AN EVALUATION ON THE IMPACT OF ACCESS TO CREDIT ON MAIZE OUTPUT AMONGST SMALLHOLDER FARMERS IN KENYA

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DECLARATION

I declare that this research project is my original work and has not been submitted for an academic in any other university or institution.

SIGNATURE……. DATE……

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This research project has been submitted for examination with my approval as the University Supervisor.

SIGNATURE…… DATE……

DR. SULE ODHIAMBO

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May the Almighty God bless you all greatly!

DEDICATION

I dedicate this research project to God, my family and friends. Without your help and support, I would not have made it this far.

ABSTRACT

This paper aimed to examine the role of access to credit on maize output amongst smallholder farmers in Kenya. The study adopted an Ordinary Least Squares (OLS) regression model as its econometric approach. The study used the Kenya Integrated Household Budget Survey (KIHBS) dataset for the period 2005/2006. The study found that smallholder farmers who accessed credit produced much more maize in comparison to those who did not access credit. Concerning sex differences in smallholder maize production, the study found that male farmers were more likely to have higher maize output than female farmers. Further, the study established that soil fertility, tertiary education, use of inorganic fertilizer, investments in farm assets and increased farm size had an increasing effect on maize output amongst smallholder farmers in Kenya.

The policy implications of the study findings are that legislators should create policies geared towards incentivising financial institutions to develop agricultural finance products by coming up with de-risking measures for this sector. The Kenyan government should also endeavour to provide an enabling environment for innovative financial technology companies to develop lending products earmarked for agriculture using mobile money.

Concerning sex differences in maize production, policymakers at national and county level should intensify programs that target to expand females' ability to access agricultural services, inputs and implements to reduce gender gap in producing maize in the country. The ability to purchase services and inputs lies upon female farmers having access to credit in equal measure as their male counterparts. Efforts should be geared towards reducing barriers of access to credit such as collateral and options should be developed by government and financial service providers to catalyse access to credit for women.

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AFC	Agricultural Finance Corporation
AGRA	Alliance for a Green Revolution in Africa
CAADP	Comprehensive Africa Agriculture Development Programme
CBK	Central Bank of Kenya
GDP	Gross Domestic Product
FAO	Food and Agriculture Organization
GoK	Government of Kenya
HLPE	The High-Level Panel of Experts on Food Security and Nutrition
KBA	Kenya Bankers Association
KES	Kenya Shillings
KG	Kilograms
IFAD	International Fund for Agriculture Development
IFC	International Finance Cooperation
IFPRI	International Food Policy Research Institute
MoA	Ministry of Agriculture
OLS	Ordinary Least Squares
PSM	Propensity Score Matching
SACCO	Savings and Credit Cooperative
SFA	Stochastic Frontier Analysis
UBL	United Bank Limited
USAID	United States Agency for International Development
USD	United States Dollars

CHAPTER ONE: INTRODUCTION

1.1 Background of the study.

Agricultural financing refers to the provision of credit or investment funds to support farm production from resources outside the household and for off-farm agricultural production activities and agri-businesses such as development, provision of inputs and distribution in wholesale and retail. The demand for agriculture finance by smallholders in the world is estimated to be US$450 billion, (Dalberg Development Advisors, 2012) most of which is unmet. As a result, those investing in agriculture, both large and small-scale farmers, input companies, storage manufacturing companies often require funds from financial service providers to conduct business. Globally, various factors impede the development of solid financial services to underserved communities in developing nations.

Firstly, risk elements related to farming frequently repress credit lenders from onward lending. Transaction costs are higher in rural areas as a result of scattered population and limited infrastructure [IFAD], 2009a). The monetary foundation in underserved areas is also very poor. Absence of records and statistics on farm enterprises make assessment of credit worthiness challenging for lenders, what's more, undermines open doors for productive speculation. Lastly, the availability of sector specific innovations on money related instruments and administrations is generally poor.

In the last two decades, new approaches have been introduced to attempt to narrow the gap in access to agricultural finance. The utilization of innovations to encourage monetary exchanges shows incredible prospects. Mobile banking, credit and movable collateral registries, correspondent banking are such solutions that can mitigate market frictions and failures in the agriculture setting. In Malawi, Giné et al (2012) shows how use of fingerprints as unique identifiers to track credit histories changed the behaviour of microfinance borrowers and increased the chance that those who had poor credit scores would repay their loans. In Kenya, mPesa is using multiple methods to serve the unbanked in the rural areas (IFPRI 2010).

In agricultural production the conversion of inputs to outputs puts considerable time lags in production and yield (Conning and Udry, 2005). This causes an agricultural enterprise to spend a considerable amount of their income on input purchases and household consumption making their savings minimal. Due to the limited access to credit, balancing household budgets to include expenditures on agricultural production is constraining. Since working

capital is a limiting factor, combinations of inputs and volume consumed by a small-scale farmer may differ from the ideal levels hence affecting ability to yield optimally. This hence recommends that farmers confronting limitations in liquidity would in general use less optimal levels and mixes of inputs unlike in the case where the production related activities are not hindered by capital requirements (Freeman et al., 1998). This may infer that the agriculture's households' readiness to embrace new technologies may improve if they had access to credit (Carter, 1984).

Credit is vital for production. It allows producer organizations to satisfy the cash needs such as land preparation costs, planting costs, costs of inputs and labour involved in tending crops as well as harvesting costs. These costs are incurred over a period yet earning little revenue from their venture. Majority of these expenditures are made in cash. Income from the agri-enterprise can also be received in cash or mPesa briefly after harvesting or even months later depending on the perishability of the products. In the absence of formal banking and credit providers in the rural areas, farmers are relied upon to keep up cash reserves to encourage production in the following cycle. Obtainability and access to credit to the smallholder farmers would allow for both more noteworthy utilization and greater purchased input use, and therefore expanding the wellbeing of farmers.

Growth of the agriculture sector requires availability of agricultural finance. In order to spur transition from subsistence to commercial farming, substantial investment in the sector is required. Although farming is a wellspring of employment for 85% of rural households in developing economies, financing for investments in agriculture tend to be limited not only for the small investors but even the large investors (IFC 2013). Less than 1 per cent of financial institutions lend to stakeholders in the agriculture sector. They shy away from accepting risks associated with farming such as floods, droughts or even huge transaction costs extending to an expansive geographical areas. Despite governments are incentivising investment for the sector, there is still more to be done to reduce financial risks incurred by lenders when lending to the sector and more so capitalising on the investment opportunities in agriculture to boost production, processing and marketing of produce.

The farming segment in Kenya represents 24 percent of Kenya's GDP, and for another 25 percent by implication through linkages with other economic divisions. (World Bank 2012). It additionally gives about 70% of rural employment in the country. The foundation of the production side of agriculture in Kenya is segmented into smallholder farmers, pastoralists,

and fishermen who together constitute around 4 million families. Average land size is also small at one hectare per household.

Despite representing over 70% of the nation's agriculture sector, small scale farmers in Kenya face a huge financing constraint that keeps them from investing in farm implements, up taking new innovations necessary to increase production, productivity and revenues of agricultural enterprises. (AGRA, 2017)

In the recent past, the agricultural sector has faced numerous challenges especially in funding. In a study conducted by IFAD, results show that low investments in agricultural sector is more evident in Kenya especially to smallholders, yet it is an important source of boost to the agricultural sector. (IFAD, 2003). Access to credit for small-holder farmers is minimal despite Kenya having a moderately all rounded banking framework (Atieno, 2006). Lack of working capital to enhance productivity has led to low output amongst small holders. In 1990 commercial banks closed rural branches to cut costs and improve profits (Betty Kibaara, J. A, 2008) resulting to the emergence of non-traditional financial institutions such as savings and credit cooperatives (SACCOs) to lend those who could not reach the threshold of bank requirements.

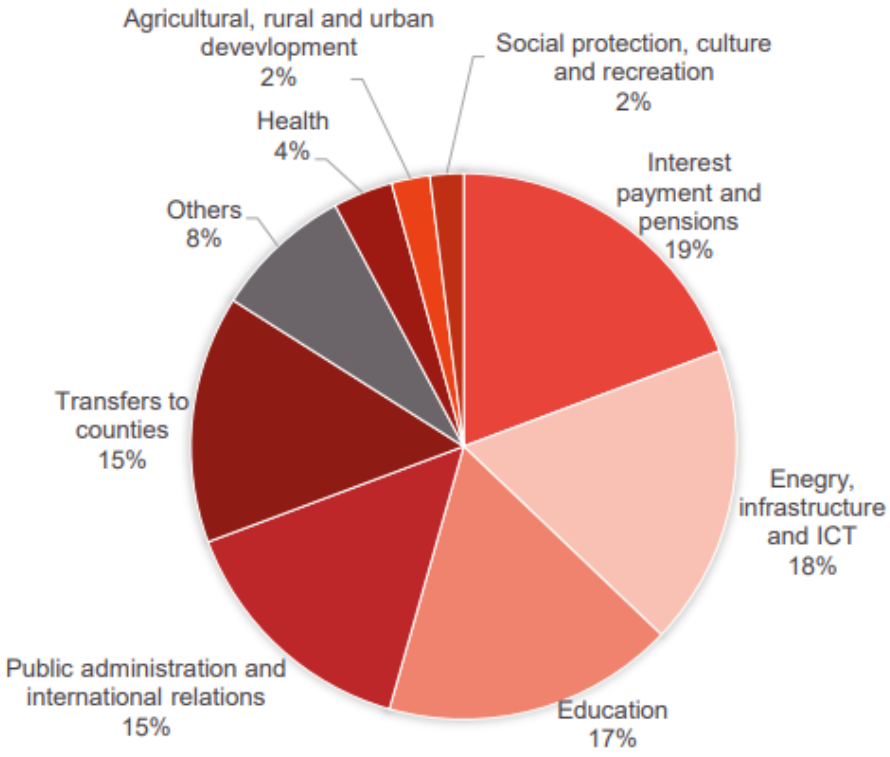
Despite the large number of banks, there exists limited competition among them which causes the lending interests rates to remain high. Lately, numerous tier three and four banks, micro finance institutions and saving cooperatives have emerged, increasing the options for accessibility of credit to the rural population but this has yet to increase the supply of credit geared towards agricultural enterprises. They gloat of having built up agribusiness departments yet the portion of agribusiness being financed in Kenya, benchmarked against national credit, stays underneath 5 percent. (CBK, 2015). The asset and working capital financing needs of numerous smallholder farmers remains neglected.

Smallholder farmers in Kenya have sited absence of investment funds and access to reasonable credit as the primary facets behind the inefficiency in farming. (Kamara, Adekele, Zuzama 2010). This financing gap blocks the nation's endeavors to move toward becoming food secure consequently improving the lives of majority of the population. It also holds back spurring of the development of the countryside, and thus, the national economy.

Agricultural production in Kenya in the recent years has been below average mainly as a result of production shocks, ineffective policies, and low investment resulting in low productivity levels among farmers. Agriculture expenditures as a percentage of total

expenditures at the national stage reduced through the period from a peak of 4.3 per cent in 2013/14 to 1.9 per cent in 2016/17. The trend in agriculture allocations and expenditures needs to be raised significantly to return to a path of high productivity and growth for the sector.

Figure 1: Budgetary allocations for various sectors for 2018/19 budget.



Source: Development Initiatives based on 2018/19 data.

Despite the growing national budget, the allocation for the agriculture sector has been dwindling over time with the recent budget allocation for the agriculture sector in the year 2018/19 being only 2% of the national budget. Kenya is one of the countries that recommitted to allocating more than 10% of its national budget to agriculture in the Malabo declaration in 2014. However, little is to be seen of the government's effort to see this to fruition as its allocation to agriculture seems to be declining yearly.

Smallholder agriculture is defined in many ways, depending on the geographic area and context. In the United States, for example, a farmer running a 100-acre farm and with an annual turnover of less than 100,000 USD may be a small-scale farmer. In Kenya, this kind of farmer would be viewed very differently. For purposes of this paper, a smallholder farmer

in Kenya is defined as one with holdings of 2 hectares or less. This definition is consistent with international literature. A study by FAO, based on data from 84 countries indicates globally that 73% of all land under cultivation are less than one hectare.

1.1.1 Relevance of Maize production in Kenya

Maize is the most predominant cereal after wheat and rice in relation to the area of land under maize cultivation and total food production (Purseglove, 1992; Osagie and Eka, 1998). Maize is at the centre of global food sovereignty with a variety of uses such as consumption as a grain; starch extricated from maize grain is utilized in making candy and noodles; edible oils extracted from maize seeds are used for culinary purposes; by products such as fabrics and plastics can be gotten from corn stock and is used as a source of nutrients in animal feeds. (Khawar et al, 2007). If largest producers and exporters of maize in the world are unable to meet expected demands for consumption and industrial uses, it will cause risk in food security.

Maize frames the most significant part of the normal eating regimen in most households in Kenya. It represents 36% of the entire calories expended and 65% of calories consumed. Yearly per capita maize utilization in Kenya is among the most elevated in the world at 103 kg/person/year. This is contrasted with worldwide per capita maize utilization at 14.8 kg; 27.9 kg for Africa and 38.4 kg for Latin America. In Tanzania, maize consumption is at 73 kg, in Ethiopia it's 52kg, and 31 kg for Uganda. (FAO 2015). Despite its significant contribution to food security and overall GDP of the country, the production and productivity of maize farmers has been declining over the years. This is mainly due to credit constraints, postharvest (storage/processing) problems, drought and limited availability of drought tolerant maize.

Emphasis has been laid on the production and productivity of maize. This is essential to agricultural policy makers, food security and overall growth of the sector and the economy. The crop is cultivated on approximately 1.6 million hectares and is grown by 98% of Kenya's 3.5 million smallholder farmers.

Food sovereignty of Kenya is majorly dependent on availability and enough supply of maize to meet household and industrial demand. Kenya has changed from being a net food seller to a persistent net buyer in the last two decades and must increase its farm productivity and income.

More than 85% of the rural households get their employment from agricultural activities, the majority of whom grow maize. With maize having such a central role in the diet of Kenyans and farming related activities, it is crucial that approaches of improving productivity of maize be sought.

1.2 Statement of the Problem

The agriculture sector is fundamental towards achieving the reduction of poverty, food sovereignty and sustainable development in most developing countries. In the Kenya Vision 2030 strategy, agriculture as a key sector with the prospect of pushing the economy to an anticipated yearly development of 10 percent throughout the decade.

It additionally perceives that there are in excess of 5 million smallholders occupied with various farm tasks in Kenya. Farming and livestock rearing are thus critical to the accomplishment of Vision 2030 whose objective will be acknowledged somewhat by the advancement of developments and commercialization of the agriculture sector. For the transition from subsistence to commercially oriented farming, farmers need access to financial intermediation which has since been difficult to find, thus, commercializing agriculture remains a dream.

The government has recently launched the Big four agenda and enhancement of food and nutrition security is one of the key components. In order to attain this, there is a focus on expanding food production and supply. The declining crop productivity has been due to facets like, resistance to pests and diseases, changing climate conditions, low adopting of technology, collapsed marketing systems, high cost of farm inputs and the change of rural land to other activities. In Kenya's rural regions, agriculture is continuing to be the most prevalent sector with more than 70 percent of the rural population deriving their livelihood from it. (GoK, 2010)

Kenya has in the last few years been producing less volumes of maize compared to its neighbouring countries in the region due to the high cost of maize production (Nyoro, 2004). Various methods to boost yield per unit area such as increasing technical efficiency must be sought in order to increase production. Credit is key to encourage uptake of innovations like of yield upgrading inputs, which cost marginally more, enhancing production hence changing the whole input-yield relationship.

Constraints in access and affordability of credit in part explains why agricultural productivity is low in Kenya. The issue in accessing credit is as pressing as ever despite the numerous formal and informal lenders in the financial system. Studies conducted by the government institutions and development programmes over the years show discrepancies between supply and demand for financial services in terms of volume and type of services.

Smallholder farmers produce most of the nation's food crops but their yields significantly lag. Essentially, the role of the smallholder farmers is critical and warrants attention to improve their productivity, grow economies, eradicate poverty, and drive social and economic progress. Smallholder farmers perform below their potential, and to increase their productivity, this category of farmers needs access to a full range of financial services.

Smallholder farmers often face difficulty in accessing agricultural credit. Formal banking and informal commercial lenders, SACCO's and cooperatives are struggling to offer agricultural credit to these farmers. Working capital and asset financing needs for smallholder farmers are hence not met. The sector hence continues to be robbed of its share of commercial credit in spite of its role to the Kenyan economy. The lack of credit to enable access of innovative inputs and technologies has contributed to the reduction in yield, low quality of produce and reduced investment from producers.

The agriculture sector strategies, big four agenda and vision 2030 lay emphasise on the use of incentives towards increasing production and therefore self-sufficiency in maize which will go a long way in ensuring food security in the country. Some of the mechanism employed over the years to incentivise or boost maize production include subsidisation of inputs; improving infrastructure such as roads; setting up of largescale irrigated maize plantations such as the Galana project; setting higher producer prices; research and extension services and legislative, institutional reforms. Despite these efforts maize production remains below domestic requirements in most years and the country continues to be a net importer of maize to cover its deficit. Kenya's growing dependence on cereal imports is also noteworthy. Imports are 37 per cent higher than they were a decade ago.

As the country's populace increases, so does the demand for maize in households. There is need to employ aggressive methodologies to bridge the deficit in production. Failure to do this may prompt importation of more food leading to higher food prices hence rise in poverty levels.

1.3 Research question

1. Does availability of credit affect smallholders who grow maize in Kenya?
2. Do there exist sex differences in maize production in Kenya?

1.4 The Study Objectives

1. To analyze the effect of access to credit on maize output among smallholder farmers in Kenya.
2. To establish the existence of sex differentials in maize production in Kenya.
3. Based on number 1&2 above make conclusions and policy recommendations.

1.5 Significance of the Study

The study aimed to create a foundation for attaining food security among the smallholder farmers not only in Kenya but even globally. The importance of agriculture has been emphasized in development agendas such as Vision 2030, medium-term plans and the big four agenda which emphasizes the importance of food security and food for all as articulated in the sustainable development goals.

Access to agricultural credit is critical for on-farm production needs of smallholder farmers so as to meet the food demand at household level and ultimately for the whole country. Pre-financing of farmers to acquire inputs for farming as well as finance to acquire farm infrastructure such as green houses, water storage facilities and storage has been termed as risky and financial institutions shy away from offering credit to small holder farmers.

This study provided information that would be useful in encouraging financial institutions to develop financial products that are affordable as well as accessible to farmers to enable better farm production which will in turn lead to farmer's ability to pay back credit facilities as well as improve small holder farmer's livelihood and income. The study also made policy recommendations which policy makers can use to develop policies that can incentivise financial institutions to offer agricultural finance at affordable rates to small holder farmers. It in effect added to the existing information available and aimed to act as a reference point for stakeholders to develop relevant regulations towards agricultural financing.

CHAPTER TWO: LITERATURE REVIEW

2.1 Theoretical Literature Review

2.1.1 Production Theory

Production function alludes to the precise scientific articulation of the relationship between various amounts of inputs utilized in the generation of a product and the corresponding quantities of output.

The function shows an input-yield relationship by portraying the frequency which assets are changed into outcomes. There are various input-output relationships in agriculture as the frequency at which the products are changed into yield will differ amid soil types, fertility of soils, innovations, rainfall amount etc.

Cobb and Douglas (1928) postulated production as a function of labour (L) and capital (K). Their function is one of the most used universal aid in empirical and theoretical analysis of growth and productivity.

In order to examine the efficient use of asset application, the modified CD function is fitted to work out the flexibilities of inputs which, in turn, are used to calculate their respective Marginal Value Product (MVP) at their geometric mean levels. The possibility of increasing production by adjusting inputs is examined on the criterion as to whether the farmers use their resources efficiently. Resource-use efficiency is judged based on neo-classical criteria that a factor of production is paid according to its marginal productivity.

There are some limitations in the application of Cobb-Douglas function. This function does not think about the relative importance of resources in the production process. A minor degree of inefficiency per unit in the use of an important resource may have several repercussions compared to a high degree of inefficiency per unit of input used in small quantity. Due to practical difficulties, resources cannot be adjusted in relation to Marginal Value Product. For example, the requirement of labour in small farms cannot be adjusted on purely economic grounds. As factors of production are not perfectly mobile the prices of them cannot be determined by a free play of market forces. This function will not guide a farmer as to which factor or resource is to be used in production. It can be a broad and rough approximation examining resource-use efficiency.

There are some essential grounds dependent on how the Cobb-Douglas function is selected to analyse the efficiency of inputs: the higher the co-efficient of determination R^2 , the better would be the fit of the production function. It means that the variable inputs (independent variables) included in the production function will appear to have better explained variation in the output (dependent variable). Second, the purpose of selection and signs of the coefficients are meaningful, and they bear appropriate discussion and reveal important facts.

The Cobb Douglas model, has since inception, been critiqued by Samuelson (1979) and Felipe and Adams (2005). Tan (2008) has likewise communicated his worries over its application in various businesses and timeframes. Tan argued that Cobb and Douglas were affected by measurable proof that seemed to demonstrate that work and capital portions of absolute yield were steady after some time in developing nations. Nonetheless, constancy over time can be disputed. The dispute is in view of the way that hardware and other capital products (K) contrast between timespans and as indicated by what is being created. The equivalent applies to the aptitudes of work (L).

2.1.2 Cost Theory of Agricultural Credit

Cost of credit acts as a benchmark that provides an estimate of a farmer's capacity to repay a facility. Transaction costs can be explained as money related to non-fiscal expenses. Money related costs of credit include borrowing expenses of refinance and the expense of interest on deposits. The non-fiscal costs include the costs on offices like office lease, phone correspondences and so forth.

The costs of agricultural loans are categorized as:

a) Costs experienced by loanees' before receiving loans such as application fees, insurance fees etc;
b) The costs which loanees' bear after receiving the credit e.g. interest rates. This cost makes
   agricultural credit costly due to the risk factors associated with this type of facility.

Small-holder farmers in developing countries remain poor because of the unaffordable cost of credit. Financiers likewise need compelling credit plans for timely supply of agricultural credit. Formal lenders should try and minimise these costs to make agricultural loan affordable.

Hypotheses of rural credit identified with interest, supply, good, social and business approach, dangers and vulnerabilities, together with the considerations of the cost of credit directly or indirectly influences the accessibility of credit and the rate of profits acquired from the utilization of credit

In rural credit markets in developing nations, the simultaneousness of formal and casual credit markets is normal. (Mohieldin and Wright, 2000). Ghate (1992) characterized formal financial service providers as enlisted organizations authorized to offer budgetary administrations. They are characterised by being regulated by a reserve bank. These establishments are prevalently urban in nature regarding the conveyance of branches the centralization of deposits and lending activities. Informal financiers as defined by Kashuliza et al. (1998) refers to lenders who are not regulated by central banks such as the rotating savings and credit associations (SACCO's) and village savings and loans associations (VSLA's). It can also be through friends, shylocks and family members. Steel and Andah (2004) describes semi-formal financiers as legal but unregulated entities such as saving cooperatives, micro-finance institutions and credit unions who primarily engage in increasing memberships in the associations and transforming deposits into membership loans.

Devi (2012) in Andhra Pradesh, India discovered that agricultural loans expanded the profitability of farm enterprises as well as encouraged more individuals to be involved in farming. She hypothesized that there was an enormous increase in use of fertilizers and pesticides, use of certified seeds, modernized implements in the wake of accepting credit which led to increase in yield per acre and ultimately farmer incomes. She also discovered that effect of rural credit was more useful on rain-fed farms than those whose farms were irrigated.

The pertinence of loans in agribusiness can't be reiterated. A study by Carter and Weibe (1990) showed that farmers require capital before and after. Capital in its initial stage finances fundamental production costs such as buying of inputs, farm hired labour etc. needs to be budgeted for prior to production. Access to finance after the process of production is particularly important when farmers' have not insured their crops or livestock as is often the case for subsistence farmers. The finances given are used for the adjustment of families' utilization periodically in case of changes in output.

2.1.3 The Financial Intermediary theory

Credit is allotted to those economic agents that can place them into the most gainful use. Valeria et al, 1991, postulated that improvement of banks and effective money related intermediation adds to development and growth by diverting reserve funds to more gainful exercises and decrease of liquidity risks. It subsequently can be reasoned that monetary intermediation prompts productive development. This means that a credit provider can facilitate development by providing loans fairly to those in need. Production growth is referred to an increment in the measure of the products and enterprises created by an economy after some time.

2.2 Empirical Literature review

Bashir et.al, 2010 using C-D function inspected the effect of credit on wheat efficiency in two towns chosen arbitrarily. From every stratum, a rundown of loanees were given credit by the United Bank Limited (UBL). Ten respondents were randomly examined from each town. The essential information was gathered through a well-organized survey by separating the region into three strata. An equivalent number of non-loanees were additionally chosen as controls. Results from the study showed that the loans played an influential part in increasing the involvement of farmers in the farming activities and facilitating the transformation of agriculture.

Chisasa and Makina, 2013 applied the C-D function to look at the effect of bank credit on crop output in South Africa. They utilized time series data from 1970 – 2009 taking variables such as agricultural yield, rain, work, capital and bank loans. Agricultural yield was the dependent variable and they used linear least squares to estimate the parameters. They presumed that the loans had a beneficial and noteworthy effect on farming yield in South Africa. Holding every single additional factor consistent, a 1% expansion in credit brought about 0.6% expansion in farming yield. The elasticities of the C-D function combined the outcome of loans (0.6%) and capital accumulation (0.4%) to give steady returns to scale, implying that doubling the two inputs would couple farming yield. Capital accretion was additionally seen to have a worthwhile and huge result on farm yield, even though it was less than that of loans, as a 1% increase in stock aggregation brought about a 0.4% increase in yield, different elements kept steady.

Dong et.al. (2010) in view of a review of 511 family units from China and utilizing endogenous switching regression technique observed that farm production inputs, farmers

ability to work and levels of education can't be completely utilized under credit constrained circumstances. The paper demonstrated that profitability of the farmers who were credit unconstrained tended to be higher than those who were constrained. They also presumed that productivity in the province could have been increased by 31.6% with the households accessing credit.

Research by Owusu in 2017 in Ghana evaluated the effect of access to loans on farm output from a random sample of 166 farm households producing cassava while employing descriptive statistics, logit model and Propensity score matching (PSM). Consequences of the logit model demonstrated that the loans had a productive and critical influence on cassava's productivity. He further prescribed that mediations to bring farming efficiency in the study area ought to think about access to credits as a key segment.

Duy, 2012 in his investigation of the "Impact of agricultural credit on farm output", using the quintile regression approach, Stochastic frontier analysis (SFA) approaches and responses from 654 farmers sampled from Pakistan to reveal that the rice yield and technical efficiency of farmers increased tremendously because of obtaining credit, the educational levels of the farmers and high level of technology. His study also showed that rice production was positively affected using formal credit rather than informal credit.

Muraya and Ruigu, 2017, in a study aiming to assess the causal factors of farm productivity in Kenya using partial factor productivity given by physical output over factor inputs, employed Cobb's production function and ordinary least square (OLS) estimation method as the method of examination. The study utilized secondary information from the period of 1980 to 2013. The study explored inflation, real exchange rate, labour force, government expenditure and climate/rainfall as the factors determining agricultural productivity. It found that an increase of one percent in government expenditure, annual rainfall, and labour force caused an increase in agricultural productivity by 0.0639032%, 0.0917103%, 0.1984402% respectively. An increase of one percent in inflation rate and in exchange rate caused a decrease in agricultural productivity by 0.0193286% and 0.405422% respectively.

Nzomo and Muturi (2014), in a study done in Kimilili, Bungoma County scrutinized the influence of rural loaning programmes on the output of rural farming households. Descriptive statistics analysed the qualitative data while cross-tabulations examined the relationship between variables. They observed from data collected from 123 small holder

farmers randomly selected from cross-sectional data established that credit in agriculture has the ability of improving farmer incomes for those who utilize it fully.

2.3 Literature Overview

Findings from the above studies have largely concluded that increasing agricultural producers' ability to obtain loans has a critical and beneficial effect on efficiency. Others show that where access to loans might not have an immediate sway on efficiency, it could have a positive resultant effect on increased capital for farm investment, adoption of agricultural technologies, productivity of food crops and facilitates the change from subsistence to commercial farming. It likewise raises the investment of farmers in the production activities.

The studies employed Cobb's production function in various ways with agricultural output as the dependent variables and independent variables varying depending on the crops. However, no studies are yet to be conducted in Kenya on the impact of credit to small holder farmers' production process and on food crops such as maize.

This study argues that Cobb's production function merits its use for analysing production processes in the agriculture sector because of the advantages it possesses. These advantages are as a result of its ability to handle several inputs in its generalised form.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

This chapter explains and outlines the model that was adopted in achieving the objectives of the study. It defines the data source, the theoretical framework on estimating small holder maize output as a function of access to credit among other factors, model specification that links maize production to its covariates, data that was used, variables definition and measurements and lastly estimation techniques together with model diagnostic tests.

3.1 Theoretical framework

An agricultural household firm utilizes a Cobb Douglas production function represented by the technological relationship between capital and labour inputs and the amount of output that can be produced by those inputs as:

Y=f (K, L) (1)

$Y_k' > 0$ & $Y_k'' < 0$

$Y_l' > 0$ & $Y_l'' < 0$

Where Y is the output, K and L are capital and labour inputs respectively, Y_k'andY_k'', Y_l'andY_l'', are the first and second order conditions for the output maximization.

We parameterized equation 1 as shown below

Y= A$K^{\beta}L^{\alpha}$ (2)

Where A represents technological progress, β the ratio of capital input in the output and α is the ratio of labour input in the output,

Now by assuming that our representative household farm has the above production cost function (2) and our representative household is a profit-maximizing unit, a household would increase factor inputs up to the point where marginal rate of return of inputs would equal to the marginal cost of inputs

To better understand the link between output and inputs in the production function, we utilized the production function to assess the link between maize farm output and inputs in Kenya. Let us recall equation 2 and further introduce other factors affecting maize output

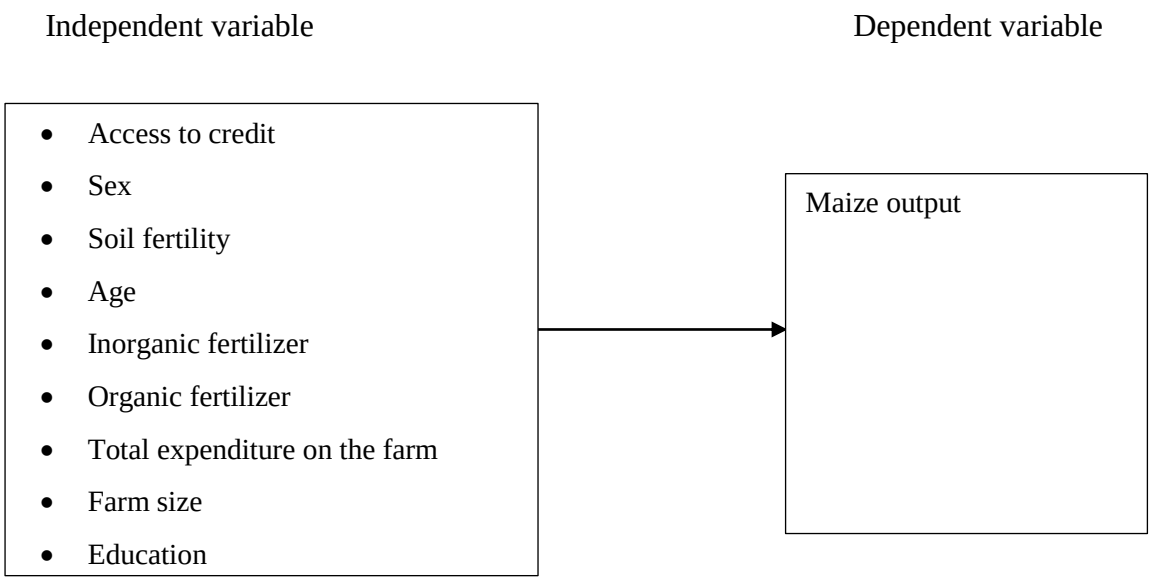
Y= A$K^{\beta}L^{\alpha}e^{\gamma z}$ (3)

Where z is a function of other factors affecting maize output namely *ac* access to credit, *g* is the sex of the farmer, *sf* is the soil fertility, *a* is the age of the farmer, *if* is inorganic fertilizer, *of* is organic fertilizer, *tef* is the total expenditure on the farm, *fs* is the farm size, *ne*, *pe*, *se* and *te* denoting no education, primary, secondary and tertiary education respectively.

$$z = \gamma(ac, g, sf, a, if, of, tef, fs, ne, pe, se, te) \quad (4)$$

The figure below illustrates how the aforementioned factors are linked to maize output.

Figure 2: Factors linked to Maize output



Source: Author's illustration based on the Augmented C-Douglas function.

First, we introduce natural logarithms to equation 2 as shown below;

$$\ln Y = \ln A + \beta \ln K + \alpha \ln L + \gamma ac + \gamma g + \gamma sf + \gamma a + \gamma if + \gamma of + \gamma tof + \gamma fs + \gamma ne + \gamma pe + \gamma se + \gamma te) \quad (5)$$

3.2 Model specification

In order to determine the link between maize output and access to credit, the concern of my study, I constructed a linear relationship using the generalized maize farm production function as shown above in equation 4.

Letting Y_i represent the households maize production output, Y_i is dependent on a vector of regressors' access to credit, sex, soil fertility, age, inorganic fertilizer, organic fertilizer, total expenditure on the farm, farm size and education.

Based on this hypothesis, we can write our regression relationship as:

$$Y_i = \sum \beta' X_i' + \mu_i \qquad (6)$$

Where X_i' is a vector of regressors as mentioned above, β' relates to the parameters to be estimated and μ_i the error term.

Now to empirically estimate our equations of interest, the following estimable econometric model was estimated;

$$\ln y_i = \alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + \beta_4 x_{i4} + \beta_5 x_{i5} + \beta_6 x_{i6} + \ln \beta_7 x_{i7} + \ln \beta_8 x_{i8} + \beta_9 x_{i9} + \beta_{10} x_{i10} + \beta_{11} x_{i11} + \beta_{12} x_{i12} + \varepsilon_i \quad (7)$$

Where y_i relates to maize output by households *i*, x_1=access to credit, x_2=sex, x_3= soil fertility x_4=age, x_5=inorganic fertilizer, x_6= organic fertilizer, x_7= total expenditure on the farm, x_8= size of the farm, x_9= no education, x_{10}= primary education, x_{11} = secondary education, x_{12} = tertiary education.

To empirically estimate the model, I applied natural logarithms to maize output, total expenditure on the farm, farm size in order to normalize the variable measurements.

3.3 Variable definition and a priori expected signs

Table 1: Variable definition and priori expected signs

Variable	Measurement	Expected signs
Dependent variable		
Maize output	Tons per hectare cultivated	
Independent variable		
Access to credit	1= Credit 0 = no credit	Positive (+)
Sex	1 = Male as household head, 0= female as household head	Indeterminate (+/-)
Soil fertility	1= Loam soil 0 = otherwise	Positive (+)
Age	Age of the household head	Indeterminate (+/-)
Inorganic fertilizer	1= If household used inorganic fertilizer; 0 = otherwise	Indeterminate (+/-)
Organic fertilizer	1=If household used organic fertilizer; 0= otherwise	Positive (+)
Total expenditure used in the farm	The amount of expenditure used in the farm	Positive (+)
Size of the farm	Size of the farm that is cultivated	Positive (+)
No education	1= Household head has no education, 0= otherwise	Negative (-)
Primary education	1= Household head has primary education, 0 = otherwise	Positive (+)
Secondary education	1= Household head has secondary education, 0 = otherwise	Positive (+)
Tertiary education	1= Household head has tertiary education, 0= otherwise	Positive (+)

3.4 Diagnostic tests

3.4.1 Multicollinearity

Collinearity refers to the linear relationship between two explanatory factors. Multicollinearity refers to highly linearly related associations between two or more explanatory variables.

3.4.2 Model Specification and Normality

A normality test determines whether sample data has been drawn from a gaussian distributed population. The goodness of a fit test was applied to ascertain that the information set was well modeled and normally distributed.

3.4.3 Heteroscedasticity

Heteroscedasticity refers to the occurrence in which the variables spread out unequally over a range of data points of a second variable that predicts it. It is present when the variance of the error terms differs across observations. The Breuch-Pagan Godfrey test was sought to test for heteroscedasticity.

3.5 Data source.

This study used the KIHBS 2005/06 data to examine the role of credit on maize output amongst smallholder farmers in Kenya. The data contains information on agricultural produce, access to credit, sex of the head of the agricultural household i.e. female-headed or male-headed household among other covariates that was used in estimating our estimable equation.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0 Introduction

This chapter outlines the results of the role of access to credit on maize production in Kenya. In the chapter, I also provide the summary statistics as well as the estimates of the model.

4.1 Summary Statistics

The descriptive statistics of the variables used in the study are presented in table 4.1. It is shown that on average, smallholder farmers produce 3.7 bags of 90 kgs of maize with maximum and minimum being 50 bags and 0.03 bags respectively. Concerning access to credit, statistics shows that 40% of smallholders' farmers access credit during the planting season.

Table 2: Summary statistics

Variable	Obs	Mean	Std.Dev.	Min	Max	Skewness	Kurtosis
Maize output	690	3.669	5.303	0.033	49.95	3.9	24.52
Access to credit	690	0.400	0.490	0	1	0.4082	1.167
Sex	690	0.659	0.474	0	1	-0.6727	1.453
Soil fertility	690	0.645	0.479	0	1	-0.6057	1.369
Age	690	48.63	14.19	20	98	0.3674	2.628
No education	690	0.645	0.479	0	1	-0.6057	1.369
Primary education	690	0.207	0.406	0	1	1.445	3.087
Secondary education	690	0.142	0.349	0	1	2.051	5.206
Tertiary education	690	0.0058	0.076	0	1	13.01	170.51
Inorganic fertilizer	690	0.442	0.497	0	1	0.2334	1.055
Organic fertility	690	0.523	0.500	0	1	-0.0929	1.009
Farm expenditure	690	2885	7827	0	107800	8.148	90.98
Size	690	0.995	0.870	0.03	5	1.547	5.719
Land slope	690	0.574	0.495	0	1	-0.2989	1.089

The average age of the household head included in this paper was 48.63 with the maximum and minimum ages being 98 and 20 ages respectively. Concerning the sex of the household head, the statistics suggests that, on average, 65.9 percent of the household heads were men with a standard deviation of 47.4%. The statistics also shows that majority (64.5 percent) of the household head had not completed primary education followed by 21 percent had primary education and 14 percent secondary. Further the statistics shows that, on average, 44.2 percent of the household reported to have used inorganic fertilizer for planting while 52.3 percent used organic fertilizer for cultivation. With regards to farm expenditure on pesticides, tractor, oxen, labour costs and other farming expenditure, surveyed households on average incurred KES 2,885 as farming costs, with the maximum expenditure being KES. 107,800.

Concerning the size of the land under cultivation, summary statistics indicate that 1 acre was the average land size that was put under cultivation. The reported minimum and maximum land that was put under cultivation was 0.03 and 5 acres. Further, an estimated 57.4 percent of the land put under cultivation was not considered to be flat but a sloppy land.

4.1 Post estimation techniques

4.4.1 Multicollinearity

To test for the collinearity problem, I computed the variance inflation factor (VIF). VIF is a post estimation technique that signifies presence of collinearity if the VIF is above 10. The results in table 4.4.1 indicates absence of collinearity problem in the estimable model since no VIF value exceeds 10, which is threshold level for multicollinearity problem. The table below reveals the VIF results.

Table 3: Multicollinearity test

Variable	VIF	I/VIF
Access to credit	1.03	0.969409
Sex	1.03	0.966647
Soil fertility	1.11	0.901718
Age	1.03	0.974521
Primary education	1.07	0.936476
Secondary education	1.12	0.889165
Tertiary education	1.02	0.981533
Inorganic fertilizer	1.29	0.778087
Organic fertility	1.08	0.924003
Log farm expenditure	1.14	0.879898
Log size	1.17	0.852176
Land slope	1.09	0.917579
Mean VIF	1.10	

4.4.2 Ramsey Model Specification test for Normality

In the study, I conducted the Ramsey Reset test to check for the normality assumption and determine whether the data has been drawn from a gaussian distributed population and the model fits the data well. From the results in table 4.4.2, we fail to reject the null because the reported p-value is 0.2950 being larger than 1, 5 and 10 percent levels of significance implying that the model has not omitted important variables and fits the data well.

Table 4: Ramsey reset test

Ho: model has no omitted variables
F (3, 666) = 1.24
Prob > F = 0.2950

4.4.3 Breusch-Pagan-Godfrey Test for Heteroscedasticity

In the study, I conducted heteroscedasticity test in order to test whether the error terms are constant across observation. Results in table 4.4.3 suggests that we do not reject the null

hypothesis because p-value is 0.0092 which is less than 1, 5 and 10 percent levels of significance. It is therefore concluded that the error terms are not constant overtime and that there exists heteroscedasticity problem in the analysis. I however used the robust standard error option to correct for this problem.

Table 5: Heteroscedasticity test

Ho: Constant variance
Variables: Fitted values of Log Maize output
chi2(1) = 6.78
Prob > chi2 = 0.0092

4.2 Econometric Results

4.2.1 Effect of Access to Credit on Maize Output amongst Smallholder Farmers.

The econometric result is presented in table six below. The results establish that farmers who accessed credit were 23 percent more likely to have increased maize production in comparison to those who did not access credit. This study finding implies that access to credit by farmers is an important instrument in improving a farm enterprise as it tends to aid small farmers to acquire necessary farm inputs like fertilizers and pesticides on time hence apply them efficiently, undertake farm investments in assets, implements and crop insurance and improves farmers' ability to cope with unexpected climate change vagaries. Ali, Deininger and Duponchel (2014) found similar findings in rural Rwanda that improving access to credit in Rwanda could increase productivity in agricultural production.

Concerning sex variable, the results establish that male farmers are 20 percent more likely to have increased maize production as compared to female farmers. There exists three possible explanation for this finding. Firstly, land, one of the most widely used asset as collateral for loans is more likely than not under the ownership of men. In most developing countries, women tend to have a constrained access to land than men, and even for those who own, there's a higher probability of them owning less land than men. Second, female farmers tend to be constrained in mobilizing hired labour for farming purposes and supervising male farm labourers since most live-in patriarchal society where they have less control over adult male labourers in households. Third, women tend to lack farming support and technologies such as

inorganic fertilizer, improved variety of seeds, pesticides, and mechanical power required to improve their farming practices which significantly contributes to the gender gap due to unequal returns to the inputs (O'Sullivan, et al., 2014). The table below showcases the results of the study.

Table 6: Econometric results

Variables	**Logarithm of Maize Output**
Access to credit	0.230**
	(0.0925)
Sex	0.200**
	(0.0937)
Soil fertility	0.197**
	(0.0957)
Age	-0.00507*
	(0.00295)
Education	
Primary education	-0.0532
	(0.110)
Secondary education	0.181
	(0.131)
Tertiary education	0.660*
	(0.390)
Inorganic fertilizer	0.354***
	(0.0970)
Organic fertilizer	-0.0947
	(0.0924)
Log farm expenditure	0.125***
	(0.0324)
Log farm size	0.543***
	(0.0523)
Land slope	-0.102
	(0.0954)
Constant	-0.235
	(0.276)
Observations	682
R-squared	0.244

*Notes: (i) Logarithm of maize output is the dependent variable (ii) t statistics in brackets (iii) *, ** and *** stands for significance at 1, 5 and 10% levels (iv) No education is the reference category for the education variables respectively.*

On the soil fertility variable, econometric results establish that land with fertile soils are 19.7 percent more likely to produce more maize as compared to those with less fertile soils. This result is indicative of the fact that soil fertility is a critical ingredient in producing maize in

Kenya and that policies that are geared towards improving soil fertility such as crop rotation, minimum soil tillage, use of compost and manure would be instrumental to enhance maize production by the smallholder farmers.

Concerning the education variable, the results indicate that farmers who have attained some form of education are more likely to have better production of maize as compared to those with no education. The implication of this finding is that education is crucial in enhancing agricultural production in the country.

Concerning the use of fertilizer, regression results show that smallholder farmers who use inorganic fertilizer are 35 percent more likely to produce more maize than those who do not use inorganic fertilizer. Furthermore, the results indicate also that the smallholder farmers who used organic fertilizer tend to produce less maize even though the effect is not statistically significant.

The econometric results also establish that increase in the expenditure on farm related activities and assets such as expenditure on pesticides, fertilizer, tractor, oxen, farm repairs and labour costs positively and significantly enhances maize production amongst small holder farmers. More specifically, the study establishes that a one percent rise in spending on farm assets increases maize production of smallholder farmers by 0.12 percent. Concerning the size of land put under maize cultivation, this was found that it positively and statistically linked to maize production. The results show that a one percent rise in land size increases maize production by 0.543 percent.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.0 Introduction

This chapter outlines a brief summary as well as the conclusions of the study. The section also highlights policy implications and lastly, suggests areas of further research on this subject.

5.2 Summary and Conclusion

This paper aimed to analyze the effects of access to credit on maize production among smallholder farmers in Kenya. Specifically, the paper sought to examine the role of access to credit on maize production by smallholder farmers and the existence of gender effects on maize production in Kenya. The study applied OLS estimation technique to the KIHBS 2005/06 dataset where 682 smallholder maize farmers were analyzed.

Concerning the role of access to credit on maize output among smallholder farmers, the study found that access to credit had an enhancing effect on the quantity of maize produced by the smallholder farmers in Kenya. In particular, the study established that smallholder farmers who accessed credit had higher likelihood of producing more maize than those who did not access credit. On the sex differentials on maize production, the study established that male farmers were more likely to produce more maize output as compared to female workers. Concerning household head education, the study established that farmers with better levels of education had higher probability of producing more maize than those with little or no education. Further, small holder farmers that used inorganic fertilizer, had higher levels of expenditure on farming activities as well as those that had relatively larger land sizes under maize production had an increased chance of producing more maize.

5.3 Policy Implications

From the study, it is observed smallholder farmers who accessed credit had higher likelihood of producing more maize output than those who had no accessed to credit. Based on this, policies should be geared towards incentivising financial institutions to develop affordable agricultural products targeting small holder farmers. Policies should also be developed to facilitate disruptive technologies like mobile money lenders to develop innovative products that encompass relevant stakeholders such as buyers and insurance products to de-risk the loans. The government should also encourage disruptive innovations from financial

technology companies that aim to reach the underserved through their innovations in the agricultural sector and specifically to enable small scale farmers acquire agricultural inputs like fertilizers and pesticides that are vital to maize production.

Since the study established existence of sex differentials in maize output among smallholder farmers, the study also proposes that there should be an intensification of programs and policies that will catalyze uptake of credit by women in financial institutions. Government institutions such as the Agricultural Finance Corporation (AFC) should remove limitations of access to credit such as collateral and find other alternatives to de-risk the loans such as group lending. This is because women form half the population of smallholder farmers in Kenya. For maize output to increase and in order to ensure food sovereignty in the country, measures should be taken to encourage equal participation in food production.

5.4 Limitations of the Study

Addressing the endogeneity problem in estimating the effects of access to credit on maize production among smallholder farmers is critical. Presence of endogeneity, which is a situation where an independent variable is linked with the error term in the estimable model, tends to lead to biased estimates. This study did not address the endogeneity problem and proposes future studies on this subject to mitigate the endogeneity problem in analyzing the effects of access to credit to maize production. Further, owing to limitations in accessing recent nationally representative data on agricultural production in the country, this study suggests future studies to consider using recent data when they are available.

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