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DETERMINANTS OF ADOPTION OF INTRODUCED LAND MANAGEMENT PRACTICES IN SANA WATERSHED, SOUTHERN ETHIOPIA

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Abstract

In Ethiopia, soil erosion is a severe problem and a major cause of the decline of land productivity. A number of soil and water conservation practices were introduced in south central highlands of Ethiopia to combat land degradation and for sustainable land management. However, the adoption of these practices is far below the expectation. The objective of this study was to examine factors affecting adoption of introduced land management practices in Sana watershed, Southern Ethiopia. Mixed research design methods were employed in order to conduct this study. Questionnaires, focus group discussion, in-depth interview and field observation were used to collect data. A binary logistic regression model was employed to analyze the collected data and to interpret the result. The result showed that sex of house hold heads, education status of house hold heads, access to extension services and training were positively correlated at significant level with the adoption of the introduced land management practices. On the other hand, the age of house hold heads, and distance of farmlands from home steads influenced the adoption of introduced soil and water conservation practices negatively. The finding showed that the identified environmental, demographic, economic, and institutional factors influence the adoption of land management practices. This implies that the regional and local administrates should consider these factors to improve farmers' acceptance of introduced land management practices and to promote agricultural productivity and environmental quality. Extension and training services on the introduced land management practices for the farmers and agricultural extension service workers should also considered by the regional and local administrates.

Keywords: Adoption, Land management, Sana Watershed, Soil Erosion

1 Introduction

The primary development goal, which is sustainable economic development of the Ethiopian government, is to achieve food security and eradicate poverty (Kharioet *al.*, 2016). While the agricultural sector has to provide commodities for domestic food consumption, supply raw materials for agro-industries and export, increase income of farm households and create expanded demand for manufactured products; the performance of Ethiopian agriculture has remained weak. Despite its importance, the performance of agricultural sector in Ethiopia has been unsatisfactory compared to the rapid population growth, for instance, the average growth rate of agricultural sector from 1982-1996 was 2.27%. This probably leads the country to have considerable food insecurity (Getaye, 2020).

Soil erosion is a global problem and considered

as one of the major issues in many countries (Berberoglu *et al*., 2020) and is a serious problem in Ethiopia (Dabi *et al*., 2017). Different soil and water conservation technologies were implemented for combating soil erosion and nutrient depletion, improving water conservation and enhancing soil and water productivity and rehabilitating degraded areas (Berberoglu *et al*., 2020). The Ethiopian farmers have long been aware of soil erosion problems and devised techniques to halt soil erosion and to conserve land resources, as part and parcel of agricultural systems (Assefa and Hanns, 2014). However, soil and water conservation practices have not been adopted and sustainably used by the farmers (Betru, 2002; Fitsum *et al*., 2002; Yeraswork, 2000).

The common land and soil degradation problems are observed in south central highlands of Ethiopia especially in the highlands of Kambata Tambaro, Wolaita and Hydiya zones. This study is undertaken to assess farmers' use of introduced and indigenous soil and water conservation interventions in the Sana middle watershed in the SNNPR. This area is among the most densely populated areas in the country with 573 persons per square kilometer (PCC-FDRE, 2008) and has steep slope topography that leads high run off during intense precipitation. Furthermore, due to long historic agricultural practices and lack of appropriate soil and water conservation practices, a number of agricultural lands, forest area, range lands, sloppy areas and grazing lands are seriously damaged.

Currently, the Ministry of Agriculture of Ethiopia has Growth and Transformation program to involve rural communities living in highly degraded and drought prone areas in soil and water conservation and afforestation practices (MoA, 2003). These practices were also implemented in the study area. In addition to government efforts, local NGO, namely KMG (Kambati Menti Gezima) has made different conservation measures like fanya juu, soil bunds, area closures, and planting different types of trees on farmlands.

Most of farmers of the study area were involved in the implementation of the soil and water conservation programs. However, the programs have not been successful in a meaningful and sustainable manner due to low adoption of farmers to the practices to alleviate soil erosion problem on their farmlands and degraded lands. Moreover, the implementation rate of the soil conservation practices was very low since the farmers resist accepting and applying the introduced land management practices effectively and continuously. Hence it is very important to study the main factors and problems related with the application of introduced land management programs. Therefore, this study is to explore demographic, economic, institutional, and environmental factors that influence households' introduced land management practices.

2 Materials and Methods

2.1 Description of the Study Area

The study watershed is located in SNNPR; in *Kambata Tambaro zone HaderoTunto zuria Wereda*. Astronomically, the study area is located between 7°9′00″N - 7°19′30″N latitude and 37°34′30″E - 37°43′30″E longitude (Figure 1).

According to south nation nationalities Bureau of Finance and Economic Development (SNNPR BFED, 2019) the study area has three agro ecological zones - *Dega, Weyna Dega*, and *kola*, which cover 17.39% and 57% and 13.04%, respectively. The Watershed is characterized by rugged topography, which comprises mountains, plains, and plateaus and its altitude ranges from 782m to 2810m above mean sea level (Figure 1). Its mean annual temperature and total annual rainfall is about 26°*C* and 850-1400mm respectively (SNNPR BFED, 2019). The main rainy season in the area is summer (*Kiremt*) that ranges from June to August with maximum rain fall and two minimum rainy seasons spring (*Tsedy*) and Authomn (*Mekar*) with little rain fall. The dry season (*Bega*) in the area is mostly from October to February (Hadero Tunto Zuria wereda agricultural and Rural Development office (HTZWARDO), 2019).

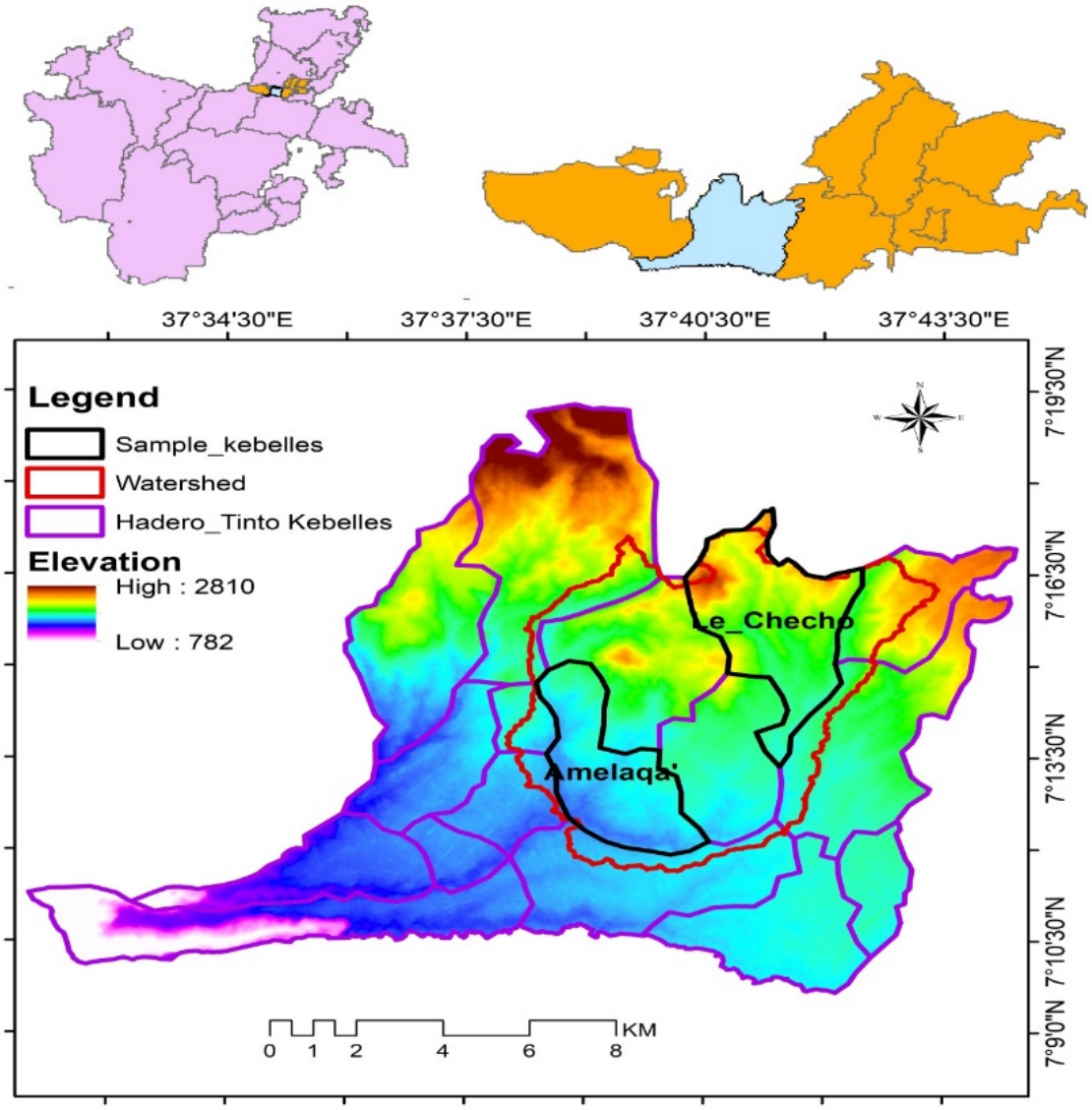

Figure 1 Map of the Study Area

2.2 Research Design and Methodology

Mixed research design approach was employed in this study. Among the different types of mixed research methods, concurrent or parallel approach was implemented. The quantitative research method enabled the researchers to collect data on all quantified relationships between adoption of introduced soil and water conservation practices and factors (household characteristics, and socioeconomic, institutional, and physical factors) affecting it. Qualitative research method was used to collect and analyze qualitative data which were used to strengthen and bridge the gap in quantitative research method.

2.3 Data Source and Data Collection Techniques

Questionnaires, in-depth interview, focus group discussion and field observation were used as the foremost primary data collection methods. The questionnaire included both closed and open-ended ques-

tions. It enabled the researchers to collect data from representative sample household farmers. In-depth interview was conducted with key informants who were considered knowledgeable about the general situation of soil and water conservation practices. In addition, the secondary data were gathered from the annual report of the related offices such as Soil and Water Conservation manuals, different written documents, books, and statistical data about the physical and socio-economic conditions of the study area.

2.4 Sampling Technique and the Sample Size

Getting representative and reliable information and drawing important conclusions about the study employing sound methodologies are a pre-requisite. Thus, the researchers used both probability and non-probability (purposive) sampling techniques. Simple random sampling technique was used to select farmers from the Sana watershed who adopted the introduced land management practices. Out of the total six *kebeles* of the watershed, two of them were purposively selected; namely *Le-checho* kebele and Amelaqe *kebele*. These kebeles were selected because they are relatively considered more degraded areas than the rest of the *kebele's* of the watershed due to their higher slope range. As a result, intensive land management intervention practices were exercised by local NGO, namely *KMG* and the government to rehabilitate degraded lands. The farmers in the areas were selected proportionately based on population size of the Kebele and their practice of adopted introduced land management.

The sample size of the respondents was determined by (Yamane, 1967) sample size determination formula. From the total 1830 household heads in the sample kebeles, 95 respondents constituted the sample size. Finally, proportional numbers of sample respondents were taken from each sample Kebeles. Key informants were selected purposively from the woreda agricultural experts, agricultural extension workers, local NGO (KMG) and kebele administrators. Based on data saturation, 7 key informants were employed. Ten knowledgeable participants were purposely selected for focus group discussion.

2.5 Data analysis and Interpretation Methods

There are different factors that determine the application of introduced land management practices. These factors can be categorized under demographic, economic, institutional, and environmental factors. In this study such factors as educational level, age, sex, households' contact with development agents, land holding size, household size, and training, distance of farmland from home, slope, annual income and access to credit are assumed to be potential determinants of application of introduced land management practices.

An attempt is, therefore, made to find out the relationship between these factors and introduced land management practices in the study area. Binary logistic regression model was applied to analyze the relationship between independent and dependent variables using SPSS 20.0. The dependent variables predict the presence or absence of characteristics or outcomes based on the value of a set of predictors or independent variables.

Before proceeding to the analysis, model fitness was considered for introduced land management practices. The fitness of the model for application of soil bund was Cox and Snell (R^2 = 0.652) and the Nagelkerke (R^2 = 0.946). The Nagelkerke value (R^2) explained that 94.6% of soil bund application has relationship with the independent variables in the model.

3 Results and Discussions

The major factors that influenced adoption of soil bund practices in Sana watershed were identified by analyzing the dependent variable (adoption of introduced land management practices) against 11 explanatory variables and the results were presented as hereunder.

Household characteristics and adoption of introduced land management practices

Among house hold characteristics, the age of the household head influenced the adoption of intro-

duced land management practices. One-unit increase in the age of farmers is found to have decreased odds of introduced land management practices by the factor of 0.233 and the result is statistically significant ($p < 0.05$) (Table 1). The negative and significant relationship could be explained that older farmers are influenced by labor shortage which can be a hindrance to practicing introduced land management. This is inconsistent with previous study conducted by Chomba (2004) which showed the age of farmers to have positive and significant influence on implementation of introduced soil and water practices.

Educational status of farmers has a predictive power in explaining implementation of introduced land management practices. Holding other repressors constant, a change in household head education level by one unit, say one grade, increases the probability of introduced land management practices by the factor of 3.017. This result is statistically highly significant ($p < 0.05$) (Table 1). The finding of positive association between household heads educational status and introduced land management practices is similar to the findings by Habtamu (2006), which identified educational status of farmers has positive influence on farmers' decision to retain introduced soil and water conservation structures. And also another study carried out by Krishna *et al.* (2008) indicate that education of the household head was found to have a positive and significant influence on the application of soil and water conservation strategies. This indicated that the higher educate level of household head increase their ability to find information.

Sex of the household heads is positively correlated with the adoption of introduced land management practices. Most of the land management practices require more labor force. Hence, male headed households are expected to spend much more time and labor in engaging on land management practices than female headed households. As logistic regression analyses indicated, the sex of the household head is positively and significantly affects the decision to use land management practices. Taking female headed households as a reference group, the odds of implementing introduced land management practices among male headed households was 2.625 times or more likely greater than that of the female headed households. This result is statistically highly significant ($p < 0.05$) (Table 1). The finding is in conformity with the assumption that male headed households are more likely to practice land management than female headed households. The result is consistent with (Krishna *et al.* 2008) that showed that male headed households have a higher chance to be involved in the use of SWC technologies than women. This might be due to the fact that Physical structures that were constructed are highly labor intensive and cannot be undertaken by women alone.

The household with larger size are supposed to be better in undertaking different land management practices since they are less likely to have shortage of labor which is required to do land conservation activities. Consistent with this expectation, logistic regression analysis indicates that there is significant relationship between number of household sizes and application land management. This implies that, as family size increases by one person, the likely for land management practices increases by a factor of 4.367. This result is statistically highly significant ($p < 0.05$) (Table1). This shows that the presence of sufficient size of labor force in a household is an important requirement for the application of land management practices. This result is similar with the survey result of Eleni (2008) that was conducted at Tulla District, Ethiopia, which state that household size could have a positive and significant relation with implementation of soil and water conservation structures. However, this result is not consistent with Bekele and Drake (2003), a study conducted in the eastern highlands of the Ethiopia and noted that in a family with a large number of mouths to feed, immediate food need is given priority and labor is diverted to off-farm activities that generate food.

Environmental factors and adoption of introduced land management practices

The distance of farm land from the home determines the application of introduced land management practices. The analysis indicates that the distance of farm land from the home is negatively associated with ap-

plication of introduced land management practices. With one-unit increase in the distance of farm land from the home the probability of introduced land management application decreases by a factor of 0.475 and the result is statistically significant at $p < 0.05$ (Table 1). The result is consistent with Berhanu and Swinton (2003) studied about investment in soil conservation in Northern Ethiopia. They found that plots distant from homesteads discouraged investment in soil conservation. Similar, study conducted by Habtamu (2006) also showed that farmers residing close to their cultivated land invest more on soil conservation measures than their counterparts living at distance. This is because cultivated lands closer to the residences receive more attention and supervision than land that is situated at the farthest distance.

A positive relationship was observed between slope gradient and application of introduced land management practices. This means sloppy land had significantly more soil bund terraces than flat fields. It indicates that a one-unit increase in the gradient of slope (from flat to very steep slope), the probability for introduced land management practices increases by a factor of 4.314. This result is statistically significant ($p < 0.05$) (Table 1.). This finding is similar to the findings of Eleni (2008) who found out that farmers cultivating steep slopes are constructing soil bunds and fanya juu on their farmland to prevent soil erosion.

Economic factors

A positive relationship was observed between income level of households and application of introduced land management practices. It indicates that when household income level increases by one birr, the probability of a household practice of applying introduced land management practices increases by the factor of 4.260. This result is statistically significant ($p < 0.05$) (Table 1). Positive relationship indicates that high income levels of households help them to be involved in the maintenance and construction of introduced land management practices than households with low income levels. This is in line with the findings of Kessler (2006), who reported that households with a higher income became interested to invest more in soil and water conservation measures than households with low income group.

Households with larger land sizes are expected to be better in introduced land management practices. This is because when households have larger farm sizes, they can plan different land management technologies due to the large land size. In this study, there is also positive significant relationship observed between farm size and introduced land management practices. It shows that an increase in a unit of landholding size leads to an increase of the odds of introduced land management by a factor of 2.192. This result is statistically significant at $p < 0.05$ (Table 1). This result is consistent with studies conducted by Habtamu (2006) who identified that farmers with large farm size were less likely to retain conservation structures. Similarly, the survey result by Eleni (2008) reported that farmers with larger farm size are more likely to invest in soil conservation measures.

Households' livestock size could be considered as one indicator for better availability of resources. On the other hand, better availability of resources is assumed to have positive impact in households' land Management practices. Hence, greater livestock holding is expected to have positive influence in households' involvement in improving their introduced land management practices. But, in this study, negative but significant relationship was observed between livestock holding and introduced land management practices.

A one-unit increase in livestock holding is found to lead to decreased odd of introduced land management practices by a factor of 0.271 and the result is statistically highly significant ($p < 0.05$) (Table 1).

The inverse relationship might be explained in terms of specialization. As a farmer specialized more in livestock production, he/she gives less focus to crop production and hence invests less in introduced land management practices. This is consistent with a previous study which indicated farmers' livestock holding size to have significant negative influence on the adoption of stone terraces (Aklilu, 2006).

Institutional factors

Access to extension services is assumed to improve farmers' attitude towards introduced land management practices. This is because farmers with access to extension services are expected to have better access to information which could play a significant role in introduced land management practices. The analysis indicated that farmers' contact with development agents have predictive power in implementing introduced land management practices. Using the odds of introduced land management practices among farmers' no contact with development agents as a reference, farmers contact with development agents have much higher chance of applying introduced land management practices. Farmers contact with development agents are found to have increased odds of applying introduced land management practices by a factor of 3.130 higher when compared to farmers of no contact with development agents and the result is statistically significant ($p < 0.05$) (Table 1). Wagayehu and Lars (2003) obtained similar result in eastern highland of Ethiopia indicating that if a farmer receives better information or advice from extension agents, the farmer will be willing to construct new conservation measures and maintain the existing ones. Contrary result was obtained by Chomba (2004) which showed that a large proportion of farmers who had contact with agricultural support programs did not continue the improved practices.

Household s' training is observed to have predictive power in introduced land management practices. By taking odds of introduced land management practices among households with no training as a reference, households with training have higher chance of implementing introduced land management practices. Households with training are found to have increased odds of introduced land management practices by a factor of 3. 4 higher when compared to households with no training and the result is statistically significant ($p < 0.05$) (Table 1.). Conversion factor used for TLU was: 0.1 for Sheep and goats; 0.8 for Horse and Mules; 0.5 for Donkeys and 0.7 for all cattle (Jahnke, 1982).

Table 1 Binary logistic regression for application of introduced land management practices

Independent Variables	Estimated Coefficient (*B*)	S.E	Wald	*P* (Sig).	Odds ratio Ex (*B*)
Age category	-2.016	0.492	4.097	0.035	0.233
Educational status	0.702	0.341	4.117	0.040	3.017
Sex	2.453	0.555	8.839	0.0013	2.625
Household size	1.474	0.551	5.350	0.008	4.367
Distance of farm land from home	-0.981	0.418	4.693	0.019	0.475
Annual income	2.111	0.487	8.669	0.0021	4.260
Land holding size	1.433	0.251	11.418	0.0041	2.192
Slope	1.198	0.469	5.108	0.011	4.314
Farmers' contact with dev't agents	2.315	0.577	8.024	0.0014	3.130
Farmers' Training	2.007	0.686	5.851	0.0033	3.400
Livestock(TLU) *	-1.305	0.344	7.587	0.0027	0.271

Notes: Significant at $P < 0.05$ confidences, Cox and Snell R^2 =0.652; Nagelderke R^2 = 0.946 (94.6%).

4 Conclusion

The study shows that majority of farmers in the watershed adopted introduced land management practices. The factors such as educational level, age, sex, households' contact with development agents, land holding size, household size and training, distance of farmland from home, slope and annual income influenced farmers to adopt introduced land man-

agement application. This implies that the regional and local administrates should provide extension and training services on the introduced land management practices for the farmers and agricultural extension service workers. These measures encourage farmers to take introduced land management practices on their farmlands. Moreover, in order to make trainings more successful, trainings should be provided with field works and field observations.

Conflict of Interest

The authors declare that there is no conflict of interest.

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