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Assessing Financial Literacy and Farmland Abandonment Relationship in Ghana

Martinson Ankrah Twumasi, Bright Senyo Dogbe, Ernest Kwarko Ankrah, Zhao Ding and Yuansheng Jiang *

College of Economics, Sichuan Agricultural University, Chengdu 611130, China
* Correspondence: yjiang@sicau.edu.cn

Abstract: Farmland abandonment has been a major concern for policymakers in most developing nations since it is associated with food security and poverty alleviation. In view of this, assessing its potential determinants is essential and timely. This study examines the relationship between financial literacy and farmland abandonment in Ghana using survey data (N = 572). The study employs endogenous switching regression (ESR) for its estimation. Our findings show that financial literacy is low among rural dwellers. Also, the findings depict that financial literacy is positively related to farmland abandonment reduction. Moreover, different household groups depict a heterogeneous relationship between financial literacy and farmland abandonment. Thus, the association between financial literacy and farmland abandonment reduction is more pronounced for low-income farm households and female farmers. We recommended that financial literacy programs can be organized or shown on national radios and television to provide financial education to the country's residents. Our findings could offer some implications for stimulating agricultural intensification while ensuring rural advancements.

Keywords: financial literacy; farmland abandonment; endogenous switching regression model; agricultural intensification; Ghana

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1. Introduction

Abandonment of farmland is a multidimensional, complex process with interrelated environmental and socioeconomic drivers [1]. Although farmland abandonment comes with positive effects, including the provision of ecological services, such as soil recovery [2] and water retention [3], its diverse effect on humankind and economic development is outrageous. For example, the abandonment of farmland serves as a threat to food security [4], widens the urban-rural income gap [5,6], and causes agricultural landscapes' biodiversity loss and agroecosystem degradation [7]. As a result, the patterns and extent of farmland abandonment we currently face are the subjects of open debate in many parts of the world. Thus, farmland abandonment has attracted the attention of researchers and policymakers in many countries around the world.

Abandonment of agricultural land is usually associated with many factors leading to low farm productivity and profitability or causing high production costs [6–8]. These factors may include undesirable physical and climatic features such as poor soil quality, steep slopes, high altitude, and limited rainfall [6,9]; unfavorable socioeconomic conditions (e.g., low farm/household income) [8] and demographic change (e.g., an aging population) [10]; reduction in the land use net income emanating from the rise in the production cost of agricultural products and services [11,12]; and urbanization due to high economic industrialization [13,14]. However, these factors, characterized by environmental, economic, and social constraints, are likely to be curtailed if farmers are financially secure and literate. Therefore, we can ascertain that an improvement in farmers' financial literacy and economic performance can lead to a reduction in farmland abandonment, all other things remaining constant.

Accessing financial services and products in the financial market is vital for farmers' economic and financial well-being [15,16]. Thus, financial services accessibility or financial market participation has been hyped as an important avenue to intensify agriculture activities and ensure agricultural sustainability. For example, studies have revealed that financial services accessibility (e.g., savings, loans, and insurance) places farmers in a position to enhance their farm productivity/income because it can help them purchase needed inputs or use new and improved farming technologies such as climate-smart agriculture techniques, modern improved crop varieties and many more [15,17,18]. Also, farmers can manage farm risk [19,20] and adopt precision agricultural practices [21,22] to intensify their farming activities when they patronize financial services. While financial inclusion has been a great crusader to household welfare and agricultural development, about two billion adults residing mostly in developing nations have no bank accounts or are participants in the financial market. Challenges traceable to both the demand and supply sides of the financial markets, coupled with a host of other factors, are partially responsible for the low financial market patronage; nevertheless, a major impediment from the demand side is low financial literacy [23–25].

Financial literacy refers to how people create or conceive financial and economic understanding and make well-informed decisions to promote financial investment and ensure good use and management of financial products and services to create wealth while reducing debt [26]. This explanation indicates that acquiring high financial skills and knowledge, i.e., being financially literate may positively affect people's financial decisions and behaviors. Studies from Ankrah Twumasi [27] and Klapper and Lusardi [26] revealed that financially literate individuals are most likely to obtain beneficial financial information to promote their wealth accumulation strategies. One needs to be financially literate to properly diagnose questions leading to sound financial decision-making, especially when participating in the financial market. Overall, we can argue that financial inclusion, a promoter of household poverty alleviation and agricultural development or intensification, is achievable through financial literacy. Thus, improving farmers' financial and economic performance, which can cause a reduction in farmland abandonment, is possible through a financial inclusion enhancer from the demand side referred to as financial literacy.

Also, financial literacy may have a direct and indirect association with agricultural land use. On one side, financial literacy may directly improve farmland use by helping farmers make informed decisions about using their land in a way of preventing or alleviating excess costs [28–30]. A financially literate farmer will stick to farmland projects that are highly profitable due to their ability to assess the cost and benefit of that project/investment. On the other hand, financial literacy has an indirect effect on farmland use through financial market participation. Akoto [29] found out that financially literate farmers are more likely to patronize the credit market to secure loans to curb challenges pertaining to their farm production. The purchase of farm insurance to curb the risk to adopt risky but profitable projects on farmland is positively associated with financial literacy [30,31]. Therefore, better use of financial resources and risk management knowledge and skills may grow as farmers' financial literacy improves, hence, enabling farmers to utilize their farmland effectively and efficiently. The literature reviewed suggests that a potential connection exists between financial literacy and farmland abandonment reduction. However, all the literature addressing factors associated with farmland abandonment e.g., [9,13,14,18,29,32] indicates no presence of data addressing whether farm households' farmland abandonment reduction can be enhanced should citizens in developing countries such as Ghana improve their financial literacy. This vacuum in literature is filled using data from Ghana.

This study has two objectives to fulfill. First, we quantitatively assess the relationship between farmland abandonment and financial literacy. We proposed a hypothesis that farmland abandonment can reduce as financial literacy improves. As established from the literature that inadequate agricultural financial incentives are significant determinants of farmland abandonment, assessing the association between an income enhancer (financial literacy) and farmland abandonment is essential. We argue that financially literate farmers

can improve their wealth accumulation and purchasing power through significant financial and investment decisions, empowering them to intensify agricultural production (e.g., adopting farm technologies and reducing farmland abandonment). Second, we examine the heterogeneous effect of how financial literacy impacts farmland abandonment based on household income and gender statutes of the farmers. We add to the existing literature in diverse ways. First, this study attempts to assess the quantitative nexus between financial literacy and farmland abandonment in Sub-Sahara Africa (SSA). Second, distinguish from prior farmland abandonment studies that prioritized agricultural credit [8,18] and NGOs grants and government subsidies [33,34] as an avenue for addressing financial barriers to farmland abandonment reduction, we reveal the essence of financial literacy and its possible effects in promoting farmland abandonment reduction in developing countries. Third, we used a suitable econometric approach to correct the potential endogeneity problem related to the treatment variable (financial literacy). Adequately dealing with potential endogeneity could bring consistency to our findings; thus, preventing unbiased estimation.

The remaining parts of the study take this form of arrangement. We presented the study's theoretical framework in Section 2. Sections 3 and 4 took the study's methodology, results, and discussions, while the conclusion and policy implication was presented in Section 5.

2. Theoretical Analysis

Financial literacy and how it influences farm household livelihood, a determinant of farmland abandonment, can theoretically be modified following the farm household model theory suggested by Huffman [35]. The theoretical model suggests that regarding a budget constraint, farm householders' utility can be characterized as a function of agricultural practices anytime the farmer maximizes utility. In the model, the household is assumed to maximize a unitary household utility function, and this can be presented as shown below:

$$Max\ U = U\ (G,\ A) \tag{1}$$

where $U,\ G\ and\ A$ are the utility, normal goods, and agricultural practices function for a household, respectively. We assume that the consumption of normal goods and intensification of agricultural practices (e.g., adopting farm technologies and reducing farmland abandonment) is subject to budget constraint, which is a function of income (I) and financial literacy (FL). Let us note that since the units of income (measured in financial units) and *FL* (measured in qualitative scales, such as low and high) are different, we cannot add the two together. Therefore, for the purpose of the study, we assume that income is expressed as high and low to meet the requirement of unit measurement. The presence of income and financial literacy improves the ability of the household to purchase goods (G) associated with the price (P_g) and agricultural practices required inputs associated with price (P_A). The scenario from the above led to a new model expressed as:

$$P_g G + P_A A \leq I + FL \tag{2}$$

Based on the study's objective, the farm household farmland abandonment decision depends on:

$$Farmland\ abandonment = f\left(FL,\ I,\ P_g, P_A\right) \tag{3}$$

Theories and literature depicting the direct link between financial literacy and household livelihood/business growth align with this model. According to Ankrah Twumasi [36] and Xu [14], an individual needs to be financially literate to make sound financial decisions. Thus, a financially literate person may easily acquire solutions to questions relating to investment and wealth accumulation, which can improve households' standard of living (e.g., smooth consumption, improved purchasing power, and business establishment). Also, financially literate individuals yearn to secure appropriate financial information; therefore, they are willing to participate in the financial market to maximize their wealth or incomes, which tends to empower them to acquire their needs [26,28]. For example, a finan-

cially literate farmer to whom financial services are made accessible (e.g., secure credit or farm/equipment insurance policy) may be able to obtain farm inputs [37] and adopt risky yet profitable agricultural technologies [20], thereby willing to intensify his/her agricultural participation, which can cause a reduction in farmland abandonment. Achieving a higher financial literacy status is likely to lead to an effect on one's income, enabling households to enjoy improved disposable income; hence, equipping them to obtain a higher indifference curve. All other things remaining constant, securing higher financial skills and knowledge (being financially literate) has a potential association with efficient and effective consumption of normal goods and intensification of agricultural practices [36]. In addition, the role of income cannot be overlooked when it comes to farmland abandonment. Studies have shown that household income enables farmers to acquire the necessary tools to improve and expand farmland utilization [38,39]. Also, other normal goods consumption (e.g., food, healthcare facility use, education, etc.) has an indirect relationship with farmland use since the share of household income to a booster of farmland use intensification may be used for other normal goods consumption [8].

As shown in Equation (3), the direct connection between financial literacy (promoter of financial services accessibility) and farm household agricultural practices is constrained by market failure in the financial markets, primarily because of high transaction costs [40]. Following Han [41], we categorized these transaction costs from the demand side into different financial, in-kind, and psychic divisions. The costs emanating from the financial side include transportation costs to attend financial literacy lectures and fees charged by financial experts when acquiring financial education. The opportunity cost of time spent searching for a financial expert and the booking or waiting time in the expertise office is attributed to in-kind costs. The psychic cost is the psychological stress of putting the acquired financial knowledge and skills into practice. Based on the above literature, individuals who have links with financially literate people are more likely to be financially literate themselves than their counterparts without such an advantage [36]. This reflects that financial literacy is an endogenous variable due to the presence of transaction costs; therefore, estimating Equation (3) by applying ordinary least squares (OLS) is likely to produce unreliable estimates. It is, therefore, tedious to account for the transaction costs in the model because of its nature of divisions. Thus, an endogeneity issue resulting from an omitted variable problem is present. Although we may account for the financial transaction costs, the other two costs (in-kind and psychic) are hard to be captured.

Prior research works examining the association between financial literacy and welfare enhancement [15], gambling behavior [42], and financial inclusion [43] have used the instrumental variable (IV) estimation approach. Consistent with these researchers, we also employed an IV estimation approach, using financial education (i.e., whether the farmer has a relative/friend with an economics or financial education background) as our instrument. Ankrah Twumasi [44] and Watanapongvanich [42] have used this variable as an instrument in their analysis. Details of the IV approach are explained in Section 4.2. We test the validity of the theoretical claim that acquiring high financial literacy improves the ability of farm households to intensify agricultural activities through a reduction in farmland abandonment and, if so, to what extent?

3. Why Ghana?

Ghana presents an interesting and relevant case study for assessing the association between financial literacy and farmland abandonment. In Ghana, the rate of financial literacy is currently at 32% [42], which is deemed relatively low. A recent global study on the financial literacy rate ranking of 144 countries placed Ghana in the 90th position [45]. The country, in recent years, has considered financial literacy policy a priority since it contributes to national development. Thus, several interventions and policies have been introduced by the national governments. For example, the Ministry of Finance and Economic Planning has launched the National Financial Literacy Week to raise awareness and enhance the public's understanding of the range of financial goods and services financial institutions offer.

Again, together with other NGOs (e.g., Danish International Development Agency (Danida) and the German Agency of International Cooperation (GIZ)), successive governments have introduced several financial education programs aimed at enhancing Ghanaians' understanding of financial services (e.g., loan acquisition, investment, and insurance cover). Despite the tremendous efforts on the part of stakeholders (successive governments, financial institutions, and charitable organizations) to witness significant improvement in the level of financial literacy of Ghanaian citizens, especially rural peasants, through training and educational programs, proof of how positively these activities are impacting their general economic welfare have been very little/minimal. A study in Ghana showed that farmers find themselves in debt after post-harvest sales because of low financial skills and education [46]. The researchers indicated that this menace partly explains why farmers are replacing their farming activities with off-farm jobs and youths are abandoning farming in Ghana. In addition to improving savings, recent studies on financial literacy in Ghana by Koomson [47] and Chowa [48] showed that improvements in the rate of financial literacy make households financially resilient. Regarding how instrumental the improvement of financial literacy is to agricultural intensification (e.g., land abandonment reduction), not much has been done in the case of Ghana and countries in SSA. We believe Ghana provides the right setting to undertake this study, given the details in the above background.

4. Methodology

4.1. Source of Data and Key Variables Definitions

The origin of the study is Ghana, and the data was collected from January 2018 to May 2018. Farmers engaged in crop cultivation were the targeted population. The collection of the data was done by employing questionnaires and face-to-face interview schedules. Every interview took about 15 to 20 min with a farmer. Engaging the respondents in in-depth interviews was for the purpose of gaining all the relevant data necessary for the study. A pre-test of the questionnaire was necessary to avoid any mistakes that would create misunderstanding for the respondents; therefore, we took a pre-test with 20 farmers in one of the selected regions. Some of the information we solicited for study include the farmers' socioeconomic and demographical characteristics (e.g., education level, age, credit accessibility, and health status), rate of financial literacy (see Table A1 in the Appendix A for the questions), farm information (e.g., abandoned farmland area, and farm size) and other variables that are important to attain the objective of the study.

The multi-stage sampling procedure was employed to reach an appropriate sample for the study. First, we choose four regions, i.e., Northern, Brong Ahafo (BA), Central, and Eastern. The purposive selection of the 4 regions led us to randomly select one district in each region at the next stage. These districts are East Gonja district, Atebubu Amantin district, Ekumfi district, and the Kwahu Afram Plains district in the Northern, Brong Ahafo, Central, and Eastern regions of Ghana, respectively. Let us note that these regions' record of having most rural dwellers engaged in agricultural activities led to their purposive selection [49]. 7 After getting the districts, we randomly chose three (3) communities from each selected district in the proceeding stage. Finally, with the help of a well-trained research team, we randomly chose 15–30 rural households comprising 600 farmers as our sample size. However, a total sample size of 572 was used for the analysis because some submitted questionnaires were not completed. A detailed sample procedure can be seen in the Appendix A in a framework form (Figure A1).

This study's aim means that we need to develop a measurement for the key variables (financial literacy and farmland abandonment). Concerning the financial literacy measurement, a set of 7 questions was selected after following existing literature e.g., [24,45,46] (see Table A1 in Appendix A). The 7 questions were used to obtain a score for the farmers. A farmer who answered all(none of) the questions rightly received a score of 7(0). These scores were converted into binary; i.e., using the median score (3) as a breakeven point, a farmer is assigned the value one (1) if his/her score is above 3 (the median score of the total financial literacy score), and zero (0) for a score equal to or below 3. This financial

literacy measurement method has been employed in prior studies, including Ankrah Twumasi [27,44] and Andoh [50]. In terms of the farmland abandonment variable measurement, the total area of farmland abandoned in the past 12 months in acres was used. Here, farmland is considered abandoned if its abandonment is not based on natural restoration of vegetation or degradation of farmland facilities reasons but due to financial issues.

Also, taking existing studies about financial literacy and farmland abandonment into consideration e.g., [9,18,24,47,48,51] and our available data, other rich control variables such as gender, age, education years, self-reported health status, smartphone use, and many others of the household/respondent were included. As stated earlier, these variables may affect both the financial literacy and farmland abandonment of the farmers. We expect age, gender, and education to positively affect the two outcome variables. Age and education are elements of human capital; thus, the skills and knowledge gained through education and aging provide financial knowledge [26,27] and also help individuals to use their lands efficiently and effectively [9]. Male household heads tend to be more financially literate than their counterparts [47]; therefore, we expect the same result in this study. We also expect healthy individuals to intensify their agricultural activities; hence, likely to reduce farmland abandonment [52]. Also, people with smartphones access the online for farming ideas and financial information [25]; hence, we expect smartphone users to have a positive relationship with financial literacy and farmland abandonment. Farmers with their land registered, members of cooperative unions, and farm machinery users are expected to reduce farmland abandonment. Cooperative members have access to market and farming techniques, which tend to motivate them to intensify their farming activities [53,54]. Also, the use of machines for cultivation promotes productivity; serving as an encouragement to reduce farmland abandonment [55]. We expect credit-constrained farmers to increase farmland abandonment and reduce their financial literacy level. Xu [24] and Ankrah Twumasi [25] showed that financial illiterates are less likely to access financial services. Also, farmers without financial services access due to being financially illiterate tend to abandon farmlands [8,18]. Table 1 exhibits all the study variables, including their definitions, means, and standard deviations. The analyses pertaining to the study's aim were accomplished by employing STATA 15 and IBM SPSS version 26 statistical packages.

Table 1. Demographic and socioeconomic characteristics of respondents.

Variables	Description	Mean	Std. Dev
Farmland abandonment	Area of cropland abandonment in acres in 2017	0.96	2.04
Financial literacy	Farmer is financially literate (1 = Yes; 0 = No)	0.31	0.44
Gender	Farmer is a male (1 = Yes; 0 = No)	0.69	0.46
Age	Farmer's age	41.66	12.20
Education	Farmers' number of years of education	5.28	4.24
Self-reported health	Farmer's health status is good (1 = Yes; 0 = No)	0.43	0.51
Household Dependency ratio	Number of older adults (60 years and above) and children below 12 years in the farmer's family	3.29	1.17
Family size	Number of household size	6.60	3.20
Smartphone use	Farmer uses smartphone (1 = Yes; 0 = No)	0.29	0.33
Mechanization	Farmer used any farming machine (1 = Yes; 0 = No)	0.35	0.42
FBOs membership	Farmer is FBO member (1 = Yes; 0 = No)	0.41	0.49
Credit constraint	Farmer was credit constrained 2017 (1 = Yes; 0 = No)	0.34	0.47
Land size	Total farmland size of the farmer (acres)	3.85	1.74
Land registration	Farmer's household land is officially registered (1 = Yes; 0 = No)	0.36	19.82
Financial education (IV)	Farmer has a relative/friend with an economics or financial education background (1 = Yes, 0 = No)	0.27	0.35
Northern	Farmer resident is in Northern region (1 = Yes; 0 = No)	0.18	0.37
BA	Farmer resident is in BA region (1 = Yes; 0 = No)	0.26	0.43
Eastern	Whether the farmer resident is in the Eastern region (1 = Yes; 0 = No)	0.27	0.44
Central	Farmer resident is in Central region (1 = Yes; 0 = No)	0.29	0.45

4.2. Empirical Model

This study aims to investigate how farmers' financial literacy influences farmland abandonment in Ghana. However, since farmers' financial knowledge and skills acquisition to be financially literate is voluntary, the problem of selection bias becomes an issue to address. Also, the characteristics of the farmer/farm household that affects the financial literacy status may have an equal effect on the outcome variable (farmland abandonment). On this note, financial literacy becomes a potential endogenous variable and addressing this problem is essential to prevent estimation bias. To address this endogenous problem, the endogenous switching regression (ESR) model is adopted for estimation. The selection of the ESR model over other methods such as the Heckman Selection Model, Regression Adjustment (RA), and Propensity Score Matching (PSM) is its ability to take into consideration the observed and unobserved (e.g., inner motivation and risk traits) factors of the farmers when the estimation is done [56,57]. To ensure consistency in our estimation, dealing with the unobserved factors becomes essential [58,59]. Thus, selecting the ESR model over the others is the best in this study's analysis.

In the ESR method, three main equations are derived. Thus, one treatment selection equation and two separate outcome equations. The two separated outcome equations are (1) financially literate farmers and (2) financially illiterate farmers. The linear equation format is used for the outcome variable (area of farmland abandoned) estimation, while the treatment equation, which estimates the factors influencing farmers' financial literacy status, is achieved using the Probit model.

The assumption here is that a farmer has an expected utility (U^*_i) and he/she will seek financial knowledge and skills to improve their financial literacy if the expected utility for being financially literate (U^*_{i1}) is greater than the expected utility of being financially illiterate (U^*_{i2}). Thus, $U^*_{i1} - U^*_{i2} > 0 = FL^*_i$. The probability of a farmer seeking financial knowledge and skills to improve their financial literacy is FL^*_i. The linear equation for the outcome variable, which is predicted by the farmer/farm household characteristics and other factors (e.g., institutional factors like cooperative membership), is also expressed below (see Equation (4)). The utility difference, which is impossible to observe, requires a latent variable equation for its expression (see Equation (5)).

$$A^*_i = \gamma Z_i + \alpha Y_i + \varepsilon_i \tag{4}$$

$$FL^*_i = \beta X_i + \mu_i \qquad FL_i = \begin{cases} 1 \text{ if, } FL^*_i > 0 \\ 0 \text{ if, otherwise} \end{cases} \tag{5}$$

where A^*_i is the farmland abandoned area (outcome variable). Z_i and Y_i are the exogenous (e.g., gender, age, education level, family size, etc.) and endogenous (financial literacy, i.e., 1 = financially literate and 0 =otherwise) variables, respectively. γ, α, and β are the vector of parameters to be estimated. μ_i and ε_i denote the random disturbance terms. The variables in X_i and Z_i are equal; however, X_i contains the IV introduced in the theoretical analysis section, but this variable should not be included in the Z_i variables. Also, this IV should not directly correlate with the area of farmland abandoned but vis-à-vis the treatment (financial literacy) variable. Based on this reason and following previous literature (e.g., [27]), the variable financial education (i.e., whether the farmer has a relative/friend with an economics or financial education background) was chosen as this study's IV. We tested the validity of our selected IV using the Pearson correlation method (see Table A3 in the Appendix A). In Table A3, a respectively significant and insignificant correlation coefficient for financial literacy and farmland abandonment variables was observed, meaning that our IV is suitable.

As indicated above that the ESR outcome has two outcome equations, we express these two equations as follows. The expressions are divided into regimes [60]

$$\begin{array}{ll} \text{Regime 1 (financially literate)} & A_{1i} = Z_{1i}\gamma_1 + \varepsilon_{1i}, \text{ if } FL_i = 1 \\ \text{Regime 2 (financially illiterate)} & A_{2i} = Z_{2i}\gamma_2 + \varepsilon_{2i}, \text{ if } FL_i = 0 \end{array} \tag{6}$$

where the farmland abandonment status for a financially literate farmer is represented by A_{1i} and A_{2i} for a financially illiterate farmer. Also, (Z_{1i} and Z_{2i}) = explanatory variables, (γ_1 and γ_2) = vector of parameters to be calculated and (ε_{1i} and ε_{2i}) = error terms.

These indicators, μ_i, ε_{1i} and ε_{2i}, are assumed to have a tri-variate normal distribution with mean vector zero and covariance matrix:

$$cov(\mu_i, \varepsilon_1, \varepsilon_2) = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{1\mu} \\ \sigma_{12} & \sigma_2^2 & \sigma_{2\mu} \\ \sigma_{1\mu} & \sigma_{2\mu} & \sigma_\mu^2 \end{bmatrix} \quad (7)$$

where the disturbance term's variance (ε_{1i} and ε_{2i} in Equation (6)) is represented by σ_1^2 and σ_2^2, while σ_μ^2 is for the variance of μ_i, the error term of Equation (4). Also, σ_{12}, $\sigma_{1\mu}$, and $\sigma_{2\mu}$ are the covariance of ε_{1i} and ε_{2i}, ε_{1i} and μ_i, and ε_{2i} and μ_i, respectively. The model assumes that $\sigma_\mu^2 = 1$ because β can be estimated only up to a scale factor [61–63]. We proceed to calculate an inverse mill ratio (IMR) (λ_1 and λ_2) and the covariance term ($\sigma_{1\mu}$ and $\sigma_{2\mu}$) are calculated to provide a remedy for the selection bias issue in the ESR model. These estimated IMR and covariance terms are introduced in Equation (6). Thus, Equation (6) takes a new expression (Equation (8)).

$$E(I_{1i} | Y_i = 1) = Z_{1i}\gamma_1 + \sigma_{1\mu}\lambda_1 E(I_{2i} | Y_i = 1) = Z_{2i}\gamma_2 + \sigma_{2\mu}\lambda_2 \quad (8)$$

An appropriate method to ensure consistent standard error in this current model is by simultaneously estimating both the selection and outcome equations using a full information maximum likelihood (FIML) method [60,61]. Through the application of the FIML approach, the $\rho_1 = corr(\mu_i, \varepsilon_{1i})$ and $\rho_2 = corr(\mu_i, \varepsilon_{2i})$ are also determined. A non-zero ρ_1 and ρ_2 indicates that selection bias resulting from unobservable factors is present. As this study is concerned, the treatment effect of how financial literacy impacts farmland abandonment status is of interest. Thus, we need to estimate the average treatment effects on the treated (ATT) and average treatment effects on the untreated (ATU). Therefore, the following steps are considered.

$$\text{Financially literate had they been literate : } E(A_{1i} | FL_i = 1) = Z_{1i}\gamma_1 + \sigma_{1\mu}\lambda_1 \quad (9)$$

$$\text{Financially literate had they been illiterate : } E(A_{2i} | FL_i = 1) = Z_{2i}\gamma_2 + \sigma_{2\mu}\lambda_1 \quad (10)$$

$$\text{Financially illiterate had they been literate : } E(A_{1i} | FL_i = 0) = Z_{1i}\gamma_1 + \sigma_{1\mu}\lambda_2 \quad (11)$$

$$\text{Financially illiterate had they been illiterate : } E(A_{2i} | FL_i = 0) = Z_{2i}\gamma_2 + \sigma_{2\mu}\lambda_2 \quad (12)$$

The above expressions (the expected outcomes) can be utilized for consistent treatment effects, ATT, and ATU, derivation while considering unobserved and observed heterogeneity [64].

$$ATT = E(A_{1i} | FL_i = 1) - E(A_{2i} | FL_i = 1) = Z(\gamma_1 - \gamma_2) + \lambda_1(\sigma_{1\mu} - \sigma_{2\mu}) \quad (13)$$

$$ATU = E(A_{1i} | FL_i = 0) - E(A_{2i} | FL_i = 0) = Z(\gamma_1 - \gamma_2) + \lambda_2(\sigma_{1\mu} - \sigma_{2\mu}) \quad (14)$$

5. Results and Discussions

5.1. Descriptive Statistics

The analysis's variables, summary statistics, and definitions can be observed in Table 1. The reported mean farmland abandoned is 0.96 acres, and 31% of the farmers are financially literate. While a respective mean of approximately 5 and 42 years is reported for the farmer's years of education and age, 43% of the farmers believe they are in good health. The respective average dependency ratio and family size are approximately 3 and 7 people. The report from Table 1 displayed that 29% of the farmers use smartphones, and 35% of them have used farming machines on their farms. About 41% of the farmers are members of farm-based organizations (FBOs), and 34% reported being credit constrained. While the mean total farmland size of the farmer is 3.86 acres, only 36% of the farmers have their lands officially registered. The sampled group reveals that 27% of the household heads

have relatives or friends with economics/financial education backgrounds. Finally, about 18, 26, 27, and 29% have their residence in the Northern, BA, Eastern, and Central regions.

Some key variables mean differences between financially illiterate and literate farmers are displayed (Table 2). The area of abandoned farmland for financially illiterate farmers is larger than their financially literate counterparts, according to Table 2. This difference supports Figure 1, which establishes that the abandoned farmland associated with financially literate farmers is lower compared to farmers who are financially illiterate irrespective of their household income level. Thus, farmers from high-income and low-income households with higher financial literacy rates have fewer abandoned farmlands. It can also be observed that financially literate farmers are educated, users of smartphones, less likely to be credit constrained, and had their land officially registered. The result further reveals that farmers with financially literate relatives or friends tend to be financially literate. While Table 2 results give a fair understanding of the study, it only displays a simple average difference that ignores the farmers' observed and unobserved factors. In that matter, our quantitative analysis of the connection between farmland abandonment and financial literacy requires a suitable econometric method such as the ESR model, which can capture the farmers' observed and unobserved factors to prevent biased estimation.

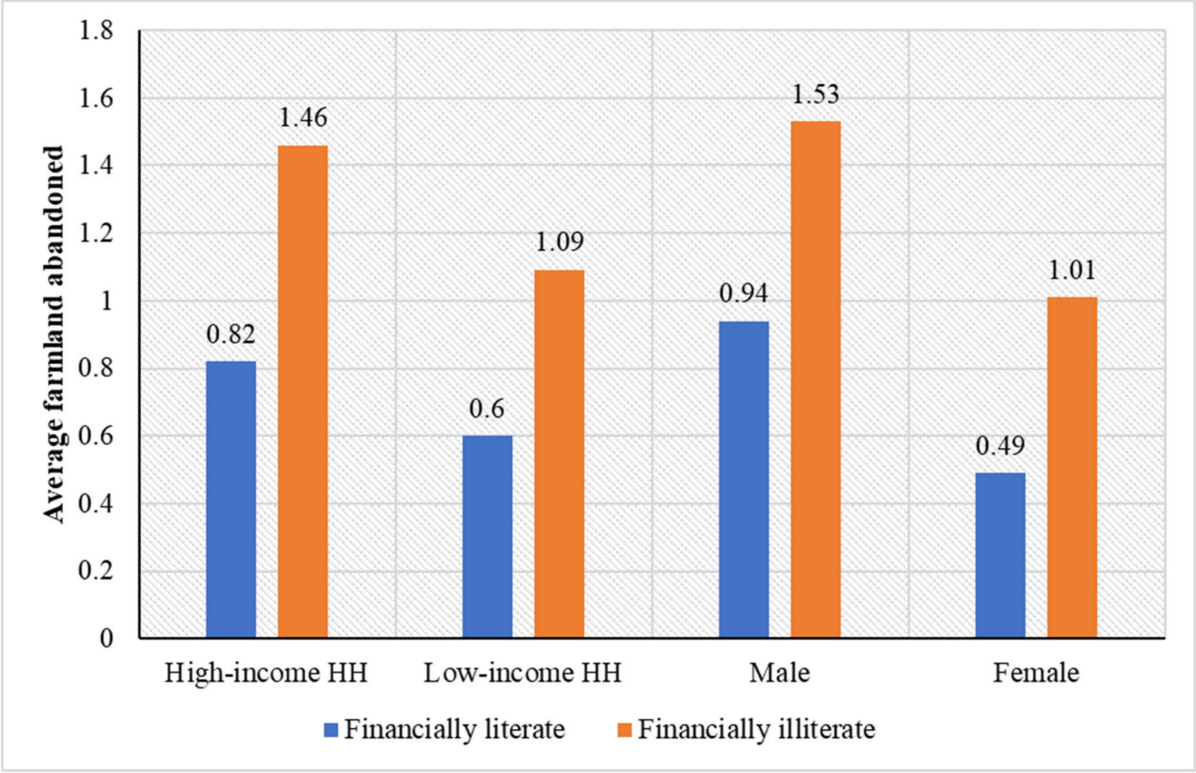

Figure 1. Distribution of average farmland abandoned by household income level and gender status. HH = Household.

Table 2. Main variables mean differences between financial literates and illiterates.

Variable	Literate	Illiterate	Differences (Normalized)
Farmland abandonment	0.71	1.27	−0.07 **
Gender	0.77	0.63	0.11 *
Age	43.75	40.52	0.09
Education	7.03	3.62	0.16 **
Self-reported health	0.44	0.43	0.02
Household Dependency ratio	3.98	2.66	0.30

Table 2. *Cont.*

Variable	Literate	Illiterate	Differences (Normalized)
Family size	5.34	7.95	−0.08
Smartphone use	0.35	0.27	0.13 *
Mechanization	0.37	0.34	0.06
FBOs membership	0.38	0.45	−0.11
Credit constraint	0.25	0.43	−0.23 ***
Land size	3.12	4.63	0.29
Land registration	0.43	0.31	0.20 *
Financial education (IV)	0.36	0.22	0.22 **
Observations	177	395	Total = 572

Source: survey results, 2018. Note: ***, **, and * respectively depict significant levels at 1, 5, and 10%.

5.2. Empirical Analysis

5.2.1. Determinants of Financial Literacy

Table 3, which was gathered from the selection equation of the ESR model (Table A2), displays the determining factors of financial literacy among the sample group. From the table, the variable, gender, is statistically significant, implying that male farmers in the study area are more financially literate than the female farmers in that area. Studies by Ankrah Twumasi [44] and Bucher-Koenen [65] support this finding. According to these researchers, females' engagement in STEM programs is generally low compared to males, thus making males more quantitatively efficient. The result also shows a positive and significant coefficient for the variable, education. Thus, a farmer's years of schooling increase their financial literacy level. Education equips individuals with vital fundamental financial skills and knowledge, which may affect their financial literacy level. Xu [24] and Lusardi and Mitchell [66] studies confirm this positive finding. For example, ref. [24] showed that educated people gain much understanding of financial services technicalities and terminologies and tend to have a higher probability of being financially literate.

Table 3. Financial literacy determinants.

Variables	Coefficients	Robust Standard Errors
Gender	0.024	0.010 *
Age	0.172	0.263
Education	0.291	0.075 ***
Self-reported health	0.016	0.086
Household Dependency ratio	−0.039	0.055
Family size	0.066	0.049
Smartphone use	0.078	0.027 **
Mechanization	0.044	0.091
FBOs membership	0.051	0.080
Credit constraint	0.096	0.047 *
Land size	−0.029	0.115
Land registration	0.088	0.030
Financial education (IV)	0.183	0.017 ***
Residual (smartphone use)	0.155	0.429
Constant	1.272	0.630 *
Regional dummies	Yes	Yes
Observations	572	

Source: survey results, 2018. Note: ***, **, and * respectively depict significant levels at 1, 5, and 10%. Northern = Reference region.

The results further revealed smartphone usage positively correlates with financial literacy. Smartphone use enables farmers to access innovations and essential financial information through the internet or text messages, which increases their financial literacy compared to non-smartphone users. This finding is in line with the conclusions of the

studies of Khanal and Mishra [67] and Ma et al. [68]. They showed that internet-based information enlightens users' knowledge and skills about new things, such as financial services; hence, improving their financial literacy. Credit constraint is also seen to influence financial literacy negatively, indicating that credit-constrained farmers are likely to be financially illiterate. People are financially constrained because they lack the primary financial knowledge and skill needed in the financial market; hence, their negative tendencies toward engaging in the financial market or patronizing financial services [24,69]. Thus, farmers with credit access tend to have more knowledge about the financial markets and are exposed to the details of these services, which improves their knowledge [25].

Finally, financial education, used as an instrumental variable, had a positive and significant coefficient. This result indicates that the likelihood of farmers with a relative/friend with an economics or financial education background being financially literate is higher compared to farmers without financial education. This finding is consistent with [27,44], whose finding explained that the flow of financial knowledge and skills provided to individuals through friends and relatives enables them to make efficient financial decisions compared to those without financial education.

5.2.2. Financial Literacy and Farmland Abandonment Association Estimate

Table A2, shown in the Appendix A, reports the estimates of the ESR models; thus, the results for the treatment and outcome equations. It can be observed from the lower part of Table A2 that the sign of ρ_1 is statistically significant, implying the existence of selection bias; hence, the application of the ESR model to compute the analysis is suitable. Moreover, the Wald test for joint independence of the equation is significantly different from zero, portraying the rejection of the null hypothesis stating that the Equation (2) error term (μ_i) and the error terms of Equation (3) (ε_{1i} and ε_{2i}) does not correlate. We did not discuss the determinants (control variables in Table A2) of the outcome variable (farmland abandonment) because those results do not provide a detailed understanding of how farmland abandonment is affected by financial literacy. The ATT and ATU are regarded as significant results that reflect the nexus between financial literacy and farmland abandonment [70]. Therefore, the interpretation of how financial literacy affects farmland abandonment is based on the treatment effect results (Table 4).

Table 4. The impact of financial literacy on the abandonment of farmland.

Mean Area of Farmland Abandoned (ESR)			**Treatment Effect**	**t-Value**
	Financially literate	Financially illiterate		
Financially literate	0.682	1.142	ATT = −0.460	−4.19 ***
Financially illiterate	1.105	1.328	ATU = −0.223	−10.17 ***
Heterogeneity effects	−0.423	−0.186	−0.237	ATE = −0.646
Mean area of farmland abandoned PSM [a]				
Financially literate	0.707	1.086	ATT = −0.379	−2.97 ***

Source: survey results, 2018. Note: *** depict significant level at 1%. Northern = Reference region. [a] Nearest neighbor matching technique is used.

Table 4 presents the average treatment effects on the treated (ATT) and the untreated (ATU). In the context of this study, the ATT represents the average effect of being financially literate on the farmers who are financially literate in terms of farmland abandonment, while ATU represents the potential gains a financially illiterate farmer could have secured had they been financially literate. The estimates show that higher farmland abandonment reduction is associated with being financially literate. Financially literate farmers are observed to have 0.682 acres as their abandoned farmland, compared with 1.142 acres had they been financially illiterate, suggesting that being financially literate resulted in reducing farmland by about 40.3% (Table 4). In the same manner, financially illiterate farmers are observed to have 1.328 acres as their abandoned farmland, compared with 1.105 acres had they been financially literate, suggesting that being financially literate resulted in reducing

farmland by about 17%. The heterogeneous effect result implies that the abandoned farmland effect on financially literate farmers is more profound than on their financially illiterate counterparts. Financially literate farmers may have the financial knowledge and skills to enjoy financial services (e.g., access to credit, insurance, and savings); hence, empowering the farmers' farm inputs purchasing power to boost productivity. When this happens farmers may be more likely to expand their production. Thus, farmland abandonment would be reduced. These findings echo Du [18] and Ankrah Twumasi's [25] results, which indicated that peasant households accessing financial services are less likely to practice farmland abandonment. It also confirms the theory underpinning this study, which states that financial literacy is a function of farmland abandonment [71].

The study conducted additional estimations to assess financial literacy's effect on farmland abandonment using the PSM method for robustness check purposes. As revealed in the lower section of Table 4, the PSM estimated ATT of financial literacy effect on abandoned farmland is −0.379, suggesting that an average farmer who is financially literate is more likely to reduce abandoned farmland by 0.379 acres than their financially illiterate counterparts. Both methods (ESR and PSM) show that financial literacy reduces farmland abandonment. Thus, results from the PSM and ESR are consistent.

5.2.3. Additional Estimates

Further estimates to heterogeneously assess farmland abandonments' impact on financial literacy are provided in Table 5. Here, the sampled group was categorized into divisions such as high and low-income households and the farmers' gender composition. In this study, households' median income was used as a breakeven point to differentiate between high- and low-income households. This implies that households whose income goes beyond (below) the breakeven point are classified as high (low) income households. Ankrah Twumasi [27] applied this method in their study.

Table 5. Disaggregated effect of financial literacy on farmland abandonment by household income and gender divisions.

Variables		Average Farmland Abandonment		ATT_{ESR}	t-Value	Change
		Financially Literate	Financially Illiterate			
Household income level	High	0.634	0.735	−0.101	−3.84 ***	13.74%
	Low	0.574	0.712	−0.138	−6.89 ***	19.38%
Gender	Male	1.005	1.184	−0.179	−2.31 *	15.12%
	Female	0.733	0.918	−0.185	−4.70 ***	20.15%

Source: Survey results, 2018. * and *** represent statistical significance at 10% and 1% alpha levels, respectively. All numbers in parentheses are robust standard errors.

The findings depict that financial literacy inversely affects farmland abandonment even after categorizing the farmers' attributes into different divisions. Particularly, the computed results reveal that the abandoned farmland effect on financially literate farmers is possible for farmers from both high- and low-income households. Nevertheless, the magnitude of percentage change is more prominent among low-income households than high-income household counterparts. The reason for this finding may be that, compared to farmers from high-income households, farmers from low-income households may see farm income as their main source of income, hence, more likely to reduce abandonment of farmland if their financial skills could help them patronize financial services (e.g., secure insurance policies and credit) to boost their production. The result agrees with Li [72], who showed that rural-urban migration reduces among farm households enjoying agricultural credit to improve their productivity.

Concerning the gender division, it can be observed that male and female farmers who are financially literate reduce farmland abandonment. To be precise, we observed that the female farmers' farmland reduction percentage is greater than their male counterparts. An explanation for this finding is the huge males' responsibility as family heads in

most developing countries like Ghana. These responsibilities may push them to patronize agricultural credit fungibility (i.e., utilize a portion of the farm loans for household expenditures); therefore, causing farmland abandonment due to insufficient funds to cultivate the land [73]. Moreover, seeking off-farm work, an unfavorable determinant of farmland abandonment [14], is high among male farmers due to their high financial responsibility as family heads.

6. Conclusions, Policy Implications, and Limitations

Farmland abandonment has been a major concern for policymakers in most developing nations since it is associated with food security and poverty alleviation. Thus, assessing factors influencing its reduction is of good essence and timely. We assess how financial literacy affects farmland abandonment in this study. The report results show that 177 out of the 572 sampled groups were financially literate. After employing the ESR model for our estimation, the following emerged from our findings. The selection equation from the ESR model (determinants of financial literacy) displayed those variables, including gender, education, smartphone use, credit constrained, and financial education as financial literacy influencing factors. The finding again depicted that financially literate farmers' probability of reducing farmland abandonment was higher than their illiterate counterparts. Moreover, different household groups depicted a heterogeneous farmland abandonment effect of financial literacy.

Based on the study's results, we highlighted some policy implications that might benefit national governments and policymakers. In the first place, the negative association between financial literacy and abandonment of farmland establishes that financial literacy is an integral determinant of farmland abandonment reduction. Therefore, improving individuals' financial literacy is essential, especially for farmers. We recommend that financial literacy programs can be organized or shown on national radios and television to provide financial education to the country's residents. Also, community leaders can be supported by the government to organize conferences aimed at empowering the financial literacy level of the rural dweller, especially when access to information through radios and televisions is hard to find. Finally, the findings revealed that it is vital to encourage females' agricultural participation because their farmland abandonment reduction was profound relative to males. This study gives evidence of the essence of financial literacy in reducing farmland abandonment; thus, intensification of agriculture engagement can be promoted if farmers are financially literate.

The following limitations are important to be noted by future researchers. First, we restricted our research study area to only four regions in Ghana because of limited funds; hence, affecting our sample size. Future researchers with adequate funds should target the entire country. Secondly, other socio-political, socioeconomics, and environmental characteristics may play a major role in farmland abandonment; thus, forthcoming research works can examine the linkage between those attributes and farmland abandonment to provide more alternative policies aimed at promoting agricultural growth. Third, the focus group for this work was farmers in crop cultivation; however, other categories of farmers, including livestock and fishery (aquaculture), who are practicing farmland abandonment exist. In coming studies can assess the financial literacy's effect on these categories of farmers. Finally, using the median as a yardstick to measure financial literacy in a dummy variable format may be associated with some shortfalls, so readers must take caution in the study's interpretation. We edge future studies to improve on this measurement when the need arises.

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Appendix A

Table A1. Questions about financial literacy and answers.

	Question	Answers
1.	Suppose you had GH¢100 in your savings account with a 2% annual interest. After 5 years, how much will you have in this account if you leave your money to gain interest? (Interest rate)	(a) more than GH¢102 (b) exactly GH¢102 (c) less than GH¢102 (d) I do not know
2.	When you save an amount of money, X, at a rate of 1% per annum and that savings suffer an increase in inflation after a year, will the value of that amount in savings be the same as it was the year of saving? (Inflation)	(a) Definitely (b) Not at all (c) I have no idea
3.	Is the following statement true or false? "Buying a single company stock usually provides a safer return than a stock mutual fund." (Diversification of risks)	(a) True (b) False (c) I do not know
4.	Which of these options is better: Borrowing GH¢500.00 and paying GH¢600 back in a month to a lender (N1) or borrowing the same GH¢500.00 from another lender (N2) and paying back the GH¢500.00 with a 15% interest in a month? (Borrowing)	(a) Borrowing from N1 (b) Borrowing from N2 (c) I have no idea
5.	If a man dies and bequeaths to his first son GH¢10,000 today and asked that another GH¢10,000 be given to other siblings 3 years from now, who becomes richer from the monies inherited (Time value of money)	(a) His first son (b) the sibling (c) Both beneficiaries (d) I have no idea
6.	Assume one's income doubles in a particular year, say 2010, and all commodity prices also double that same year. will one be able to buy more or less with that income today (Money illusion)	(a) More than today (b) The same (c) Less than today (d) I do not know
7.	A brand new farm machinery is less costly to insure than second-hand farm machinery? (insurance)	(a) Absolutely true (b) Totally untrue (c) I have no idea

Source: Ankrah Twumasi et al. [44], Lusardi et al [66], and Andoh et al. [50].

Table A2. Determinants of financial literacy and farmland abandonment.

Variables	First Stage Selection Equation	Second Stage Farmland Abandonment Equation	
	Financially Literate	Financially Literate	Financially Illiterate
Gender	0.024 (0.010) *	0.036 (0.018) *	0.061 (0.076)
Age	0.172 (0.263)	−0.097 (0.046) *	−0.043 (0.067)
Education	0.291 (0.075) ***	0.003 (0.000) **	0.011 (0.018)
Self-reported health	0.016 (0.086)	−0.055 (0.027) *	−0.113 (0.107)
Household Dependency ratio	−0.039 (0.055)	−0.086 (0.220)	0.063 (0.031) *
Family size	0.066 (0.049)	−0.006 (0.009)	−0.056 (0.024) *
Smartphone use	0.078 (0.027) **	0.048 (0.022) *	0.145 (0.177)
Mechanization	0.044 (0.091)	−0.086 (0.030) **	−0.064 (0.014) ***

Table A2. *Cont.*

Variables	First Stage Selection Equation	Second Stage Farmland Abandonment Equation	
	Financially Literate	**Financially Literate**	**Financially Illiterate**
FBOs membership	0.051 (0.080)	−0.079 (0.041)	−0.060 (0.013) ***
Credit constraint	0.096 (0.047) *	0.033 (0.112)	0.095 (0.011) ***
Land size	−0.029 (0.115)	0.042 (0.017) **	0.011 (0.007)
Land registration	0.088 (0.030)	0.021 (0.059)	0.061 (0.045) *
Financial education (IV)	0.183 (0.017) ***		
Residual (smartphone use)	0.155 (0.429)	0.063 (0.056)	0.018 (0.069)
Constant	1.272 (0.630) *	3.261 (1.282) **	1.774 (0.708) **
Regional dummies	Yes	Yes	Yes
σ_1	0.170 (0.147)		
σ_2	0.613 (0.451)		
ρ_1	0.072 (0.019) ***		
ρ_2	−0.032 (0.113)		
LR test of indep. eqns.: 4.26 **; Log likelihood = −887.839; Observations = 572			

Source: survey results, 2018. Note: Note: ***, **, and * respectively depicts significant level at 1%, 5%, and 10%. Northern = Reference region. All numbers in parentheses are robust standard errors.

Table A3. Pearson correlation analysis of the selected IV.

Variables	Correlation Coefficient	*p*-Value
Financial literacy	0.049 **	0.016
RE adoption	0.186	0.112

Source: Survey results, 2018. Note: ** $p < 0.5$.

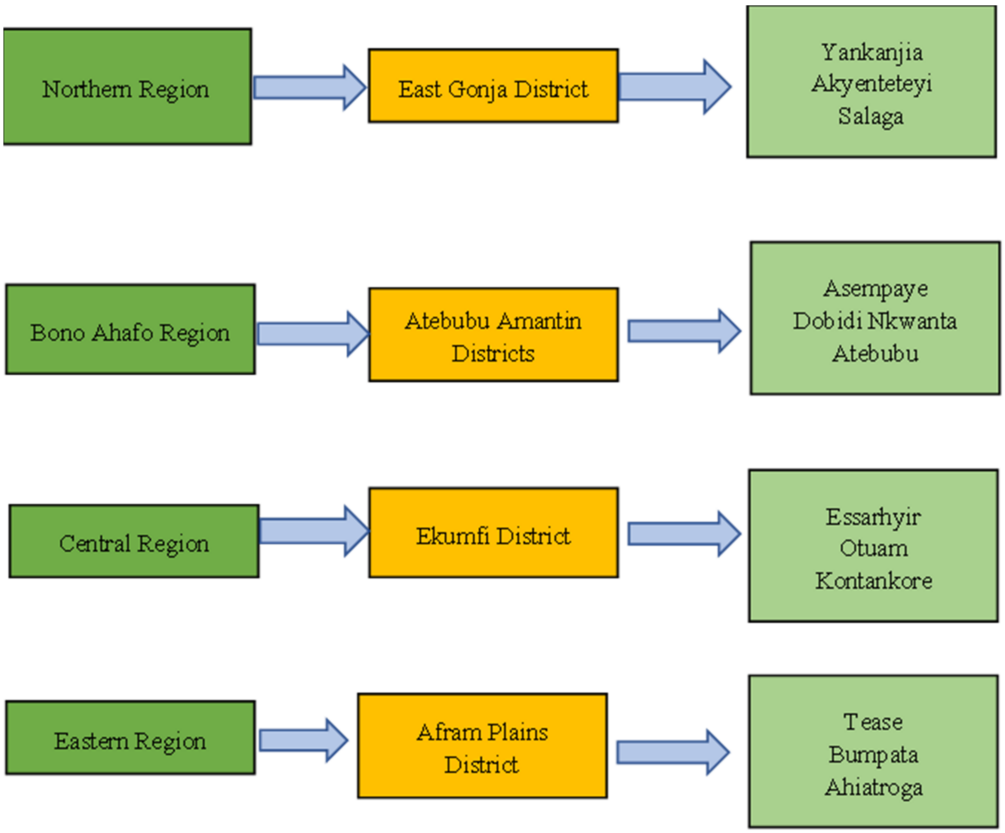

Figure A1. Diagram of household sample selection procedure.

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