

# **RELATIONSHIP BETWEEN FARM PRODUCTION CAPACITY AND AGRICULTURAL CREDIT ACCESS FROM COMMERCIAL BANKS**

**Grace Kariuki Njogu**

School of Human Resource Development, Entrepreneurship and Procurement Department, Jomo Kenyatta University of Agriculture and Technology, Kenya

**Dr. Tobias Olweny**

Jomo Kenyatta University of Agriculture and Technology, Kenya

**Dr. Agnes Njeru**

Jomo Kenyatta University of Agriculture and Technology, Kenya

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## **ABSTRACT**

In Kenya and across the globe, the proportion of commercial bank's loans the agricultural sector relative to other sectors is generally low. This is despite the considerable financial intermediation opportunities resulting from a low agriculture orientation index by most governments to the sector. This study aimed at investigating the influence of a borrower's production capacity on access to commercial bank credit. The target population were 21, 576 dairy farmers registered with the livestock production unit in Murang'a County, Kenya. A double hurdle approach

was used for inferential analysis. Findings revealed that a borrower's production capacity had a significant positive influence on credit access. To enhance the proportion of commercial bank's credit to the agricultural sector, the study recommends that a deliberate dissemination of information about the usability of production resources in credit processes, including the legal provisions on alternative collaterals, and insurance contracts in credit processes.

*Key Words: credit, access, production capacity, double-hurdle*

## **INTRODUCTION**

The second sustainable development goal (SDG) affirms the need for a holistic approach and purposeful investment targeting improvement of agricultural productivity, capacity, and incomes due to the increasing world population and the current urbanization trends. While the trends offer bright prospects for creating jobs and enhancing income in the sector, there is need for sustainable financial services to support the agricultural sector. Agricultural Orientation Index (AOI) statistics shows that governments' investments in the sector across the globe are consistently low. The average global AOI show a declining trend from 0.38 in 2001, to 0.24 in 2013, and 0.21 in 2015 (United Nations, 2015), while the national expenditure to the sector in Kenya ranged between 3.2% to 4.9% between 2003 and 2010 (AGRA, 2013). This necessitates financial intermediation efforts to supplement the governments' investment in the sector.

Banks play a critical role in financial intermediation process, by mobilizing savings and reallocating resources from less productive to more productive use. Credit is widely recognized as an effective intermediating avenue necessary for a greater adoption of modern technologies, enhanced production efficiencies, and subsequent increase in farm incomes (Akpan, Inimfon, Udoka, Offiong, & Okon, 2013; Christen & Anderson, 2013). Data show that commercial banks' involvement in lending to the agricultural sector is consistently low across the globe. During the period 1991 to 2013, the proportion of global credit to agriculture stood on average 10.01% in Africa, and agricultural loans by banks usually represent less than 5–10 per cent of their total portfolios (FAO, 2015), and is mainly limited to large farms, and plantations. Only a few banks such as Equity Bank in Kenya and Syed General Bank of Senegal have been dynamic enough to downscale loans to non-traditional markets such as the farming households (Meyer, 2015).

Commercial banks have the greatest potential to serve rural clients. Besides being government regulated, and therefore representing the lowest risk for rural clients, they have branches that tap rural markets and can effectively diversify risks geographically. In addition, banks have resources to invest in products; and staff to serve different market segments (Nahr, 2014). Yet, bankers cannot demonstrate a commitment to finance agriculture until they are convinced of a way forward for achieving growth and a profitable business model in agriculture (Global Partnership for Financial Inclusion [GPFII], 2015). This is to enable them to deal with a combination of factors such as fluctuating input and output prices, and demand-side factors such as contract enforcement difficulties that negatively affect the behaviour of market participants in credit repayment (Akpan et al, 2013). Although the final decision to extend credit principally rests with the lenders who evaluate a loan request, banks depend on borrowers to create demand for the loan products. Recognizing that the clients are not homogeneous, the paper argues that a borrower's production capacity is an important factor for consideration in catalyzing sustainable interventions through products, processes, and policies necessary for improving the flow of private capital to agricultural clients, demonstrating to stakeholders that smallholder farming can be profitably financed by commercial banks and promoting financial inclusion and increasing commercial banks' lending volume to the agricultural sector.

## **THEORETICAL LITERATURE REVIEW**

The information asymmetry theory presents the way economists think about functioning of markets by acknowledging the existence of uneven information in markets. The theory, proposed by Akerlof (1970) affirm that traditional money lenders demonstrated discrimination in their lending activities, primarily based on personal knowledge of the borrower, and the ease of enforcing credit contracts in future. The theory argues that lenders fail to sign up for business, not because of a lack of viable financing opportunities, but to shield against economic cost of dishonesty due to uncertainties resulting from uneven information. The presence of uneven information necessitates signaling, where a lender needs to interpret a potential borrower's signal of their creditworthiness without the knowledge of the borrower (Spence, 1973). Conventionally, commercial banks have in the interpreted signals from borrowers in the agricultural sector as risky and basically un-creditworthy. However, as asserted by Stiglitz & Weiss (1981), parties to a contract are not homogeneous. There are many differences in the qualities of a subject that could be used to screen the applicants into categories that reflect specific capability, hence the need to identify borrowers who possess qualities likely to result in a productive credit contract.

The inherent information asymmetry justifies the need to seek information on either party to a financial contract (Jensen & Meckling, 1976). Ideally, a bank should stipulate all the actions that it would expect the borrower to undertake to ensure that the borrowers' behavior remain consistent with the objective of guaranteeing loan repayment and the bank's profit (Fletcher, 1995). However, where the lender is not able to verify facts presented by the potential borrower, they cushion themselves against potential losses by turning down a loan request and may opt to

lend to more secure applicants. Yet, the financial intermediary is almost always in a better position to collect relevant information about stakeholders, and can serve as an information sharing coalition (Diamond, 1984), who can mine information and monitor actions to guard the stakeholder's interests (Crawford, Pavanini, & Schivardi, 2013).

Repeated interactions between a borrower and the bank allows for accumulation of information, minimizing the borrower- lender information gap, which is critical in the credit decisions (Nott, 2003), and qualitatively reducing information asymmetries (Scholtens & Wensveen, 2010). By evaluating cross-sectional information and re-using information over time, parties in financial intermediation reduce the likelihood of occurrence of undesirable information asymmetry consequences (Gan & Wang, 2013; Degryse & Ongena, 2008). This expose private information and reveals actual capabilities, and helps to build trust and confidence between parties (Claus & Grimes, 2013) enhancing their chances of credit access.

Production in a broad sense refers to all economic activities undertaken by a producer, including combining various inputs, in order to achieve an output which has value, and which adds to the producer's utility. The production capacity can be described as a measure of output per unit of input, evaluated by analyzing the relationship between resources employed in production and the output returns (Elhiraika & Ahmed, 2008). The objective of measuring production capacity is to assess the maximum possible output from a given level of investment, in order to determine whether or not activities and processes undertaken generate real income growth that improve the competitiveness of producer operations (Baffoe, Matsuda, Masafumi & Akiyama, 2014). Credit access and production capacity affect each other in a symbiotic way. For constrained households, productivity is tightly linked to financial endowment (Boucher, Guirkingner & Trivelli, 2009). A producer who does not have financial resources lacks the means to invest in output enhancing production processes. This affects farm resource allocations, and results in low productivity (Sossou, Noma, & Yabi, 2014). Similarly, a producer who invests in output enhancements reports higher output, which translates in higher cash flows, a desirable characteristic for credit access (Boucher, Guirkingner & Trivelli, 2009). Therefore, although credit is desirable for credit constrained households to enhance productivity, a challenge arises because for a household to access credit, it must first possess productive assets which provide collateral for the lender to cushion them from losses in the event of loan default (Baffoe & Matsuda, 2015).

Producers increase their capacity by using existing assets and equipment more effectively, or by investing in more efficient production technologies (Tang, Guan, & Jin, 2010). Traditional and non-mechanized production requires more working capital to meet the hired- hand labour needs (FAO, 2011). Thus, producers keen to improve efficiencies in production align their methods and processes with practices that boost their output. These include investments that enhance output such as intensification of mechanization in production methods, the adoption of efficiency enhancing techniques such as labour saving technologies, and investment in value addition processes. This resultant impact technology adoption is on both the operating expenditure and

operating income, and affects the likelihood of both credit demand, as well as the credit access (Ajah, Eyo & Ofem, 2014).

In sub-Saharan Africa, there is a low adoption of innovations and mechanization, and borrowers have difficulty getting enough resources needed to finance their innovations (Burke, 2014). This is linked to poor to the fact that lenders limit the credit extended to firms engaged in innovation projects due to high information asymmetries and frictions, which make it difficult to appraise new technology (Piga & Atzeni, 2007). Yet, there is a need to integrate innovation support with financial service provision because mechanization and modern technology can have tremendous impact on productivity and risk reduction (Binswanger & McCalla, 2010; FAO 2011). However, the overwhelming reason for low use credit to finance modern technology in agriculture is the lack of sound information which can be incorporated into institutional credit processes (Rahman & Zeba, 2011). Since production enhancement increases the returns on investment, then production capacity can be a premise for arguing a business case with a rational financier.

Whereas households with more assets may be in a better position to meet collateral requirements needed to take up loans, some may not be willing to pledge them as collaterals in loan application (Awunyo et al, 2014). Still, others lack the knowledge that some of the resources in their possession are provided for in law as tangible assets that can be used as collateral against bank credit (Sebu, 2013). The producers therefore fail to display desirable behavior, necessary to make decisions that would ultimately improve their financial wellbeing (Atkinson & Messy, 2012). This is reflective of lack of understanding of the correlation between financial literacy concepts such as risk management, and the individual's financial status.

## **EMPIRICAL REVIEW**

Various studies that have examined the relationship between assets used in production, and loan demand and subsequent credit access. Olagunju & Ajiboye (2010) found land size was a major criterion for accessing loans in Nigeria where loan applicants with very small farm sizes did not access loans from banks. This collaborate findings by Abu, Domanban, & Issahaku (2017), who found that small scale enterprises often either lack collateral or possess collateral of low quality which exacerbates their recovery difficulties, hampering their credit access. Sebu (2013) found that in Malawi, the larger the household land size, the less like the need for external financing as large farm size corresponded with well to do families. Olwande and Mathenge (2012) found that a low access to credit limit the ability to access inputs to improve the output of production, while Sebu (2013) found that the higher the asset value, the less likely a household was to require credit. Njuguna & Nyairo(2015) found that in Kenya, collateral requirements affect access with 45% of applicants failing to access credit due the inability to raise the required collateral.

Betubiza & Leatham (1995) found a 1.7% correlation between attraction of investable funds from commercial banks, and the value of farm machinery in use, concluding that mechanization was not statistically significant in the credit allocation decision. Elhiraika & Ahmed (2008)

found the mechanized subsector in Sudan was associated with farm business tendencies, and better organization as the mechanized farm owners were more organized and usually more educated, resulting in a better access to modern banking services including credit. Nuryartono, Zeller and Schwarze (2005) found that the additional loans from the formal credit markets were used to finance adoption of new technologies which increased productivity and income. Similarly, Adeleke, Kamara, & Brixiova (2010), found investment potentials exist for smallholder producers support services such as establishing farm machinery and equipment plants. Rahman & Zeba (2011) found the need for credit arise because modern technology meant to enhance production was costly and producer's personal resources were inadequate, hence firms adopting modern technology were more likely to seek external financing. Individuals in need of external financing must signal their capacity and sustainability of the ventures to which the funds are to be employed. However, the extent of credit demand is based on the evaluation of its benefits by the borrowers themselves (Atkinson & Messy, 2012).

## **RESEARCH METHODOLOGY**

The study targeted 21,576 dairy farmers in who could potentially create demand for commercial banks' loan products appropriate for dairy sector clients. The accessible population was 21,576 farmers who sold their output through thirty five dairy cooperative societies in Murang'a County. The study adopted the Cochran formula to generate the sample of 384 respondents as the population was large and variability proportion was not known (Cochran, 1977).

$$n = Z^2pq/e^2 \quad (\text{Cochran, 1977})$$

Random sampling technique was used to select the borrowers' sample, and questionnaires used to obtain primary information using a cross-sectional survey strategy from the representative individuals sampled from the population.

### **Empirical model**

The double-hurdle model was used in the study. The model, originally formulated by Cragg (1971) is a maximum likelihood estimator which assumes two separate hurdles must be passed in order to report non- zero consumption. The first hurdle was an evaluation of the likelihood for involvement in commercial bank credit (participation decision). This was estimated using the ordinary Probit model. The second hurdle was an estimation of the loan amount sought (consumption decision) estimated using truncated Tobit model. The Tobit model used censored data where observations with zero credit values were systematically excluded from the sample to allow for a scrutiny of the relationship between production capacity and the dependent variable. The bivariate model was represented as the participation ( $P^*$ ) and consumption ( $Y^*$ ) models respectively;

$$Pi^* = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + U_j; \quad Pi^* = \{1\} \text{ if } Pi^* > 0; \text{ and } 0 \text{ if } Pi^* \leq 0 \text{ and};$$



$$Y^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon_j$$

Where :  $P^*i$  = Latent discrete participation choice variable;  $Y^*i$  = Observed amount of credit borrowed from a commercial bank;  $X_{i(i=1-3)}$  = Vector of explanatory variables;  $\alpha_i$  &  $\beta_i$  = Vector of parameters;  $U_i$  &  $\epsilon_i$  = Standard error terms, normally,  $U_i \sim (0,1)$  and  $\epsilon_j \sim 0. var$

A positive level of commercial bank credit access  $Y^*$  was observed only if there is participation ( $P^* = 1$ ) and actual use of commercial bank credit; ( $y > 0$ ) . A geometric mean composite index ( $\prod x_i^{1/n}$ ) was used to consolidate the scores of the significant constructs of the first hurdle, for the estimation of the second hurdle parameters.

The model assumes a stochastic structure, meaning that it has a random probability distribution or pattern that may not be predicted precisely. Thus, the error terms,  $U_i$  and  $\epsilon_j$  are assumed to have a bivariate normal distribution as  $U_i \sim N(0,1)$  ; and  $\epsilon \sim N(0, \delta^2)$ ; and independent, such that the correlation coefficient,  $\square\square\square\square$ . For this assumption to hold, data was checked for any violation of the typical statistical assumptions in order to obtain unbiased, efficient, and consistent parameter estimates. These included goodness of fit test, assumptions of bivariate normality, homoscedasticity and independence of error terms across participation and consumption equations. Data was reduced into summaries that could be interpreted using descriptive statistics and subsequently scrutinized in inferential analysis and hypothesis testing.

## **RESULTS AND DISCUSSIONS AND DISCUSSIONS**

### **Response and Demographics**

Of the 384 questionnaires issued, 316 questionnaires were returned comprising 80.29% response rate, of which 71.2% of the respondent farmers' were male while 28.8% were female. Respondent's age was measured as a continuous variable and was grouped into four sub-categories as; less than 30 years, 30 - less than 50 years, 50 - less than 70 years, 70 years and above. Findings indicated that only 10.1% of the respondents were less than 30 years of age. The sector was dominated by persons in the age bracket of between 30 - less than 50 years who constituted almost half of the respondents (48.7%). The 50 - less than 70 years age bracket comprised 32.6%, while 8.6% were aged 70 years and above. Age is a proxy for maturity (Awunyo et al, 2014) and results showed that most respondents were within the active working age group; hence could assume the rigours associated with the agricultural sector (Erasto, 2014). 93.7% of the respondents had a formal education, while only 6.3% did not have any formal education. Among those with formal education, 8.1% and 21.6% had a primary and secondary school certificate as the highest education qualification respectively. 44.3% had either a diploma or a certificate education; 23.9% had a bachelor's degree, while 2.7% had post graduate qualifications. High literacy levels supported the research as most of the respondents understood the context of the questions with ease (Rahji & Fakayode, 2009).

The duration of time a respondent was registered with a cooperative society provided a proxy for assessing experience. Findings indicated that 53.5% of respondents had over 3 years' experience, while 34.2 % had between 1-3 years of dairy farming experience. 8.5% of the respondents had between 6 months and one year, while only 3.8% had not attained the minimum 6 months. Farming experience influence the credit decision because for one to qualify for an agricultural credit facility, they must have evidence of milk supply of at least six months (Muema, 2015).

The production capacity was assessed by evaluating output level against assets employed in production. Output in production is a signal for venture sustainability, and a pointer to good business management (Gorton & Winton, 2002). Since the absolute output and assets measures for respondents were not identical, proportions were calculated from the data to provide relative and comparable measures as: Productive Assets; Collateral Value; and Value-adding technology value to Output respectively. The average output was 4.38 litres per day which translated to a monthly average output of 131.4 litres per month, while the value of total investment in dairy animals revealed a high disparity with investment values ranging between a minimum of Sh20,000 and a maximum of Sh1.9 million. However, only 89 respondents (28.2%) could validate the worth of their livestock from formal sources such as insurance companies within one year prior to the date of the research. The rest relied on subjective indicators such as purchase value to approximate the current value. Further, only 6 out of the 316 respondents (1.9%) had a Kenya stud book registration certificate which was a prerequisite to secure financing relating to movable assets. 187 respondents (59.2%) had no information regarding the formal registration of dairy animals, while 286 respondents comprising 90.5% did not know that livestock was included in law as a tangible assets that could be used as collateral in the Kenya movable property security act (2017). The findings suggested that respondents were not adequately exposed to provisions in the legal and regulatory environment that could enhance formal credit access. On land ownership, the study revealed that the land units held by respondents were highly subdivided at an average of 1.7 acres per household, which was way below the national average of 2.3 acres (AGRA, 2013). Land adjudication was highly formalized with 60.8% of the respondents having title deeds to their land, while 31.3% had joint use of the family land. The remaining respondents had lease/ tenancy arrangements (5.7%) while the rest (3.2%) had informal occupancy arrangements. Land ownership is a widely used criterion by lenders in scoring and loan applicants without land are hardly able to raise lender's collateral requirement (Olagunju & Ajiboye, 2010).

Respondents had other assets with collateral value and valid ownership documents. These included vehicles (12%), assortment of farm machinery (7%), and financial assets (1.2%). Although ownership of tangible assets provides alternative income source as they can be disposed to meet urgent needs, and therefore may reduce the demand for credit (Erasto, 2014), Meyer (2015) asserts that the ownership of assets with collateral value enhances success in credit application as lenders use collateral value in credit scoring. This is because lack of, or possession of low quality collateral exacerbates lender's loan recovery efforts and hamper credit access for



most small scale enterprises (Abu, Domanban, & Issahaku, 2017). The study revealed a low investment in value adding technologies, modern mechanization, and innovative technologies in dairy farming. 22.2% had invested in some basic labour saving technologies including chaff-cutters, and milking equipment. Among those who had investment in innovations and mechanization, 27.1% had financed their acquisition using a loan from a commercial bank. However, this was largely amongst large scale investors who invested in high breed livestock engaged in value addition through milk processing. The use of modern farm technologies, value addition, and mechanization of processes increases yields, and in turn, household income and ability for loan repayment (Binswanger & McCalla, 2010).

### **Credit Access Indicators**

Distance to nearest commercial bank was used to assess proximity to commercial banks. Cumulatively, 62.7% of respondents could access a commercial bank branch within a radius of less than 20 kilometres, while 98.1% within a 30 kilometers radius, while only 1.9 % had to travel for more than 30 kilometres to access a bank branch. Agency banking outlets improved the ease of access. Overall, 80% of the respondents had access an agency banking outlet within a 10 kilometre radius. In response to whether respondents had ever sought commercial bank credit, 71.5% answered in the affirmative, while 28.5% had never sought. An analysis of the credit patterns revealed that 31.4% applied but were unsuccessful, while 42% were a one- time customers who successfully accessed the initial loan but did not request subsequent loans. The other 59 respondents had serviced more than one bank loan over the recall period.

A comparison of credit amounts required /applied for against amounts of credit received showed that commercial banks were meeting only a small proportion of the user needs. The proportions of financing required (83.2% Asset financing; 58 % working capital; 34.1% Development financing) underscored the financing gap of the sector. The average access rate was 24.51% for asset financing credit needs, while that of working capital and capital development was 32.1% and 10.02% respectively. The study sought to establish if respondents would have desired a higher loan than the amounts applied for at the same credit terms. 63.8% of the respondents' answered in the affirmative, implying that the amounts applied for was less than the actual credit constraints. The findings were consistent with assertions by Nahr (2014) that commercial banks were not adequately meeting financing needs despite the vast financing deficit in the sector.

### **INFERENCE ANALYSIS**

A graphical approach was first used by plotting Q-Q graphs to assess plausibility of normality in all data (Tingley, et al, 2014) . Q-Q plot of the dependent variable revealed visual deviations from the diagonal line, which necessitated the quantification of deviations to investigate if data came from a normally distributed population. Shapiro-Wilk's W test, which is recommended for small and medium samples ( $n < 2000$ ) was done (Garson, 2012). The resultant P-value for the selected significance level confirmed that data was normally distributed (Tingley et al, 2014).

To facilitate hypothesis testing, it was essential to ensure non-violations of the basic assumptions of the two models in the double- hurdle approach before attempting to estimate the regression equations. Goodness of fit tests for each model was performed. The measurement models were assessed for goodness of fit using the maximum likelihood estimator. Parameters were obtained by maximization of the log likelihood function (Christian, 2010). The log likelihood was negative, and likelihood ratio chi squares at three degrees of freedom (LR chi2 (3)) were positive, indicating that the fitted models’ predictor coefficients were not simultaneously zero.

**Table 1: Goodness of Fit test results**

Probit Model				
No. of obs	LR chi 2	Prob> Chi 2	Pseudo R2	Log likelihood
316	14.24	0.0001	0.3317	-13.14367
Tobit Model				
	Number of obs	Wald chi2(4)	Prob> chi2	
Production Capacity	201	11.94	0.0035	
Statistic: Value	Limit [0 , +Inf]			

In the truncated Tobit model, Credit access was left censored to exclude zero - credit responses. The model was designed to assume a value of one (1) where a loan facility had been used, and Zero (0). The model was estimated using maximum likelihood estimation. Based on the p-values (Prob> chi2), the study rejected the null hypothesis that the regression coefficients were simultaneously equal to zero 5% per cent level of significance. Thus, all the variables in the second model were a good fit at a 95% confidence interval. The error terms in each of the models in the double hurdle model are assumed to be uncorrelated. Adopting Cragg (1971) methodology, the study investigated the two error terms. Under the null hypothesis of no correlation, the results showed standardized coefficients therefore the study concluded that the error terms of the two separate stochastic were independent and normally distributed.

**Table 2: Relationship between 1st Hurdle and 2nd Hurdle error terms**

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	T	P-value
(Constant)	-874.36	642.63	.328	-1.361	.185
Error1	1078.81	679.03	.292	1.589	.124

a. Dependent Variable: error 2

Results from the Probit regression show that output was significant in determining the likelihood to seek commercial bank credit ( p-value = 0.0144) This affirmed the assertion by Gorton & Winton (2002) who posit that output of production is a signal for sustainability of a business and good management practices. Comparable ratios were used to provide relative measures for expressing the relationship between output and other resources employed for the assessment of the influence of a borrower’s productive capacity on the likelihood credit access. The P-values

corresponding to all the proportions were significant (Table 2), indicating that an increase in each of the measures enhanced the borrower’s likelihood to seek bank credit.

The analysis of marginal effects of changes show that 13.27% of the likelihood of accessing commercial bank credit was attributed to the total assets employed in production, while 23.65% was attributed to collateral value. The study found 344% in the likelihood to seek bank credit was attributed to a unit increase in the proportion between output level and the mechanization value at a 95% confidence level. Fatoki & Odeyemi (2010) assert that investment in productive assets and especially the availability of collateral impact on access to debt finance. This is because firms with tangible assets have higher financial leverage as collaterals resolve problems derived from information asymmetries and uncertainty about quality of projects and the riskiness of collaterals (Fatoki & Odeyemi, 2010).

The marginal effect of output to collateral, and that of output to value adding technologies were significant at 95% confidence interval (p- value<0.05) Investments in modern technologies showed a greater influence on the likelihood for participation (marginal change = 344%) compared to the availability of collaterals (23.67%). This affirmed the argument that investing in value addition enhances the need for external financing of the employed technologies. Burke (2014) assert that enhancement of the production efficiency through modern techniques is a viable premise for arguing a business case with a rational financier as it enhances returns on investment, and generates additional income. This is because formal credit markets are increasingly offering products supporting adoption of productivity enhancing technologies (Nuryartono, Zeller and Schwarze, 2005). The findings were consistent with Elhiraika & Ahmed (2008) who found the mechanized subsector in Sudan was associated with better farm organization and business tendencies, resulting in a better access to modern banking services including credit.

**Table 3: Productive Capacity Probit model regression results**

CreditAP	Probit Model				Marginal effects			
	Coef.	Std. Err.	Z	P>z	Dy/dx	Std. Err.	Z	P>z
Output	0.024313	0.009896	2.46	0.0144				
Asset/oup	1.175623**	0.46435	2.53	0.011	0.6950517 <sup>ns</sup>	0.3590243	1.93	0.054
Colla/oup	0.709505**	0.359024	1.98	0.049	0.23647**	0.087433	2.71	0.0071
Vatec/oup	0.354734**	0.135747	2.61	0.009	3.4466**	1.548458	2.23	0.0265
_Cons	-6.45232	3.242487	-1.99	0.047	-6.22152	1.211642	-5.13	0.0000

\*\* Significant parameter, P<0.05

A composite index summarizing the multi-dimensional phenomena of the first hurdle indicators was constructed from the first hurdle. The study used the significant measures and retained variables whose Z value was greater than the Z-critical of 1.96 in the analysis.

The study hypothesis was stated as: **Borrower's production capacity has no significant influence on access to commercial bank credit in Kenya.**

To test the hypothesis, the truncated Tobit regression which was left censored was carried out. The model utilized data with credit access ( $Cr > 0$ ). The Z-score statistic was used to determine whether there was a relationship between the variables. Findings indicated that production capacity had a positive coefficient (2.314025), which is significantly different from 0, and the p value (0.000) is less than 0.05 level of significance at the 95% confidence interval, the study rejected the null hypothesis and accepted the alternative hypothesis, concluding that a borrower's production capacity (PC) has a significant influence on credit access from commercial bank.

**Table 4: Production capacity Truncated Tobit model regression results**

CreditAP	Coef.	Std. Err.	Z	P>z
Productive_capacity	2.314025	0.529978	4.36	0.000
_cons	-3.006191	0.906107	-3.32	0.001
Wald Chi2(1)	11.94			
Log likelihood	-31.825			
Pseudo R2	0.3317			

The relationship between a borrower's production capacity and credit access from a commercial bank was therefore depicted as:

$$\text{Credit access} = -3.006191 + 2.314025\text{PC} + \epsilon$$

The findings affirms the interdependence of credit access and production capacity, where availability of additional financial resources resulted in investment in output enhancing technologies and processes, which is led to high output and improved in cash flows. Conversely, a financially constrained producer could not afford to enhance the productivity of their livestock. In addition, the dependence of land as collateral disadvantaged the farmers as land was highly subdivided. Further, though all respondents owned livestock, most lacked information on available avenues of utilizing livestock to access finance.

## **CONCLUSIONS AND RECOMMENDATIONS**

The study concluded that the proportion of output to assets with collateral value influenced credit access, and arrived at three main observations. First, the study noted that credit access was low and attributed this to reduced collateral value from land, which was highly acknowledged as the primary security. The study also found that though all respondents owned livestock, there was a general lack of information regarding the formal registration and insurance of dairy animals, or the legal provision on possible use of formally registered livestock as collateral for credit in Kenya. Finally, findings revealed that there was an unmet financing need of financing investment in value adding technologies. With the findings, the study recommends for deliberate

dissemination of information on legal provisions and industry requirements on alternative collaterals for credit such as movable assets. The study also advocates that stakeholders should support the farmers to align their investments with production efficiency. Specifically, banks should develop credit products with repayment models that support investment in value adding technologies, and value addition across the value chain as this provides a rational business case that can benefit both the borrower and the lender given the mutual dependence of productivity and credit access.

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