

# Application of A Probit Model in Assessing Determinants of Formal Financial Saving Behavior of Rural Households: The Case of Sinana District, Ethiopia

Mekonin Abera Negeri

Madda Walabu University, Ethiopia

Email: [tgsmoke@gmail.com](mailto:tgsmoke@gmail.com)

Received: 30 October 2017 | Revised: 18 December 2017 | Accepted: 29 December 2017

## Abstract

*This paper assesses determinants of formal financial saving behavior of rural households in Sinana district, Ethiopia. A random sample of 267 rural households was selected from four rural kebeles of the district. The study used both a descriptive statistics and econometric model for the analysis of primary data. The descriptive result shows that the average annual income of the respondents was found to be 55,260 ETB. Accordingly, 47.6% of the sampled households practiced a formal financial form of saving. The result of the Probit model depicts that the probability of practicing formal financial saving is positively and significantly influenced by the education status of household head, annual income, annual expenditure and access to extension services. On the other hand, distance from the nearest formal financial institution negatively and significantly influenced the probability of practicing formal financial saving. Therefore, interference of government and policy makers is needed to promote the awareness of rural communities about the importance of formal financial saving behavior.*

**Keywords:** Formal financial saving; households; probit model; sinana district; Ethiopia.

**JEL code:** C01.

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## 1. Introduction

In the developed countries, income is generated at a higher rate which encourages people to have more savings which push to more investment. But in a developing country like Ethiopia, the income standard is almost uncertain and leads to more consumption rather than saving (WB, 2012). The continent of Africa has been considered as having an unsatisfactory growth in its saving rates and this slows down capital accumulation. The low saving rate in Ethiopia influences the ability of banks to lend to small enterprises due to the limited availability of capital (NBE, 2011). According to Ngoc (2013), the speed of the loan application process and the probability of getting bank loans increases as a firm buys more services from the bank, and as the firm owner manager spends more time developing inter personal relationships with bank officers. To achieve a higher rate of growth with relative price stability, the marginal propensity to save should be raised by appropriate incentives and policies (Degu, 2007).

Households' savings in Ethiopia has experienced a variety of changes over the past one or two decades due to the changes in lifestyles and consumption models in a developing country. Only about six million households save money in financial institutions in Ethiopia. The saving rate to GDP of Ethiopia is the lowest saving rate when compared to that of China, Bangladesh and South Africa, which all have better saving rates. Hence, Ethiopia is characterized by a poor saving culture which has resulted in very small domestic savings available for investment (CBE, 2011). Savings in rural Ethiopia are mainly made up from income from

agricultural activities. They are also characterized as seasonal and irregular as the cash flow through the sale of agricultural products and availability of work is also seasonal (Dejene, 2003).

Saving is a very important component which is responsible for combating or meeting any emergency accrued by individuals or households or any corporate agencies. According to Rogg (2006), the investment gap is a serious problem faced by poor countries including Ethiopia. Because of this gap, it is difficult for these countries to finance investments needed for growth from domestic saving. Saving is more meant for meeting contingencies but sometimes it also acts as a form of investment. In Ethiopia, saving is less considered because of irregularity and seasonality of income. The unavailability or few formal financial institutions in the rural areas of Ethiopia could be a disincentive for formal saving.

According to Girma et al. (2014), most of the saving related studies conducted in Ethiopia are done at a macro level and little is done at a micro level. On the other hand, most of the authors use secondary data which may not be a good representative of reality (Dufera et al., 2017). In the studies conducted on saving and income expenditure among rural and urban households for various expenditure classes, little effort has been made to study the determinants of saving related to the behavior of the individual. Thus, the present study uses a primary data source which is directly collected at the household level to fill the above-mentioned gaps. The study identified some important variables which determine formal financial saving behavior of rural households in the study area

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using micro econometric analysis.

In a country in which the majority of the people lives in rural areas, formal saving is of paramount importance for promoting rural households' savings. The result of the study will also help to make relevant decisions in the development of appropriate policies by policy makers and can be used to raise the awareness of rural households about the importance of household savings. The rest of the paper is structured as follows after this brief introduction: The second section explains the literature review, the third section deals with data and methodology, the fourth section presents key findings and their possible discussion, and the fifth section provides concluding remarks and recommendations.

## **2. Literature review**

### ***2.1. Theory of saving***

There are several hypotheses of saving that are implied from consumption theories (hypotheses) as saving is the amount of income not consumed. Three theories (permanent income hypothesis, relative income hypothesis and life cycle hypothesis) are overviewed in line with income, consumption and saving because they are directly and indirectly used as variables of interest for the current study. The permanent income hypothesis states that people will spend money at a level consistent with their expected long-term average income. A household will save only if his/her current income is higher than the anticipated level of permanent income, in order to guard against future declines in income. According to this hypothesis, income growth is one of the primary determinants of domestic saving through its effect on the lifetime income of the working population. This is

because a higher rate of income growth raises the aggregate income of active workers relative to those not earning labor incomes and this will raise the lifetime resources of workers on which consumption and saving depends (Nayak, 2013).

According to the relative income hypothesis of Duesenberry (1949), the satisfaction an individual derives from a given consumption level depends on its relative magnitude in the society relative to average consumption rather than its absolute level. Higher growth rates lead to higher saving rates, which is inconsistent with the lifecycle or permanent income theory, since the lifetime resources of an individual increases as growth rate increases. Based on this theory, Duesenberry drew two conclusions: First, the aggregate saving rate is independent of aggregate income and this is consistent with the time series evidence. Second, the propensity to save of an individual is an increasing function of his/her percentile position in the income distribution which is consistent with the cross-sectional evidence.

The life cycle hypothesis presumes that individuals base consumption on a constant percentage of their anticipated life income. With population growth, there are more young people than old, more people are saving than are not saving, so that the total not saving of the old will be less than the total saving of the young, and there will be net positive saving. Individuals save to prepare for their retirement when they must dissave and consume. The marginal utility of consumption at a time of lower income is higher than that at a time of higher income (Nayak, 2013).

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## **2.2. Forms of saving**

Saving can be performed in different ways depending on accessibility of saving institutions, and individual's preference and behavior. Accessibility of saving institutions (formal or informal) has a great impact on the saving behavior of people. Formal financial institutions (Birhanu, 2015) possess modern accounting and reporting systems and these institutions include private and government banks as well as microfinance institutions that are engaged in saving and credit/loan service deliveries for the communities. In Africa, banks are considered as the main type of formal institutions that are involved in sound mobilization of saving.

Access to formal financial services (Woldemichael, 2010) deeply helps the poor to manage financial resources and to achieve relief from poverty. Due to the inaccessibility of formal financial institutions in Ethiopia, informal saving behaviors such as 'Iqub', 'Idir', buying livestock and jewelry, as well as keeping cash at home have been widely practiced (MoFED, 2014). According to Carpenter and Jensen (2002) households' savings in financial institutions take the form of savings accounts, treasury bonds, corporate bonds, shares and stocks, mutual funds, cash value of life insurance, retirement plans and in non-financial assets such as land, houses, vehicles and other real property.

## **2.3. Related empirical studies**

Saving behavior of rural households is affected by different demographic and socioeconomic factors as confirmed by different studies. Girma et al. (2013) conducted a study on determinants of saving in Ethiopia using household level data. The result of the Tobit model

indicated that education of the household head, land holding size and annual income of the household positively affected the household saving. Dufera et al. (2017) investigated determinants of rural households' savings in Gindeberet woreda, Ethiopia and identified significant variables using a Tobit model. The result showed that distance from nearest financial institution, livestock holding, income, primary occupation of household head and dependency ratio are significant variables influencing the amount of savings made by households.

A study by Gina et al. (2012) indicated that education, employment, level of social support and degree of economic strain have a weak association with saving among rural, low income individuals in Africa. Rehman et al. (2010) investigated the determinants of households' saving in the Multan district of Pakistan and found that the age of the household head has a positive relationship with household savings. Education of household head, children's educational expenditures, family size, liabilities and marital status significantly and inversely affect household saving. According to Obayelu (2012) large household size would reduce the saving rate and thus reducing the number of children can help beef up savings to protect families from income shortfall. Moreover, he pointed out that diversification into non-farming activities was found to increase the saving rate of the rural household heads. Households involved in non-farm activities were found to save more as compared to those not involved. Kifle (2012) investigated determinants of the saving behavior of cooperative members using survey evidence from Tigray region, Ethiopia. The empirical analysis using multiple linear

regression reveals that gender, households' income, amount of loan borrowed and years of cooperative membership significantly raise households' savings.

The study by Michael (2013) using multivariate regression analysis showed that income, locality, and sector of employment, national health insurance registration, age, education, household size and marital status are the main determinants of the level of savings. Tsega and Yemane (2014) explored determinants of household saving in Ethiopia using a Tobit model. The result of their study depicts that income, age, sex, marital status, forms of institutions used for saving and frequency of getting money are significant determinants of household saving. Another study by Abdul et al. (2013) showed that educational status, value of assets, shock to household head and having a commitment to a financial institution positively and significantly influenced the decision of the household head to save with a financial institution in Ghana. The net dependents, being a male household head and being a Muslim household head negatively affect their decisions to save in the district.

Therefore, this present study tries to explore important variables determining the formal financial saving behavior of rural households using micro econometric analysis.

### 3. Data and methodology

#### 3.1. Data and variables

##### 3.1.1. Sampling procedure and sample size

The study was conducted in Sinana district of Bale Zone, Ethiopia which is located in the south eastern part of the country. To select a representative sample, a two stage random sam-

pling technique was applied. At the first stage, four kebeles namely Sanbitu, Nano Robe, Wel-tahiberisa and Horaboka were selected from twenty kebeles of the district based on the cost of sampling. At the second stage, households were selected for interview by a systematic random sampling technique. The sample size was calculated using the sample size determination formula for proportions (Cochran, 1977) as follows.

$$n_0 = \frac{pq \left( Z_{\alpha/2} \right)^2}{d^2} \quad (1)$$

If  $n_0/N$  is greater than 5%, the initial sample size  $n_0$  will be adjusted by the following formula.

$$n = \frac{n_0}{\left( 1 + \frac{n_0}{N} \right)} \quad (2)$$

Where:  $p$  is the proportion of households who are expected to practice formal financial saving behavior,  $Z$  is the value of standard normal distribution at a chosen level of significance and  $d$  is some margin of error in the estimation,  $n_0$  and  $n$  are the initial sample size and the required sample size, respectively, and  $N$  is population size. The value of  $p$  is fixed at 0.50 due to the absence of any related previous study. Setting  $p = 0.50$ ,  $\alpha = 0.05$  and  $d = 0.06$ , the total sample size obtained was 267 households out of 6010 total households in the selected *kebeles*. In practice, we first calculate  $n_0$ . If  $n_0/N$  is negligible (less than 5%),  $n_0$  is a satisfactory approximation to  $n$ . In our case, there is no need of adjustment for  $n$  since  $n_0/N$  is negligible.

##### 3.1.2. Source of data

A primary data source was used for the current study and a pretested questionnaire was used to generate the necessary information from the selected 267 rural households of Sinana district. The questionnaire was translated to the local language (Afaan Oromo) and collected in July, 2017 under the supervision of the author. The statistical software packages used for the data analysis are SPSS version 20 for the descriptive part and STATA version 12 for the econometric part.

### 3.1.3. Variables of the study

*Dependent variable:* The dependent variable of the econometric model was formal financial saving and coded as  $Y_i = 1$  for the household who practiced formal financial saving behavior and  $Y_i = 0$ , otherwise.

*Independent variables:* Based on the literature reviewed, the explanatory variables selected for the study were:

$X_1$  = Sex of household head (1 = Male, 0 = Female)

$X_2$  = Education status of household head (1 = literate, 0 = Illiterate)

$X_3$  = Land size (Hectare)

$X_4$  = Annual total income (1000 ETB)

$X_5$  = Annual expenditure (1000 ETB)

$X_6$  = Access to credit (1 = Yes, 0 = No)

$X_7$  = Distance from formal financial institution (Minute)

$X_8$  = Access to extension service (1 = Yes, 0 = No)

$X_9$  = Livestock holding (TLU)

$X_{10}$  = Religion of household head (1 = Christian, 2 = Muslim)

### 3.2. Method of data analysis

In addition to the descriptive statistics, a

popular econometric model, the Probit model, was used to explore major determinants of the formal financial saving behavior of the rural households in the study area. Even if binary logistic and Probit models provide approximately the same results and follow the same procedure (for both parameter estimation and interpretation), the Probit model is extensively recommended for the analysis of latent dependent variable.

*The conceptual framework of the probit model:* The Probit model assumes that while we only observe the values of 0 and 1 for the variable  $Y$ , there is a latent, (unobserved) variable  $Y^*$  that determines the value of  $Y$ . The conventional formulation of a binary dependent variable model assumes that  $Y^*$  is generated by a classical linear regression model of the form:

$$Y_i^* = X_i^T \beta + u_i \quad (3)$$

Where,  $Y^*$  is a continuous real-valued index variable for observation  $i$ , that is unobserved, or latent,  $X_i^T$  = a  $1 \times K$  row vector of explanatory variables for observation  $i$ ,  $\beta$  = a  $K \times 1$  column vector of regression coefficients and  $u_i$  = random error term for observation  $i$ .

$$Y_i = \begin{cases} 1 & \text{for } Y_i^* > 0 \\ 0 & \text{for } Y_i^* \leq 0 \end{cases} \quad (4)$$

In the functional form of the Probit model, specifically we assume that the model takes the form  $Pr(Y=1/X) = \Phi(X_i^T \beta)$ , Where,  $\Phi$  is the Cumulative Distribution Function (CDF) of standard normal distribution.

*Estimation of the Probit Model:* The parameters  $\beta$  are typically estimated by the maximum likelihood technique which is given as:

$$L(\beta) = \prod_{i=1}^n [\Phi(x_i' \beta)]^{y_i} [1 - \Phi(x_i' \beta)]^{1-y_i} \quad (5)$$



The log likelihood is obtained by taking the log of both sides of equation 5.

$$\ln L(\beta) = \sum_{i=1}^n \{y_i \ln[\Phi(x_i'\beta)] + (1-y_i) \ln[1-\Phi(x_i'\beta)]\} \quad (6)$$

Because of the symmetry of the normal density,  $1-\Phi(x_i'\beta)$  can be expressed as  $\Phi(-x_i'\beta)$ . Hence, the log likelihood function will have the following form.

$$\ln L(\beta) = \sum_{i=1}^n \{y_i \ln[\Phi(x_i'\beta)] + (1-y_i) \ln[\Phi(-x_i'\beta)]\} \quad (7)$$

The estimator  $\hat{\beta}$  which maximizes this function will be consistent, asymptotically normal and efficient provided that  $E(XX')$  exists and is not singular. This log-likelihood function is globally concave in  $\beta$  and standard numerical algorithms for optimization will converge to the unique maximum.

*Interpretation of the Probit model:* The interpretation of the parameter of the Probit model is not straightforward as in the ordinary least square method. It does not quantify the effect of the explanatory variable on the predicted probability when other covariates remain the same and shows only the direction of the influence. The magnitude cannot be interpreted using the coefficient because different models have different scales of coefficients. The marginal effect is used to interpret the Probit model and calculated as follows:

$$\frac{\partial P(y=1)}{\partial x_j} = \Phi(x'\beta)\beta_j \quad (8)$$

The marginal effects reflect the change in the probability of  $y = 1$  given a one unit change in an independent variable, keeping other covariates fixed. Coefficients and marginal effects of the Probit model have the same sign.

**Table 1: Distribution of households by general characteristics**

Variables	Item	No. of households	Percent	Variables	No. of household	Mean	St. dev.
Sex	Male	170	63.7	Age (year)	267	40.15	15.25
	Female	97	36.3	Family size (number)	267	4.87	2.38
Education	Literate	155	58.1	Distance from financial institution (minute)	267	86.42	73.70
	Illiterate	112	41.9				
Religion	Muslim	166	62.2				
	Christian	101	37.8				

Source: Computed from survey, 2017

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## 4. Results and discussion

### 4.1. Descriptive analysis

#### 4.1.1. General characteristics of sampled households

The current study was conducted on 267 randomly selected rural households of which 170 (63.7%) were male-headed and the rest 97 (36.3%) were female-headed households. The majority of these households, 155 (58.1%), were literate and the rest 112 (41.9%) were illiterate. The religion categories of the sampled households shows that 166 (62.2%) of the respondents were Muslims and the rest, 101 (37.8%), were Christians. Accordingly, the average age of the sampled households was 40.15 years with a standard deviation of 15.25 and the average family size per household was found to be 4.87 members with a standard deviation of 2.38 (Table 1). Distance from a formal financial institution is considered as a demographic characteristic of the rural households, which highly influences the saving status. The result shows that the sampled households are expected to walk 86.42 minutes on average to arrive at the nearest formal financial institution (Table 1).

#### 4.1.2. Resources, income and expenditure

Land is an important resource for rural households as it can be accumulated in terms of a productive asset. The result depicts that the average size of the land holding size of sampled households was 1.72 hectares with a standard deviation of 1.14. Rural households who have a larger area of farm land can utilize more capital and finally their income increases so that their probability to save in a financial form increases. Livestock holding is one of the main cash sources to purchase agricultural inputs. To assess the livestock holding of each household, the Tropical Livestock unit (TLU) per household was calculated. The result depicts that the average livestock holding of households was 4.20 TLU with a standard deviation of 3.14.

The major sources of income for the sampled households are crop production, livestock production and off/non-farm activities in the study area. Income is an important factor that analyses the saving status of households. The result shows that the average annual total income of the sampled households was 55,260 ETB with a standard deviation of 49,020. The result indicated that a significant number of sampled households spent their income on food, clothing and the purchase of agricultural inputs. The average annual expenditure of the

**Table 2: Distribution of households by resources, income and expenditure**

Variables	No. of households	Mean	St. dev.
Land size (hectare)	267	1.72	1.14
Livestock holding	267	4.20	3.14
Annual income (1000 ETB)	267	55.26	49.02
Annual expenditure (1000 ETB)	267	18.09	14.89

*Source: Computed from survey, 2017*



**Table 3: Distribution of households by saving practice and basic accesses**

Variables	Item	No. of households	Percent
Did you practice formal financial saving behavior?	Yes	127	47.6
	No	140	52.4
Access to credit	Yes	69	25.8
	No	198	74.2
Access to extension service	Yes	167	62.5
	No	100	37.5

Source: Computed from survey, 2017

sampled households is found to be 18,090 ETB with a standard deviation of 14,890 (Table 2).

#### 4.1.3. Financial saving

The study explored whether the sampled households practiced formal financial saving behavior or not and accordingly confirms that 127 (47.6%) of the sampled households practiced a formal financial form of saving and the rest, 140 (52.4%), did not practice a formal financial form of saving. Those households who did not practice a formal financial form, practiced informal saving behaviors such as ‘*Ekub*’, ‘*Idir*’ and saving cash at home which is considered as a traditional form of saving.

#### 4.1.4. Access to credit and access to extension service

Basic accesses such as access to credit and access to extension services are among the important variables that determine the formal financial saving behavior of households. The result of this study confirms that only 69 (25.8%) had access to credit and the rest, a significant number, 198 (74.2%), of the sampled respondents did not have access to credit. The livelihood of these households is basically dependent on agricultural crop production and they need access to credit to purchase agricultural

inputs such as fertilizers and improved seeds. Regarding agricultural extension services, 167 (62.5%), of the sampled households had access to extension services and the rest, 100 (37.5%), did not have access to an extension service (Table 3).

#### 4.2. Econometric analysis

As outlined in the methodology section, a Probit model was used to explore determinants of the formal financial saving behavior of rural households. This model uses a maximum likelihood technique which is an iterative procedure for estimation of parameters. The Wald Chi<sup>2</sup> statistic as indicated by the statistically significant P- value ( $P < 0.000$ ) indicates that the model has strong explanatory power. In order to overcome some estimation problems, a robust standard error is printed. The marginal effect which quantifies the effect of a unit change in the explanatory variable on the dependent variable is computed by the STATA command ‘*margins*’. Ten variables are entered as explanatory variables in the econometric model and five of them were found to be statistically significant. The coefficients and marginal effects of the Probit model are given in Table 4 and possible discussion and interpretations of these

variables are as follows.

*Education status of household head*

The education status of the household head positively and significantly influenced formal financial saving practice. The result of the marginal effect shows that, other variables being constant, the probability of practicing formal financial saving is increased by 10.7% for literate households over that of illiterate households. The implication of this result is that literate households appreciate the importance of saving and are more likely to practice modern financial saving options than are illiterate households.

*Annual income*

In line with a different theory of saving, annual income of households positively and statistically influenced formal financial saving practice. Income would increase households' saving ability and enhance the probability of saving in formal financial forms. The finding of a marginal effect depicts that for a 1000 Birr increase in annual income, the probability of practicing formal financial saving increases by 0.3%, other variables being constant. The result obtained supports the theory that as income increases, saving is expected to increase.

*Annual expenditure*

**Table 4: Coefficients and marginal effects of Probit model**

Probit regression	Number of observations = 267				
	Wald Chi2 (10) = 55.16				
	Prob > Chi2 = 0.000				
Log likelihood = -147.32268	Pseudo R <sup>2</sup> = 0.2026				
<b>Explanatory Variables</b>	<b>Coeff.</b>	<b>Robust St. Err</b>	<b>Z</b>	<b>P &gt;  Z </b>	<b>Marginal effect</b>
Sex of household head (1 = Male)	0.260	0.180	1.44	0.149	0.082
Education of household head (1 = Literate)	0.340	0.172	1.98	0.047**	0.107
Land size of household head (Hectare)	-0.145	0.098	-1.48	0.139	-0.045
Annual income (1000 ETB)	0.011	0.003	3.57	0.000*	0.003
Annual expenditure (1000 ETB)	0.028	0.011	2.60	0.009*	0.009
Access to credit (1 = Yes)	-0.160	0.210	-0.76	0.446	-0.050
Distance from financial institution (Minute)	-0.002	0.001	-1.93	0.053***	-0.001
Access to extension service (1 = Yes)	0.336	0.186	1.80	0.071***	0.105
Tropical livestock unit (TLU)	0.032	0.037	0.86	0.389	0.010
Religion (1 = Muslim, 2 = Christian)	0.103	0.187	0.55	0.581	0.032
Constant	-1.462	0.457	-3.20	0.001	

*Significance level: \* (1%), \*\* (5%) and \*\*\* (10%)*

*Source: Computed from survey, 2017.*

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Annual expenditure is another important factor considered as a determinant of saving. The result shows that annual expenditure positively and significantly influenced formal financial saving practice. The finding of a marginal effect further depicts that as annual expenditure increases by 1000 Birr, the probability of practicing formal financial saving increases by 0.9%, other variables being constant. This strange result may occur due to some reasons such as if expenditure is utilized on productive agricultural activities, it can create additional assets which in turn increases saving. The other probable convincing reason is that the majority of the respondents responded during the survey that they spend the majority of their expenditure on the purchase of agricultural inputs such as fertilizer and improved seed, which in turn is expected to increase output and annual income.

*Distance from the nearest formal financial institution*

Distance from a formal financial saving institution negatively and significantly influenced formal financial saving practice. The result of the marginal effect depicts that as distance from a formal financial institution increases by one minute, the probability of practicing formal financial saving decreases by 0.1%, other variables being constant. This implies that households who reside nearest to formal financial institutions are more likely to save from their income in a financial institution than those households who reside far from formal financial institutions.

*Access to extension services*

On the other hand, access to extension ser-

vices positively and significantly influenced formal financial saving practice. The result of marginal effect depicts that the probability of practicing formal financial saving is increased by 7.1%, other variables being constant, for households having access to extension services over those households who do not have access. The implication is that the awareness about saving can be increased by scheduling different extension services for rural households.

### **5. Conclusion and recommendations**

The main target of this study was to identify major factors determining the formal financial saving behavior of rural households based on the data of 267 rural households. The descriptive result revealed that the average annual income of the sampled households was 55,260 ETB and 47.6 % of the sampled households practiced formal financial saving behavior. The econometric model result revealed that the probability of practicing formal financial saving increases with the increase in education status of the household head, annual income, annual expenditure and access to extension services. On the other hand, the probability of practicing formal financial saving decreases with an increase in distance to the nearest formal financial institution. Two recommendations are put forward based on the finding of the study: Firstly, the significant variables explored by the current study need special attention by policy makers and stakeholders to increase the formal financial saving practice in the study area. Secondly, the development agents should be able to increase the awareness of rural communities about the importance of formal financial saving.

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## Acknowledgement:

The necessary budget for this study was funded by Research, Community Engagement and Technology Transfer Vice President, Madda Walabu University.

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