultural technologies from government agencies (Tenge *et al.* 2004). The odds ratio also suggests that if a farmer is educated (literate), other factors held constant, the likelihood of awareness will be two times higher than an illiterate farmers (Table2).

A significant positive relationship was found between farmers' previous soil and water conservation experience (EXPER) and their current perception of SWC practices**.** This result is in agreement with the findings of Ervin et *al.* (1982), who reported farmers with adequate experience of conservation measures are better aware of soil degradation problems and more likely to invest more on conservation measures than their inexperienced counterparts. Contacts with extension agents (EXTEN) positively and significantly influenced the perception of farmers on conservation practices. Contact with extension gives access to information on innovations, advice on types of SWC measures and their use, and management of technologies which will directly lead the farmers to increase investments in conservation. This result is in contrary to the finding of Aklilu (2006) that showed agricultural extension is more focused on crops and livestock production than on SWC, so that farmers having contacts with extension agents tend to reduce investments in conservation.

The slope of a plot (SLOPE) also shapes the farmers' perception of conservation practice negatively. As the slope of the plot increase the distance between two consecutive conservation structures will decrease and this creates disincentive to invest in soil conservation practice. This is because the structures of soil and water conservation take more area of land and it will create inconvenience for farm operation like oxen plough. This result is in conformity with the finding of Hurni (1988) and Berhanu (2004). Participation/training in soil and water conservation (TRAIN**)** has a positive and significant effect on conservation perceptions. Farmers who participated in training by development agents on SWC works were more aware of soil erosion and conservation than those who did not participated. In their finding, Nagassa *et al.* (1997) in Ethiopia reported that training of farmers and their participation in extension workshops improves their perception of soil degradation problem and facilitates the adoption of improved technologies.

Plot ownership (PLOTOWN) and land tenure security (TENURE) of the household has found to positively and significantly influence the perception of SWC practice. The result indicated that own managed plots tend to be more conserved than rented or sharecropped plots. This is because besides the shortage of resource, farmers were not secure for sharecropped and rented plots. Berhanu (2004) in northern Ethiopia reported that farmers' long term investment in soil and water conservation was correlated with land tenure security. Security of land owner ship encourages manure use and construction of soil conservation structures, but not the use of commercial fertilizer (Senait, 2005).

4. Conclusion

The main focus of this study is to assess the perception and responses of farmers to soil and water conservation. Soil erosion and loss of soil fertility on cultivated lands is a very problematic issue in the study area. The result show that 57% of the respondents of respondents believe soil erosion can be controlled. But their actions and capacity was constrained by various socioeconomic, institutional and biophysical factors. Basic influencing factors were education of the household head, farmers' previous soil and water conservation experience, contacts with extension agents, slope of a plot, and training in soil and water conservation**,** plot ownership and land tenure security. In promoting soil and water conservation technologies to farmers, attention needs to be paid to the farming environment, institutional and socio-economic characteristics of the target groups, and the need for designing and implementing appropriate policies and programs that will influence farmers' perception towards the introduction of soil and water conservation measures in their agricultural practices.

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