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# **Farmers' Perception and Access to Mechanization in Maize Production in Kamwenge District, Western Uganda**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

Farm mechanization has been an important aspect in bringing out a significant improvement in agricultural productivity. In Uganda, mechanization acts as a backbone of the present agricultural systems across the country. Despite its recognized role towards agriculture, farmers still perceive its use and need differently mainly in terms of hire costs, traditional culture, size and topography of land, availability and social status. The study was examining farmers' perceptions towards mechanization in maize production in Kanara sub-county in Kamwenge district. The objectives were to: determine farmers' perceptions on the usefulness of mechanization on maize production, determine the relationship between socio-economic characteristics and farmers' perception of mechanization, identify the factors limiting the use of agricultural mechanization among maize farmers, and to establish how best agricultural mechanization could be promoted for sustainable production.

The study employed a cross-sectional survey design engaging both qualitative and quantitative approaches for data collection and analysis. Information was gathered from 362 respondents using questionnaire and interviews. Data was analyzed using SPSS version 20 to generate both descriptive and inferential statistics. Farmers' perceived mechanization to perform more work than humans, reliable, time saving, and accessible and high work accomplishment rate. Farmer

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perceptions were influenced by socio-economic characteristics for example; age, land size, gender, income level/status, employment status, type of land owned and availability of labor. The study identified the challenges associated with the use of agricultural mechanization such as; less access to mechanization information significant at 5%, land ownership type at 0.03 (5%), household size 0.03 (5%), access to credit 0.04 (5%), years in maize farming at 0.05 (5%), availability and access to implements at 0.09, high costs of hire at 0.02 (1%), slope of the land at 0.07, and fuel costs at 0.00 (1%). These would be solved by extending credit services to the farmers, community capacity building, awareness creation, group formation, promoting mechanization as part of production, establishing contract farming schemes, increasing investment in agricultural mechanization, training and education and forming public–private partnerships. The study concluded that farmers had varying perceptions about agricultural mechanization which depended mainly on socio-economic factors. It recommended the need to promote rural-urban migration as this could create more land and encourage farmers to adopt mechanization since it may create more land reserve.

*Keywords: Farmers' perceptions; use; mechanization; maize production.*

## 1. INTRODUCTION

FAO defines mechanization as “the application of tools, implements and machinery in the way of achieving agricultural production” [1]. Essentially, agricultural mechanization is a representation of technological change through the adoption of non-human sources of power to undertake agricultural operations. Mechanization in agriculture is the process of using agricultural machinery mostly tractors, irrigation systems to simplify farming with the infrastructure and raising the incomes of farmers, especially those in rural areas [2].

In Sub-Saharan Africa (SSA), the need for sustainable agriculture intensification is all over recognized and appreciated. This is due to increasing population pressure on limited cultivable land in many parts of sub-Saharan Africa (SSA), farm size has been shrinking, fallow periods have been shortened, and soil fertility has been declining [3]. More emphasis has been placed on increasing the efficiency and production with which land, water and nutrients, however farm power appears to be a ‘forgotten resource’ [4]. Low farm mechanization has continuously resulted in high labor drudgery throughout the production cycle. Sustainable intensification of maize production systems required an increase in power supply mainly via improved access to mechanization [5]. Mechanized maize production is practiced in almost all the producing parts of Sub-Saharan Africa, but there is still a limited understanding of the economic, social, and institutional conditions underlying this trend. There has been a striking growth in the use of agricultural machinery in East Africa since the early 1990s [6]. In the

cereal-producing areas of East Africa, mechanization is commonplace within the local farming system, including in smallholder production systems.

In Uganda, maize is the staple food crop, as it is estimated that 1.6 million hectares are under maize production. More than 70% of Uganda’s maize is grown by farmers owning less than 3 acres of land (Mado, 2010). Despite a huge contribution of the crop towards food and income security, producing areas across the country still experience production inefficiencies due to labor shortage resulting from continued dependence on human labor [7], (IFPRI, 2013). In a move to intensify production in maize sector, mechanization has been promoted to replace human labor [8]. The current state of mechanization in Uganda differs between the districts and social classes. While large and medium scale farmers in the country have switched to full mechanization, majority of smallholder farmers remain non-mechanized affecting their efficiency, production capacity and output levels, profits and food security.

Agricultural mechanization has not been fully successful with smallholder farmers due to others issues like (1) weak supportive infrastructure, (2) issues of incorporating four-wheel tractors with small-scale farming, (3) neglecting private sector engagement in ownership of implements (4) high costs of fuel and renting as well as (5) no awareness and limited access to machines. Therefore, improving infrastructure, increasing viability of small-scale mechanization, addressing fuel and rental costs, and engaging private sector offer opportunities

for renewed and innovative farming mechanization initiatives [9].

Kamwenge district is one of the major maize producing areas in Uganda [8]. However, the maize production is still managed through human labor which causes inefficiencies in production. Continuous use of human labor has made it difficult to achieve agricultural growth of 4% as envisaged in the country's Vision 2021. Among the factors limiting farmer's adoption to agricultural mechanization are attitude and perceptions which are mainly influenced by different socio-economic, cultural and traditional factors. Achieving productive and sustainable maize-based systems in the district requires best intervention in agricultural mechanization and changing the way farmers perceive it.

### 1.1 Research Problem

Maize is an important food and income security crop that supports livelihood of millions of small-scale farmers in Uganda. Production of maize has increased from 2.8 million MT (2015) to 4 million MT (2017) (MAAIF, 2019). The need to generate income by small holder farmers to sustain their families through covering some costs at household level like school fees for children, health services, and production for food has led to the region invest more in maize production as there is also high demand in the market in the nearby countries like South Sudan, Kenya and Rwanda (MAAIF-Performance-Report-2016-2017).

Therefore, the role of maize in food security in the country cannot be underestimated (FAO, 2015). Regardless of its economic importance in Uganda, the maize crop has not been produced consistently in its full potential to meet the food and industrial needs of the country. Maize production inefficiencies are largely attributed to different factors but mainly fragmented land, pest and diseases and over dependence on human labour which is always scarce and costly. Farm mechanization was introduced and promoted to increase on labor effectiveness. Kanara sub-county in Kamwenge is one of the areas where maize is produced in Uganda. As result of continuous rural-urban migration, the sub-county continues to experience labour shortage which has largely affected the maize sector (NAADS, 2016). In a move to address the issue of labour scarcity, government together with private investors introduced tractor hire services. Smallholder farmers are therefore expected to

utilize such mechanization services to boost production that has gradually declined. However, the adoption of farm mechanization in Kanara sub-county has remained low due to un-known factors [8].

Several studies conducted in other parts of Uganda like Masindi, Mbale, Mubende, Kasese and Kabarole districts have linked factors like attitude and perceptions to low adopt of farmer mechanization. However, despite the efforts made, many challenges still hinder agricultural mechanization. The majority of farmers have minimal access to information on the availability of affordable equipment, which can enable them improve on their outputs [10].

There was a general lack of literature to justify the situation in Kamwenge District as no study has been done in the area to assess the phenomena. The study was carried out to determine small scale farmer's perceptions and other factors that limit access to mechanization in maize production in Kamwenge District.

### 1.2 Study Objectives

The study was done to determine factors that influence farmers' perception towards mechanization on maize production in Kanara sub-county in Kamwenge district. The specific objectives were to; determine farmers' perceptions on the usefulness of mechanization in maize production, determine the relationship between socio-economic characteristics and farmers' perception on mechanization; identify the factors limiting the use of agricultural mechanization, and establish how best agricultural mechanization can be promoted for sustainable production.

### 1.3 Conceptual Framework

The conceptual framework is based on a systems model as prescribed by Ludwig von Bertalanfy (1970) which essentially describes the coming together of individuals, groups or systems operating together to achieve a common goal. In this case the intention is to analyze the factors that affect access of mechanization to farmers in Kamwenge District specifically Kanara Sub-county

The study looked at mechanization perceptions as the independent variable and maize production as the dependent variable. These two variables inter-dependent to improve maize

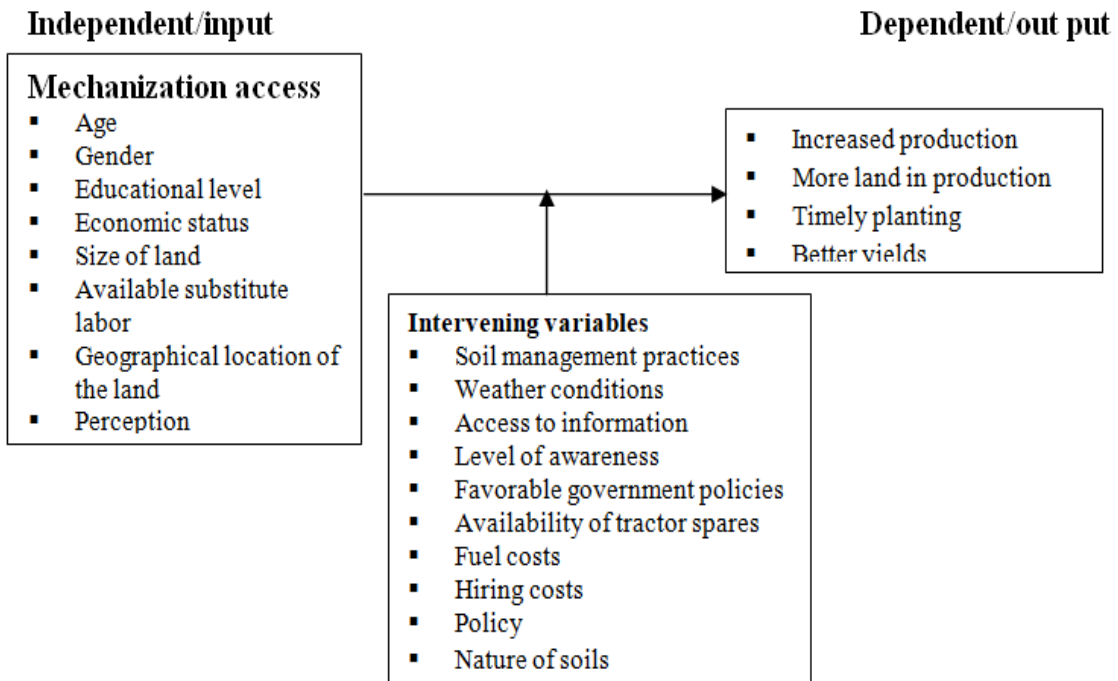
output. Farmer's perceptions towards mechanization were influenced by household characteristics like age, gender, educational level, economic status, size of land, labor, and geographical location, nature of farm soils and the ability to meet tractor hire costs. These characteristics influence farmer's perceptions either positively or negatively. Positive perceptions towards mechanization, mean farmers have to adopt the innovation which improves productivity in a long run (Jyoti and Tarunvir, 2008). Mechanization also ensures timely planting and harvesting which is key in minimizing post-harvest losses. However, adoption of mechanization itself cannot maximize production, farmers also need to implement proper soil management practices, get access to mechanization information, and regulated fuel costs as well as produce under supportive weather conditions.

**1.4 Theories that Underpin the Study**

The study adopted two theories that is innovation diffusion theory and Theory of Planned Behavior. Diffusion of innovation theory deals with "innovation – development process" which deals with six stages of need or problem, through

research (basic and applied), development, commercialization (recommendation) of innovation through dissemination and adoption of the innovation by the end users to its consequences (functional or un-functional) (Rogers, 2003).

Diffusion in this study examines how ideas are spread among groups of people. Diffusion goes beyond the two-step flow theory, centering on the conditions that increase or decrease the likelihood that an innovation, a new idea, or practice, were adopted by farmers of a given community. It is believed that people who adopt an innovation early have different characteristics than people who adopt an innovation later. When promoting an innovation to a target population, it is important to understand the characteristics of the target population that will help or hinder adoption of the innovation. There are five established adopter categories, and while the majority of the general population tends to fall in the middle categories, it is still necessary to understand the characteristics of the target population. When promoting an innovation, there are different strategies used to appeal to the different adopter categories.



**Fig. 1. Conceptual framework schema**  
 Source: (Research Data 2021)

- a) Innovators - These are people who want to be the first to try the innovation. They are venturesome and interested in new ideas. These people are very willing to take risks, and are often the first to develop new ideas. Very little, if anything, needs to be done to appeal to this population.
- b) Early Adopters - These are people who represent opinion leaders. They enjoy leadership roles, and embrace change opportunities. They are already aware of the need to change and so are very comfortable adopting new ideas. Strategies to appeal to this population include how-to manuals and information sheets on implementation. They do not need information to convince them to change.
- c) Early Majority - These people are rarely leaders, but they do adopt new ideas before the average person. That said, they typically need to see evidence that the innovation works before they are willing to adopt it. Strategies to appeal to this population include success stories and evidence of the innovation's effectiveness.
- d) Late Majority - These people are skeptical of change, and will only adopt an innovation after it has been tried by the majority. Strategies to appeal to this population include information on how many other people have tried the innovation and have adopted it successfully
- e) Laggards - These people are bound by tradition and very conservative. They are very skeptical of change and are the hardest group to bring on board. Strategies to appeal to this population include statistics, fear appeals, and pressure from people in the other adopter groups.

## 2. METHODOLOGY

The study was conducted in Kanara sub-county one of the major Maize producing sub counties in Kamwenge district. The area's economy is purely agriculture majorly maize with a few members of the community relying on SMEs like brick laying, shops and bars and stone quarrying for a living. Both crops and livestock are practiced at subsistence and commercial level for both food and income According to the population census (2012), there was estimated to have 33,000 residents. Maize production is ranked the most important agricultural crop in the area followed by banana (Twinamasiko, 2004). The growth of the

maize sector is stimulated by high demand of maize products due to the expanding population and improved incomes in the rural-urban settings. The area's major comparative advantage lies in the favorable production environment, the fertile soils and strategic geographical location within Uganda.

A cross sectional study design employing both quantitative and qualitative technique was used to gather and analyze responses from maize farmers and other key informants like extension workers and district agricultural officers. Qualitative data included types of soils, topography of the land and types of machines used or needed. The design helped in generating basic knowledge by clarifying issues and in-depth studying of farmer's perceptions towards mechanization in maize production. The quantitative approach enabled exactness and clarity in the measurement of the variables while the qualitative approach enabled extensive and deeper investigation into the phenomena. Data was gathered from 362 respondents using questionnaire and interviews. A sample of 362 maize growing farmers were selected randomly using single population proportion formula with 95% level of confidence and 5% margin of error. Following Kish and Leslie (1965) sample estimation formula, the sample was estimated as below;

$$n = Za/2pq / e^2$$

Where

n - Sample size  
 e - Degree of accuracy 0.05  
 p – Maize farmers 62%  
 q - non-maize farmers 38%  
 Z- 1.96 standard normal deviation  
 $\alpha$  = Level of significance (0.05)  
 $n = 1.962 \times 0.62 \times 0.38 / 0.05^2$   
 $= 3.8416 \times 0.62 \times 0.38 / 0.0025$   
 $= 0.9050 / 0.0025$   
 $n = 362$  respondents.

A multi-level sampling procedure was employed while conducting this study. The first level involved a purposive selection of two sub-counties from the district because they were major growers of maize with the biggest number in the district according to the guidance given by the extension workers who were first approached before meeting farmers. This was to critically get real and actual information for data collection. The second level involved a purposive selection of extension workers and district agricultural

officers. The third level involved a proportionate total random selection of 362 contact farmers from the study area. These constituted the sample for the study. A “Hat drawn” technique was used in selecting the individual sample. Key informants were purposively selected.

A semi-structured questionnaire for both closed ended and open-ended questions was designed and used to collect quantifiable responses from respondents. Questions were designed in English and later translated into local languages for respondents to read and respond in the languages they understood. Prior to data collection, the questionnaires were pre-tested on 2 respondents outside the target sub-county but in Kamwenge district. This helped in verifying the relevance and appropriateness of the instrument. This tool was checked for completeness, coded and entered into Microsoft Excel version 2013 and later imported to SPSS version 20.0 software for cleaning and analysis. Data was analyzed to generate descriptive and inferential statistics which aided in presentation and interpretation of findings. The results of the analysis were presented in statistical tables.

Multi-stages sampling technique was employed for this study. The first stage involved a purposive selection of two sub-counties from the district. The second stage involved a purposive selection of extension workers and district agricultural officers. The third stage involved a proportionate random selection of 362 contact farmers from the study area. These constituted the sample for the study.

### 3. RESULTS

According to the findings in Table 1, majority 55.5% of the respondents were male and 44.5% female. More than a half (60.8%) were married, 25.1% never married and 14% separated. Mean age of the respondents were 34 years with a

minimum of 15 and a maximum age of 71. Average years in school 9 with a minimum of 3 and a maximum of 16. An average household had 6 members with a smallest having 4 and biggest 10. Average land ownership were 12 acres with a minimum of 1 and maximum of 17 acres.

As shown in Table 2, 20.9% of the respondents mentioned maize shellers as the most used maize production implement in the area, 18.5% talked of sprayers, 14.9% tractors, 9.4% cultivators, 8% threshers, 6.9% boom Sprayers, 5.5% water carts, 3.3% ploughs, 2.5% Ox-drawn ploughs and 1.5% disk harrows. Majority (26.7%) of the respondents alleged that mechanization performed more work than humans, 22.9% revealed that it is more reliable, 21.5% alleged it had high work accomplishment rate, 12.4% time saving, 9.3% saves more of household and hired labor while 6.9% said they are more accessible.

The analysis in Table 3, indicate that different socio-economic characteristics had an influence on the way farmers perceive mechanization and these included; age, land size, gender, income status, employment status, type of land owned, availability of labor and religion. Odd ratios (OR) were used to interpret the relationship between characteristics and the dependent variable at 5% level of significance.

The analysis revealed that age had a significant influence on farmers’ perception on mechanization in Kanara sub-county. The reported odd ratio of (OR=1.006, 95% C.I [ .964, 1.049]) indicated that as age increased by one year, the chances of a community member adopting mechanization also increased by 1.006 and vice vasa. This implies that the more increase in year is likely to adopt mechanization in maize production due to accumulated experience.

**Table 1. Percentage distribution of respondents on demographic characteristics (n=362)**

Variable	Category	Frequency	Percentage
Gender	Male	161	44.5
	Female	201	55.5
Marital status	Never married	91	25.1
	Married	220	60.8
	Separated	51	14
	Minimum	Maximum	Mean ± SD
Age in years	15	71	34.61 ± 23.061
Years in school	3	16	9.21 ± 5.790
Household size	4	10	6.29 ± 3.581
Total land ownership	1	17	12.210 ± 5.170

**Table 1. Farmers’ perceptions on the usefulness of mechanization on maize production**

Variables	Response	Frequency	Percent
Implements used in maize production	Tractor	54	14.9
	Ox-drawn ploughs	09	2.5
	Cultivators	34	9.4
	Disk Harrows	6	1.5
	Boom Sprayers	25	6.9
	Water carts	20	5.5
	Sprayers	67	18.5
	Ploughs	12	3.3
	Maize shellers	76	20.9
	Threshers	29	8
Perceived benefits of using implements over human labor	Time saving	45	12.4
	High work accomplishment rate	78	21.5
	Perform more work than humans	97	26.7
	Saves more that household and hired labor	34	9.3
	More reliable	83	22.9
	They are accessible	25	6.9
	<b>Total</b>	<b>362</b>	<b>100.0</b>

**Table 2. Relationship between socio-economic characteristic and farmers’ perception on mechanization**

These findings were got by applying a logistic regression that helped in coming with these results as it is shown below.

$$\log\left(\frac{p}{1-p}\right) = \alpha + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_n$$

$$\log\left(\frac{p}{1-p}\right) = \alpha + b_1\text{Age} + b_2\text{Land size} + b_3\text{Gender} + b_4\text{Income status} + b_5\text{Employment status} + b_6\text{Type of land owned} + b_7\text{Availability of labor} + b_8\text{Religion} + b_n$$

Variable	Category	OR	95% C.I for O.R		Sig.
			Lower	Upper	
Age	Age in years	1.006	0.964	1.049	0.787
Land size	Land in acres	0.912	0.744	1.120	0.000
Gender	Male	1.402	0.482	4.079	0.536
	Female*	1			
Income status	Farm income	1.722	0.680	4.358	0.252
	Employment*	1			
Employment status	Employed	2.234	1.167	4.276	0.015
	Not employed*	1			
Type of land owned	Ownership	5.635	2.003	12.332	0.018
	Renting*	1			
Availability of labor	Available	1.261	0.662	2.402	0.480
	Not available *	1			
Religion	Christian	2.037	0.924	4.489	0.017
	Moslem*	1			

Study findings also revealed that gender had an influence on farmers’ perception on mechanization. The odd ratio (OR = 1.402, 95% C.I [0.482, 4.079]) for men implied that men were

1.402 times likely to perceive mechanization positively than women. This is because men own land and are heads of the family placing them in position to use any form of mechanization.

Land size had an influence on farmers' perception on mechanization. Big size land positively influenced agricultural mechanization and vice versa. In addition, farmers with big sized land can use it as security to access mechanical implements on credit because part of their land can give security to credit access.

The analysis revealed that income status had an influence on farmers' perception of agricultural mechanization. The reported odd ratio of (OR =1.722, 95% C.I [0.680, 4.358]) implied that farmers with more income were 1.7 times likely to welcome mechanization compared to farmers without an income.

Results established that employment status had a significant influence on farmers' perception of mechanization in Kanara sub-county. The odd ratio reported for employment status (OR =2.234, 95% C.I [1.167, 4.276]  $p=0.015$ ) implied that farmers who are employed had 2.2 chances of adopting mechanization than the un-employed. This is because farmers who are employed are in position to save more money to buy mechanization materials, pay for tractor hire costs, oxen and others.

Ownership of land influenced farmers' perception of agricultural mechanization in Kanara sub-county. The reported odd ratio of (OR =5.635, 95% C.I [2.003, 12.332]  $p=0.018$ ) was an indication that farmers who owned land were 5.6 times likely to adopt mechanization compared to those that rented the land. This is because farmers who own land do not incur much costs in renting or accessing land for agriculture, this increases their chances of using the available money to invest in farm mechanization than farmers that rent the land.

Labor availability significantly influenced the way farmer's perceived agricultural mechanization in Kanara sub-county. The odd ratio reported for labor (OR =1.261, 95% C.I [.662, 2.402]  $p=0.480$ ) revealed that farmers with access to labor were 1.2 times likely to positively perceive the influence mechanization than those without labor. This is because machines require human labor to operate, therefore there is no doubt that those with labor to operate the machines would positively perceive mechanization.

The analysis presented in Table 4 above discusses the factors limiting the use of agricultural mechanization among maize producing farmers.

From the analysis, the p-value (0.04\*) implied that access to mechanization information was a positive and a significant factor influencing the use of agricultural mechanization among maize producing farmers at 5 percent. This implied that as people continue to access information on mechanization would force them to adopt using mechanization for maize production.

Size of land was a positive and significant factor influencing farmer's use of agricultural mechanization. A coefficient of 0.64 significant at ( $p=0.00^{**}$ ) implied that farmers who had no access to large sizes of land had less chances of using agricultural mechanization and vice versa.

Land ownership type had a negative but significant at ( $p=0.03^{**}$ ) relationship with the use of agricultural mechanization for maize production. Those who owned land were more likely to apply mechanization than those who rented.

Slope of the land had an influence on farmer's use of agricultural mechanization among maize producing farmers as indicated by a positive perception and significant coefficient at 0.26 and a significant at ( $p=0.07$ ) indicated that flat land influenced agricultural mechanization than a steep sloped land.

Fuel costs of machinery like tractors had a positive and significant effect at 1 percent level on the use of agricultural mechanization. The coefficient of 0.52 at ( $p= 0.00^{**}$ ) indicated that the more the costs, the lower the chances of using mechanization and vice versa.

Access to credit had a positive and significant influence on farmer's use agricultural mechanization at 5%. Farmers with credit access would automatically be able to get some money to invest in agricultural mechanization and vice versa.

Household Size had a negative but significant ( $p=0.03^{**}$ ) relationship with the use of agricultural mechanization for maize production. House hold with less member were less likely to influence mechanization than bigger households (minimum=4 maximum=10).

Years in maize farming indicated that had a positive and significant relationship with farmer's use of farmer's use agricultural mechanization. A coefficient of 0.22 at ( $p=0.05^{**}$ ) implied that the more years a farmer is in maize production, the more chances of mechanizing agriculture where it was significant at 5 percent and vice versa.

**Table 3. Parameter estimates for the factors limiting the use of agricultural mechanization among maize producing farmers**

The findings of the study for the significance and coefficient values were got by using a logic model to estimate parameters of limiting factors and as shown below.

$$Y_i = \alpha + b_1 + b_2 + b_3 + b_4 + \dots + e + x_n$$

$$Y_i = \alpha + b_1 \text{ Access to mechanization information} + b_2 \text{ Land ownership type} \\ + b_3 \text{ Household Size} + b_4 \text{ Access to credit} + b_5 \text{ Years in maize farming} \\ + b_6 \text{ Availability and access to implements} + b_7 \text{ High costs of hire} \\ + b_8 \text{ Remoteness of the area} + b_9 \text{ Slope of the land} + b_{10} \text{ Terrain of land} \\ + b_{11} \text{ Fuel costs} + b_{12} \text{ Age of household head} + b_{13} \text{ Size of land} + e + x_n$$

Where the factors limiting the use of agricultural mechanization were represented by Yes=1 and No=0

Variable	Coefficient	Std. Error	P-value
Constant	0.22	0.30	0.46
Access to mechanization information	0.06	0.03	0.04**
Land ownership type	-0.36	0.17	0.03**
Household Size	-0.26	0.12	0.03**
Access to credit	0.52	0.25	0.04**
Years in maize farming	0.22	0.11	0.05**
Availability and access to implements	-0.16	0.09	0.09
High costs of hire	0.45	0.25	0.02***
Remoteness of the area	0.21	0.22	0.35
Slope of the land	0.26	0.11	0.07
Terrain of land	0.49	0.27	0.01**
Fuel costs	0.52	0.48	0.00***
Age of household head	0.18	0.42	0.66
Size of land	0.64	0.68	0.00**

Level of significancy: \*\*\*, significant at 1% \*\* significant at 5% \* significant at 10%

High costs of hire had a positive and significant influence on farmer’s use of agricultural mechanization among maize farmers. The coefficient of 0.45 significant at (p=0.02\*\*\*) implied that farmers who were able to hire agricultural machinery because of farm income and employed were likely to use agricultural mechanization and vice vasa.

Terrain of land had a positive and significant influence on farmers’ perceptions of farm mechanization. The coefficient of 0.49 and being significant at (p=0.01\*\*) implied that the land terrain had influence mechanization especially where soils can be cultivated.

**Table 5. Ways of promoting agricultural mechanization**

Response	Frequency	Percent
Training and education	20	5.5
Promoting mechanization as part of production	29	8
Promoting farmer group formation	39	10.7
Establishing contract farming schemes	27	7.4
Creating public–private partnerships	19	5.2
Increase investment in agricultural mechanization	22	6
Community capacity building	43	11.8
Rural-urban migration	53	14.6
Creating awareness	41	11.3
Extending credit services to the farmers	69	19
Total	362	100.0

Results of the strategies for promoting agricultural mechanization for sustainable production Kanara sub-county were analyzed and presented in Table 5. Most (19%) of the respondents recommended credit extension, 14.6% talked of rural-urban migration as would create enough spaces for mechanization, 11.8% community capacity building through training, 11.3% awareness creation, 10.7% group formation, 8% promoting mechanization as part of production, 7.4% establishment of contract farming schemes, 6% increasing investment in agricultural mechanization, 5.5% periodical training and education while 5.2% talked of the creation and strengthening public-private partnerships.

#### 4. DISCUSSION

The study discovered varying farmer perceptions towards the usefulness of mechanization on maize production. Respondents alleged that mechanization (farm implements) performed more work than humans, were more reliable, time saving, more accessible and had high work accomplishment rate than humans. Agricultural mechanization was generally perceived to increase profit margin and also make possible for farmers to make use of optimum production period. In addition, mechanization improved the quality of farm products in terms of taste, yield, processing and storage. Farm mechanization boosts faster production, less human labor need and allows low or less time in operations of farm tasks which is an advantage to lead both increased farm yields and to work on a greater intensity of land use. Mechanization is mostly often seen and perceived as a direct substitute for labor which is undesirable in places of extensive labor supply, and often in the case of less developed countries. This finding is in line with Olaniyi & Adewale, [11] who argued that agricultural mechanization is perceived to play important roles in agricultural production such as increased working capacity and speed of execution are proof of the technical roles of mechanization. Rahman, [5] reported that, "mechanization contributes to increase in food production, productivity and advancement of rural economies". The use of machines makes it possible for some jobs which the farmer could not otherwise undertake perfectly and timely for example, rapid clearing of forest, ploughing in dry weather in order to plant with the early rains and green Manuring on prepared field yard. The roles of agricultural mechanization are to increase the farm output per human hour and to reduce

spoilage, waste and other losses of agricultural produce.

This study established a significant relationship between different socio-economic characteristics and farmers' perception on mechanization. Big sized land positively influenced the adoption of agricultural mechanization and vice versa. In other words, farmers with big sized land can use it as security to access mechanical implements on credit because part of their land can give security to credit access. This finding is comparable to IITA, [12] that also found that land size was significantly influenced the adoption of mechanization. Access to land influenced usefulness of mechanization.

Ownership of land influenced farmer's perceptions on mechanization in Kanara sub-county. Farmers that owned land were more likely to adopt mechanization compared to those that rented land. This was because farmers who own land do not incur much costs in renting or accessing land to do agriculture, this increases their chances of using the available money to invest in farm mechanization than farmers that rent the land. This finding was in line with Baudron & Gerard [13] who reported that such business establishments are making efforts to educate tractor operators and to develop a basically self-sufficient system because they are provided with repair shops. Accordingly, the following introduces a farmer in the suburbs of Kampala in the province of Wakiso who has been enabled to use the power tiller through the support of NAADS, where the small sized agricultural implement is employed. He owns a 30-acre land to cultivate strawberries, vegetables (qinggengcai (bok choy), tomato, pumpkin, garland chrysanthemum, etc.).

Income status had an influence on adoption of mechanization. Farmers with more income were 1.7 times likely to adopt mechanization compared to farmers without an income. This maybe as a result of farmers looking at agriculture as productive when mechanization is acquired and used. This finding is in line with Johansen [7] who stated that lack of investment in production-enhancing technologies brings in very low levels of production, that further consolidates the continuing situation of low level farmer income. The lack of demand for mechanization drives another debilitating element: supply. This is also in line with IFPRI (2015) who said that the poor supply of various tools/equipment and power sources (limited

choice and low volume of sales) sometimes lead to higher prices of agricultural mechanization inputs, which in later leads to higher ownership and running costs high. The high cost of using farm machinery complicates the system which leads back to low demand.

The study came out with a number of factors limiting the use of agricultural mechanization among maize producing farmers. Fuel costs of machinery like tractors had a positive and significant effect on the use of agricultural mechanization. This finding is in line with Johansen [7] who argued that when hiring the tractors to farmers, most of the SSA government systems also used to charge subsidized rates including rates for the purchase of tractors, their implements and spare parts. The rates of fuels and oils for the tractors as well as rates for tractor maintenance and repairs were also subsidized.

Access to credit had a positive and significant influence on farmer's use agricultural mechanization at 5%. The implication is that farmers with access to credit facilities would automatically be able to get some money to invest in agricultural mechanization and vice vasa. This findings is in line with Foster & Rosenzweig [14] who argued extending credit products to farmers to invest in agricultural machinery not only allows them to raise their productivity and participate more fully in the market economy, but can also incentivize the local machinery manufacturing industry to supply their needs. This was also discussed by Ghosh [15] that this can be reflected in low investments commonly in fixed assets, for example, agricultural machinery that commonly have high start-up investment costs for farmers or other people and therefore, returns taking a long period of time which may be economically unsustainable for interested smallholders even if profitable.

High costs of hire had a positive and significant influence on farmer's use of agricultural mechanization among maize farmers. The coefficient of 0.45 significant at ( $p=0.02^{***}$ ) implied that farmers who were able to hire agricultural machinery because of farm income and employed were likely to use agricultural mechanization and vice vasa. While hire services of mechanization exist in many countries, there are various barriers like: lack of market access for machinery; low/less demand; limited access to insentives; absence of financing; and limited

know-how with regard to running an enterprise and maximizing profits.

Remoteness was a significant factor limiting the use of agricultural mechanization among maize producing farmers. The more the farmers are placed deep in the village where the government is not interested in its development and where there are poor roads, poor health and others like food insecurity may lead to farmers fail to adopt mechanization to boost production and vice vasa. Rural roads (and often main trunk roads) are frequently in a state of poor repair, which adds to high distribution costs. Furthermore, registration can be an issue if the owner wishes to transport a tractor across district lines to deliver hire services.

Land ownership type had a negative but significant relationship with the use of agricultural mechanization for maize production. Those who owned land were more likely to apply mechanization than those who rented. The finding is also in support of Gupta (2011) who mentioned land tenure as one of the most important issues in agriculture; in many countries, lack of security of tenure severely shakes investment in the agricultural sector. For a successful transition from semi-subsistence farming to profitable and commercial sector productive agriculture, land tenure must be secured and guaranteed by the state as well as by local laws and traditions in a community. This gives farmers the security and confidence to invest in mechanization fearing no risk.

In regard to the identified challenges, respondents came up with a number of strategies that can be adopted to promote agricultural mechanization use among maize farmers in Kanara sub-county and the rest of the other areas. The key strategies highlighted included; Extending credit services to the farmers, community capacity building, creating awareness, promoting farmer group formation, promoting mechanization as part of production, establishing contract farming schemes, increase investment in agricultural mechanization, training and education and creating public-private partnerships.

Farmer group formation was suggested by respondents to develop and acquire mechanization. Farmer groups are important institutions in that they allow access to information as well increase the chances of accessing farm machinery through combined

efforts. This encourages farmers to adopt mechanization. This finding is in line with Johansen [7] who argued that farmer groups are a possible option for cheap tractor ownership. This could possibly involve 5-15 smallholders who are together and can ably raise some finance required for a 2-wheel tractor and additional implements.

Respondents suggested the need to establish contract farming schemes as this could offer an opportunity to increase the successful uptake of mechanization by contractors having enough funds to invest in mechanization and increase productivity. The finding is in line with Ghosh [15] who argued that contract farming would appear to be an unlikely model to successfully promote mechanization. Firstly, maize contract farming is relatively uncommon. Rarer still are maize off takers who have tractors and would be willing to invest further in mechanization for supplying smallholder farmers. Furthermore, while contract farming arrangements sometimes include the provision of seed or fertilizer on credit, investments in tractors are more substantial, while at the same time seen as less essential by the off-taker for smallholders to deliver required volumes or quality.

The study called for the government to increase investment in agricultural mechanization since it can access machines and modern technologies at a reduced price or credit. This would encourage quality production and supply of agricultural produce at the required time for consumption. This in a long run could help in agriculture modernization and production of high quality maize products that can meet international market. The finding is in line with Johansen [7] who argued that mechanization initiatives involve close collaboration between the public and private sectors. For example, the Potato Initiative Africa (PIA) – operating in Nigeria and Kenya – is implemented within the German Food Partnership (GFP) and involves private sector agricultural machinery suppliers.

The study further suggested the need for training and education. This could lead farmers to acquire new knowledge and skills that may help them on how to operate machines on farm and hence produce highly. Awareness creation can be done using locals through locally available media platforms like radio stations, meetings, seminars, workshops and televisions. This finding is in line with Ghosh [15] who argued that a thorough analysis is required of the existing

situation and of the measures needed to ensure that adequate training facilities exist to promote safe and environmentally friendly mechanization. Training programs should be developed to cover the needs of farmers, operators, mechanics and other relevant stakeholders involved in the provision of agricultural machinery services. Training centres should be attached to existing further education institutions with the aim of integrating the various knowledge blocks required in mechanization and agro-food value chains.

The study revealed that extending credit services to the farmers could be one of the best strategies for promoting agricultural mechanization among maize farmers in Kanara sub-county. It was established that farmers do not have access to credit services on mechanization tools due to limited security, failure to access credit facilitating firms in the area, therefore extending credit services to the farmers could really help farmers own mechanical equipment and boost their production in maize farms. This can be through giving loans at low interest rates, equipment at credit to farmers. The finding is in line with Kumar and Kumar [16].

## 5. CONCLUSION

In conclusion, the study confirmed that farmers had different perceptions on the usefulness of mechanization on maize production as both positive and negative respectively. They perceived mechanization to perform more work than humans, reliable, time saving, accessible and had high work accomplishment rate. Farmers perceived agricultural mechanization use as an effective strategy for improving maize productivity because it saves more time, increases labor efficiency, and there is high production capacity got from using mechanization over human labor. Farmer perceptions towards mechanization were influenced by socio-economic characteristics such as; age, land size, gender, income status, employment status, type of land owned and availability of labor. The study also concluded that limited capital, limited access to mechanization information, remoteness of the area, education level, access credit and household size are the factors limiting agricultural mechanization use among maize in Kanara sub-county. To promote the use and adoption of agricultural mechanization in the area, a number of strategies were suggested including credit extension, capacity building,

awareness creation, farmer group formation, establishing contract farming schemes, increase investment in agricultural mechanization, increasing credit access to farmers, give access to information in the new agricultural technologies, training and education and creating public-private partnerships among farmers in the area.

## 6. RECOMMENDATIONS

The government should also have more agricultural land to improve on the agricultural output levels of the country. Setting policies that favor people to stay in urban areas can create large space of land that can be put under agriculture and in so doing, the need to produce more for the available population will demand for mechanization as a factor that gears much production.

There is need to modernize roads in the area so as to make the place be accessible and help farmers get access to market for their produces. This should be done by involving local councils in construction of roads with in Kanara sub-county.

Government should subsidize mechanization implements so as to enable farmers easily acquire machines at cheaper prices to increase productivity and quality.

While access to credit has a positive influence on manure adoption, it is still expensive and inaccessible to most agricultural households. Government should consider the implementation of the plan for providing households with loans at low interest rates.

The need for education and awareness. Farmers should be educated on the effectiveness of mechanization to enable them acquire skills and knowledge on how to operate machine. This may motivate farmers to purchase implements and use them on farm hence increasing quality and quantity.

The government should increase rural investments to create job opportunities among smallholder farmers. This could create off-farm employment opportunities that give rural farmers finance to purchase mechanization implements.

There is need to strengthen the extension services. Increasing extension service delivery will provide farmers with adequate knowledge and information on mechanization and processing prior to application.

## CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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