academicJournals

Vol. 6(1), pp. 22-32, January, 2014
DOI: 10.5897/JDAE2013.0450
ISSN 2006-9774 ©2014 Academic Journals
http://www.academicjournals.org/JDAE

Journal of Development and Agricultural Economics

Full Length Research Paper

Tenure security and soil conservation investment decisions: Empirical evidence from East Gojam, Ethiopia

Akalu Teshome

Amahar Agricultural Research Institute, Ethiopia P. O. Box 527, Bahir Dar, Ethiopia.

Accepted 30 July, 2013

The purpose of this study is to investigate the mutual relation between tenure security and soil conservation investment and to examine the influence of other socio-economic and institutional factors on soil conservation investment and tenure insecurity. A formal survey is conducted in two districts of East Gojam Zone of Amhara region. The Zone and the districts are selected because of their long time experience with soil conservation development activities and land re-distribution. A two-stage random sampling procedure is used to obtain sample households. Because the structural model represents a simultaneous binary choice system, the investment and insecurity equations are estimated using a two-stage probit method. The results show that tenure insecurity is an important variable that affects the probability of investing in soil conservation technologies. However, the reverse relation is insignificant. Farmers' soil conservation investment decisions are positively and significantly related to slope, age, education level and public investment, whereas, tenure insecurity and distance from the main road have a negative significant influences on soil conservation investments. The analysis of tenure insecurity reveals that expectation of redistribution and farm size has a negative influence on tenure security, whereas education level has a reverse effect.

Key words: Tenure security, soil conservation investment, simultaneous binary choice system, two-stage probit, Ethiopia.

INTRODUCTION

Land degradation is one of the major environmental problems in developing countries. Soil erosion by water is the principal cause of land degradation, and a major constraint to agricultural development in developing countries (de Graaff, 1996). Globally, the problem of soil erosion is widely recognized and millions of dollars are spent every year on soil conservation projects. But in spite of money being spent and great effort being made, the problem is gradually getting worse. An important factor in land degradation and farmers' investment in soil conservation in developing countries is the change in the socio-economic environment of farm households resulting from policy reform measures taken at higher levels (Heerink et al., 2001). As population increases and land becomes scarce, land demand by the growing number of land claimants may be met by non-market mechanisms such as state land redistribution, informal land contracts and customary inheritance. The persistence of such mechanisms and absence of an established legal rights land system has resulted in

E-mail: akalu_firew@yahoo.com.

increasing tenure insecurity and continued land fragmentation (Amare, 1998). The absence of tenure security is highly linked to poor land use which in turn leads to environmental degradation (Otsuka and Place, 2001; Wannasai and Shrestha, 2008).

Ethiopia is one of countries that is heavily dependent on peasant agriculture and is affected by extensive degradation of agricultural land. Coupled with the poor performance of the agricultural sector, high population growth, land scarcity, technological stagnation, misguided policies and deficient institutional structure hinder sustainable utilization of agricultural land (Shiferaw, 1998).

Reducing resource degradation, increasing agricultural productivity, combating poverty, and achieving food security are major challenges of the nation. The poor agricultural practice and the country's intrinsic fragile biophysical conditions have resulted in large areas becoming severely degraded. Land degradation is most severe in highlands (over 1500 m altitude), which account for more than 43% of the country, 95% of the cultivated area, 75% of the livestock and host about 88% of the population. Hurni (1988) estimates that the annual rate of soil loss on crop land is on average 42 t/ha per year. If soil erosion continues with this rate, by the year 2010 some 60000 km^2 of agricultural land will have disappeared.

The Amhara National Regional State (ANRS) is one of the nine regional states of Ethiopia. The Region is endowed with huge potential of land and water for agriculture, but these are now under the threat of land degradation due to soilerosion. A recent study by Gete (2003) revealed that Western Amhara (Gojam) which was once known as bread basket of Ethiopia is now at severe risk due to soil degradation. The cause of soil erosion in ANRS is a combination of natural factors such as topography, erratic and erosive rainfall patterns and human actions including destruction of vegetation cover through deforestation, overgrazing, and inappropriate agricultural practices that are not in harmony with the environmental conditions. In this regard, dense population, primitive farming practices combined with intensive rains and rugged topography intensified land degradation (Betru, 2003).

To alleviate these problems, a massive conventional soil conservation program has been launched since 1975 (Shiferaw and Holden, 1998). In spite of the effort in introduction, the adoption rate has been minimal (Shiferaw and Holden, 1998, 1999).

Investment in soil and water conservation practices are influenced and constrained by socio-economical and institutional factors (de Graaff, 1993; Shiferaw et al., 2009). Soil conservation investment may be undertaken when sufficient returns are expected for a considerable period of time in comparison with the situation when such investments are not made. This is possible with a secure land tenure system.

Since the beginning of the twentieth century, Ethiopia has implemented different types of interventions in the area of land tenure. Currently, land is the state property and redistribution is the sole mechanism through which land transfer to accommodate new demands. The majority of the smallholders in Ethiopia (76%) are not sure whether their current land will belong to them in five years time (Ethiopia Economic Association, 2002 cited in Dessalegn, 2004). Benin and Pender (2001) in their study of the incidence of land redistribution in the Amhara region of Ethiopia revealed that every community has experienced at least one redistribution since 1974, and nearly half had a land redistribution since 1991, mainly in the recent redistribution since 1997. And also about four-fifths of the communities expect redistribution in the future. The stronghold of the state over rural land and subsequent action of land allocation through redistribution has given rise to tenure insecurity by rural farmers (Dessalegn, 2004). Cognizant of this problem, the government of Ethiopia has introduced land certification very recently to increase tenure security and farmers' propensity to investment.

Lack of secure rights on land decreases farmers' incentives to invest in land improvement (Besley, 1995; Otsuka and Place, 2001; Mekonnen, 2009). Moreover soil conservation investment is constrained and influenced by credit facilities, extension service, infrastructure availability, household endowment and household and farm characteristics. This implies that there are a lot of institutional and socio-economical factors that might hinder farmers to invest their own conservation measures.

In view of this, it is important to investigate the factors influencing subsistence farmers' soil conservation decisions in the context of northwestern Ethiopia. The main objectives of the study are to investigate the mutual relation between tenure security and individual soil conservation investment and to examine the influence of other socio-economic and institutional factors on individual soil conservation investment and tenure insecurity

Analytical model

Following the above description of the relationship between property rights, uncertainty and utility maximization, we use a one-period household model to assess the impact of tenure security on land related investments as the conceptual basis for our empirical investigation. There are two alternatives hypotheses related to tenure security and investment. The first one is that more secure land rights will have a positive impact on investment. In this case tenure security is exogenous. The other hypothesis is that investment is undertaken to enhance tenure security, in this case tenure security is endogenous.

In our situation, the farmer willingness to invest may be affected by the perception of risk. A farmer decides whether to invest in soil conservation technologies by considering risk of losing land, due to redistribution sometimes in the future. When the farmer feels secure about the tenure system he may decide to invest in soil conservation technologies and his production may increase as the result of the investments. Meanwhile he may lose his investment some time in future due to redistribution. If a farmer feels insecure about tenure he may decide not to invest in soil conservation technologies and his production may decrease due to soil erosion. But he will not lose any investment when redistribution is undertaken. The farmer decides whether to invest or not by considering the above scenarios.

Assuming that farmers maximize expected utility, the decision whether to invest ($I_i = 1$) or not ($I_i = 0$) is based on a comparison of expected utilities of investing or not investing soil conservation technology. Using the difference in expected utilities gives the following decision rule:

$$I_i = \begin{cases} 1, if, E[U_I^I - U_I^O | z_i, \gamma_i] > 0 \\ 0, if, E[U_I^I - U_I^O | z_i, \gamma_i] < 0 \end{cases} \quad (1)$$

Where E denotes expectation of a farmer which is conditional on household and farm characteristics (z_i) and perception of risk (γ_i). U_I^I denotes utility of investing soil conservation and U_I^O is utility of not investing soil conservation. The utility level of investing or not investing depends up on the expectation of income with the presence or absence of soil conservation technologies. Considering an individual farmer with utility function $U(\omega)$, where ω is income which depends on individual and farm characteristics (z_i) and variables affecting perception of risk (γ_i). Farmer's expected utility is assumed to be increasing in income $[\omega]$, as indicated in Equation (3)

$$\max E[U(\omega) | z_i, \gamma_i] \quad (2)$$

Subject to

$$\omega = \sum_{t=1} (Y_i A_i p_i - w_I I_i - C) \quad (3)$$

$$Y_i = Y(I_i, F_i, A_i, Z_{1i}) \quad (4)$$

$$I_i = I(T_i, Z_{2i}) \quad (5)$$

$$T_i = T(I_i, Z_{3i}) \quad (6)$$

This equation defines income $[\omega]$ as annual crop revenues minus the unit cost (w_i) of conservation investments (I_i) and other variable costs (C). Crop revenue is the product of crop price (p_i), yield (Y_i) per hectare and land area (A_i). Yield, in turn, is concavely increasing with the presence of soil conservation investments $(Y'(I_i) > 0)$ and also depends on fertilize use (F_i), land area (A_i) and other factors (Z_{1i}) such as soil fertility, pest and weather condition. Soil conservation investment (I_i) depends on tenure security $(I'(T_i) > 0)$. This implies that better land security leads to more land investment. Soil conservation investment (I_i) also depends on other factors (Z_{2i}) such as slope of the plot, farm size, distance of the homestead from the main road, age of the household, extension contact, public investment, number of oxen, and education level.

On the other hand, tenure security is endogenous; security of tenure can be enhanced through investment $(T'(I_i) > 0)$. Tenure security also depends on other factors (Z_{3i}) such as farm size, expectation of re-distribution, age and education level of the household.

Hypotheses

Investment hypotheses

From the theoretical framework, several hypotheses can be derived that serve in empirical examination. Investments are measured in this study with the presence of soil conservation technologies on farmers' fields (fanya juu terrace[1], fanya juu with plantation and perennial) or not. The farmers are asked whether they invest or not individual soil conservation measures on their own plots. Investments undertaken by mass mobilization are not considered. Therefore, our dependent variable represents the presence of investment or not on farmer fields and it is a function of social, institutional, physical, and economical and attitudinal factor.

Development of the model is influenced by a number of working hypotheses. Based on the literature reviewed it is hypothesized that farmers decision to invest in conservation measures is influenced by combined effects of social, economical and institutional factors. A number of variables are expected to influence investment in soil conservation measure explained as follows:

Slope of the plot (Slope): Slope is an indicator of the probability of erosion on the land (Laper and Pandy,

---

[1]A fanya juu terrace is made by digging a trench and throwing the soil uphill to form an embankment. In our case farmers plant a grass strip on the fanya juu.

1999). The steeper the slope, the more likely the land will erode. Hence, it is hypothesized that investment tends to be likely on steeper slope.

Tenure insecurity (T_i): Tenure insecurity measures the perceived risk of loss of land at some time in the future. Investment is undertaken when the household is assured that he will reap the benefit for a considerable time. The household that feels insecure will not invest in soil conservation measures. So it is hypothesized to negatively influence investment.

Farm size (Farms): To invest soil conservation measure, the farm size is the crucial matter. Farmers having a large farm invest more than the others (Shiferaw and Holden, 1998). So it is hypothesized to positively associate with investment decision.

Distance to the main road (Disth): Distance to the main road is hypothesized to be negatively related to the probability of investment of soil conservation measures, since households near to main road tend to have access to information and are more likely to be visited by extension agents (Laper and Pandy, 1999).

Family size (Shh): Larger families will be able to provide the labor that is required for soil conservation investment. So it is hypothesized to be positively related to soil conservation investment.

Level of Education (Edu): Level of education is assumed to increase a farmer's ability to obtain, process, and use information relevant to the investment of soil conservation decision (Laper and Pandy, 1999). Education is therefore expected to increase the probability of investment of soil conservation.

Number of oxen (Ox): Number of oxen is hypothesized to be positively related to the probability of investment. This is because oxen are indicator of wealth and it is used in digging while soil bund is constructed.

Age of the household (Age): The age of household is hypothesized to be negatively related to the probability of investment. This is because old farmers are more suspicious about new technologies than young (Shiferaw and Holden, 1998).

Extension contact (Extc): Farmers who have frequent contact with extension agent are positively influenced to invest (Makokha et al., 1999). So it is hypothesized to be positively related to soil conservation investment.

Public investment (Pubcon): Farmers who have public investment are expected to have positive attitude towards soil conservation. This is because they perceive the benefit of the measures. Here public investment is a soil conservation investment practice which is constructed on farmers' plots by mass mobilization of the community. From Equation (5) the model of investment is specified as follows:

$$\text{Investment} = f(\text{Slope, Tenure Insecurity, Farms, Disth, Shh, Edu, Ox, Age, Extc, Pubcon}) \quad (6)$$

Tenure insecurity hypotheses

Tenure insecurity is measured as the perceived risk of loss of land some time in future. The farmers are asked about their expectation of handling their lands at different time interval (1 year, 5 years, 10 years and throughout their life time). The response will fall in one category: Insecure land holding or secure land holding. Therefore, our dependent variable represents the feeling of tenure insecurity and it depends on a lot of factors. A number of variables are expected to influence tenure security, explained as follows.

Farm size of the household (Farms): During re-distribution, farm size was one of the yardsticks to lose land. In line of this, the household who has a large farm size fear the risk of losing his/her land. So it is hypothesized to be positively related to tenure insecurity.

Investment (I_i): Land tenure security is influenced by investment. Tenure security can be enhanced through investment. Land related investment is undertaken to enhance security of land holding (Brasselle et al., 2001). This implies that investment will be undertaken by insecure households in order to increase their security. So it is hypothesized to be positively related to tenure insecurity.

Expectation of re-distribution (Expredis): The household may expect re-distribution due to the government land re-distribution policy. So it is hypothesized to be positively related to tenure insecurity.

Education level of the household (Edu): Level of education is assumed to increase farmers' ability to obtain information about the tenure system. So it is hypothesized to positively relate to tenure insecurity.

Number of oxen (Ox): Number of oxen is the proxy variable for wealth and power. Wealthy households may f ear losing their land due to the past redistribution criteria. So number of oxen is hypothesized to be positively related to tenure insecurity.

From equation 3.6 the model of tenure insecurity is specified as follows:

$$\text{Tenure insecurity} = f(\text{Age, Edu, Farms , Ox, Expredis, Investment}) \quad (7)$$

METHODOLOGY

Study areas, sampling procedure and data collection

The study is undertaken in two major districts (Gozamen and Awabel) of East Gojam zone, Amhara region. The Zone and the Woredas are selected purposely because of their long time experience of soil conservation development activities and their land re-distribution experiences. Rigorous SWC activities were implemented in the study areas in 1999 by the District Agriculture Office with financial support from the Swedish International Development Agency (SIDA) as part of its on-farm research program in Amhara Region.

A two stage sampling procedures is used to select farmers for the study. Kebeles (Dijil Watershed and Gudalema Watershed) are selected using a random sampling procedure. Following the selection of Kebeles, 60 farmers are randomly selected from each Kebeles (Watersheds). Data are collected from primary and secondary sources. Secondary sources include published and unpublished information about soil conservation activities, agricultural production, farming system and other socio-economic information. This information is collected from the zonal and Woreda level office of Agriculture. Primary data are collected from sample farmers using a structural questionnaire. Moreover, group discussions are undertaken with opinion leaders of respective districts.

Empirical model and estimation

Investment and tenure insecurity equation and their estimation

In this study, we empirically investigate the relations laid out in the theoretical model by a system of binary choice equations. As discussed earlier, the influence of tenure insecurity on soil conservation investment is direct. Alternatively, some factors may simultaneously affect both tenure insecurity and investment. With a simultaneous equations model two or more endogenous variables are determined jointly within the model. Both are also depend on set of exogenous variables. Simultaneity induces correlation between error terms of each equation in the system. Ordinary least squares (OLS) can not be used to estimate this model, because the relationship specified by equations violates the OLS assumption of zero covariance between the disturbance term and the independent variables. Estimation of such model through OLS will lead to biased and inconsistent estimates of the coefficients (Verbeek, 2002). As a result, the main estimating technique is two stage least squares (2SLS) for continuous variable and two stage probit estimation in the case of binary choice (Maddala, 1983).

I_i^* and T_i^* are endogenous (latent) variables and β and γ are the set of parameters and the simultaneous equations model is written the following form:

$$I_i^* = \beta_{11} T_i^* + \gamma_1 Z_{1i} + u_1 \tag{8}$$

$$T_i^* = \beta_{21} I_i^* + \gamma_2 Z_{2i} + u_2 \tag{9}$$

Where, $I_i = 1$ if I_i^*>0; $I_i = 0$ otherwise; $T_i = 1$ if T_i^*>0; $T_i = 0$ otherwise.

For this study, our simultaneous probit equations model is:

$$I_i = f(Z_1, X, T_i) \tag{10}$$

$$T_i = f(Z_2, X, I_i) \tag{11}$$

Where investment (I_i) and tenure insecurity (T_i) are binary [0,1] indicator variables for a given household. The Z and X are vectors of observed exogenous variables representing household and farm specific characteristics and institutional setting. And f represents the non-liner transformation of I_i^* and T_i^*

To investigate the relationship between investment and tenure insecurity, we use a simultaneous probit equation model which consists of two simultaneous binary choice equations. The estimation procedure comprises the following steps: First, the reduced form of tenure insecurity (exogenous variable) is estimated and then its predicted value obtained. Second, the predicted value of insecurity $(\hat{T}_i^*)$ is used as a regressor in the investment equation. The process is repeated for insecurity equation using predicted value of investment $(\hat{I}_i^*)$.

Before running the model all the hypothesized explanatory variables were checked for the existence of multi-collinearity problem. In this study, variance inflation factor (VIF) and contingency coefficients were used to test multi-collinearity problem for continuous and dummy variables, respectively.

RESULTS AND DISCUSSION

Descriptive analysis of soil conservation investment

About 44% of the households in the study invest in their own conservation technology (Table 1). Family size, age and farm size variables are assumed to influence the decision to invest in the soil conservation technology. The average family size, farm size and age of the households' head in the study area are 5.6, 1.47 and 38.6, respectively. But in this study no significant differences in these variables between investing and non-investing households are found based on univariate t-test.

The number of oxen is hypothesized to influence the decision of soil conservation investment. This is because the number of oxen indicates the wealth status of the household. The average number of oxen per household is 1.88. A t-test indicates that investing households on average have significantly more oxen (2.11) than non-investing households (1.69). Education level is also assumed to influence decision of soil conservation investment. The majority of the households who invest in soil conservation technologies (69.2%) are literate. The chi- square test shows a systematic association between the level of education and soil conservation investments.
Frequency of extension contact is also assumed to influence the decision of soil conservation investment. About 82.7% of investing households and 53% of non-investing households has high level of extension contacts. The chi-square analysis shows a systematic association between soil conservation investment and extension contact. Furthermore, the presence of public soil conservation investments on the plot of household is hypothesized to influence in decision of investments. This

Table 1. Characteristics of investing and non-investing households in the study area.

Characteristics		Investing HH (N=52)		Non-Investing HH(N=66)		t- statistic
		Mean	S.D	Mean	S.D	
Age(years)		40.59	12.01	37.06	11.95	0.11
Family size		5.94	1.77	5.48	2.00	0.19
Farm size (ha.)		1.54	0.79	1.40	0.71	0.37
Distance from main road (km)		0.95	1.09	1.32	1.0	0.05**
Number oxen		2.11	0.83	1.69	1.15	0.02**
		% of investing HH		% of non-investing HH		χ^2 statistic
Slope	Yes	86.4		50.0		0.000**
	No	15.4		50.0		
Tenure insecurity	Yes	30.8		56.1		0.006**
	No	69.2		43.9		
Level of Education	Literate	61.5		39.7		0.001**
	Illiterate	38.5		62.1		
Extension Contact	High	82.7		53.0		0.001**
	Low	17.3		47.0		
Public investment	Yes	59.6		34.8		0.007**
	No	40.4		65.2		

*Significance at the 10% level; **significance at the 5% level.

is because the households who have public investments may perceive the benefit of the technologies. About 59.6% of investing households and 34.5% of non-investing households has public soil conservation investments.

The chi-square analysis reveals a systematic association between the presence of public investments and individual soil conservation decision. In addition insecurity of tenure is hypothesized to influence soil conservation investment. This is because investment may be undertaken when the household is assured that he will reap the benefit for a considerable time. The household who feels insecurity may not invested soil conservation measures. About 56.1% of non-investing households and 30.8% of investing households feel tenure insecurity. The chi-square analysis also reveals a systematic association between tenure insecurity and soil conservation investment.

Descriptive analysis of tenure security

Around 55% of the sample households feel secure about their landholdings (Table 2). Farm size is hypothesized to influence the feeling of tenure insecurity. The households who have a larger farm size may feel insecurity of tenure because they fear some plots of their land may be taken away through redistribution. Insecure households on the average have a larger farm size (1.7 ha) than secure households (1.29 ha). The t- test shows that this difference is significant. Moreover, the number of oxen is also assumed to influence the feeling of tenure security. This is because the number of oxen indicates the wealth status of the household. Insecure households on average have significantly more oxen (1.7) than secure households (1.29).

Expectation of redistribution is assumed to influence the feeling of tenure insecurity. This is due to the prevailing land tenure policy. About 92.2% of insecure households and 75% of secure households expect re-distribution in the future. This indicates that expectation of land redistribution does not totally lead to tenure insecurity. This is because farmers expect that there will be land redistribution for landless youth from large size holders or land from dead people or from grazing areas. Chi-square analysis reveals a systematic association between tenure insecurity and expectation of re-distribution in the future. Level of education is also hypothesized to influence the feeling of tenure insecurity. However, Chi-square analysis shows no systematic association between education level and tenure insecurity.

Table 2. Descriptive statistics results of tenure security and insecure households in the study area.

Characteristics		Insecure household (N=53)		Secure household (N=65)		t- statistic
		Mean	S.D	Mean	S.D	
Age (years)		39.4	12.5	37.9	11.71	0.5
Farm size (ha.)		1.7	0 .8	1.29	0.62	0.003**
Number oxen		2.0	1.1	1.7	0 .95	0.065*
		% Land insecure HH		**% Land secure HH**		**χ^2 statistic**
Investment	Yes	24.5		55.4		0.006**
	No	75.5		44.6		
Expectation of redistribution	Yes	92.2		75.4		0.018**
	No	7.8		24.6		
Level of Education	literate	58.5		46.2		0.182
	illiterate	41.5		53.8		

*Significance at the 10% level; **significance at the 5% level.

Table 3. Two- stage probit estimation results of investment of soil conservation.

Variable	Coefficient	Standard error
Age	0.033**	0.013
Level of education	0.678**	0.299
Family size	-0.037	0.096
Distance	-0.318**	0.131
Farm size	0.267	0.262
Extension contact	0.321	0.327
Number of oxen	0.188	0.160
Public conservation	0.815**	0.303
Slope	1.048**	0.333
Insecurity(predicted value)	-0.856*	0.518
Constant	-3.171	0.776
Regression diagnostic		
Chi-square	45.79	
Probability >Chi-square	0.000	
Pseudo R-square	0 .290	
Count R^2	0.756	
Base line for count R^2	0.56	
Number of observations	115	

*Significance at the 10% level; **significance at the 5% level.

Soil conservation investment model

Using the variables described in Equation (8) is estimated using two- stage probit method. Two-stage probit estimation results (Table 3) reveal that the investment decision of soil conservation technologies is influenced by different factors at different levels of significance.

Most of the regressors used in this model have signs in line with our prior expectations. The results show that farmers' soil conservation investment decisions are positively and significantly related to slope, age, education level and public investment. Similarly, tenure insecurity and distance from the main road have negative significant influence on soil conservation investment. Some variables like farm size, extension contact and number of oxen have positive signs but are not significant.

Consistent to our expectation, the level of the slope of plot is positively related to the decision of the soil conservation investment and statistically significant. This implies that farmers who operate on fields with steeper slope are more likely to invest in soil conservation technologies than the others. This may be explained by the positive relationships between slope and severity of soil erosion. This result is consistent with the findings of Shiferaw and Holden (1998) and Gebremedhin and Swinton (2003) in Ethiopia, and Lapar and Pandey (1999) in the Philippines. Therefore, the level of the slope of the plot is an important factor for the decision of soil conservation investment.

As expected, tenure insecurity has a significant negative influence on soil conservation investments. This suggests that tenure insecure households are less likely to invest in soil conservation technologies. It is argued that in Ethiopia, land is state property and farmers have only use and lease rights and redistribution of land is a common phenomenon.

For instance, in the Amhara region, Benin and Pender (2002) revealed that nearly half of the communities have experienced land redistribution since 1991 and about four-fifths of the communities expect redistribution in the future. This expectation of redistribution may erode tenure security and hence farmers may not undertake land improving investment because they may not be able benefit fully from the returns on their investments. This result is consistent with findings by Besley (1995) in Ghana, Hays et al. (1997) in Gambia, Gavian and Fafchamps (1996) in Nigeria, Ostuka et al. (2003) in Ghana, Winters et al. (2004) in Ecuador and Fraser (2004) in Southwest British Columbia. Moreover, a study conducted by Geberemedehin and Swinton (2003) in the Tigray region of North Ethiopia is in line with our result. Thus, tenure insecurity has a negative influence on soil conservation decision. Conversely, Benin and Pender (2001) in their study in Amhara found that land redistribution and expectation of land redistribution have a statistically insignificant effect on the influence of land investment.

Similarly, Holden and Yohannes (2002) in Southern Ethiopia revealed that tenure insecurity has no negative effect on long term investment like planting of perennials. These differences could be explained by the differences of socio-economic and land re-distribution experiences between Amhara and Southern regions, but the different results for the same region may be due to methodological difference.

As hypothesized, the presence of public soil conservation investments on a plot is positively related with individual soil conservation investments and statistically significant. This means that households who have public investments on their plots are more likely to invest in individual soil conservation technologies than others. This is because they perceive the benefits of soil conservation technologies. This result is consistent with the finding of Gebremedhen and Swinton (2003) in Ethiopia. They found that farmers, who have nearby public investment, are encouraged to invest in private soil conservation measures. Therefore, public soil conservation is stimulating individual soil conservation investment.

Consistent with our expectation, the coefficient of distance from the main road is negative and significant. It implies that farmers whose homesteads are far from the main road have a lower probability of investing in soil conservation technologies. This can be due to the fact that households near the main road tend to have access to information and are more likely to be visited by extension agents. Moreover, the transaction cost of searching for technical knowledge and information is lower for farmers living close to the road. This result is in line with the findings of Gebremedhen and Swinton (2003) in Ethiopia and Lapar and Pandy (1999) in the Cebu districts of Philippines. It can be concluded that distance from the main road is a crucial factor for the individual soil conservation decision.

Investment is found to be positively and significantly influenced by education status of the households. This suggests that literate farmers are more likely to invest in soil conservation measures than illiterate farmers. It is argued that literate farmers have the ability to obtain, process and use information related to soil conservation technologies and they are also taking more rational decisions. This result is consistent with the findings of Pender and Kerr (1999) in Aurepalle district of India and Lapar and Pandy (1999) in the Cebu district of Philippines. Thus, level of education has a positive influence on the decision of soil conservation investment.

Contrary to the hypothesis, the household age is found to have a significant and positive effect on the decision of soil conservation investment. This result implies that older farmers are more likely to invest soil conservation technologies. An explanation could be that farmers cognizant the problem of soil erosion through their life experience and hence they may take decisions of soil conservation investments. The overall model goodness of fit represents by model count R-square is satisfactory. Using the model we predict that 44 households would investing and that 71 would not investing.

In reality 50 households did invest and 65 did not. When we evaluate the predictions it is found that 33 of these 44 predictions of investing are correct and 11 not. Of the 71 predictions of non-investing 54 are correct and 17 not. So in total there are 33+54=87 correct predictions and 11+17=28 wrong predictions. Overall the predictive power of the model is 87/115=0.756. Moreover, the prediction of a model with only an intercept and no explanatory variables is 65 of the 115 observations. This gives us a baseline for predictions. So, the explanatory variables in the model give us an additional 22 correct predictions.

Table 4. Two stage probit result of determinants of tenure insecurity.

Variable	Coefficient	Standard error
Age	-0.003	0.011
Level of education	-0.511*	0.287
Farm size	0.491**	0.191
Number of oxen	0.063	0.135
Expectation of redistribution	0.609*	0.135
Investment (predicted Value)	0.262	0.367
Constant	-1.222	0.566
Regression diagnostic		
Chi-square	19.01	
Probability>Chi-square	0.0042	
Pseudo R-square	0.1203	
Count R^2	0 .678	
Base line for count R^2	0.55	

*Significance at the 10% level; **significance at the 5% level.

Tenure insecurity model

The results of two stage probit estimation for tenure insecurity are presented in Table 4. Most of the explanatory variables used in this model have signs similar with our prior hypothesis. The results indicate that tenure insecurity is positively and significantly related to farm size and expectation of redistribution. Age and number of oxen variables have negative and positive signs, respectively, but are not significant.

As expected, farm size is positively and significantly related to tenure insecurity. This result suggests that large farm size holders are more likely to feel tenure insecure. It is argued that owners of more than the average landholding may fear loss of some plots of land through redistribution. Moreover, the large farm size holders may feel tenure insecurity due to the past land redistribution policy as well as a great land holding inequality in the community. This result is also in line with the finding of Holden and Yohannes (2002) in some study sites of Southern Ethiopia.

Contrary to the hypothesis, the variable education is significant with a negative sign. This implies that literate farmers are less likely to feel tenure insecure. This may be explained by the fact that educated farmers may have alternative employment and the result they may give less attention to farm activities. Hence they may not feel tenure insecurity. However, Holden and Yohannes (2002) in their study in southern Ethiopia found that educated households (above grade 6) feel more tenure insecure. They argued that educated farmers may have better information about recent redistribution history of Amhara region.

As hypothesized, expectation of redistribution is positively and significantly related to the feeling of tenure insecurity. This result suggests that farmers who expect re-distribution are more likely to feel tenure insecurity.

It is argued that farmers may expect redistribution due to the government land policy as well as the past redistribution experience in the region and these perceptions may be a real source of tenure insecurity[2]. Therefore, expectation of redistribution due to land policy is the main source of tenure insecurity.

Age, whether investing soil conservation or not, and number of oxen do not have a significant effect on the feeling of tenure insecurity. Particularly, the finding of investment is not in line with the new finding of Brasselle et al. (2002) in Burkina Faso. They suggest that investment may be undertaken to enhance tenure security rather than as a consequence of more secure rights. The reason that our results are not in line with their findings may be that during the previous redistribution, investments did not guarantee tenure security and most farmers has lost what they invested and denied of their rights to compensation and payments for their investment. Investments may influence tenure security in flexible indigenous and customary land tenure system.

The model goodness of fit represents by model count R-square is acceptable. Using the model we predict that 40 households would feel insecurity and that 75 would secure. In reality 51 households felt insecurity and 64 secure. When we evaluate the predictions it is found that 27 of these 40 predictions of insecure are correct and 13 not. Of the 75 predictions of secure 51 are correct and 24 not. So in total there are 27+51=78 correct predictions and 13+24=37 wrong predictions. Overall the predictive power of the model is 78/115=0.678. Moreover, the

[2]Some authors use tenure insecurity and expectation of redistribution interchangeably. Here the two terms are different. Some farmers may expect re-distribution but they do not feel tenure insecurity due to their farm and personal characteristics. For instance small farm holders may expect re-distribution in the future but may not feel insecurity due to the size of their holding. This is because they are sure that they are not evicted from their small size

prediction of a model with only an intercept and no explanatory variables is 64 of the 115 observations. This gives us a baseline for predictions. So, the explanatory variables in the model give us an additional 14 correct predictions.

Conclusions

The result of the analysis indicates that tenure insecurity is an important factor that affects the probability of investing in soil conservation technologies. However, the reverse relation is insignificant. This shows that tenure insecurity has a negative impact up on the propensity to invest in soil conservation. This is because uncertainty in use rights leads to insecurity and reduced investment in land. Without clear and enforceable use rights, everyone is afraid others will reap the benefits of one’s own investment. Under conditions of tenure insecurity, resource use and investment decisions regarding land cannot be made with the long term. Planning horizons will be short term, and oriented to maximizing immediate profits. In Amhara Region, tenure insecurity is the result of the past redistribution and government land policy and hence farmers do not undertake long term soil conservation investment. Therefore, the land policy should provide long-term and lasting tenure security to the peasant. Secure and stable rights to the land may possibly help in creating positive incentive to undertake long term investments by land users, stimulating the rural economy. Moreover, secure rights may increase the planning horizon of farmers. The new initiatives undertaken by the regional government to address the problem of tenure insecurity through a user right document is a promising start. But registration of land use rights without prior legal clarification of land rights may not increase tenure security[3].

The analysis of soil conservation investment equation reveals that age, education, distance from the main road, public conservation investment, slope and tenure insecurity are the main socio- economic and institutional factors that influence individual soil conservation decision. The study shows that the presence of public investments has a substantial positive impact on private soil conservation decision. This is because farmers perceive the benefit of soil conservation technologies. Thus, continuing and expanding public soil conservation measures that serve as demonstration sites with collaboration of research, extension and farmers is of paramount importance. In this study we find a negative relation between distance from the main road and decision to invest soil conservation. This results suggest that policy makers to give emphasis on expanding road facilities. Expansion of road network has facilitated access to market and as the result the improvement in communication has enabled farmers to keep better informed about outlets. This has provided farmers with strong incentives to seek ways of increasing production by better conservation technologies. The analysis also shows that literate farmers have higher probability of investing soil conservation technology compared to illiterate farmers.

The analysis of insecurity model reveals that expectation of redistribution and farm size have a positive influence on tenure insecurity, whereas education level has a reverse effect. Almost all farmers expect future redistribution and this may erode tenure insecurity. To reverse this situation, the regional government should consider a policy that may end up periodic land redistribution and there should be an awareness campaign to inform all the stakeholders about it to immune them from this problem. Additionally, improving access to land rather than redistribution through other means such as development of land rental markets and encouraging longer lease may be an alternative strategy in situation where formal land transactions are not possible. However, investment has no a significant influence on tenure insecurity.

To sum up, the implication of these findings is that tenure security should be the top priority agenda for the regional government in order to increase farmers’ propensity to invest in soil conservation technologies and thereby to reduce soil erosion in particular, and to combat resource degradation in general. Finally, the study underlines the need to carry out future research to investigate the impact of land certification on tenure security.

[3]User rights documentation is being undertaken within the context of existing legislations. And these legislations are the ones that are responsible for promoting tenure insecurity.

REFERENCES

Amare T (1998). The effect of tenure security and land fragmentation on productivity and investment in smallholder agriculture: Evidance from Tiyo woreda, Arsi, Ethiopia.

Benin S, Pender J (2001). Impact of land redistribution on land management and productivity in the Ethiopian Highlands. Land Degrad. Dev. 12:555-568.

Besley T (1995). Property rights and Investment Incentives: Theory and Evidence from Ghana. J. Polit. Econ. 103(5):903-937.

Betru N (2003). Soil and water conservation program in the Amhara National Regional State. In: Tilahun A., (ed.).Natural Resource Degradation and Environmental Concerns in Amhara Regional State, Ethiopia: Impact on Food Security. Bahir Dar, Ethiopia.

Brasselle A, Gaspart F, Platteau J (2001). Land tenure security and investment incentives: Puzzling evidence from Burkina Faso. J. Dev. Econ. 67:373-418.

De Graaff J (1993). Soil conservation and sustainable land use: An economic Approach. Royal Tropical Institute. The Netherlands.

De Graaff J (1996). The Price of Soil Erosion: An economic evaluation of Soil conservation and watershead development Wageningen. The Netherlands.

Dessalegn R (2004). Searching for tenure security? The land system and new policy initatives in Ethiopia. Forum for social studies, Addis Ababa, Ethiopia.

Gavian S, Fafchamps M (1996). Land tenure and allocative efficiency in Nigeria. Am. J. Agric. Econ. 78:469-471.

Gebremedhin B, Swinton S (2003). Investment in soil conservation in northern Ethiopia: the role of land tenure security and public

programs.Agric. Econ. 29:69-84.
Gete Z (2003). Resource use and poverty in the Ethiopian highlands. In: Tilahun A., (ed.). Natural Resource Degradation and Environmental Concerns in Amhara Regional State, Ethiopia: Impact on Food Security. Bahir Dar, Ethiopia.
Hays J, Roth M, Zepeda L (1997). Tenure Security, Investment and productivity in Gambian Agriculture: A Generalized Probit Analysis. Am. J. Agric. Econ. 79:369-382.
Heerink N, Kuyvenhoven A, Wijk M (2001). Economic Policy Reforms and Sustainable Land use in Developing Countries: Issues and Approaches. In: Heerink, N., Keulen, H., Kuiper, M., (eds.). Economic Policy and sustainable Land Use: recent advances in quantitative analysis for developing countries. Physical Verlag, New York.
Holden S, Yohannes H (2002). Land Redistribution, Tenure Insecurity, and Intensity of production: A Study of Farm Households in Southern Ethiopia. Land Econ 78(4):573-590.
Hurni H (1988). Degradation and conservation of the resource in the Ethiopian highlands. Mt. Res. Dev. 8(2/3):123-130.
Lapar ML, Pandey S (1999). Adoption of soil conservation: The case of the Philippines uplands. Agric. Econ. 21:241-256.
Maddala GS (1983). Limited-dependent and qualitative variables in econometrics. Cambridge University Press.
Makokha M, Odera H, Maritam II.K, Okalebo JR, Iruria DM (1999). Farmers' perception and Adoption of soil management technologies in Western Kenya. Afr. Crop Sci. J. 17(4):549-558.
Mekonnen A (2009). Tenure security, resource endowments, and tree growing: Evidence from the Amhara region. Land Econ. 85(2):292-307.
Ostuka K, Place F (2001). Land tenure and Natural Resource Management: A comparative study of agrarian communities in Asia and Africa. IFPRI, Washington DC.
Otsuka K, Quisumbing A, Payongayong E, Aldoo JB (2003). Land tenure and the management of land and trees: the case of customary land tenure areas of Ghana. Environ. Dev. Econ. 8:77-104.
Pender J, Kerr J (1998). Determinants of farmers' indigenous soil and water conservation investment in semi-arid India. Agric. Econ. 19:113-125.
Shiferaw B (1998). Peasant Agriculture and Sustainable Land Use in Ethiopia: Econmic Analyses of Constraints and Incentives for Soil Conservation. Ph.d. Thesis. Agricultural University of Norway.
Shiferaw B, Holden S (1998). Resource degradation and adoption of land Conservation technologies in the Ethiopian High lands: A case study in Andit Tid, North Shewa. Agric. Econ. 18:233-247.
Shiferaw B, Holden S (1999). Soil Erosion and Smallholders' conservation Decisions in the Highlands of Ethiopia. World Dev. 27(4):739-752.
Shiferaw B, Okello J, Reddy RV (2009). Adoption and adaptation of natural resource management innovations in smallholder agriculture: reflections on key lessons and best practices. Environ. Dev. Sustain. 11:601-619.
Verbeek M (2000). A guide to Modern Econometrics. Chichester, John Wiley & Sons, Ltd.
Wannasai N, Shrestha RP (2008). Role of land tenure security and farm household characteristics on land use change in the Prasae Watershed, Thailand. Land Use Policy. 25:214-224
Winters P, Crissman C, Espinosa P (2004). Inducing the adoption of conservation technologies: Lessons from the Ecuadorian Andes. Environ. Dev. Econ. 9:695-719.