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THE EFFECT OF CREDIT-USE ON THE PROFITABILITY OF SMALLHOLDER MAIZE-FARMING IN GHANA

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ABSTRACT

The study assesses credit-use and its effect on profitability among smallholder maize farmers in the Bono region of Ghana. A multistage sampling technique involving the purposive, stratified and simple random sampling techniques was employed in the selection of the Bono region and two municipalities within the region as the study area, as well as the selection of 200 smallholder maize farmers respectively. The study considered both formal and informal sources of credit such as friends and relatives, *susu* (traditional thrift groups), farmer groups, trade creditors, rural banks, money lenders, and NGOs. The factors influencing the decision of a farmer to use credit, the determinants of farmers' credit-use intensity and the indicators of profitability among smallholder farmers were investigated. The study employed the use of a binary probit model to estimate the factors influencing the decision of a farmer to use credit, and a Tobit regression model to estimate the intensity of credit-use by smallholder maize farmers. Indicators of profitability such as Gross margin, Net revenue and Return on Investment were used to estimate the profitability of the smallholder maize farmers. A mean test for significance was conducted to estimate the statistical differences among the maize farmers' profitability. The probit regression results revealed that age, gender, experience in farming, farming objective, collateral, farm size, and membership to farmer associations significantly influence maize farmers' decision to use credit. Results from the Tobit model revealed that landownership, educational level of farmer, production cost per hectare and interest rate had a significant impact on farmers' credit-use intensity for maize production. The result from the Gross Margin analysis showed an average total revenue of GH¢ 1644.95 for credit users and GH¢ 975.31 for non-credit users, while the average net revenue among credit users and non-credit users were GH¢ 312.23 and GH¢ 192.42 respectively. The average return on investment for credit and non-credit users was GH¢ 0.2503 and GH¢ 0.1567 respectively. These results imply that the use of credit has a significantly positive effect on smallholder maize farmers' gross margins, net revenue, returns on investment, and on their profitability in general. The paper recommends that stakeholders in agriculture include in their sensitization programmes ways of enhancing credit-use by especially smallholder maize farmers as this has positive implications for their profitability. Financial institutions must better facilitate access to credit by commercial farmers, and also develop innovative financing packages that favor farmers and better manage risk to these financial institutions.

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Background

Agriculture is a crucial sector in the development of most low-income countries. Ghana is a largely agrarian economy with most of her citizens relying heavily on agriculture for survival (Antwi *et al.,* 2017). The agriculture sector is very essential and dominant in Ghana's economy as it accounts for over 50 percent of foreign exchange earnings by the country (MoFA, 2011). Farmers in most developing countries are smallholders operating on a limited scale and often relying on family land and family labour. The Ghanaian agriculture sector, for instance, is dominated by small-scale farmers who cultivate less than two hectares of land each and are mostly located in rural areas. These farmers are often constrained logistically, having difficulty accessing farming accoutrements such as inputs, machinery, skilled labour and other requisite factors of production. These constraints are mainly as a result of inadequate financing. The resulting low yield leads to low productivity which adversely affects their profitability.

Maize production in Ghana requires a lot of investment in productivity-enhancing factors such as fertilizer, agrochemicals and other farming inputs. Farmers who produce on a small scale and cannot afford most of these productive resources require financial support in the form of credit. Credit-use enhances the ability of the farmer to access requisite factors of production, enabling them to access adequate farm lands, afford both skilled and unskilled labour and also giving them the opportunity to deploy modern farm technology to boost production which in turn increases their efficiency of production, enabling them to be and/or stay profitable (Antwi and Onumah, 2020; Antwi, 2020).

The dominance of smallholder farming in Ghana seems to suggest that policy enacted to enhance agricultural development should target smallholder farmers more. Policies such as the GPRS II, FASDEP II, METASIP and financial institutions such as the Agricultural Development Bank were designed and set up to help facilitate access by farmers to input resources and markets by making credit available and accessible to them. The motivation for these policies and institutions was to improve farmers' productivity to enhance increased farm income and improve living standards (World Bank, 2008). Current rural development strategies outlined in FASDEP II are converging on agricultural modernization through the transformation of the subsistence smallholder farmer to one that produces for the market. The purpose is to achieve commercial orientation and the adoption of productivity-enhancing technologies and associated inputs like credit. To improve farmers' access to credit, it is important to strengthen the capacity of operators in the credit management system, educate farmers on the merits of credit-use and the procedures for access, and also seek to link formal and informal financial service delivery systems. In view of this, the Ministry of Food and Agriculture (MoFA) seeks to improve farmers' income and improve their living standards by enhancing the cultivation of staple crops through the use of a credit instrument (Olwande & Mathenge, 2012).

According to Bashir *et al.* (2010), farmers' ability to use inputs efficiently is often streamlined by their access to credit. This assertion is buttressed by studies by Girabi & Mwakaje (2013) and Ashaolu *et al*. (2011) that credit users are more productive than those without credit. Research findings by Al-Hassan *et al*. (2006) and Omiti *et al.* (2009) highlight higher profit and prospects of curbing poverty to ensure sustainable livelihoods, expanded production and the adoption of productivity-enhancing technologies for credit users. Accessing credit is however difficult for smallholder farmers because most of them do not have the required collateral to signal guaranteed credit worthiness. According to Onumah & Acquah (2011), credit sustainability in low-income countries is riddled with many challenges and this poses a major development obstacle.

The Bono region of Ghana remains the major maize crop producer of the country (MoFA, 2011). Among the major cereal crops produced in Ghana, maize production accounts for 50-60%, being volumetrically the second most produced crop after cocoa (MiDA, 2010). It is estimated that about 70% of smallholder farmers in Ghana produce maize. Unfortunately, a large proportion of these farmers lack the necessary financing for input resources to attain optimum production and profit levels. This study investigates how smallholder maize farmers access and use credit and how this directly or indirectly affects their farm profitability.

Theoretical Framework

The theory underlying this study is based on individual investment behavior and their respective profit maximization. The microeconomic theory on producer profit maximization is an area of economic research that has been studied extensively, where investments, individual choice, prices and quantities, among several other exogenous variables, influence an individual's (farmer's) output level. Being a rational producer, a farmer would choose the best yielding options given that production inputs are substitutable goods, like fertilizers, credit, improved seed, and technology.

As posited by Mansfield (1991), producers maximize profit by producing a quantity of goods that indicate the level of combination of production inputs. Based on the theory of production maximization (for producers), farmers derive satisfaction from the utilization of the inputs they use in farming to maximize output levels. Assuming a farmer has access to credit as an intermediate good, then the farmer's expected production output, according to Greene (2012), is represented mathematically as shown:

$$Q_{ij} = q_i(Y_j, X_j, e_{ij})$$

where Q_{ij} is the Output level of farmer *i* by good/input *j*, Y_j is the household income for farmer j, X_j is the vector of the observed characteristics of the farmer and of the given choice of the farmer, and e_{ij} is the unobserved error term of the indirect production (profit) function. The farmer will agree to adopt an input only if the output (profit) derived from the improved state is greater than the profit derived from the status quo. That is, if

$$Q_i\left(Y_j - Y_i^*, X_j, e_{ij}\right) > Q_j(Y_j, X_j, e_{ij})$$

where Y_i^* denotes the farmer's income (profit margin). The probability that the *jth* farmer's response 'yes' is an indication that he or she has access to credit is given by:

$$\Pr(\text{yes}) = Q_i\left(Y_j - Y_i^*, X_j, e_{ij}\right) > Q_{ij}(Y_j, X_j, e_{ij})$$

A common formulation of the Production Maximization Model is the Additive Profit Model (Cameron & Trivedi, 2005). The Additive Profit Model assumes that the production (profit) function is additively separable into deterministic and stochastic preferences. This is presented mathematically as:

$$Q_{ij} = Q_i(Y_j, X_j) + e_{ij}$$

Hence, the probability statement that a respondent's answer is 'yes' to access to credit is illustrated as:

$$\Pr(\text{yes}) = Q_{ij}\left(Y_j - Y_i^*, X_j\right) + e_{ij} > Q_{ij}(Y_j, X_j) + e_{ij}$$

Now let P_i denote the dependent variable in which the study will censor farmers who are not P for maize production. According to Greene (2012), P_i is hypothesized to be a function of farm household socioeconomic characteristics such as age, sex, education, household size, access to credit, fertilizer, etc. These exogenous variables were employed using a simple linear regression model specified as:

$$P_i = \beta_i X_i' + \varepsilon_i$$

Where β_i is the vector of the estimated parameters, X_i is the vector of the farmers' household socioeconomic characteristics and ε_i the error term which captures all other factors that affect households' profit margins in the model.

Relevant to the objectives of this study, it is imperative to look at the profitability analysis of maize production. Profitability analyses are grounded in financial evaluations that include gross margin, net revenue and Return on Investment analyses. Profitability analysis was used because it takes into account both cost of inputs and revenue from outputs. The total cost involved in the production of a hectare of maize is the sum of fixed or capital cost and variable or operational cost. According to Jolly & Clonts (1993), fixed cost is the cost that must be paid whether there is production or not, and this usually accrues before the first production period in the form of start-up cost. This fixed cost includes the cost of capital assets such as cost of land or land rental, equipment like cutlasses, hoes, silos, knapsack machines, etc. The variable cost includes the cost incurred during operations, and this cost depends directly on the scale of operations. Variable costs are incurred on inputs such as seed, labour, fertilizer, pesticides, etc. The output, which is the quantity of maize produced, is multiplied by the unit price to get the revenue per quantity.

The theory of profit maximisation employed in this study implies that a rational smallholder maize farmer will not increase production if the cost incurred on such production-increment is more than its corresponding benefits or revenue-gain. This theory serves as a guide for the farmers in making rational decisions on the volumes of output to produce. The study follows the informed assumption that the smallholder maize farmers are rational and therefore increasing profit is their primary objective and this will be achieved by efficiently utilizing available input variables to produce optimum output levels.

METHODS OF DATA ANALYSIS

Sources of Credit to Smallholder Maize Farmers

The study sought to, among other things, identify and describe the sources from which smallholder maize farmers in the study area obtain credit. Information was gathered from respondents on whether or not they used credit in the 2016 maize farming season and from which specific sources the credit was obtained. Descriptive statistics such as frequencies and percentages were used to describe the results of this objective.

Factors Influencing Farmers' Decision to Use Credit

The Binary Probit model was used to estimate the factors influencing use of credit among smallholder maize farmers in the study area. Several studies on access to credit have shown that there exists some heterogeneity between credit users and non-credit users (Feder *et al.,* 1990; Dong *et al.,* 2010). According to Feder *et al*. (1985), many models used in measuring credit-use fail to meet the statistical assumptions necessary to validate the conclusions based on the hypotheses tested. To overcome this problem with regards to the use of a linear probability model, the logit and probit models have been recommended as more appropriate (Gujarati, 2004). In this study, it is appropriate to use the probit model since the probabilities are between 0 and 1.

The Binary Probit model is specified as:

$$\Pr(Y^* = 1/X) = \emptyset\,(X^1\beta) = Y^* = \beta_O + \beta X_1 + \mu_1$$

where P_r is the Probability of credit-use (1 = farmer used credit for maize production, 0 = otherwise), Ø is the cumulative density function, β are the coefficients to be estimated, Y^* and X are the dependent and explanatory variables respectively and μ is the random disturbance term. The variables used in the model are further described in Table 1.1.

Table 1.1: Variables used in the Probit regression model

Variable	Descriptions	Measurement	*A priori* Expectation
Dependent (Y*)	Use of credit	Dummy (if Yes = 1, No = 0)	
AGE	Respondent's Age	Years	+/-
GEN	Gender of Respondent	Dummy (Male = 1, Female = 0)	+
HH_SIZE	Household Size	Number	+
EDU	Educational Level	Years spent in School	+
EXP	Farming Experience	Years	+
OBJ	Farmer's Objective	Dummy (commercial = 1, other = 0)	+
COLTRAL	Collateral	Dummy (if required = 1, other = 0)	-
FAM_SIZ	Farm size	Hectares (Ha)	+

HH_INC	Annual Household Income	Ghana Cedis (GH¢)	-
FBO	Group membership	Dummy (FBO member= 1, otherwise = 0)	+
SAV	Savings Account	Dummy (Savings account=1, none = 0)	
DIST	Distance to credit source	Dummy (close (≤2km) = 1, far (>2km) = 0)	+

Explanatory Variables in the Probit Regression Model

Gender of respondent was measured as a dummy variable. A value of 1 was assigned a male farmer and 0 a female farmer. Gender was expected to have a positive relationship with credit-use because male farmers are often less risk averse vis-à-vis credit-use as compared to their female counterparts. According to Buvinic (1979), the two major factors that restrict female farmers' use of formal credit are their lack of control over economic resources and the fact that the nature of their economic activity does not usually require the use of credit. Hence, males are expected to use credit more frequently than female farmers.

The age of the farmer in this survey was stated as the actual years lived of a farmer. This was captured in years and as a continuous variable. Age has a mixed effect on the likelihood of a farmer using credit. Age is expected to have either a positive or a negative relationship with use of credit. The age of a respondent is included in the model as a proxy for maturity and the potential ability of the borrower to utilize and repay credit (Rahji & Fakayode, 2009). Older people are normally reported as more risk averse than young people and rarely enter into debt obligations. Moreover, older people usually find it relatively more difficult to comprehend the operations and conditions of financial institutions with regards to loans and other financial obligations (Adams *et al*., 1992).

Household size of the farmer measures the number of individuals in a particular house/home who eat from the *same* pot. Household size was expected to have a positive influence on farmers' access to credit since larger households tend to have a higher demand for credit in order to effectively oversee consumption expenditure.

With regards to education, formal education of farmers was measured by the number years spent in school. This was expected to have a positive relationship with credit-use. Previous studies attribute this to the fact that the higher the level of formal education attained, the better one's understanding of the procedures and requirements of obtaining credit for agricultural activities. Experience in farming was also measured by the number of years a farmer had been engaged in maize farming. Farmers' probability of using credit was expected to have a direct relationship with experience in farming. This can be explained on the premise that more experienced farmers might be aware of the importance of credit-use.

Farmers in the region engage in maize-cultivation for subsistence purposes or for sale. The farming objective in this study was measured as a dummy where a value of 1 was assigned a maize farmer whose main objective for farming is commercial and 0 if farming is for subsistence purposes. The effect of the farming objective is expected to have a positive relation with use of credit since commercial farmers are expected to invest more in their farming activities and will subsequently require larger capital.

Farm size was measured by the actual land-holding used for maize cultivation, measured in hectares. It was expected that farmers with larger farms would require larger financial investment hence the likelihood of using credit. Farm size was therefore expected to have a positive relationship with the probability of a farmer using credit. According to Belshaw (1959), an average land-holding farm size relates positively to the chances that a farmer would use credit. This is because the larger the farm size, the more labour required to cultivate and maintain the crops, which would demand additional resources including capital to achieve favorable and more profitable results.

Household income was measured as the sum of annual income from maize cultivation and income from any other economic activity engaged in by the farmer. Household income was measured in Ghana Cedis (GH₵) and the effect on the likelihood of using credit was expected to be negative, meaning that high income earning farmers will be able to finance their farming activities through equity.

Group membership, which was treated as a dummy variable where 1 denotes a farmer who belongs to a farming association/group and 0 if otherwise, was included in the model. This is relevant especially in Ghana where one of the main roles of farmer organizations is to aid farmers get access to credit as well as to credit providers. It was therefore hypothesized that farmers who are members of farmer associations will use more credit than those who are not.

Another variable used in the model is whether a farmer has a savings account with a bank or financial institution. This was measured as a dummy variable where the value 1 was assigned to farmers who have a savings account and 0 to those who do not. Farmers with savings accounts are expected to have relatively easy access to credit and are likely to use credit to support their farming activities.

Distance was measured as the distance to the collection point of credit from the place of habitation of the farmer. It was captured as a dummy variable where the value of 1 represents a distance of not more than 2km between the farmer's place of abode and the credit collection point. 0 was assigned distances above 2km.

Determinants of Credit-Use Intensity Among Maize Farmers

The Tobit model was employed to estimate the credit-use intensity of smallholder maize farmers in the Bono region of Ghana. The Tobit regression model establishes the relationship between a non-negative dependent variable Y_i and the explanatory variable X_i. The Tobit model supposes that there is a latent (unobserved) variable, Y_i. This variable linearly depends on X_i via a parameter vector.

Model specifications

The Tobit regression model was employed in the analysis to estimate the credit-use intensity because an attempt to use the ordinary least square method of estimation to model smallholder maize farmers credit-use could result in biased estimates (Maddala, 1992). The Tobit model estimation was therefore conducted to utilize zero and non-zero values of the dependent variable (credit amount used in maize production by credit users) in order to take into account, the significant number of variations in the amount of credit observed. This model has been widely utilized in applied micro econometric studies (Brehanu & Fufa, 2008; Amemiya, 1984) and studies of household behavior (Song *et al.,* 2012; Jingchao & Kotani, 2012).

The relationship between the censored variable (y) and the independent variables can be expressed by the Tobit model, where it is assumed that the observed endogenous variables Y_i for observations i = 0, 0.5, 1, 1.5, 2…n satisfy the following:

Y_i^* is observed to be a censured dependent variable such that $Y_I^* \geq 0$, that is non-negative.

Where the Y_i^*s are the latent variables generated using the linear regression model;

$$Y_i^* = X^i \beta^i + \varepsilon_i$$

where X^i is the vector of the regressed variables. The model error term ε_i is assumed to be normally distributed with zero mean and constant variance.

$$Y_i^* = \beta_0 + X^i \beta^i + \varepsilon_{i\,;} \text{ where } \varepsilon_i \sim N(0, \sigma^2)$$

Where;

Y^* = credit amount devoted to maize production

β_0 = constant term

β^i = coefficient of explanatory variable X^i, where i = 1, 2, … 8

ε_i = error term

Table 1.2: The determinants of credit-use Intensity

Variables	Description	Measurement	*A priori* Expectation
Y^*	Credit amount used/Ha	GH₵ /Ha	N/A
X_1	Age	Years	+/-
X_2	Household Size	Number	-
X_3	Land Ownership	Dummy (Self ownership = 1, otherwise = 0)	+
X_4	Savings	Dummy (Save at Bank = 1, otherwise = 0)	+
X_5	Education Level	Years	+
X_6	Total Production Cost/Ha	GH₵ /Ha	+/-
X_7	Interest Rate	GH₵ /Ha	-
X_8	Farming Objective	Dummy (Commercial =1, Non-commercial = 0)	+

Effect of Credit on Smallholder Maize Farmers' Profitability

Profitability of Smallholder Maize Farmers

The profitability indicators that were used to estimate the effect of credit-use on the profitability of smallholder maize farmers (i.e. gross margin, net revenue and return on investment) were calculated on a per-hectare basis of maize farm cultivated for the 2016 cropping year.

Estimation of Gross Margin

Gross margin analysis is useful for production cycles of less than or equal to a year (Johnson, 1991) as this enables costs and returns to be directly linked to enterprise, and helps to establish the profitability of that enterprise (Adegeye & Dittoh, 1985). The study employed the use of gross margin analyses per hectare as an indication of plot level performance; that is, how well credit user and non-credit user farmers did on their land with the resources that were available to them. The gross margin was computed by documenting the difference between the total sales/gross income and the variable costs.

Estimation of Total Revenue

The total revenue component in the analysis includes all revenue generated from a hectare of maize farm cultivated. The computations took into account the total output of maize obtained from a hectare of maize farm cultivated, whether sold for income, consumed by the household or given out as gifts. To arrive at the total revenue therefore, the total quantity of maize harvested by each farmer was multiplied by the average price of GH₵120.00, which is how much a 50 kg bag of maize was sold for.

Estimation of Total Variable Cost

In estimating the total variable cost of production, all the variable costs incurred in cultivating a hectare of maize farm was taken into account. The quantities and prices of fertilizer, seeds, agrochemicals, labour and land rentals per hectare, storage cost and interest on operating capital used in the 2016 cropping year were obtained from farmers and subsequently used in estimating the cost of production directly linked to their output.

Test for significant difference in input-use among farmers

The t-statistics was computed to help determine whether there is a significant difference between input variables among credit and non-credit users. The formula for the t-statistics is the Z scores which is specified as:

$$Z = \frac{X_1 - X_2}{\int_1^2 / N_1 + \int_2^2 / N_2}$$

where X_1 and X_2 are sample means of alternative groups, $\int_1$ and $\int_2$ are sample variables for the two groups and N_1 and N_2 are the sample size for the compared groups.

Hypotheses:

H_O: There is no significant difference in the input-use between credit users and non-credit users.
H_A: There is significant difference in the input-use between credit users and non-credit users.

Estimation of Net Revenue/Net Margin

$$NM = GM - D$$

where NM is the Net Margin*,* GM the Gross Margin and D the depreciation of fixed assets

Estimation of Fixed Cost/Assets

In estimating the fixed cost in maize production, machinery and equipment such as cutlasses, hoes, knapsack sprayers and silos were taken into consideration and depreciated. The straight-line method of depreciation was used. There was no salvage value considerations for the assets.

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$$\text{Depreciation} = \frac{\text{Value of asset}}{\text{Useful Life}}$$

Estimation of Return on Investment

The total production cost for this analysis is the same as the total cost of production estimated for the gross margin analysis.

$$\text{Return on Investment} = \frac{\text{Net Margin}}{\text{Total Cost of Production}}$$

Hypotheses:

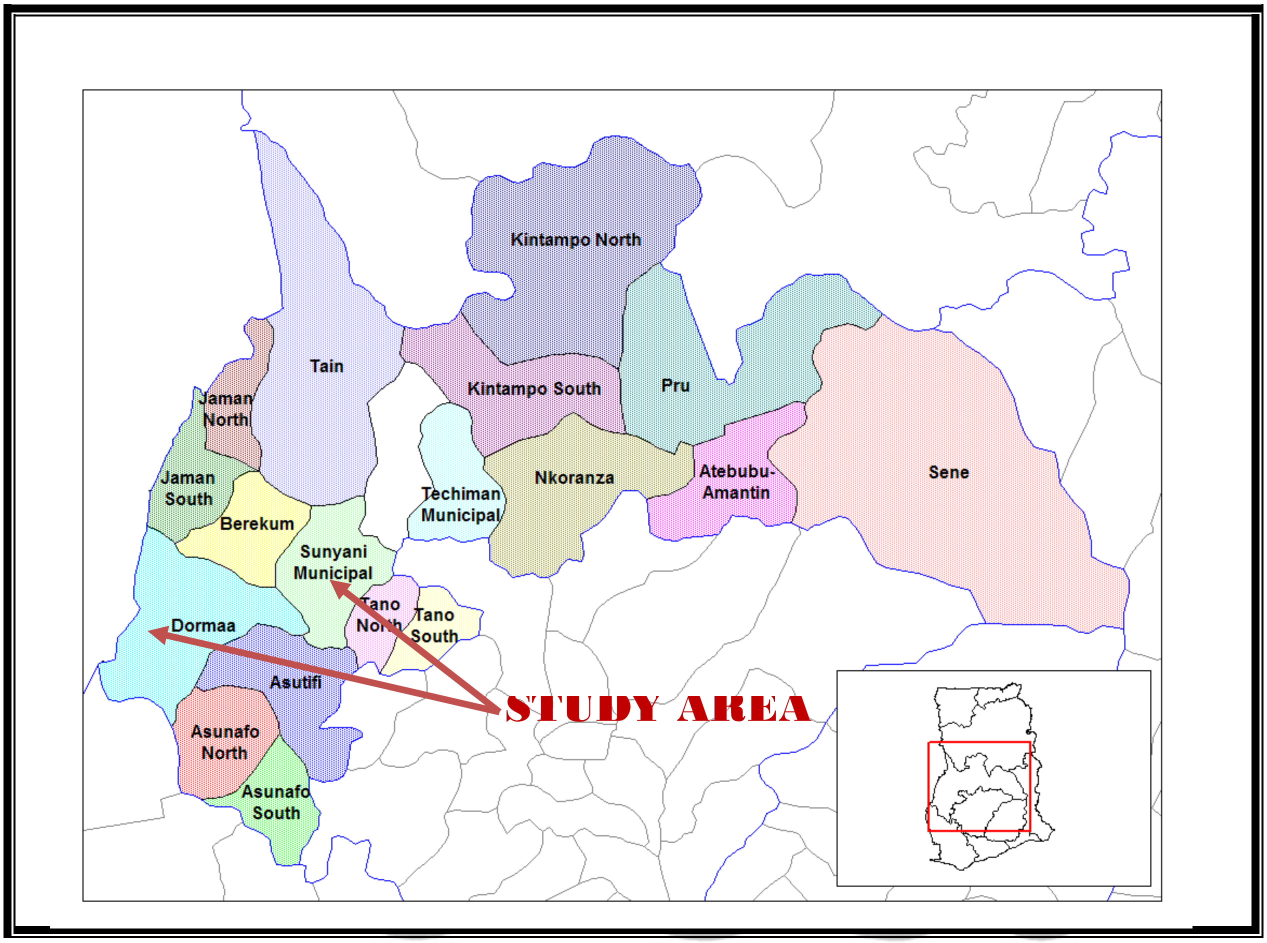
H_O: There is no significant difference between the profit levels of credit users and non-credit users.
H_A: There is a significant difference between the profit levels of credit-users and non-credit users

The difference in mean test was used to determine whether there is significant difference between the gross margin and net revenue of farmers. The results from the estimates was used to determine the significant differences in the profitability indicators among credit users and non-credit users.

Study Area

The study was conducted in the Bono region of Ghana. The region is the second largest in Ghana with a land area of 39,558 km^2. It shares borders with the Northern region on the North, the Ashanti and Western regions on the South, the Eastern and Volta regions on the Southeast and East respectively, and La Cote D'Ivoire on the West. The region is characterized by relatively tropical temperatures and the vegetation type is in two forms – the semi deciduous forest in the southern and southeastern parts and the guinea savannah woodland in the northeastern parts of the region.

Figure 1.1: A pictorial representation of the Bono region of Ghana.



Source: (Bono region Planning Unit)

The Bono region has a population of about 2,282,128 (GSS, 2010). Agriculture is the mainstay occupation of the people in the region. Most of the active group of the region are subsistence food crop farmers. Major crops grown in the Bono region include staple food crops like maize, cassava, plantain, yam, cocoyam as well as cash crops such as cashew, cocoa, tobacco, oil palm, mango, etc. Among the districts of the region, maize is largely produced in the Sunyani Municipal (West), Dormaa Municipal (East) and Nkoranza.

Sampling Technique and Sample Size

The Bono region was purposively selected for its vibrancy in maize production. The districts selected for the study, due to their high share in maize production, were the Sunyani and Dormaa Municipalities. The second sampling stage involved selecting communities where maize production is done on a relatively large scale. The stratified sampling approach was used to select four communities under each sampled district, and the desired sample size was arrived at using a simple random sampling technique. The simple random sampling technique ensured that all farmers have an equal probability of being selected, which is not the case when sampling units consist of towns or villages of unequal size (Morris *et al*., 1999). Twenty-Five farmers were selected as respondents from each community/village resulting in a total of 200 respondents (Table 1.3).

Table 1.3: Distribution of sampling units by districts and communities/villages

Districts	Communities/Villages	Sample Size
Sunyani Municipal	Yawhema	25
	Danyame	25
	Wawasua	25
	Nkrankrom	25
Total		**100**
Dormaa Municipal	Koraso	25
	Asuotiano	25
	Mantukwa	25
	Wamanafo	25
Total		**100**
TOTAL NUMBER OF RESPONDENTS		**200**

Source: Field Survey, 2017

RESULTS AND DISCUSSION

Demographic and Socio-Economic Characteristics of Respondents

The results show that 54.5% of the sampled respondents were males whilst 45.5% were females. With regards to gender distribution, it is evident that smallholder maize farmers in the Bono region are dominantly males. Females usually perform other domestic and economic roles like housekeeping and marketing of agricultural produce and may not have as much time for farming as their male counterparts. Also, some women often serve as helps on the farms of their husbands and do not own their own farm.

Smallholder farmers in Ghana generally have low levels of formal education and this was evident in this study with 42% of the respondents having had no formal education. This is corroborated by the findings of Antwi and Onumah (2020) that reported an average of 1.9 years spent in formal education for smallholder soybean farmers in Ghana. Among those farmers who had had formal education, the majority (41%) had only basic education, 11.5% and 5.5% had attained Senior High School and tertiary levels respectively. Comparative to the situation in other regions, maize farmers located in the Bono region have some appreciable level of education which could enhance their adoption of new technologies and their willingness and ability to secure credit.

Land ownership is one of the factors that influences a farmer's decision to use credit. The results show that majority of maize farmers (32.5%) use family land for maize cultivation, 31.5% have joint ownership, 18% rent the land for farming, 4.5% of them were squatters and 1% use government land. Only about 12.5% own the land.

About 64% of the respondents belong to farmer associations. Farmers' membership to these social networks generates social capital that members can rely on as 'social collateral' for accessing credit and other productive resources (Udry & Conley, 2006). The results also showed that the main occupation of the respondents is farming, with about 97.5% of respondents plying farming as their primary economic activity.

The average household size for credit users and non-credit users was 6 and 4.97 respectively. The minimum age of credit-user farmers was 28 years and maximum age was 72 years, with average ages of 45.6 and 44 years respectively for credit users and non-credit users, whiles the mean age difference of credit users and non-credit users was 1 year, 6 months. For respondents who were credit constrained, the minimum and maximum ages were 22 and 67 years respectively.

Smallholder farmers in the study area have relatively high experience in maize farming. Credit users had an average experience of 19.1 years whiles non-credit users had an average farming experience of 20.14 years. The average landholding (for maize cultivation) for credit users was 1.268 Ha (with 0.2 and 2.4 Ha being the minimum and maximum respectively) whiles that of the non-credit users was 0.758 Ha (with 0.2 and 1.6 Ha being the minimum and maximum respectively).

Production Characteristics of Farmers

Different farm sizes were recorded for credit and non-credit users. The average landholding (for both agricultural and other purposes) for credit users was 3.9 Ha whiles that of the non-credit users 4.3 Ha. From the estimation, non-credit users tend to have more landholding for agricultural production than credit users. However, the area cultivated by credit users was higher (3.4 Ha) than that of non-credit users (2.72 Ha).

Table 1.4: Production characteristics of farmers

Variable	Credit users				Non-credit users					
	Min	Max.	Mean	S.D.	Min	Max.	Mean	S.D.	t-stat	Sig
Total land size (Ha)	1.6	6.2	3.9	1.53	1.6	7.5	4.3	1.45	1.94	0.06
Total Cultivated Land Size (Ha)	1.6	3.4	1.8	0.664	1.6	2.72	1.2	0.441	1.75	0.08
Maize Farm Size (Ha)	0.2	2.4	1.268	0.515	0.2	1.6	0.758	0.364	2.13	0.04
Output per Ha (kg)	850	2887.5	1749.1	352.7	500	2025	1205	203.3	-9.5	1.04
Seed used per Ha (kg)	9.4	31.3	14.4	3.46	6.4	18.6	8.5	2.34	5.93	0.0
Fertilizer used per Ha (kg)	0	435.5	213.2	94.34	0	350.4	165.5	92.5	8.92	0.0
Agro-chemicals used per Ha (litres)	2	6	2.6	0.94	2	4	1.8	1.05	1.94	0.06
Total Man-days	7	15	8.6	3.91	5	8	3.7	2.01	3.86	0.01

Source: Authors' computation (Field Survey, 2017)

Most of the production characteristics of credit users such as output of farm produce, improved seed, fertilizer, agro-chemicals and labour were significantly different from that of non-credit users. The output of credit users was 1749.1 kg/Ha which was higher than the 1205kg/Ha of non-credit users. Credit users used an average of 14.4 kg/Ha of maize for sowing while non-credit users used 8.5 kg/Ha. According to MoFA (2011), the recommended quantity of seed planted per Ha should not exceed 25kg, depending on the maize variety.

Credit users used more fertilizer, averagely 213.2kg/Ha, as compared to non-credit users (165.5kg/Ha). The recommended fertilizer-use for maize is 210 kg/ha made up of 90kg of N, 60 kg of P and 60 kg of K (MoFA, 2011). The increased usage of fertilizer among credit users may be due to the fact that some extra funds were available to them and/or they were able to purchase *extra* fertilizer from the amount of credit sourced from financial institutions. The same can be said for the quantity used of agrochemicals. Credit users used an average of 2.6 litres/Ha whiles non-credit users used 1.8 litres/Ha. The recommended quantity of agrochemical-use for maize is 2.5 litres of weedicides (MoFA, 2011). Also, credit users used more labour per hectare (8.6 man-days) than non-credit users (3.7 man-days).

Sources of Credit to Smallholder Maize Farmers

Table 1.5 provides a list of the different sources of credit to smallholder maize farmers. The assertion by Owusu-Antwi & Antwi (2010) that informal credit providers in Ghana serve as major sources of credit to farmers appears to be the case for maize farmers in the Bono region of Ghana. About 43% of the respondents received credit from relatives and friends, 14% sourced their credit from "Susu"/thrift savings groups, and 7% accessed funding from money lenders. About 8% of the respondents received credit from the rural banks that operate in these communities. Other farmers sourced their credit from NGOs and farmer groups, representing 6% and 11% respectively. Limited availability of and accessibility to formal credit as well as the cumbersome procedures involved in accessing such funds, including requirements to provide collateral, might be some of the reasons for the dominance of the informal credit sector among credit-using maize farmers.

Table 1.5: Sources of credit to smallholder maize farmers

Credit Source	**Frequency**	**Percentage**
Relatives and Friends	47	43
"Susu" (Thrift groups)	15	14
Farmer Groups	12	11
Traders	12	11
Rural Banks	9	8
Money Lenders	8	7
NGO	6	6

Source: Field Survey, 2017

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Despite the proliferation of other forms of informal credit provision in Ghana, friends, relatives and *susu* are seen to be the main sources of informal credit to maize farmers. This is corroborated by Aryeetey & Udry (1995) who posit that majority of the lending activities in the informal sector are facilitated by relatives and friends.

Table 1.6: Credit amount devoted to maize Farming from the Identified credit sources

Source of Credit	``N	Min.	Max.	Mean	`Std. Dev.
Rural Banks	9	300	800	500	``180.278
NGO	6	400	850	575	`154.11
Relatives and Friends	47	200	1500	731.91	`272.952
Money Lenders	8	250	1000	687.5	`278.082
Susu	15	500	800	673.33	`127.988
Farmer Groups	12	500	1000	725	`198.206
Traders	12	500	1500	841.67	`362.963

Source: Field survey, 2017

As shown in Table 1.6, farmers who allocated credit sourced for maize-cultivation during the 2016 cropping season received from traders a minimum of GH¢ 500.00 and a maximum amount of GH¢ 1,500.00 with a mean amount of GH¢841.67. About 43% of the farmers who sourced their credit from relatives and friends received a minimum of GH¢ 200.00 and a maximum of GH¢ 1500.00 with a mean amount of GH¢ 731.91. On average, GH¢ 575.00 and GH¢ 500.00 was sourced from NGOs and rural banks respectively.

Factors Influencing Farmers Use of Credit

The study also set out to identify the factors influencing the decision of smallholder farmers to use credit. As shown in Table 1.7, a Pseudo R-squared of 0.8133 indicates that independent variables used in the model are able to explain the dependent variable to up to 81.33%.

Table 1.7: Factors influencing farmers' decision to use credit

Variables	**Coeff.**	**Marginal Effect**	**P-Value**
Age	-0.123	-0.048***	0.008
Gender	1.769	0.602***	0.006
Household Size	0.113	0.045	0.368
Education Level	-0.186	-0.074	0.358
Experience in Farming	0.083	0.328*	0.084
Farming Objective	1.307	0.517***	0.006
Collateral	-2.133	-0.669***	0.001
Farm Size	1.157	0.457**	0.032
Household Income	-0.001	-0.001**	0.030
Farmer Association	2.609	1.032***	0.000
Savings	4.035	0.931	0.993
Distance	-1.602	0.577	0.997
Constant	0.197		

No. of Obs = 200; LR chi^2 = 222.89; Prob>chi^2 = 0.0000; Pseudo R^2=0.8133; Log likelihood = -25.58349

*, ** and *** denote significant levels at 10%, 5% and 1% respectively

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With a coefficient of -0.048, the 'Age' variable is statistically significant (at 1%) which implies that a 1% increase in the age of a farmer will result in a 0.048% decrease in the likelihood of the farmer to access and use credit, all things held constant. In other words, an increase in a farmer's age by one year will lead to a 0.048% decrease in the farmer deciding to access credit.

Gender is statistically significant at 1% with a positive marginal effect of 0.602. This result agrees with *a priori* expectations that Gender has a positive relationship with the decision to access credit, further implying that males are more likely to access/use credit due to their relatively higher love for risk and their control over production resources such as land, etc. The onus of taking decisions concerning production usually lies with the male farmers.

Farming experience is statistically significant at 10% with a positive marginal effect, indicating that farmers' use of credit is positively influenced by the number of years a farmer has been engaged in maize-cultivation. The farming objective is also statistically significant at 10% with a positive marginal effect, which indicates that the probability of a commercial farmer securing credit for farming is higher than that of a subsistence farmer. This result agrees with the study's expectation, which hypothesized a positive relationship between farming objective and access to credit.

The Collateral variable is statistically significant at 10% with a marginal value of -0.669. This result indicates that maize farmers are less likely to access and use credit when collateral is demanded of them. This result is consistent with *a priori* expectations and also with findings by Chauke *et al.* (2013) which report a negative relationship between access to credit and collateral.

Farm size is statistically significant at 5% with a marginal effect of 0.457. This result is consistent with *a priori* expectations that there's a positive relationship between farm size and access to credit. This indicates that the bigger the farm size, the more likely it is for the farmer to access credit. This result is consistent with Obisesan (2013) which reports a positive relationship between access to credit and land area cultivated. Just as farm size, household income is statistically significant at 5% with a marginal effect of -0.001. This indicates that a 1% increase in household income will lead to a 0.001% decrease in access to credit, demonstrating a negative relationship between household income and access to credit, consistent with the study's expectations.

Farmer Association is significant at 1% with a marginal effect of 1.032, implying that the probability of a farmer who belongs to a farmer association or FBO to access credit is higher than the probability of non-members to do so. This result can be explained by the fact that most financial institutions prefer to disburse credit to farmers who belong to an organization as they find them more credit-worthy. Also, in the case of credit disbursements by the groups the farmers belong to, member farmers (and not non-member farmers) are more likely to access these funds. This result is also consistent with Obisesan (2013) which reports a positive relationship between membership to an organization and access to credit.

Determinants of Credit-Use Intensity by Smallholder Maize Farmers

This study also set out to identify the factors that determine the credit-use intensity of credit users. The results from the Tobit regression (Table 1.8) reveal some socio-economics factors that are significant in determining the amount of credit used for maize cultivation. From the results, land ownership was statistically significant at 5% with a coefficient of 247.521 implying that the landownership status of smallholder maize farmers determines the amount of credit investment they are likely to make in maize farming. This result is in agreement with *a priori* expectations which hypothesized a positive correlation between credit amount devoted to maize production and land ownership.

Table 1.8: Determinants of credit-use intensity among credit users

Variables	**Coef.**	**Std. Err**	**P>{t}**
Age	-0.928	4.502	0.837
Household Size	20.374	19.892	0.308
Land Ownership	247.521*	102.547	0.018
Savings	-48.951	144.158	0.735
Education	95.282*	42.858	0.028
Total Production Cost/Ha	0.504***	0.139	0.000
Interest Rate	-2.198***	-0.441	0.000
Farming Objectives	-55.372	62.142	0.375
Constant	-717.602	364.427	0.052
*P<0.10, ***P< 0.01, Pseudo R-squared = 0.624, Obs = 109, Log likelihood = -812.72286, LR Chi^2 = 72.06, Prob >Chi^2 = 0.0000			

Source: Field Survey, 2017

Also, from the analysis, education of farmers is statistically significant at 5% with a coefficient of 95.282 indicating that for every 1-year increment in farmer education, the credit intensity of the farmer goes up by 95.282 units. This is consistent with the study's expectation of a positive correlation between education level and credit amount used in maize production. Therefore, more educated farmers tend to better understand the credit system with respect to interest rates, etc., and are likely to access adequate amounts of credit to increase their leverage.

Total production cost per hectare is statistically significant at 1% with a positive coefficient indicating a positive relationship between the cost of production and the credit amount invested in maize-farming. Farmers therefore tend to invest more/use more credit with increase in production cost. Interest rate is also statistically significant at 1% but with a negative coefficient, indicating that the higher the interest rate, the less intense the credit-use by farmers.

Profitability of Smallholder Maize Farmers

The results of the Gross Margin analysis indicate that, total cost of production among credit users ranged from GH¢ 598.00 to GH¢ 2930.00 per hectare with a mean of GH¢ 1247.66 per hectare (Table 1.9) as compared to non-credit users whose production costs ranged between a minimum of GH¢ 415.00 and a maximum production cost of GH¢ 1695.00 per hectare with a mean of GH¢ 782.89 (Table 2.1). Smallholder farmers who used credit for farming incurred an average cost difference of GH¢ 464.77 more than non-credit user farmers. Credit users are able to adopt modern technology, improved seeds, more efficient farming methods, etc., in farming and hence are more likely to incur extra production cost. The result from the Gross Margin analysis shows an average total revenue of GH¢ 1644.95 for credit users as against GH¢ 975.31 for non-credit users.

Table 1.9: Gross Margin analysis for credit users

Variable	Minimum (GH¢/Ha)	Maximum (GH¢/Ha)	Mean (GH¢/Ha)	Std. Deviation (GH¢/Ha)
Total Revenue	720	4200	1644.95	558.689
Variable Cost of Production				
Total cost of seed	25	150	70.87	26.465
Total cost of fertilizer	0	200	75.23	40.325
Total cost of Agro-chemicals	15	90	45	15.943
Cost of labour				
i. Total Land clearing cost	100	350	157.25	123.257
ii. Total wedding cost	100	200	100.55	84.698
iii. Total cost of sowing	16	150	101.72	49.391
iv. Total fertilizer application cost	30	100	58.02	20.619
v. Total transportation cost	20	200	72.65	24.421
vi. Total cost of Harvesting and packaging	50	480	174.43	93.079
Interest on Operating Capital	80	210	110.02	29.37
Land (Rental Value) per Ha	120	200	100.44	15.47
Storage Cost	0	200	55.94	55.49
Cost of Credit (Interest Rate)	42	400	125.54	61.897
Total Variable Cost	598	2930	1247.66	440.425
Gross margin	122	1270	397.29	118.264

Source: Field Survey, 2017

The Gross Margins of credit users for the 2016 season ranged between GH¢ 122 and GH¢ 1270 with an average gross margin of GH¢ 397.29 per hectare against a mean Gross margin of GH¢ 192.421 for non-credit users (Tables 1.9 and 2.1). The results indicate that credit users had a higher average Gross Margin than non-credit users, documenting a difference of about GH¢ 204.87. These results confirm the findings of Schuphach (2014) and Wainaina *et al.* (2012) which establish that credit enhances increases in the gross margins of smallholder farmer.

Table 2.1: Gross Margin analysis for non-credit users

Variables	Minimum (GH¢/Ha)	Maximum (GH¢/Ha)	Mean (GH¢/Ha)	Std. Deviation (GH¢/Ha)
Total Revenue	460	2170	975.31	364.998
Variable Cost				
Total cost of seed	25	125	57.14	25.079
Total cost of fertilizer	0	150	55.31	34.7
Total cost of Agro-chemicals	15	160	40.9	10.403
Cost of labour				
i. Total Land clearing cost	80	200	122.4	50.161
ii. Total weeding cost	50	120	67.25	25.348
iii. Total cost of sowing	20	90	55.02	26.244
iv. Total fertilizer application cost	20	130	52.04	14.370
v. Total transportation cost	20	120	68.91	20.055
vi. Total cost of Harvesting and packaging	45	210	115.34	30.029
Interest on Operating Capital	50	120		15.125
Land (Rental Value) per Ha	90	150	98.57	15.89
Storage Cost	0	100	50.01	20.49
Total Variable Cost	415	1675	782.89	287.798
Gross Margin	45	495	192.42	77.2

Source: Field Survey, 2017

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The results of the Gross Margin analysis suggest that farmers who use credit are able to use farm inputs extensively and appropriately as a result of their ability to purchase them in adequate quantities, as buttressed by the findings of Bashir *et al.* (2010). Similar reports by Girabi & Mwakaje (2013) revealed that credit-user farmers are more productive than those without credit due to their ability to use input resources efficiently, and the subsequent revenue they generate.

T-test results, as shown in Table 2.2, indicate that most of the production characteristics of credit users such as improved seed, fertilizer, labour, rental value of land and storage cost are significantly different from that of non-credit users and this can be attributed to the boost in production that credit gives when adequate and/or extra funds are invested in these factors of production.

Table 2.2: Tests for mean differences in input-use among farmers (GH¢/Ha)

Variable	Credit Users	Non-Credit Users			
	Mean	Mean	Mean Diff.	t-stats	Sig.
Improved seed	70.87	57.14	13.73	3.741	0.000
Fertilizer	75.23	55.31	19.92	1.473	0.042
Agro-Chemicals	45	40.9	4.1	3.121	0.002
Cost of Labour					
Land clearing cost	157.25	122.4	34.85	3.567	0.001
Weeding cost	100.55	67.25	33.3	2.452	0.014
Cost of sowing	101.72	55.02	46.7	5.731	0.000

Fertilizer Application cost	58.02	52.04	5.98	2.33	0.021
Land (Rental Value)	100.44	98.57	1.87	2.461	0.126
Storage Cost	55.94	50.01	5.93	1.564	0.163
Transportation cost	72.65	68.91	3.74	4.356	0.001
Harvesting cost	174.43	115.34	59.09	2.567	0.012

Source: Field Survey, 2017

From Table 2.2, it is observed that credit users had significantly more access to all the input variables than non-credit users. Farmers who used credit were able to purchase requisite farm inputs for production based on the fact that their operating capital was higher than that of their counterpart non-credit users.

There was a mean difference of GH¢ 13.73 between credit users and non-credit users for improved seed-use. For fertilizer, credit users invested an average amount of GH¢ 75.87 whiles non-credit users used an average amount of GH¢ 55.31, recording a mean difference of GH¢19.92. The increased usage of fertilizer among credit users may be due to the fact that some excess funds were available to purchase fertilizer. This implies that credit users were able to apply fertilizer purchased by their savings and own capital as well as through extra funds from credit sources.

Agro-chemical applications by credit users was significant at 1% and with t-stats of 3.121 indicating a significant change in the amount of agro-chemicals used by smallholder farmers. The cost of labour among farmers varied with respect to the type of labour employed. The mean difference between credit users and non-credit users signifies the potential for the credit user to engage hired, more professional labour.

Table 2.3: Net Margin analysis among smallholder maize farmers (GH¢/Ha)

	Credit Users				**Non- Credit Users**			
Variable	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**
Gross Margin	122	1270	397.29	118.264	45	495	192.42	77.2
Less Fixed Cost								
Depreciation	75	135	85.06	15.246	60	105	69.31	35.795
Net Margin	47	865	312.23	57.678	-15	375	123.11	41.405

Source: Field Survey, 2017

The results of the Net Margin analysis between credit users and non-credit users (Table 2.3) reveals differences in the net profit of both categories of maize farmers. The average gross margin of credit-user maize farmers was GH¢ 397.29 whiles that of non-credit users was GH¢192.42. Though both credit users and non-credit users have a positive range of profit, credit users recorded an average net margin of GH¢ 312.23 as compared to GH¢ 123.11 for non-credit users.

Table 2.4: Return on Investment estimation among smallholder maize farmers (GH¢)

	Credit Users				**Non- Credit Users**			
Variable	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**
Net Margin	47	865	312.23	57.678	-15	375	123.11	41.405
Total Production Cost	598	2930	1247.66	440.425	415	1675	785.89	287.798
Return on Investment	0.0786	0.2952	0.2503	0.1309	-0.0361	0.2239	0.1567	0.1439

Source: Field Survey, 2017

Table 2.4 presents the results for the estimation of return on investment of credit users and non-credit users. From the results, it is observed that the average return on investment for credit users is GH¢ 0.2503 suggesting that a smallholder farmer who used credit is likely to receive as return on his/her investment (per hectare), the monetary value of GH¢0.2503. That is, for every cedi invested, the farmer will receive GH¢0.2503 as return. Non-credit users recorded a mean return on investment of GH¢0.1567.

The results for the test for mean difference in profitability among credit and non-credit users show that the p-value calculated for Gross margin is statistically significant at 1%. This result implies that there is a significant difference in the Gross margin between credit users and non-credit users – a positive significant difference of GH¢ 204.87.

The results for the net margin analysis indicate a significant difference between the net margins of credit and non-credit users. The result on the return on investment also reveals statistically significant mean differences of GH¢ 0.0936 between credit users and non-credit users. This further implies that credit users are better off since their returns on capital invested is statistically higher than that of non-credit users.

Table 2.5: Test for mean difference in the profitability indicators among Farmers (GH¢)

	Credit Users	**Non-Credit users**			
Variable	**N=109**	**N=91**			
	Mean	**Mean**	**MD**	**t-stat**	**sig.**
Gross Margin	397.29	192.42	204.87	2.812	0.001
Net Margin	312.23	123.11	189.12	1.893	0.002
Return on Investment	0.2503	0.1567	0.0936	0.031	0.006

Source: Field Survey, 2017

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Conclusion

Profitability remains one of the key indicators of business-success. Commercial farming continues to be the backbone of Ghana's (and Africa's) economy. The profitability of the sector is therefore key to economic development. Especially for smallholder maize-farming, there is the need to make available adequate funding for the sub-sector, maize being an important staple and a huge source of revenue.

Considering that credit-use improves the profitability of smallholder maize-farming and maintains/improves the viability of the agricultural sector (as established by this study), it is imperative that credit-access for smallholder maize-farming be facilitated to increase efficiency, improve productivity and maintain/increase profitability.

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References

[1] A.A. Obisesan, "Credit Accessibility and Poverty Among Smallholder Cassava Farming Households in South West Nigeria," *Greener Journal of Agricultural Science,* vol. 3, no. 2, pp. 120-127, 2013.

[2] A. Brehanu and B. Fufa, "Repayment Rate of Loans from Semi-Formal Financial Institutions among Small-Scale Farmers in Ethiopia: Two-limit Tobit Analysis," *The Journal of Socio-Economics,* vol. 37, no. 6, pp. 2221-2230, 2008.

[3] A.C. Cameron and P.K. Trivedi, *Microeconomic Methods and Applications.* Cambridge University Press, 2005.

[4] A.J. Adegeye and J.S. Dittoh, *Essentials of Agricultural Economics.* Ibadan, Nigeria: Impact Publishers, 1985.

[5] Buvinic, *Working Women: International Perspectives on Labour and Gender Ideology.* 1979.

[6] C.M. Jolly abd A.H. Clonts, *Economics of Aquaculture.* Haworth Press Inc.: Binghamton, N.Y., 1993.

[7] C. Udry and T. Conley, *Social Networks in Ghana: No. 33.* Ghana, Legon: University of Ghana, Legon. 2006.

[8] D. Gujarati, *Basic Econometrics. 3rd Edition.* McGraw-Hill International Editions, 2004.

[9] D.E. Antwi and E.E. Onumah, "Agglomeration Externalities, Productivity and Technical Efficiency of Soybean Farms in Ghana," *Global Scientific Journals*, vol. 8, no. 1, pp. 2833-2846, 2020.

[10] D.E. Antwi, "Cluster Economies, Productivity and Technical Efficiency – A Narrative Review," *Global Scientific Journals*, vol. 8, no. 4, pp. 1102 – 1117, April 2020.

[11] D.E. Antwi, J.K.M. Kuwornu, E.E. Onumah and R.C. Bhujel, "Productivity and Constraints Analysis of Commercial Tilapia Farms in Ghana," *Kasetsart Journal of Social Sciences*, vol. 38, no. 3, pp. 282 - 290, January 2017.

[12] D.T. Johnson, *The Business of Farming. A Guide to Farm Business Management in the Tropics.* London: McMillan Publishers Ltd. 1991.

[13] D.W. Adams and D.A. Fitchett, "Informal Finance in Low-Income Countries," *Journal of Management Research*, vol. 3, no. 1, 1992.

[14] E. Aryeetey and C. Udry, "The Characteristics of Informal Financial Markets in Sub-Saharan Africa," *Journal of African Economies*, vol. 6, no. 1, 1995.

[15] E.E. Onumah and H.D. Acquah, "Outreach and Sustainability of Inventory Credit Programme in Ghana," *Journal of Agricultural Sciences*, vol. 56, no. 2, pp. 145-164, 2011.

[16] E. Mansfield, "Academic Research and Industrial Innovation," *Research Policy*, vol. 20, no. 1, pp. 1-2, 1991.

[17] F. Dong, J. Liu and A. Featherstone, "Effects of Credit Constraints on Productivity and Rural Household Income in China. 2010.

[18] F. Girabi and A.E.G. Mwakaje, "Impact of Microfinance on Smallholder Farm Productivity in Tanzania: The Case of Iramba District," *Asian Economic and Financial*, 2013.

[19] G. Feder, R.E. Just and D. Zilberman, "Adoption of Agricultural Innovations in Developing Countries: A Survey," *Economic Development and Cultural Change*, vol. 33, no. 2, pp. 255-298, 1985.

[20] Ghana Statistical Service (GSS), *2010 Population and Housing Census – National Analytical Census Report.* Ghana, 2010.

[21] G. Owusu-Antwi and J. Antwi, "The Analysis of the Rural Credit Market in Ghana," *The International Business and Economics Research Journal*, vol. 9, no. 8, pp. 45, 2010.

[22] H. Belshaw, *Agricultural Credit in Economically Underdeveloped Countries.* 1959.

[23] J.L. Feder, C.A. Chilcote and G.L. Bush, "Regional, Local and Micro Geographic Allele Frequency Variation Between Apple and Hawthorn Populations of Rhagoletis Pomonella in Western Michigan," *Evolution*, vol. 44, no. 3, pp. 595-608, 1990.

[24] J.M. Omiti. D.J. Otieno, T.O. Nyanamba and E. McCullough, "Factors Influencing the Intensity of Market Participation by Smallholder Farmers: A Case Study of Rural and Peri-Urban Areas of Kenya," *African Journal of Agricultural and Resource Economics*, vol. 3, no. 1, pp. 57-82, 2009.

[25] J.M. Schupbach, "The Impact of Outgrower Schemes and Large-Scale Farm Employment on Economic Well-Being in Zambia," *Doctorate Dissertation*, University of Zurich, 2014.

[26] J. Olwande and M. Mathenge, "Market Participation Among Poor Rural Households in Kenya," *The International Association of Agricultural Economists (IAAE)*, 2012.

[27] M.A.Y. Rahji and S.B. Fakayode, "A Multinomial Logit Analysis of Agricultural Credit Rationing by Commercial Banks in Nigeria," *International Research Journal of Finance and Economics*, vol. 24, no. 91, pp. 97-103, 2009.

[28] Millenium Development Authority (MiDA), *Investment Opportunity in Ghana: Maize, Rice, and Soybean*. Ghana. 2010.

[29] Ministry of Food and Agriculture (MoFA), *Agriculture in Ghana: Facts and Figures (2010).* Statistics, Research and Information Directorate (SRID), 2011.

[30] M.K. Bashir, Y. Mehmood and S. Hassan, "Impact of Agricultural Credit on Productivity of Wheat Crop: Evidence from Lahore, Punjab, Pakistan," *Pakistan Journal of Agricultural Science*, vol. 47, no. 4, pp. 405-409, 2010.

[31] M.L. Morris, R.B. Tripp and A.A. Dankyi, "Adoption and Impacts of Improved Maize Production Technology: A Case Study of the Ghana Grains Development Project," 1999.

[32] O.F. Ashaolu, S. Momoh, B.B. Phillip and I.A. Tijani, "Microcredit Effect on Agricultural Productivity: A Comparative Analysis of Rural Farmers in Ogun State, Nigeria," *International Journal of Applied Agricultural and Apicultural Research*, vol. 1, no. 2, pp. 23-35, 2011.

[33] P.K. Chauke, M.L. Motlhatlhana, T.K. Pfumayaramba and F.D.K. Anim, "Factors Influencing Access to Credit: A Case study of Smallholder Farmers in the Capricorn District of South Africa," *African Journal of Agricultural Research*, vol. 8, no. 7, pp. 582-585, 2013.

[34] P.W. Wainaina, J.J. Okello and J. Nzuma, "Impact of Contract Farming on Smallholder Poultry Farmers' Income in Kenya," *International Association of Agricultural Economists*, pp. 18-24, Apr. 1985. (Journal or magazine citation)

[35] R.M. Al-Hassan, D.B. Sarpong and A. Mensah-Bonsu, *Linking Smallholders to Markets.* Ghana Strategy Support Programme (GSSP) Background Paper No. GSSP 0001. International Food Policy Research Institute, Washington D.C. 2006.

[36] T. Amemiya, "Tobit Models: A Survey," *Journal of Econometrics*, vol. 24, no. 1, pp. 3-61, 1984.

[37] World Bank, *Finance for All? Policies and Pitfalls in Expanding Access.* Washington, D.C.: World Bank, 2008.

[38] W. Greene, *Economic Analysis. Seventh Edition.* England: Pearson Education Limited, 2012.

[39] Z. Jingchao and K. Kotani, "The Determinants of Household Energy Demand in Rural Beijing: Can Environmentally Friendly Technologies Be Effective?" *Energy Economics*, vol. 34, no. 2, pp. 381-388, Apr. 2012.

[40] Z. Song, G. Yang, Y. Guo abd T. Zhang, "Comparison of Two Chemical Pretreatments of Rice Straw for Biogas Production by Anaerobic Digestion," *Bioresources*, vol. 7, no. 3, pp. 3223-3236, 2012.