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# An Analysis of Credit Use and Expenditure on Agricultural Production - The Case of Maize Farming in Uasin Gishu County of Kenya

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**Abstract**

Kenya's economy is highly dependent on agriculture with maize production being one of the main agricultural activities. It produces an average of 23 million bags of maize annually with Uasin Gishu County accounting for 14.3% (3.29 million bags) of this national output. Production is associated with increasing cost and this brings to fore the question of financial requirements and expenditure, on agricultural production (Kamau and Otieno, 2013). To understand this puzzle, this study sought to answer the question regarding sources of finance for farmers and their expenditure on maize production.

The study sought to establish the existing relationship between usage of loan facilities and expenditure on the one hand, and maize production on the other. Using exploratory survey design, 144 maize farmers from across the county were sampled and the data collected was analyzed using descriptive and inferential statistics. Descriptive statistics was used to capture the level of maize production, usage of loan facilities and expenditure by the maize farmers. Inferential analysis was used to draw conclusions concerning the relationships and differences found in research results.

The analysis of variance (ANOVA) results showed a very low positive correlation between output and source of finance, credit or non-credit, as given by r = 0.2185. Only 4.77% of output is explained by source of finance ($r^2$ = 0.0477). The analysis of covariance (ANCOVA) results showed a high positive correlation between output and the two explanatory variables source of finance (credit or non-credit) and expenditure as given by r = 0.7175. Over fifty-one percent of output is explained by both expenditure and source of finance (credit or non-credit) as given by $r^2$ = 0.5148.

In the analysis of variance, the estimated $D_i$ is statistically significant because of the t-value which is 2.6667 and the P-value which is 0.0086. This means that the numerical values of maize output for credit users and non-credit users are statistically different.

**Key Word:** Credit financing/Non-equity financing, Expenditure, Maize, Production/Yield, Uasin Gishu

## 1.0 Introduction/Background

Agricultural sector is the leading sector in Kenya. Over 85 percent of the rural populations derive their livelihood from it. Most of them engage in maize production. With rising cost of production, which in 2009 stood at US$617 for the efficient producer, US$496 for the average producer, and US$344 for the inefficient producer, per hectare, and an output of 49.4 bags, 37.1 bags, and 24.7 bags for the efficient, average, and inefficient producer respectively (Tegemeo Institute, 2009), there is need for farmers to access and use credit financing. Lack of sufficient funds translates into inadequate working capital with farmers being unable to purchase productivity–enhancing inputs such as hybrid seeds and fertilizers. Farmers need financial support so that proper and sufficient farm inputs can flow into agricultural regions and trigger a production response. Among other institutions, the Agricultural Finance Corporation (AFC) provides seasonal crop credit to maize farmers for production of hybrid maize (AFC, 2009).

There had been a tremendous growth in maize production in Kenya from independence, up to around 1997 (Karanja, et al., 1998). However, maize production has stagnated over the last 13 years in Kenya, and significantly in Uasin Gishu County, leading to shortages and increased quantities of imported maize.

Kenya's "grain basket" zones incur higher costs of production than the major maize growing areas of Uganda (Nyoro, Kirimi and Jayne, 2004). In the absence of price supports and open trade between Kenya and Uganda, competition from maize imports from Uganda has negatively affected Kenya's maize surplus areas (Kibaara, 2005).

In spite of credit facilities being readily available to maize farmers, production has stagnated over the years and there was need therefore to establish why this was so and determine what needs to be done to reverse the situation.

Farmers require finance to purchase productivity-enhancing inputs such as hybrid seeds, fertilizers, pesticides, and land preparation. This scenario pointed to a need to determine whether there is a relationship between

agricultural financing and maize production.
The study aimed at determining the level of maize production at the farm level in Uasin Gishu County, determining the usage of loan facilities among maize farmers in the county, and establishing the relationship between usage/non-usage of loan facilities and expenditure on one hand and maize production on the other.
The study tested the hypothesis that no relationship exist between loan facility usage, expenditure, and maize production in Uasin Gishu County.

## 1.1 Problem Statement

With an ever increasing population, coupled with high levels of poverty, especially within the slum and rural areas, both the public and private sectors have been pumping large sums of money, into maize farming with an aim of increasing productivity. The Kenya government, through the ministry of agriculture and other state corporations and agencies, has been providing subsidized farm inputs, including fertilizer and seeds to the maize farmer. Banks and other financial institutions, including micro – finance institutions have been providing credit to the farmers. Despite all these efforts, maize production has stagnated, over the years.

## 1.2 Research Objectives

### 1.21 General objectives

The general objective of the study was to determine the level of maize production and usage of credit facilities by farmers in Uasin Gishu County and to establish the relationship between usage of loan facilities and expenditure on one hand, and maize production on the other.

### 1.22 Specific objectives

The specific objectives of the study were:
1. To determine the level of maize production at the farm level in Uasin Gishu County.
2. To determine the usage of loan facilities among maize farmers in Uasin Gishu County.
3. To establish the relationship between usage of loan facilities and maize production.
4. To establish the relationship between usage of loan facilities and expenditure on one hand, and maize production on the other.

## 1.3 Hypotheses

The study tested the following hypotheses:

1. $H_0$: There is no significant relationship between loan facility usage and maize production.
   $H_1$: There is a significant relationship between loan facility usage and maize production.

2. $H_0$: There is no significant relationship between loan facility usage and expenditure on one hand, and maize production on the other.
   $H_1$: There is a significant relationship between loan facility usage and expenditure on one hand, and maize production on the other.

## 2.0 Review of Literature

This chapter dealt with the review of literature related to the study. The review was done in order to identify and evaluate the findings of earlier research on the area of production. Particularly, the Cobb-Douglas production function was looked at.

## 2.1 Review of Theories

A production function is the relationship by which inputs are combined to produce outputs. Production is any activity that creates present or future utility. Production may also be described as a process that transforms inputs (factors of production) into outputs (Frank, 2006). Among the inputs into production, economists have traditionally included land, labour, capital, and entrepreneurship. To this list, it has become increasingly common to add such factors as knowledge or technology, organization, and energy. A production function is the relationship by which inputs are combined to produce outputs. It is the relationship between inputs and output that identifies the maximum output that can be produced per time period by each specific combination of inputs (Browning & Zupan, 2004).
A production function is a mathematical description of the various technical production possibilities faced by a firm (International Encyclopedia of the Social Sciences, 2008). Production function can be expressed either as a Cobb-Douglas function, Leontief function or Constant Elasticity of Substitution (CES) function.

**2.2 Criticism of the Theories**

The general equation for the production function is Q = f (K, L). This function defines the maximum rate of output (Q) per unit of time obtainable from a given rate of capital and labour input. Output may be in physical units such as motor vehicles or computers, or it may be intangible as in the case of medical care, transport, or education.

According to Petersen & Lewis, 1999, this production function is more of an engineering concept that is devoid of economic content. It simply relates output and input rates. The production function does not yield information on the least-cost capital-labour combination for producing a given level of output, nor does it reveal the output rate that would yield maximum profit. The function only shows the maximum output obtainable from any and all input combinations. Prices of the inputs and the price of output must be used with the production function to determine which of the many possible input combinations is best, given the firm's objective.

**2.3 Theoretical Framework**

This study used a model that related input and proxies for financial use. This model states that:

$$Y = f(X_i),$$

Where: Y stands for output (maize yield) and $X_i$, the input (credit financing/cost of production, source of finance, expenditure on farm inputs). The model is derived from the Cobb-Douglas production function theory which is, perhaps, the most widely used production function (Browning & Zupan, 2004) and which takes the form:

$$Q = AK^{\alpha} L^{\beta}$$

Where α and β are numbers between zero and 1, and A can be any positive number (Frank, 2006). The multiplicative form, Cobb-Douglas production function is widely used in economics because it has properties representative of many production processes. For a two-input production process, the total product of labour ($TP_L$) is defined as the maximum rate of output forthcoming from combining varying rates of labour input with a fixed capital input, and the total product of capital ($TP_K$) is the maximum rate of output forthcoming from combining varying rates of capital input with a fixed labour input.

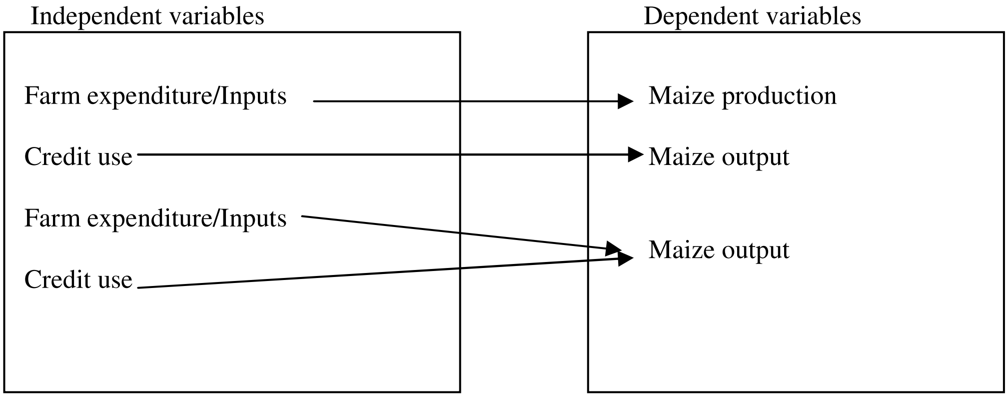
Production economics theory deals with production of goods using a set of inputs. A production function is a model used to formalize this relationship. Below is a specification of a production function:

$$Q = f(L, S, F\ldots)$$

Where Q represents a farmer's output (maize, in our case), L may represent the amount of labour, S represents quantity of seeds used in production of Q, while F represent the amount of fertilizers applied (funds are required to finance all these). The objective of the producer, or farmer, is to maximize profit either by increasing the quantity of Q produced or by reducing the cost of producing Q (Webster, 2003).

The production function shows the maximum amount of the good that can be produced using alternative combinations of labour (L), seed (S) and fertilizer (F). Q is also referred to as the total physical product (TPP).

**2.4 Conceptual Framework**




**3.0 Research Methodology**

This chapter looks at the research design adopted for the study, the target population, a description of the research instruments used, as well as the sample and sampling procedures used. It also describes the data collection and data analysis procedures.

**3.1 Research Design**

The study was conducted through an exploratory survey design. The main purpose of exploratory research studies is that of formulating a problem for more precise investigation, or of developing the working hypotheses from an operational point of view. The study explored the use/non-use of credit finance by maize farmers in Uasin Gishu County. It specifically investigated the relationship between credit financing and expenditure on one hand and maize production on the other.

### 3.2 Target Population

The study was conducted among the 134,491 farm holders (KFSSG, MoA, GoK, 2008) in Uasin Gishu County. The area of study was chosen using a combination of multistage and convenience sampling technique.
The county was chosen because it is at the heart of Kenya's maize growing zones and is an important part of the grain basket region. A large part of the county is arable land covered with maize fields.

### 3.3 Research Instruments

Research questionnaires and interviews were used as the main tools for collecting data. The selection of these tools was guided by the nature of data to be collected, the time available, as well as by the objectives of the study. The use of semi-structured instruments enabled the researcher to balance between qualitative and quantitative data collected and on the other hand provided more information.

### 3.4 Sample and Sampling Procedures

In determination of sample size, the researcher used a method that allowed him to predetermine the accuracy of the sample result. This is the confidence interval method of determining sample size. Confidence interval is the range whose endpoints define a certain percentage of the responses to a question.
The sample size was determined using the formula: $n = \frac{Z^2pq}{e^2}$

Where; $n$ = sample size (where target population is greater than 10,000)
$Z$ = standard error associated with the chosen level of confidence (1.96)
$p$ = the proportion in the target population estimated to have the characteristic of interest
$q$ = 1- $p$
$e$ = acceptable sample error (the level of statistical significant or confidence level).

Under this method, as there is no estimate available of the proportion in the target population assumed to have the characteristic of interest, 50% (or 0.5) was used. Therefore, with the proportion having the required characteristic ($p$) being 0.5, the $Z$-statistic was 1.96 and for the desired accuracy ($e$) at 0.05 level of significant, and the sample size was given by:

$$n = \frac{Z^2pq}{e^2} = \frac{(1.96)^2(0.5)(0.5)}{(0.05)^2} = 384$$

The sample therefore consisted of 384 maize farmers. The study employed stratified random sampling technique to select the sample, strata being the divisions and farmers being selected proportionately to the number of farm holding in each of the six divisions of Uasin Gishu County. This was meant to ensure equitable representation of the population in the sample. Finally, 144 respondents who had the characteristic of interest (consistent use or non-use of credit finance) were picked for purposes of this study.

### 3.5 Data Analysis Procedures

To facilitate answering of the research objectives and hypothesis, Data analysis was carried out using both descriptive and inferential statistics. Descriptive statistics deals with collection, classification, presentation and description of data and information. Inferential statistics deals with analysis, interpretation and decision making on the basis of the results. Descriptive analysis was used to capture the level of maize production, expenditure, and use or non-use of credit financing in the Uasin Gishu County.
Inferential analysis was used to draw conclusion concerning the relationships and differences found in research results. Therefore, regression analysis technique was used to measure association between use of credit financing, expenditure, and maize production.
Regression analysis predicts an unknown variable using a known variable. Both simple and multiple regression analysis models were used. The models are used when the study is about prediction of variables from other predictor variables. The model below was used to determine the relationship between maize yield/output and use/non-use of credit financing:

$$Y = \beta_1 + \beta_2 D_i + U_i$$

Where:

- Y = maize output (in bags per hectare)
- D = 1, credit users; 0, non-credit users
- U = error term

The following model was used to determine the relationship between output on one hand and use/non-use of credit and expenditure on the other:

$$Y = \beta_1 + \beta_2 D_i + \beta_2 X_i + U_i$$

Where:

- Y = maize output (in bags per hectare)
- $D_i$ = 1, credit users; 0, non-credit users
- $X_i$ = expenditure per hectare (in shillings)
- $U_i$ = error term

Y is the output (dependent variable); $\beta_1$ is the intercept coefficient; $\beta_2$ is a constant; and $D_i$ and $X_i$ are the inputs (independent/explanatory variables).

All data was analyzed at a level of significance of 95% or $\alpha = 0.05$. This value ($\alpha = 0.05$) was chosen because the sample size was adopted from figures calculated on the basis of 0.95 level of confidence.

## 4.0 Research Findings

This chapter presents the finding of the study. It goes on to discuss and interpret these findings.

### 4.1 Analysis of Variance (ANOVA)

A simple linear regression analysis was run relating output to one qualitative (dummy) variable (use or non-use of credit). The model for this regression is:

$$Y = \beta_1 + \beta_2 D_i + U_i$$

Where:

- Y = maize output (in bags per hectare)
- D = 1, credit users; 0, non-credit users
- U = error term

Assuming that the disturbances hidden in the model satisfy the usual assumptions of classical regression model, the mean yield (bags per hectare) for credit users is:

$$E(Y/D_i = 1) = \beta_1 + \beta_2 (1)$$
$$= \beta_1 + \beta_2$$

Where: E – is the expected maize yield where the farmer is a credit user. Mean yield (bags per hectare) for non-credit users is given by:

$$E(Y/D_i = 0) = \beta_1 + \beta_2 (0)$$
$$= \beta_1$$

### 4.11 Results of the Analysis (ANOVA)

Running a regression analysis yielded the following results:

$$Y = \beta_1 + \beta_2 D_i + U_i$$
$$\hat{Y} = 30.98 + 2.86D$$

Se (0.5855) (1.0714)
t (52.9165) (2.6667)
P (0.000) (0.0086)
F 7.1112 (0.0086)
$r = 0.2184$
$r^2 = 0.0477$

### 4.12 Interpretation

The results show that the mean maize yield for non-credit users is 30.98 (or approximately 31) bags per hectare, while credit users' output is 33.84 bags (i.e. 30.98 + 2.86) (approximately 34 bags). The estimated $D_i$ is statistically significant because of the t-value which is 2.6667 and the P-value which is 0.0086. This means that the numerical values of maize output for credit users and non-credit users are statistically different.

The results show a very low positive correlation between output and source of finance, credit or non-credit, as given by r = 0.2185. Only 4.77% of output is explained by source of finance ($r^2 = 0.0477$).

### 4.2 Analysis of Covariance (ANCOVA)

The second regression analysis related one quantitative (Xi) and one qualitative ($D_i$) explanatory variables on one hand, and output on the other. The regression model was:

$$Y = \beta_1 + \beta_2 D_i + \beta_2 X_i + U_i$$

Where:

- Y = maize output (in bags per hectare)
- $D_i$ = 1, credit users; 0, non-credit users
- $X_i$ = expenditure per hectare (in shillings)
- $U_i$ = error term

### 4.21 Results of Analysis (ANCOVA)

Running a multiple regression analysis yielded the following results:

$$\hat{Y} = 8.8711 + 1.8408D + 0.0007X$$

| | | | |
|---|---|---|---|
| Se | (1.9436) | (0.7724) | (0.000) |
| t | (4.5643) | (2.3832) | (11.6498) |
| P | (0.000) | (0.0185) | (0.000) |
| F | 74.7877 (0.000) | | |

R = 0.7175

$R^2 = 0.5148$

### 4.22 Interpretation

The results show that the multiple regression analysis is statistically significant because of the t-value which is now 2.3832 and the P-value which is 0.0185. We can now conclude that holding expenditure constant, maize output for non-credit users is 8.8711 (or approximately 9) bags per hectare and for credit users is 10.7119 bags per hectare (8.8711+1.8408) (or approximately 11 bags).

Holding the effect of use or non-use of credit finance constant, the expenditure coefficient of 0.0007 means that output goes up by 0.0007 bags for every Sh.1 (one shilling) spent on maize farming.

The results of regression analysis show a high positive correlation between output and the two explanatory variables source of finance (credit or non-credit) and expenditure as given by r = 0.7175. Over fifty-one percent of output is explained by both expenditure and source of finance (credit or non-credit) as given by $r^2 = 0.5148$.

### 5.0 Conclusion and Recommendations

The study established that the average maize output in the county is 31.83 bags and that only 30.56% of the farmers use credit financing. Based on these findings, the researchers recommend that the government should intervene using measures such as fiscal policies, persuasion, and direct intervention to influence lending rates for agricultural finance so as make credit accessible and affordable to farmers. The prevailing rate of interest is too high for majority of the farmers.

Maize production in the county is low, but there is potential for increased production using non-equity financing. This may be achieved with lower interest rates and more friendly credit terms such as flexible interest rates and monthly repayments. Since most of the arable land in the county is already under cultivation, one way to increase yield per unit area is by increasing technical efficiency through the use of appropriate quality and quantity of inputs. This may only be possible where financing is readily available, accessible, and affordable.

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**Appendices:**

**Regression Analysis Results**

**APPENDIX I: ANOVA Results**

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0.218381892 |
| R Square | 0.047690651 |
| Adjusted R Square | 0.040984247 |
| Standard Error | 5.883745131 |
| Observations | 144 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 246.1791388 | 246.1791 | 7.111211 | 0.008549525 |
| Residual | 142 | 4915.820861 | 34.61846 | | |
| Total | 143 | 5162 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* |
|---|---|---|---|---|---|
| Intercept | 30.98019802 | 0.585454522 | 52.91649 | 2.36E-95 | 29.8228651 |
| X Variable 1 | 2.857011283 | 1.071371732 | 2.666685 | 0.00855 | 0.739111898 |

| *Upper 95%* | *Lower 95.0%* | *Upper 95.0%* |
|---|---|---|
| 32.13753 | 29.82287 | 32.13753094 |
| 4.974911 | 0.739112 | 4.974910667 |

**APPENDIX II: ANCOVA Results**

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0.71746484 |
| R Square | 0.51475579 |
| Adjusted R Square | 0.5078729 |
| Standard Error | 4.21482574 |
| Observations | 144 |

ANCOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 2 | 2657.169405 | 1328.5847 | 74.78767 | 7.24779E-23 |
| Residual | 141 | 2504.830595 | 17.764756 | | |
| Total | 143 | 5162 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95.0%* | *Upper 95.0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | 8.87112744 | 1.943596066 | 4.56428555 | 1.08E-05 | 5.028771234 | 12.7134836 | 5.028771 | 12.71348364 |
| X Variable 1 | 1.84084696 | 0.772418866 | 2.38322372 | 0.018494 | 0.31382781 | 3.36786612 | 0.313828 | 3.367866119 |
| X Variable 2 | 0.00069606 | 5.97483E-05 | 11.6497902 | 2.16E-22 | 0.000577937 | 0.00081417 | 0.000578 | 0.000814174 |

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