ORIGINAL ARTICLE

Determinants of Maintenance Decision of Introduced Soil and Water Conservation Practices in Fagita Lekoma District, North West Highlands of Ethiopia

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ABSTRACT

Land degradation owing to soil erosion and nutrient depletion is considered to be the central problem constraining the development of the agricultural sector in Ethiopia. Even though a number of soil and water conservation methods were introduced to combat land degradation, maintenance of these practices remains below expectations. The objective of this study was to identify major factors affecting farmers 'maintenance decision of introduced soil and water conservation (SWC) technologies in *Fagita Lekoma* District, North Western Highlands of Ethiopia. This study employed both quantitative and qualitative methods. A total of randomly selected 160 farm households were interviewed using semi-structured questionnaire. To analyze factors determining maintenance decision of introduced SWC technologies, the Tobit Regression Model was employed. Farmers' maintenance of improved soil and water conservation technologies as measured by meters per hectares was positively and significantly influenced by sex of household heads; farm size; perceived profitability of the technology; contact with extension agents; and slope of the land. On the other hand, participation in off-farm work and education status of household heads negatively and significantly affected maintenance decisions. Contrary to expectation, perception of tenure security, farmers' perception to erosion problem, soil fertility, age of household head, livestock holding and family size of households showed no significant influence on farmers' maintenance decision. Since, farmers would likely maintain SWC structures if they perceived the technology as profitable, the Agricultural Offices of the districts should work to demonstrate the profitability of the technologies. Extension advice should also practically show how conservation practices increase productivity and profitability.

Key words: Northwestern Ethiopia, Maintenance decisions, Soil and Water Conservation

INTRODUCTION

The economic development of Ethiopia depends on the performance of the agricultural sector. However, diminishing productivity owing to soil erosion induced degradation of agricultural land has been a great concern (EFAP, 1994). Recognizing land degradation as a most important environmental and socio-economic problem, the government of Ethiopia has made several interventions in the past three decades. As a result, large areas have been converted to terraces, covered by soil bunds, closed by area closures and planted with millions of tree seedlings. Yet, the achievements have fallen far below expectations. The country still loses tremendous amount of fertile topsoil, and the threat of land degradation is broadening alarmingly (Teklu and Gezahegn, 2003).

The most imperative reason for low performance of soil and water conservation (SWC) activities is the low adoption of SWC technologies. Farmers at the start have been coerced to participate in the construction of SWC structures because the construction is undertaken through group labour. The rate of continued use is, however, very low because most farmers prefer to get rid of the structures from their farmland instead of maintaining them after they are constructed. Therefore, implementation of SWC may not lead to sustained land rehabilitation unless the technologies are maintained and utilized continuously.

Thus, appropriate understanding of the major factors affecting farmers' maintenance decision of SWC technologies would assist in the formulation and implementation of the policy interventions designed to induce voluntary continued use. Because farmers have the ultimate say on maintenance decision, clear knowledge of the factors that influence farmers' maintenance decision is an essential step in the effort of combating severe soil erosion. The fact that the study site is in the part of the country where there is scant information on land users' conservation behavior further substantiates the significance of the study. The main objective of this study was to identify the major factors affecting farmers' maintenance decisions of introduced SWC technologies in Fagita Lekoma district, Northwester Ethiopia.

The Study Site

The study was carried out in Fagita Lekoma district. It is found in Awi Administrative zone, Amhara Regional State, Northwestern Ethiopia. The study area has 25 *kebeles* (rural administration) with a total population of 129,650 including 64,102 males and 65548 females (CSA, 2008). In terms of topography, the district is predominantly mountainous. It is situated at at altitude ranging from 1800-2950 meters above sea level. The district has both Dega and Woina Dega agro-ecological zones (55% of the area comprised of Dega and 45% Woina Dega). The district has an average temperature ranging from 22 to 26^0c. Total annual rainfall is comparatively very high with a long-term mean of 2371 mm per annum. More than 97% of the population is engaged in agriculture. The soils are mostly red and moderately fertile with a high production potential (CSA, 2004). Soil erosion in the study area is severe and is the result of the mountainous and hilly topography, a low degree of vegetation cover and gully erosion. Soil erosion has made cultivation infeasible in several parts. This together with increasing population pressure has forced farmers to constantly cultivate new and more marginal areas. Most SWC efforts have focused on highly degraded areas. Marginal steep lands have been terraced with a few structural SWC measures. Despite their promotion, maintenance of SWC practices has been limited. Thus, land degradation remains a threat to agricultural production.

MATERIALS AND METHODS

Data for this research was mainly obtained through a household survey that was conducted in 2012 using a structured survey questionnaire. The questionnaires generated information on household demographic and socio-economic characteristics and on additional factors affecting maintenance decision of the introduced conservation technologies. Besides, qualitative information was obtained from informal group discussions held with male and female farmers of various ages as they are relevant to explaining the perception of farmers and to identify problems associated with the SWC technologies.

The sampling procedure was a combination of purposive and random sampling techniques. The first step was purposive selection of three sample *kebeles*. The criterion for the selection of these *kebele*s was based on the fair consideration of the average length of maintained SWC works per ha conducted by each *kebele* of the study area. To this end, recent statistical data about maintenance of the introduced SWC works conducted by each *kebele* of the district was obtained. Finally, those *kebeles* with the highest (Kwari), medium (Amen Abo) and lowest amount (Tafoch Danbul) of SWC works were selected as sample *kebeles* of the study area. The second stage was simple random sampling of households from the list of each selected kebele. And finally, 160 sample households managing 456 farm plots were drawn out of the total households of the three sample *kebeles*.

To analyze factors determining farmers' maintenance decision of introduced SWC technologies, Tobit Regression Model with the STATA Software Version 11.2 was employed. On the other hand, for the informal group discussion conducted with HHs, a qualitative analysis was used.

Model Specification

Farm households in Fagita Lekoma district differ based on the intensity of maintenance of SWC structures. There are non-maintainers of these improved SWC measures. Since some households do not maintain bund terraces and cut-off drains, the reported proportion of households is equal to zero. As noted in Greene (2000), a dependent variable that has a zero value for a significant fraction of the observations requires a censored regression model (also referred to as a Tobit Regression Model). Tobit model is superior over other dichotomous regression models in that the later only attempts to explain the probability of maintaining or non-maintaining of technologies rather than the intensity or extent of maintenance. Strictly dichotomous variable often is not sufficient for examining the extent and intensity of maintenance decision (Feder *et al*., 1985). Thus, analysis of the determinants of the maintenance of SWC requires the application of a censored regression model. Censored regression is preferred because it uses data at the limit as well as those above the limit to estimate regression. Following Maddala (1997), the Tobit model can be derived based on defining a new random variable y^* that is a function of a vector of variables x as:

$Y^*_i = \beta x_i + \varepsilon_i$,

$y_i = 0$ if $Y^*_i \leq 0$, ……Equation (1)

$y_i = 0$ if $Y^*_i > 0$,

Where: y_i =is the observed (limited, censored) dependent variable, y_i^* =is a latent variable that is not directly observable, x_i =is a vector of factors affecting y^*, β_i =is a vector of unknown parameters, ε_i =are residuals that are assumed to be independently and normally distributed with mean zero and constant variance, σ^2 and i= are the index of the observed values from 1, 2 ….n.

The above model follows many previous analyses (Amemiya, 1985) in that it assumes censoring at 0 (although other values are possible) and that the error terms are normally distributed.

$$\log L = \sum_{y_i>0}^{n} -\frac{1}{2}\left[\log(2\pi) + \log\sigma + \frac{(y_i - \beta x_i)}{\sigma}\right] + \sum_{y_i=0}^{n} \log\left[1 - \emptyset\left(\frac{\beta' x_i}{\sigma}\right)\right] \text{ ... Equation (2)}$$

Where, L is the Likelihood Function and $\emptyset$ is the cumulative normal distribution function. The marginal effect on y (the observed variable) of a change in an explanatory variable x differs from the value of the β coefficient in the censored regression model. The marginal effects are a function of the x values, and are given by:

$$\frac{\partial E[y_i/x_i]}{\partial x_i} = \beta.\emptyset\left(\frac{\beta x_i}{\sigma}\right) \text{ ..... Equation (3)}$$

Where, $\emptyset$ is the cumulative normal distribution function. Often these marginal effects are calculated and reported at the mean values for the vector x, although in principle they could be calculated for individual households. Mc Donald and Moffit (1980) proposed a useful decomposition of these marginal effects, because a change in the x's has two different effects. One is that x affects the

conditional mean of y_i^* in the positive part of the distribution. However, *x* also affects the probability that the observation will fall in that part of the distribution. Expressed mathematically, this decomposition is as follows:

$$\frac{\partial E[y_i/x_i]}{\partial x_i} = P[y_i > 0]\frac{\partial E\left[\frac{y_i}{x_i}, y_i > 0\right]}{\partial x_i} + E\left[\frac{y_i}{x_i}, y_i > 0\right]\frac{\partial P[y_i > 0]}{\partial x_i} \ldots\ldots \text{Equation 4}$$

Where, *P* indicates probability. The marginal effects will be reported for this study.

Empirical studies and variables

A review of previous studies is important as it provides some conceptual and theoretical basis for identifying the relevant variables to be included in the analysis. The dependent variable represents farmers' involvement in the maintenance of SWC practices in each plot. It is represented by the length of bund terraces maintained (m/ha) and/or the length of improved cut-off drain maintained (m/ha). Regarding the determinant factors, many studies have related farmers' conservation decisions to a range of variables that are often classified as household and plot level factors (Baidu-Forson, 1999; Bekele and Drake, 2003), although the use of these variables often lacks consistency in the conservation literature.

The most important household level attributes considered in the Tobit Regression Analysis include:

Age (AGEHH): The effect of age of the farmer on maintenance decision may be either negative or positive (Bekele and Drake, 2003; Lapar and Pandey, 1999). Older age often associated with long years of farming experience could positively influence maintenance decision. In contrast, younger farmers with longer planning horizons are likely to invest more in the maintenance of SWC technologies. Sex (SEXHH): In most cases males continue the use of improved SWC technologies better than women (Anley *et al*., 2007).

Education Level of the Household (EDUHH): The study conducted by Gebremedehin and Swinton (2003) did not found level of education as an important factor, possibly because of the generally low level of education among their sample farmers. Another study carried out by Amsalu and de Graaff (2006a) found different results: education of household heads was found to have a positive and significant influence on the continued use of

improved soil and water conservation technology.

Family Size (FAMLY): Family size might have dual effects on land users' maintenance decisions. The findings of Bekele and Drake (2003) noted that in a family with a greater number of mouths to feed, competition arises for labour between food generating off-farm activities and maintenance of SWC practices. On the other hand, large family size may relax labour constraints needed for maintenance of conservation measures (Gebremedhin and Swinton, 2003).

Perception of soil erosion as a menace to crop production (PERCP): Theoretically, those farmers who perceive soil erosion as a problem having negative impacts on productivity are likely to make a decision in favor of maintaining SWC technologies (Gebremedhin and Swinton, 2003). On the other hand, when farmers do not acknowledge soil erosion as a problem, they will not decide to maintain any conservation technologies.

Farm Size: Large farms could reflect greater capacity that encourages conservation (Cramb *et al*., 1999), while the potential loss of land for conservation may discourage investments on small farms.

Perceived Profitability of the Technology(PROFT) was measured as a dummy variable where farmers were asked whether they think the SWC technology is profitable or not. Amsalu and De Graff (2006a) noted that some of the most important characteristics of conservation technologies that influence maintenance decision of farmers are effectiveness in controlling soil loss, benefits to be obtained from adoption, and appropriateness to the farming system circumstances. If the improved SWC technologies do not appear to be relevant to the farmers in view of these criteria, it is highly unlikely that they will maintain them.

Participation in Off-Farm Work (OFARM): Participation in off-farm work could keep the labour force needed for maintenance activities away from the farm. Further, income obtained from off-farm work may obscure the benefits accruing from maintenance activities (Bekele and Drake, 2003).

Livestock Ownership (LIVESTOK): The fact that livestock is considered as an asset that could be used in the production process or exchanged for cash or other productive assets suggests a positive influence on the continued use of SWC technologies (Bekele and Drake, 2003).

Perception of Land Tenure Security (TENUR): According to Gebremedhin and Swinton (2003), secure land tenure rights reinforce private incentives to continued use of SWC technologies. It is therefore difficult to decide its effect at the beginning.

Contact with Extension Agents (EXTEN): This refers to the number of times the extension agents visit the farmers to give extension advices on soil and water conservation technologies. Contact with extension agents, a proxy for access to information, was likely to contribute positively to farmers' maintenance decision.

Plot level attributes included in the Tobit Regression Analysis were slope (categorized into gentle slope and steep slope) and soil fertility (categorized into low fertility and high fertility).

Slope: Since erosion severity is likely to increase with steepness in slope, the effect of steep slope is positive on maintenance decision of conservation make long-term investments in soil conservation. Contrary, Amsalu and De Graaf (2007) found that tenure security had no significant influence on measures (Amsalu and De Graaff, 2006b).

Soil Fertility: Because marginal productivity loss due to erosion will be higher from plots with fertile soils that are expected to give high return in the short-term, soil fertility influence maintenance decision positively (Bekele and Drake, 2003).

RESULTS AND DISCUSSION

Determinants of Farmers' Decision to Maintain SWC Technologies

Table 1 shows descriptive statistics of the variable in the tobit regression. Sex of the household head, participation in off farm activity, perceiver profitability of the technology and obtaining extension advice were measured as dichotomous dummy variable.

Table 1: Descriptive statistics of variables in regression

Variable in regression	N	Minimum	Maximum	Mean	Std. Deviation
Age of HH head	160	25	72	42.14	10.525
Sex of HH head	160	0	1	0.78	0.415
Educational status of HH head in years	160	0	10	1.31	2.568
Farm size in hectare	160	0.5	3.5	1.814	0.7155
Participation in off farm activity	160	0.00	1.00	.4625	0.50016
Family size	160	2.00	12.00	6.2875	1.96314
Perception to erosion problem	160	2.00	4.00	3.3875	0.54930
Land owner ship	160	0.00	2.00	1.4313	0.52151
Perceived profitability of the technology	160	0.00	1.00	0.8000	0.40126
Obtaining extension advice	160	.00	1.00	0.8750	0.67990
Live stock holdings in TLU	160	0.03	8.01	3.6869	2.34597
Maintenance (M/ha)	160	0.00	125.00	32.9950	37.76923
Valid N (listwise)	160				

Presence or uptake of conservation practices alone may not lead to sustained land rehabilitation unless the technologies are maintained continuously. Thus, determinants of farmers' maintenance decision of improved SWC measures were examined in Fagita Lekoma District (called *woreda* in Amharic, the official language of Ethiopia), NW Highlands of Ethiopia. Results of Tobit regression analysis revealed that maintenance decision of the introduced SWC technologies was influenced by both household and plot level attributes (Table 2 and 3). The log likelihood ratios for all cases were significant ($p < 0.01$). This indicates that there exists useful information in the estimated regression models.

Household Level Attributes

Variables at household level found to have significant influence on maintenance decision include sex, education, farm size, and participation in off-farm work, perceived profitability of the technology and extension contact (Table 2).

Age of household head (AGEHH) was not found to be the main factor to determining maintenance of improved SWC technologies in the study area. Sex of house hold head (SEXHH) was found to have a positive and significant influence on maintenance decision of the introduced SWC measures ($p<0.05$). Male headed households increased the probability of maintenance decision of conservation technologies by 27.4 percent. On average, male headed households had increased the length of maintenance of improved SWC technologies by 9.35 metre per hactare. The reason for low maintenance behavior of female headed households was probably that maintenance of SWC measures demanded much labour and cannot be done by women alone.

Education level of household heads (EDUHH) and maintenance decision of conservation technologies had negative and significant relationship. Each additional year of schooling decreased the probability of maintenance decision of conservation technologies by 4.4 percent. Hence, the effect of insufficient education was not the main hindrance of farmers' involvement in maintenance of SWC. One of the reasons for low maintenance behavior of sample educated farmers was probably that educated farmers are more involved in off-farm activities. The results of t-test showed that education status of sample households and involvement in off-farm work was found to have direct and significant relationship ($p<0.01$). This indicates that educated farmers were highly engaged on off-farm

activities than non-educated households. Amsalu and de Graaff (2006a) stated that participation in off-farm work could keep the labour force needed for maintenance of introduced SWC away from the farm.

Table 2: Maximum Likelihood Estimates of Tobit Regression Model for Household Attributes

Household Level Variables	**Coef.**	**Std. Err.**	***t***	***P>t***	***Marginal Effects on***	
					Prob.	***Intensity***
AGEHH	-0.193	0.441	-0.44	0.661	-0.001	-0.074
SEXHH	26.97	10.26	2.63	0.009	0.274	9.351
EDUHH	-4.315	1.937	-2.23	0.027	-0.044	-1.662
FARMS	30.40	8.192	3.71	0.000	0.311	11.712
OFARM	19.56	8.927	2.19	0.030	0.197	7.626
FAMLY	0.811	2.533	0.32	0.749	0.008	0.312
PERCP	7.870	7.280	1.08	0.281	0.080	3.032
TENUR	-3.454	7.106	-0.49	0.628	-0.035	-1.330
PROFT	78.06	19.68	3.97	0.000	0.638	22.299
EXTEN	17.75	5.710	3.11	0.002	0.182	6.839
LIVESTOK	2.737	1.996	1.37	0.172	0.028	1.054
CONSTANT	-180.798	41.252	-4.38	0.000		
Log likelihood = -450.608						
Number of observations = 160						
Censored observations= 77						

Household family size (FAMLY) was not found to be the main factor determining maintenance of improved SWC technologies in the study area. Although family size as a proxy variable for labour available was not found to be significant, discussion with farmers as well as survey questionnaire asking for reasons for lack of maintenance of the SWC structures indicate that low labour availability is a deterrent factor. The majority of the farmers (72 %) who have not maintained the SWC structures in their farmland have indicated that the main reason was lack of labour.

Farmers' perception to erosion hazard (PERCP) did not significantly affect maintenance of SWC technologies. Theoretically, those farmers who perceive soil erosion as a problem having negative impacts on productivity and who expect positive returns from conservation are likely to make a decision in favor of constructing and maintaining available conservation technologies.

The effect of farm size of households (FARMS) was found to be positive and significant ($p<0.01$), suggesting that farmers who hold large farms were more likely to maintain improved SWC technologies. Each additional hectare of land increased the probability of maintenance decision of conservation technologies by 31.1 percent. On average, each additional hectare of land holding size has increased the length of maintenance of improved SWC technologies by 11.71m/ha. This agrees with the argument that larger farms offer operators more flexibility in their decision-making. During informal discussion, the majority of farmers believed that SWC technologies put too much land out of production. This could indicate that farmers having smaller farm plots would be discouraged from maintaining the technologies because marginal loss of land occupied by conservation technologies would be higher for farmers having smaller farm plots.

Livestock ownership represents the livestock holding of the household in tropical livestock unit. It was assumed that income generated from livestock can be used to purchase inputs and to hire labour for maintenance activities. In this study, however, livestock holdings of households did not affect significantly maintenance of SWC technologies.

Participation in off-farm work (OFARM) and maintenance decision of SWC technologies had negative and significant effect ($p<0.05$) on maintenance of SWC technologies. Farmers who did not participate in off-farm work increased the probability of maintenance decision of conservation technologies by 19.7 percent. On average, farmers who did not participate in off-farm work increased the length of maintenance of improved SWC technologies by 7.62 m/ha. Farmers in the study area engage themselves in off-farm income earning activities in the nearby urban centre. Hence, the effect of participation in off-farm activities on maintenance decision was found to be significantly negative. Short-term benefits from off-farm activities seem to attract farmers' labour

more than investments in maintenance of conservation practices. This indicates that the lack of time for maintenance of conservation measures due to involvement in off-farm work may have been more a matter of lack of cash income (Cramb *et al*., 1999) than capital accumulation.

Farmers' perceived profitability of improved SWC practices (PROFT) positively and significantly influenced maintenance behavior of farmers ($p<0.01$). This indicates that farmers who found the technologies profitable have retained improved SWC measures. Farmers who found SWC technologies profitable increased the probability of maintenance decision by 63.8 percent. On average, farmers who perceived SWC technologies profitable increased the length of maintenance of improved SWC technologies by 22.29 m/ha. Therefore, as Amsalu (2006) noted, to ensure continued use, the conservation component must be profitable to the farmer. Particularly, farmers are very curious about the yield effect of the technology since the structures take up productive land, and maintenance is often labour intensive and costly. During informal discussion, farmers who did not retain conservation structures indicated that increase in crop yields associated with SWC technologies could not recompense for the 'lost lands' and the 'labour cost' due to the construction and maintenance of SWC structures. This indicates that some farmers do not consider the long term benefit of SWC structures. Further, they complained about yield losses due to pest infestation associated with the bund terraces rather than effectiveness of the measure in erosion control. This was also found to be the case among the farmers in Wolaita and Wollo where farmers failed to maintain or even deliberately cleaned out SWC structures because the structures were not perceived as profitable by farmers (Beshah, 2003).

Extension services (EXTEN) measured in number of visits or contacts per month by the extension agent to a farmer positively and significantly influenced farmers' maintenance decision. Each additional visit of a farmer by the extension agent increased the probability of maintenance decision by 18.2 per cent. On average, each additional visit has also increased the length of maintained SWC technologies (m/ha) by 6.839. Farmers having more contact and receive extension advice was found to maintain the introduced SWC technologies. This is probably due to the fact that they got technical support and information about the

importance of SWC technologies. Other studies arrived at different conclusions in relation to the effect of extension services on farmers' maintenance decision of SWC technologies (Amsalu and de Graaff, 2006a; Gebremedhin and Swinton, 2003; and Semgalawe and Folmer, 2000). For example, Amsalu and de Graaff (2006a) found out negative effect of extension contacts on farmers continued use of SWC technologies, which is counter intuitive.

There was no significant relationship between perception of land tenure security (TENUR) of farmers and maintenance decision of improved SWC technologies. In line with the result obtained in this study, Amsalu and De Graaf (2007) also found that perception of tenure security had no significant influence on farmers' continued use of SWC technologies in Ethiopia.

3.2. Plot Level Attributes

Plot level attributes included in the estimation were slope (categorized into two classes) and soil fertility (categorized into two levels). Positive and significant relationship was found between steep slopes (STEEP) and maintenance of improved SWC technologies (Table 3). Steep slope farm plots increased the probability of maintenance decision by 56 percent. On average, steep slope farm plots increased the length of maintenance of improved SWC technologies by 39.7 metre.

Since soil erosion severity is much likely to increase as the steepness of the slope increases, farmers who had a steeper farm plots tend to maintain introduced SWC technologies than those having flat and gentle slope lands. Soil fertility conditions of farm plots (FERTILITY) were not found to be an important factor determining maintenance level of farmers. The impact of high soil fertility on maintenance decision of farmers was not significant.

Table 3: Likelihood Estimates of Tobit Regression Model for Plot Level Attributes

Plot Level Variables	Coef.	Std. Err.	T	P>t	Marginal Effects (dy/dx) on Prob.	Intencity
STEEP	93.46	11.06	8.45	0.00	0.56	39.74
GENTLE	17.57	9.86	1.78	0.08	0.12	6.03
LOWFERT	8.28	7.95	1.04	0.30	0.06	2.89
HIGHFERT	-9.85	9.69	-1.02	0.31	-0.07	-3.26
CONSTANT	-42.45	9.67	-4.39	0.00		
Log likelihood = -1235.0795						
Number of observations =456						
left-censored observations (at Maintenance ≤ 0) =256						

CONCLUSION AND RECOMMENDATIONS

This study tried to assess the major factors influencing maintenance decision of SWC technologies. Since farmers have the ultimate say on the decision of maintenance, clear knowledge on farmers' perception and the factors that influence farmers' maintenance decision is an essential step in the attempt of combating soil erosion and land degradation. So, according to the results obtained from this study, farmers' maintenance decision of improved SWC technologies was positively and significantly influenced by sex of household heads; farm size; perceived profitability of the technology; contact with extension agents; and steep slope of the land. On the other hand, participation in off-farm work and education status of household heads affect maintenance decision negatively and significantly. Finally, age of household heads; livestock holding; family size of households; soil fertility; perception of tenure security; and farmers' perception to erosion problem showed no significant influence on farmers' maintenance decision.

Since the introduced SWC technologies required high labour for maintenance, the agricultural offices of districts should encourage farmer collaborations and community participations which enable farmers to get the labour required to maintain SWC structures. In this regard, special attentions should be

given for farmers' collaboration to support female headed households. Since farmers would likely maintain SWC structures if they perceived the technology is profitable, the Agricultural Offices of the districts should work to demonstrate the profitability of the measures. Extension agents should practically show how conservation practices increase productivity and profitability. In addition to this, since SWC structures were more likely to be maintained on steep slopes, farmers maintained SWC technologies on farm plots where they expect more benefits from conservation. This suggests that conservation efforts should target areas where expected benefits are higher, like on steep slope lands so as to encourage maintenance decision. Finally, taking an integrated and comprehensive approach that takes into account the various factors influencing maintenance decision in the preparation of SWC plans and implementation is quit important to encourage maintenance of SWC structures.

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