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Hiwot Mekonnen[1]**, Kaleab Kebede, Musa Hasen, Bosena Tegegne**
Haramaya University, School of Agricultural Economics and Agribusiness, Ethiopia

Farmer's Perception of Soil and Water Conservation Practices in Eastern Hararghe, Ethiopia

Abstract. The perception of farmers is an important part of their decision-making. Therefore, it is imperative to understand the perception of farmers towards soil and water conservation and the socio-economic determinants. The knowledge would help understand farmers decision whether to adopt soil and water conservation practices or not. This paper analyses the perception of farmers towards SWC by taking a sample of 240 farmers from Eastern Hararghe, Ethiopia. Descriptive statistics and generalized linear model are used to describe the data and identify the important factors influencing farmer's perception respectively. On average, Sample farmers are found to have a good understanding of soil and water conservation with standard deviations ranging from 0.615 to 1.551. The factors that positively determined the perception of farmers in the study area are; training, plot size and number of ploughing. Manure application and plot distance affected perception negatively. Following the results, we recommend extension agents in the area to provide continuous trainings and advice farmers to follow up on their land, especially to those who are far from their plots.

Keywords: perception, soil and water conservation, generalized linear model, Ethiopia

Introduction

Recent development in the field of behavioural economics stresses the importance of perception of economic agents in adjusting their choices of scarce resources (Weber, 2003). Perception of farmers towards soil and water conservation (SWC) is, therefore, an important factor in their adoption decision of different SWC practices. The agriculture of developing countries is characterised by unsatisfactory productivity which is attributed to, mainly, environmental degradation and low adoption of improved practices (Graaff *et al*., 2008; Nin *et al*., 2002; Fulginiti and Perri, 1997; Feder *et al*., 1985).

Resource depletion and degradation poses a serious problem in a country where more than 90 million people have to dwell. To make matters worse, most of the population of Ethiopia resides in the highland areas where land is sloppy and prone to erosion. Awareness of the farmers, constituting about 85% of the total population, on sustainable agriculture is unsatisfactory. For example, a research conducted by Tessema *et al*., (2015) on the Ethiopian farmer's decision to adopt conservation tillage, found farmers opting for the traditional multiple ploughing over conservation tillage. This could be the result of farmer's poor perception of soil degradation and its consequences on their production and productivity.

Although adoption of agricultural technologies is rigorously researched, the perception component seems to be ignored. It is the perception of the decision makers, that plays an important role in their final economic decision; such as whether to adopt a certain technology/ SWC practice or not. The attention given by researchers, in the area of risk and

[1] PhD, P.O. box 103, Haramaya University, Dire Dawa, Ethiopia, email: hiwot.jambo@gmail.com.

climate change, towards perception may be due to this fact (Fosu-Mensah *et al.*, 2012; Deressa *et al*., 2010; Weber, 2010; Slovic *et al*., 1982).

Proper utilization and conservation of resources should be at the heart of any development intervention. How much do resource users know about resource degradation? Do they know how their activities are affecting natural resources and the environment? How well aware are farmers about sustainable resource utilization? This article analyzes the awareness of farmers towards SWC practices and the factors that affect their perception.

Research Methodology

The Study Area

This research is conducted on sample households from three districts of Estern Haraghe zone, Ethiopia, namely, Meta, Gurawa and Haramaya. The three districts are similar in their farming system which is dominated by maize, sorghum and *chat*[2] cultivation. Meta district consists of 47 *kebeles*[3] distributed over three agro-ecological zones. It is home to 252,269 people out of which 93% are Muslims. In addition, the district is known for its coffee production, covering about 50 square km of land. Gurawa district comprises of 46 *kebeles* in three agro-ecological zones and hosts 81,310 people, with more than half of them relying on aid. Haramaya district has 271,018 people living in it; out of which 96% are Muslims.

Data Type, Source and Sampling

The research uses a quantitative data obtained from a survey conducted on 240 respondents from nine *kebeles* of the three districts of Eastern Hararghe. Multi-stage sampling is used to purposively select three districts based on their farming system. The 9 *kebeles* and 240 sample households are then selected randomly.

Method of Data Analysis

To address the objective of this research, both descriptive and econometric methods are employed. Measures of central tendency, frequency and percentages are used to describe the data. A generalised linear model (GLM) is employed to identify the factors that affect the perception of farmers towards SWC.

In order to capture the perception of farmers' we ask ten different questions (Table 3) related to the SWC and are evaluated by the respondents on a five scale likert. We then transformed the questions into an index by assigning equal weight. The index value is between zero and one, making the OLS estimation incompetent as it results in biased and inconsistent estimates. As a result, following Papke and Wooldrige (1996) we implement the Generalized Linear Model (GLM), which allows the modelling of a fractional dependent variable. Although some researchers use the Tobit model for such type of data, it

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[2] Chat (*Catha edulis)* is a drug chewed for stimulant effect**.**

[3] Kebele is the smalles administrative unit in Ethiopia.

is not appropriate since all values are observed – not censored—leading to estimated values that are out of the range of the observed values. The GLM is specified as:

$$G\ (E(Y)) = \alpha + \sum \beta k\ Xik$$

Where G (E(Y)) is some function of the expected value of Y and Y~ F, F representing the distributional *family*. If Y has a normal distribution, the family is normal/Gaussian, which is the case for our variable (Table 3). G is the *identity* link function which shows how the expected value of the response relates to the linear predictor of explanatory variables; i.e. G (E(Y)) = E(Y) for linear regression, which is the case for our data.

The Explanatory Variables and Hypothesis

Household and Institutional Characteristics of Respondents

Age: older farmers, because of their longer experience, could have a higher perception compared to their less experienced counterparts. Soil erosion and yield reduction as a result of it takes longer time to be visible to farmers making it difficult for younger farmers to have as good understanding and perception as the older and more experienced farmers.

Education: The education level of household heads as a dummy variable. Our sample respondents did not have a significant difference in their education level—which is why we gave zero to respondents who can't read and write and one for those who can read and write wheather from formal or religious education.

Cooperative membership: members of cooperative are expected to have a higher perception than non-members because they have more access to discussions with fellow farmers and might learn from one another. Farmer to farmer discussions could be more powerful than top down government policy interventions in shaping perception and decision making farmers.

Extension Duration: This variable shows the number of years the respondent farmer started using extension service. We chose this variable instead of do you have access to extension service because a farmer who just started to get the service and a farmer who started using the service for a relatively longer time would fall into the same category, making it difficult to capture the correct contribution of the service. The frequency of extension contact could have been a better proxy. However, farmers usually respond to how many times do you meet with development agents in one year by considering every social contact such as *chewing chat*. Therefore, we choose to use the duration to capture the positive contribution it might have in enhancing farmer's perception towards SWC.

Training: This variable shows if the farmer has received any training pertaining to SWC (1 if received training and 0 if not). Farmers who have received training are expected to have a higher perception towards SWC.

Plot characteristics of respondents

Plot Size: Measured by qoxi[4] is the size of one of the plots of farm lands that the respondents own. Sample farmers own, on average, more than two plots of land. However, we are taking the first plot's characteristics to capture the farmer's perception towards SWC. We expect a positive relationship.

Plot distance: Measured in minitues of walking is also the distance of the first plot from home of the respondent. The farther the plot, the lower the perception; this could be due to fewer visits to the plot to understand its SWC status.

Plot slope: **Measured categorically** is the respondent's perception of the steepness of their first plot. We expect a positive relationship because attributed the fact that a good understanding of the slop of plots is associated with a better perception. Meaning, farmers with steep slope might easily recognize the damage of their land due to erosion and water runoff.

Number of trees: farmers may plant trees on their farm-land to protect soil erosion. Therefore, the more trees are present on the farmland, the better the perception of the farmer on SWC.

Number of ploughing: measures the amount of ploughing farmers use before plantation. The more they plough the higher their perception. We assume that if farmers plough more, it is becase they are trying to get the more fertile soil underneath because the topsoil has been eroded.

Manure application: is a dummy variable, 1 if the respondent applies manure 0 otherwise. A negative relationship is expected between the perception of farmers and manure application. This is because farmers that apply manure to their field might take them a longer time to perceive the decline in fertility of their land than those who do not apply manure to their field.

Inorganic fertilizer application: also a dummy variable, 1 if the respondent uses inorganic fertilizer 0 otherwise. Farmers who use fertilizer might not be able to observe the decline of harvest due to loss of soil fertility of their land, making us assume a negative relationship between fertilizer application and their perception towards SWC.

Results and Discussions

Description of the data

The following table displays the mean, standard deviation, minimum and maximum values of our data along with the number of observations.

The average age of our sample respondents is 40 years. Around 33% of sample respondents are members of cooperatives and 54.5% have some form of formal education. Our respondents have an average of about 8 years of extension service and 88.3% have received some training regarding SWC. Respondents have at least one plot with an average of 1.744 *qoxi* land, an average walking distance of 12 minutes, and plough their field 2.3

[4] Qoxi is a local measurement of land which is equivalen to 1/8th of a Hectare

times on average. 61.7% and 73.3% of sample farmers use manure and chemical fertilizer respectively.

Table 1. Data Description

Variable	No. of Observations	Mean	Std. Dev.	Min.	Max.
age	236	39.322	10.090	20	80
cooperative membership	240	0.333	.472	0	1
school	240	0.545	.498	0	1
extension duration	240	7.775	3.642	1	30
training SWC	240	0.883	.321	0	1
p1size	238	1.744	1.511	0	15
p1distance	228	12.618	17.000	0	120
p1slope	239	1.694	.567	1	3
p1trees	240	.533	.499	0	1
p1plow	240	2.273	.583	1	4
dummymanure	240	0.617	.487	0	1
fertp1	240	0.733	.443	0	1

Source: own calculation using own survey data.

Farmer's knowledge and perception of the slope of their field plays an important role in shaping their perception towards SWC. Majority of sample farmers (59%) perceive that their land has a medium slop. Farmers with a steep slope, according to their perception, are only around 5% of our respondents.

Table 2. categorization of slope of plots by respective farmers

Slope of plot1	Freq.	Percent	Cum.
Plain	86	35.98	35.98
Medium	140	58.58	94.56
steep	13	5.44	100
Total	239	100.00	

Source: own calculation using own survey data.

The sample respondents are presented with the questions and a five scale likert; 1. strongly agree, 2. disagree, 3. neutral or undecided, 4. agree and 5. strongly agree. Table 3. provides overall information as to where an average respondent belongs based on their perception of SWC. The average response for the negative statements is below 3 whereas for the positive it is well above 3. The response for "Soil fertility and crop productivity can be managed to a large extent by applying mineral fertilizers only" is around 2, which could mean that farmers have a lower faith in the power of chemical fertilizer in improving soil fertility. From the discussions we had with farmers, many held inorganic fertilizer responsible for the decline of their soil fertility.

Table 3. Descriptive statistics of the ten questions used to measure perception

Variable	No. of Obs.	Mean	Std. Dev.	Min	Max
Soil erosion is the leading cause that results decline in soil fertility	240	4.825	0.615	1	5
Soil fertility and crop productivity can be managed to a large extent by applying mineral fertilizers only	240	2.345	1.268	1	5
Applying compost and farm yard manure to soil has no impact on soil property rather a waste of labor and time	240	2.808	1.551	1	5
Applying cow dung and leaving crop residue on the field has little impact on soil fertility improvement, so it is better to use these as fuel for cooking	240	2.983	1.472	1	5
Cultivation of mixed crops (intercropping) not only increase total production but also reduces soil erosion	240	4.000	0.976	1	5
Constructing and maintaining physical SWC measures (terracing, soil bunds, stone bunds, cut off drains and mulching) on farm plots decrease surface water runoff	240	4.633	0.796	1	5
Physical SWC measures for crop production are costly and labour-intensive activity that has little contribution to improve and maintain soil fertility	240	3.425	1.501	1	5
Physical SWC measures maintain soil fertility and also enhance crop yields in the long-run	240	4.262	1.015	1	5
I do not have the knowhow to construct and maintain Physical SWC measures on my plots	240	1.467	0.775	1	5
I have no intention to construct physical SWC measures on my plots because it will bring me no benefit in resulting increase in my agricultural production	240	1.425	0.819	1	5

Source: own calculation based on own survey data.

Econometric result

The following table presents the factors that affect farmer's perception towards SWC. The result of the GLM regression shows a positive correlation among training on SWC, plot size and the number of times farmers plough their field and their perception of SWC, the dependent variable. On the other hand, plot distance and manure application are negatively related with sample respondents' perception of SWC. The findings of the econometric regression match our hypothesis.

Training, especially when it focuses on a specific area, has a significant impact in improving perception and understanding of people (Delaney et.al., 1996). Training can also create motivation and improve productivity of workers (Khan *et.al*., 2015). That could be why farmers who took training on SWC have a better perception than those who didn't. Obtaining training improves the perception of farmers by about 3.9% compared to farmers who do not obtain any training regarding SWC.

The other significant variable is land size. Farmers with larger farm size have a better perception towards SWC than those farmers with smaller land size. Farmers might give less emphasis to their lands if they are smaller and might not attribute the reduction in yield to soil degradation as much as they do for the size. Also the SWC practices occupy some space on farm land, which could indirectly influence farmers' perception towards using any SWC on smaller plots. A one *qoxi* increase in land increases perception by 0.7%.

Table 4. Results of parameter estimation of the GLM model for farmers' perception of SWC

Variables	Coef.	OIM Std. Err.
age	0.000	.000
cooperative membership	-0.010	.011
school	0.0104	.011
extension duration	-0.002	.001
training SWC	0.039**	.017
plot size	0.007*	.003
plot distance	-0.001***	.000
plot slope	0.008	.009
Plot trees	0.013	.011
No of ploughing	0.025**	.010
Manure application	-0.023*	.011
Chemical fertilizer	-0.000	.000
Constant	0.465	.040

***, ** and * significant at 1%, 5% and 10% probability level, respectively

Source: own calculation based on own survey data.

Plot distance has an inverse relationship with perception. Plots farther from home might not be visited often and receive attention that could enable farmers to observe changes on its fertility. An increase in one minute of walking distance is found to decrease farmers' perception by 0.1%. Maro *et al.* (2013) also have found similar result.

Farmers plough their land to obtain the fertile soil underneath in addition to controlling weed and mixing organic matter with the soil. The more farmers understand the decline of fertility the more they plough to increase their harvest. This is why we have found a positive relationship between the number of ploughing and SWC perception. One additional ploughing indicates a 2.5% increase in perception of farmers.

Manure application is found to have a negative interaction with perception. This could be attributed to the potential of manure application in improving fertility and water retention of the soil (Wortmann and Walters, 2007). Farmers who apply manure to their field are found to have a 2.3% reduction in their perception.

Conclusions and Recommendations

Based on our sample data, we have come to learn the importance of training in improving farmers' perception towards SWC. It is, therefore, very important for the district agricultural office to provide continuous educational programs on SWC practices. Providing innovative SWC options, which do not consume much of smallholding farm lands, should be at the heart of policy making to create a sustainable agricultural production. This will especially help farmers with relatively smaller holdings.

Introducing and promoting minimum tillage could be very helpful. Farmers tend to plough more when they perceive declining fertility which can lead to a vicious cycle of more erosion—more loss of fertility—more ploughing. Educating farmers is also necessary on the use of manure. Manure application can improve fertility of the soil and its moisture retention. Some farmers use manure as an energy source for their household than use it on the farm. A strong work is required by all stakeholders to strengthen the perception of farmers towards SWC and improve their production and productivity.

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