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THE IMPACT OF ACCESS TO AGRICULTURAL SERVICES ON MAIZE PRODUCTIVITY IN UGANDA

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Abstract

Over the years, the government has continuously increased funding to the agricultural sector through providing agricultural services to farmers. Therefore, the study's broad objective was to examine the influence of access to agricultural services on maize productivity in Uganda. Specifically, the study analysed the access to credit services, extension services and access to markets and their influence on maize productivity. The analysis was based on Uganda Census of Agriculture data collected in 2008/2009 by the Uganda Bureau of Statistics (UBoS). Employing regression analysis, results show that access to credit services, extension services and market significantly increase maize productivity. Therefore, study recommends that government need to strengthen farmer's to access credit, extension services and markets is necessary to improve low levels of farm yields in maize production in Uganda.

Keywords: agricultural services, maize, maize productivity, Uganda

INTRODUCTION

Agricultural productivity measures the performance and provides a guide to the efficiency of the sector (Thirtle *et a*l., 1993 & 2005; Conradie *et al.,* 2009). In Uganda, 85% of the population is engaged in agricultural production which contributes 42% of the national gross domestic product, 80% of the export earnings, and employs 90% of the labour force (UBoS, 2014). According to the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) Development Strategy and Investment Plan 2005/2008, the main Agriculture sub-sectors include crops contributing about 80%, livestock contributing 13% and fisheries contributing about 6%. Over 95% of the farmers are smallholders with landholdings ranging from 0.5 to

10 acres. Out of about 31 million Ugandans, 85% live in rural areas of which 73.3% are engaged in subsistence agriculture (UBoS, 2014). Most of the agriculture is characterized by small land holdings with a few isolated commercial holdings (Musiime *et al*., 2005).

Notwithstanding the above, the share in total GDP has been declining. For instance, the share of the agriculture sector to Gross Domestic Product (GDP) has continued to decline from 20.2% in 2004/05 to 14.7% in 2009/10 and 13.9 % in 2011/12 (MFPED, 2011). However, despite of the declining share of agriculture to GDP, the sector remains important because it provides the basis for growth in other sectors such as manufacturing and services (Government of Uganda, 2010). For example, agriculture being the largest employer, 83% of women (83%) is employed in agriculture as primary producers and contributes 70-75 per cent of agricultural production. In the face of the global financial crisis, agriculture is contributed foreign exchange revenue from regional trade exports and therefore improving the country's balance of payments position, and in the process helps to stabilize depreciation of the shilling (UBoS, 2014).

Although the role of agriculture in poverty reduction and overall growth in Uganda is well recognized, investment in the sector remains minimal, at 5% and less than 10% as agreed in the Maputo declaration (UBoS, 2014). The slow pace of socioeconomic transformation in Uganda can therefore be attributed to the neglect of the agricultural sector as an engine of growth (Tibaidhukira, 2011). Many studies have suggested that modest increases in agricultural production witnessed are largely due to expansion in cultivated land. Farmers' constraints such as limited access to credit services, extension services, market services and institutions are still large (Pratt, 2008). Still, despite of continued government efforts to improve agricultural productivity, agricultural productivity has slowly grown with the maize crop fluctuating between seasons (Delgado, 2003; Fernandez-Cornejo, 2006; Okoboi, 2011; Okoboi, Kuteesa, & Barungi, 2013). This research therefore contribute to the growing literature to address maize productivity in developing countries with specific emphasis on the access to credit services, access to extension services and access to market services. Specifically, study examined the influence of access to credit services, extension services and markets on maize productivity. The study focused on maize because it is an important crop in Uganda. Maize is the most highly cultivated crop with about 86 per cent of Uganda's agricultural households (UBoS, 2014). Maize is the number-one staple food for the urban poor, in institutions such as schools, hospitals and the military. Also, the crop is the number-one source of income for most farmers in Eastern, Northern and North-Western Uganda (Ferris *et al*., 2006).

LITERATURE REVIEW

Agricultural export production in any country including Uganda hinges on the efforts of rural producers and processors who typically receive the least benefits from the marketing and processing of their products. Nurturing and building the capacity of farmers' groups is one way of improving quality, profitability and marketing efficiency. Clearly the effective implementation of policies to expand the access of services to encourage agricultural exports urgently needs to be addressed to benefit smallholder farmers as they produce and process these goods (Kyomugisha, 2008). Therefore, in the extant literature researchers have been interested to understand the contribution of different farming interventions on agricultural production, productivity and efficiency. In respect to maize production, numerous researchers have investigated the factors that drive productivity and efficiency of maize farmers. The important factors under investigation have been access to credit, markets and extension services. For example, Mulinga (2013) looked at an economic analysis of factors affecting technical efficiency of smallholders maize production in Rwanda and found out that access to credit were significant variables leading to technical inefficiency. Kamau & Otieno (2013) report similar results in Kenya, that there is a significant relationship between credit financing and maize production.

Martey *et al*; (2015) argues that provision of credit enhances timely purchase and efficient allocation of factor inputs to produce the maximum output. The study used the propensity score matching analysis was used to compare the average difference in technical efficiency between farmers with credit and those without credit in Northern Ghana. In another study using a logistic regression, Kiplimo (2013) clearly pointed out that access to credit has significant positive effects to smallholder farms in both Eastern and Western regions of Kenya.

In Ethiopia, by estimating a Cobb-Douglas type stochastic frontier production function, Yilma *et al*., (2008) clearly pointed out that participation in an extension program was found to increase the productivity of maize farmers. They thus suggested that improving the extension access of farmers could help in increasing the technical efficiency of maize production.

Evenson & Mwabu (1998) used the quintile regression technique and the results reveal that extension services have a discernible impact on productivity and that the impact was at the highest top end of the distribution of yields residuals, "suggesting that productivity gains from agricultural extension may be

enhancing unobserved productive attributes of farmers such as managerial abilities. The implication of this finding is that other factors such as farm management abilities and experience affect the effectiveness of extension as a determinant of agricultural productivity (Odhiambo & Nyangito, 2003).

Maziku (2015) in estimating the effects of transaction costs on market participation and sales of maize in the major maize producing districts (Mbozi and Sumbawanga) of Mbeya and Rukwa regions, located in the Southern Highland of Tanzania. Using the two-stage Heckman model, the findings showed that the distance to market had shown negative effects on farmers' market participation. This implies that smallholder farmers' market participation will increase with the reduction in the distance to the market. In northwestern Ethiopia, Minten et al. (2013) found out that transaction and transportation costs increased fertilizer prices at the input distribution center between 20 and 50 percent which reduce crop productivity. Similarly, Zerfu & Larson (2010) showed that the other challenge is the transportation time by farmers in rural Ethiopia to reach the markets.

In particular, access to markets is hindered by both observable and unobservable costs in agriculture. Observable (tangible) costs are associated with transport, handling, packaging, storage costs; whereas unobservable (intangible) costs include information asymmetries, search costs, bargaining costs and the costs of enforcing contracts (Cuevas & Graham, 1986; Staal *et al.,* 1997; Hobbs, 1997; Key *et al*., 2000; Holloway *et al*., 2000; Birthal *et al*., 2005; Jensen *et al.,* 2007). All these costs limit agricultural productivity.

METHODOLOGY

Theoretical framework

There are many theories researchers use to model agricultural production and productivity. The competing theories are the production theory (Battese, 1992), the theory of economic efficiency (technical and allocative efficiency) (Chukwuji, *et al*., 2006), the theory of the farm household (Barnum and Squire, 1997), and the transaction costs theory (de Janvry *et al.,* 1991). The theories of economic efficiency; whether technical and allocative efficiency measures only the technical or allocative efficiency of the firm, rather than the household (Barnes, 2008). The transaction costs theory explains the farmers' behaviour in terms of transaction costs as a determinant in the input and output markets (de Janvry et al.,

1991). Though, this is relevant with most of small holder maize farmers; most times there are other determinants for the output markets.

In the farm-household model, agricultural households are assumed to maximize utility subject to the production function and time and income constraints (Barnum & Squire, 1997). This is not a case for most households in Uganda which do not consider utility maximization and thus the theory of production was better suitable for this study. Theory of production has been extensively used to the development work of most economies. In Uganda, the theory of production has been applied in the National Agricultural Advisory Services (NAADS) as one of five core programmes under the Plan for Modernization of Agriculture (PMA). Other studies have also employed the theory of production to model production and productivity in agriculture and other sectors (Nyamekye, 2016; Felipe & Adams, 2005; Battese, 1992). The theory explains the process of combining various inputs to produce an output for consumption (Battese, 1992). The Production function signifies a technical relationship between the physical inputs and physical outputs of the firm, for a given state of the technology.

$$Q = f(X_1, X_2, X_3, \ldots, X_n) \qquad (1)$$

Where $X_1, X_2, X_3, \ldots, X_n$ are various inputs such as land, labor, capital among others. In this study agricultural services as access to credit, access to extension and access to markets are used as proxies for the inputs in this theory of production.

Q is the level of the output for a firm.

If labor (L) and capital (K) are only the input factors, the production function reduces to;

$$Q = f(L, K) \qquad (2)$$

The above production function describes the technological relationship between inputs such as land, labour, capital and output of the firm (Battese, 1992). The strength of the theory of production is that it enables the understanding of the relationship between inputs and output, which benefits producers by minimizing the costs associated with inputs and consumers due to the lower prices derived from lower costs for the producer. This relationship is also essential in distinguishing between the short-run and the long-run, where the short-run is the period of time where at least one factor of production is fixed and in the long-run all factors of production are variable and the state of technology changes. In this study to

capture the influence access to credit, extension and market services, equation 2 above is augmented with variables that capture access to credit services, access to extension services and access to markets. The dependent variable was maize productivity.

Model Specification and Estimation

Maize productivity was measured as yield (metric tons per hectare). Accordingly, a maize productivity equation for a given household is specified as below;

$$\mathbf{Yield_i = f\ (C_i, E_i, M_i)}$$

Where

$Yield_i$ is the total maize output per hectare for the i^{th} household

C_i is indicates access to credit services by the maize farmers for the i^{th} household

E_i indicates the access to extension services by the maize farmers for the i^{th} household.

M_i indicates the access to markets by the maize farmers for the i^{th} household.

The estimated productivity multiple regression model is given as below:

$$\mathbf{Y_i = \beta_0 + \beta_1 C + \beta_2 E + \beta_3 M + u_i}$$

Where

Y is Maize productivity or yield.

$\boldsymbol{\beta_i}$ are coefficients.

C is access to credit services.

E is access to extension services.

M is access to markets.

$\mathbf{u_i}$ is a disturbance term.

Data and Source

The study used secondary data that was obtained from the 2008/2009 Uganda Census of Agriculture (UCA). The census was administered by the Uganda Bureau of Statistics (UBoS) and covered all the 80 districts in the country as of 1st July 2007. The 2008/2009 Uganda Census of Agriculture (UCA) collected data on various structural characteristics of the agricultural holdings such as: Number and size of holdings; Land access/ownership/tenure and use; Demographic characteristics of the holder and his/her household; Use of agricultural labour; Access and use of implements and farm machinery etc.; Irrigation; Agricultural credit/loans; Agricultural buildings/storage facilities; Mode of transportation; Sources of agricultural information and, Access to facilities for example electricity, roads, markets, inputs among others.

DATA ANALYSIS

The individual characteristics of the maize farmers were analyzed using measures of central tendency and dispersion organized in a table such as mean, standard deviation and frequencies. The variables included age, literacy, access to credit, access to extension services, and access to markets, family labour, hired labour, fertilizers, farmer membership and marital status. This understand the relationship between access to credit, access to extension, access to market and maize productivity, pearson correlation analysis was conducted. The study also employed a multiple linear regression model to ascertain the influence of independent variables on the dependent variable. Diagnostic tests were carried out to check for heteroscedasticity, normality of variables and multicollinearity (Greene, 1993).

RESEARCH FINDINGS

Descriptive Analysis

Table 1 below presents the descriptive results of the production variables. On average, the farmers had received at least one (1) visit from the extension service officers. The disparity in the number of extension visits is two (2). This implies that fewer visits could affect the farmers maize productivity, given that it is too low and yet farmers need the extension services.

A maize farmer was on average 46 years and the disparity in the farmers' age was 16 years. The youngest farmer was 12 years and the oldest was 99 years. This shows that farmers are above the youthful age which could make them concentrate on their farms.

It is clear in the Table 1 that a higher proportion of the farmers were illiterate that is, they cannot read and write (0.3). This could lead to a reduction of maize productivity, since some farming practices require a farmer to read and write especially on recording the inputs used. On average, maize farmers access credit of 124,164 Uganda shillings. This is low and could negatively affect their maize productivity, since they need more credit to purchase inputs such as seedlings, hoes, tractors among others.

The average distance to the local market is about 5 kilometres. The disparity in the market access is about 14kms. This is quite far away from the farmers and therefore farmers may not be able to sell their produce. This in turn could lead to a reduction in their maize productivity.

On average, 2 individuals were used as family labour and average of 7 individuals were used as hired labour on the maize farm. Since on average, more labour used is hired than family labour, then this could lead to more maize productivity, given the laziness of most family labour on the farms.

A higher proportion of the maize farmers did not use fertilizers (0.3). This could affect negatively their maize productivity since fertilizers tend to generally increase productivity on the farm.

Furthermore, a higher proportion of the maize farmers did not have membership to a farmer organization. This limits their access to agricultural services like extension, credit and markets among others, which in turn reduces their maize productivity.

Also, on average a maize farmer produces about 0.9 metric tons per hectare. This is too low, given the amount of arable land available in Uganda. However, this could partly be due to inaccessibility of agricultural services like credit, extension and markets among others.

Table 1: Distribution of Maize Farmers' characteristics

Variable	Obs	Mean	Std. Dev.	Min	Max
Age (Years)	29897	45.78182	16.25202	12	99
Literacy (Yes=1)	29897	0.294946	0.4560261	0	1
Loan amount received	29896	124164	0.3297738	0	26.132,100
Access to extension (Number of visits)	29897	0.7728535	2.218576	0	60
Access to markets (Distance to the local market, Kms)	29897	5.337319	13.91947	0.001	500
Family labour (Individuals)	29897	1.906646	0.9841609	0	14
Hired labour (Individuals)	29897	6.773456	29.37577	0	960
Fertilizers (Yes=1)	29897	0.3097301	0.46239	0	1
Farmer membership (Yes=1)	29897	0.1540957	0.3610465	0	1
Yield (Metric tons per hectare)	29897	0.8768817	1.675912	0.007	7.90

Source: *Author's calculations based on UCA 2008/2009*

Furthermore, ascertain the correlation structure between study maize productivity and access to credit, extension and markets, Pearson correlation analysis was used. The results are presented in Table 2 below. Maize productivity and access to credit have a very low but significant positive correlation (0.0363). It indicates that when access to credit increases (decreases), it leads to an increase (decrease) in maize productivity. There is also a very low positive correlation between maize productivity and access to extension (0.0186) and this correlation is highly significant at 5%. It indicates that when access to extension increases (decreases), it leads to an increase (decrease) in maize productivity. There is a negative correlation between maize productivity and access to markets (-0.0333) and this correlation is

highly significant at 5%. It implies that when access to markets increases (decreases), it leads to a decrease (increase) in maize productivity.

A significant positive correlation between access to extension and access to markets (0.1566) was also observed. This means that when access to extension increases (decreases), and then also access to markets increases (decreases). Access to markets and access to credit revealed a significant low positive correlation (0.0278).Nonetheless, access to markets and access to extension also revealed a low positive significant correlation (0.0021).

Table 2: Pearson Correlation Analysis Results

	Access to credit	Access to extension	Access to markets	Maize productivity
Access to credit	1			
	0.1566*			
Access to extension	0.000	1		
	0.0278*	0.0021		
Access to markets	0.000	0.239	1	
	0.0363*	0.0186*	-0.0333*	
Maize productivity	0.000	0.000	0.000	1

*Correlation coefficient is significant at $p < 0.05$**

Diagnostic Tests

Testing for Heteroscedasticity

The study used the Breusch-pagan test and found out that the chi-square = 23.09 and this was significant at 5% level (p = 0.0000), thus implying that there was heteroscedasticity. Since heteroscedasticity was detected, OLS with robust standard errors were run.

Testing for Normality

The use of irregularly distributed variables, variables which may not be normally distributed in a regression analysis may result into inefficient estimates (Greene, 1993). Hence, normality of the variables was tested using the normality distribution graph procedure, the histogram. Variables that were found not to be normally distributed were normalised by transforming the values into natural logarithm.

Testing for Multicollinearity

A pair-wise correlation was run to establish the existence of multicollinearity in the model. The results showed that the independent variables were not highly correlated therefore there was no threat to multicolinearity.

Multivariate Analysis

The multiple linear regression results are presented in Table 3 where the dependent variable is maize productivity. The regression model was estimated was to establish the influence of access to credit, extension and markets on maize productivity. Overall the model fits data well given that the F-statistics is statistically different from zero. The R-squared of 0.68 shows that access to credit; access to extension and access to markets explain 68% of the variation in maize productivity. Individually, other factors being constant, access to credit significantly increase maize productivity by 0.07 for a unit increase in the amount of loan received by the farmer. The result is consistent with previous studies (Kiplimo, 2013; Mulinga, 2013; Kamau & Otieno, 2013) who have found out that access to credit services leads to increase in maize production. Simtowe *et al* (2009) study in Malawi showed that when credit-constrained maize farmers received credit, they tended to increase the cultivation of hybrid maize which is more productive.

The results further showed that access to extension services significantly increase maize productivity. This is in line with (Bindlish & Evenson, 1993; Yilma & Berg, 2000; Nambiro et al, 2010; Adegboye et al, 2013; Mulinga (2013); Urassa, 2015) who asserted that extension services had positive effects on maize production. However, although the coefficient for access to markets was statistically significant, the negative sign implies that further from the local market reduces maize productivity other factors being constant. The result supports the argument made by Maziku (2015) that the further the farmer is away from the market reduces farmers' market participation. This implies that smallholder farmers' market participation increases with the reduction in the distance to the market. Likewise, Siziba et al (2011) also found a negative and significant effect of the distance to markets to agricultural production and argue that this underscores the adverse impact of increased transportation cost on market participation.

Table 3: Multiple Linear Regression Results

In Maize productivity (Yield)	Robust Coefficients	Standard Errors	t-value	P-value
In Access to credit (Loan amount received)	0.0675525	0.0278759	6.73	0.000
In Access to extension (Number of visits)	0.0017866	0.0043977	0.41	0.685
In Access to markets (Distance to the local market, Kms)	-0.0041388	0.0007089	-5.84	0.000
Constant	0.8794538	0.0114587	-76.75	0.000
Number of obs = 29896				
F(3, 29892) = 26.26				
Prob > F = 0.0000				
R-squared = 0.68				

CONCLUSIONS AND RECOMMENDATIONS

Agricultural services such as access to credit services, access to extension services and access to markets reflects the ability of a maize farmer to generate higher productivity. Higher productivity by the farmer has strong implications for economic growth of Uganda. This paper attempted to determine the impact of access to agricultural services on maize productivity in Uganda. The results indicate access to credit services significantly increases in maize productivity. This suggests the need by government to strengthen measures to increase farmer's accessibility to credit through farmer groups, Village Savings Loan Schemes (VSLS) and farmer banks. Access to extension services was also found to increase maize productivity significantly. This result points to the traditional role of agriculture extension in improving productivity. Therefore, supporting the provision of agricultural extension services to small holder maize farmers is one way to achieve higher farm productivity of maize farmers. Access to markets was also found to influence maize productivity significantly such that farmers far way from markets are associated with reduce productivity. This implies that access to market works as stimuli to farm productivity. Therefore, government should provide market infrastructure nearer to the farmers to allow them to market participate and improve productivity.

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