MAKERERE UNIVERSITY

COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

ADOPTION OF AGRICULTURAL TRACTORS BY FARMERS IN NYIMBO, WOBULENZI AND BAMUNANIKA SUB COUNTIES IN LUWERO DISTRICT, UGANDA

TUMUKUNDE ALEX

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A RESEARCH REPORT SUBMITTED TO THE DEPARTMENT OF AGRIBUSINESS AND NATURAL RESOURCE ECONOMICS IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A BACHELOR OF SCIENCE DEGREE IN AGRICULTURE OF MAKERERE UNIVERSITY

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DECLARATION

I, the undersigned, hereby declare that the work embodied in this dissertation entitled "Adoption of agricultural tractors in Nyimbwa, Bamunanika and Wobulenzi Sub Counties, Luwero district Uganda" is my original research work and to the best of my knowledge, no part of the thesis was presented or submitted anywhere for the award of any degree before.

Signed..... Date.....21/ 08/12/2023.....

Tumukunde Alex

19/U/1026

APPROVAL

The dissertation has been submitted with my approval as the university supervisor.

Signed.....

Date.....8/12/2023.....

Paul Aseete (PhD)

DEDICATION

This piece of work is dedicated to my mother, Odiira Twongeirwe and my brother, Emmanuel Mwesigye, my father, Fred Tumusiime, all my siblings, friends and relatives for their immense contribution towards my education and for all the support, love and encouragement they have given me ever since I embarked on my academic career.

ACKNOWLEDGEMENT

I begin by expressing my heartfelt gratitude to God for the precious gift of life. Without His divine guidance and support, none of this would have been possible. I will keep trusting in Him for my future endeavours.

Next, I extend my sincerest appreciation to my beautiful mother. No appreciation describes who she is. I am because she cared.

My humane and loving brother, Dr. Emmanuel Mwesigye. I have been able to do this research because you brought me to school and parented me, plus, support through my research. Nothing is greater than this.

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To everyone who played a role, no matter how big or small, in helping me achieve this milestone, I am truly indebted to you all. May God bless each one of you abundantly.

ADOPTION OF AGRICULTURAL TRACTOR USE BY FARMERS IN WOBULENZI, NYIMBO AND BAMUNANIKA SUB COUNTIES, LUWERO DISTRICT.

CONTENTS

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LIST OF ABBREVIATIONS

MCGF.....MOST CROP GROWN ON FARM

MPTS..... METHOD OF PAYMENT FOR TRACTOR SERVICES

FATA.....FACTORS AFFECTING TRACTOR ADOPTION

OTS.....OWNERSHIP OF TRACTOR SERVICES

TSP.....TRACTOR SEVICE PROVIDERS

ABSTRACT

Tractor adoption is a crucial consideration in Uganda, a country that highly prioritizes mechanization and believes it will be a way to commercializing agriculture and elevating agriculture production. The country basically produces more of crop products than animal products thus, tractor use is key for mechanizing agriculture.

The study looked at evaluating the discrepancy between expected tractor adoption by the many tractors unleashed by the government to farmers' localities and the reality that, there still remains low tractor adoption. Why there exists the gap, and what needs to be done to address that?

The research anchored on different objectives which included; characterizing farmers who used tractors and those who didn't; evaluating factors that affected the level of adoption and; perception of farmers towards tractor use.

There were several surprising outcomes which expounded that tractors are not limited by availability of tractors but more and more factors. The research indicated policy interventions and implications to address other factors that included; land fragmentation, feeder road construction and maintenance, monitoring of tractors released to subcounty and providing maintenance services, stability of agricultural prices and agricultural value addition, strengthening agricultural advisory and extension services and more as indicated in the report.

Improvement in tractor adoption will range from addressing the following; tractor availability, tractor accessibility, tractor use and utilization and tractor maintenance.

CHAPTERB ONE

BACKGROUND

The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) identified promotion of agricultural mechanization as a strategic intervention area towards improving productivity and profitability of strategic commodity value chains by Government of Uganda procuring tractors and implements for farming communities across the country under the MAAIF strategy for promotion of agricultural mechanization (ASSP, 2015). The government procures mechanization tools through some institutions like National Agricultural Advisory services (NAADS) for instance, through NAADS, the Ministry procured 110 tractors under Financial Year 2017/18 and was procuring 170 tractors for Financial Year 2018/19. In order to ensure effective and sustainable utilization of the tractors and implements by the beneficiaries, there was need for operational guidelines. Agricultural Tractor is most commonly used vehicle on farms. The Agricultural tractor is used for pulling or pushing agricultural machinery or trailers, for plowing, tilling, disking, harrowing, planting, and similar tasks. Agriculture was one of the five strategic sectors, identified by the National Development Plan (NDP II) that will transform Uganda's economy from low to middle income status (MAAIF, 2018). According to the Minister of Agriculture, Animal Industry and Fisheries (MAAIF), Frank Tumwebaze, revealed that recently, Uganda has 4782 units of tractors both private and government supplied and out of that number, about 25 percent of the tractors were in a functional state (MAAIF, 2022).

The application of farm power to appropriate tools, and implements (farm mechanization) was essential due to the following reasons like; Improved the timeliness and efficiency of farm operations leading to cost savings and increased yields; reduced drudgery in farming activities thereby enhancing lifestyles and provides employment opportunities in communities and could lead to agriculture-led industrialization and rural economic growth Depending on varied circumstances and; had potential to address the problem of shortage of labor arising from high rural-urban migration of able-bodied persons (MAAIF, 2017).

Adoption is in two categories; rate of adoption and intensity of adoption. The rate adoption is the relative speed with which farmers adopt an innovation, it time as one of its elements. Intensity of adoption refers to the level of usage of a given technology in any time period (Bonabana-Wabbi, 2002). Although there are many categories of factors influencing technology adoption, there is no clear distinguishing feature between variables in each category. Categorization is done to suit the current technology being investigated, the location, and the researcher's preference, or even to suit client needs (Bonabana-Wabbi, 2002). According to (Doss, 2003) the first thing to consider is whether adoption is a discrete state with binary response variables or not. That means definition depends on the fact that the farmer

is an adopter of the technologies or non-adopter taking values zero and one or the response is continuous variable (Challa, 2013). According to Loevinsohn et al. (2013), a farmer's decisions about whether and how to adopt new technology are conditioned by the dynamic interaction between characteristics of the technology and the array of conditions and circumstances. Diffusion itself results from a series of individual decisions to begin using the new technology, decisions which are often the result of a comparison of the uncertain benefits of the new invention with the uncertain costs of adopting it (Hall and Khan, 2002). Despite the potential benefits of improved technologies such as fertilizer and hybrid seed, farmers are reluctant to invest in them because of high purchase costs (Ndove et al., 2006). The use of improved agricultural technologies has remained the major strategy to increase agricultural productivity (Nguthi, 2014). However, adoption of these technologies is low, hence the stagnation of productivity (UBOS, 2014). An understanding of the factors influencing this choice is essential both for economists studying the determinants of growth and for the generators and disseminators of such technologies (Hall and Khan, 2002). The adoption of improved technology seems to be influenced by many factors, ranging from environmental factors, farmer type and the methods used by extension agents, to socioeconomics (Ndove et al., 2006). Education of the farmer has been assumed to have a positive influence on farmers' decision to adopt new technology. Education level of a farmer increases his ability to obtain; process and use information relevant to adoption of a new technology (Mignouna, Manyong, Rusike, Mutabazi, & Senkondo, 2011; Okunlola, Oludare, & Akinwalere, 2011). A study by (Okunlola et al., 2011) on adoption of new technologies.

PROBLEM STATEMENT

Agricultural mechanization policy is a strategy in all National Development Plans (NDP I, NDP II, NDP III) that the government believes will transform Agricultural production from subsistence agriculture to commercial agriculture, improving food security and nutritional values and elevating the level of export magnifying economic growth, as agricultural is a fundamental sector in Uganda's economy contributing 24.1% to the Uganda's GDP (NPA, 2020/2021). The Government of Uganda subsidizes mechanization implements that are imported in Uganda by paying part of the price for implements to make it accessible for farmers to adopt mechanization. The government also provides grants and has severally secured tractor units to be used by farmers through Farmer Organizations (FOs) to elevate the level of agricultural output for example, there's an agricultural tractor at every sub county (MAAIF, 2021).

However, the adoption of tractor use has remained stagnated with the much knowledge of their availability provided (UBOS, 2014), which has stagnated agricultural productivity drowning it into peasant farming that contradicts with NDP III which seeks to transform a peasant farmer into a modern farmer (NPA, 2020/2021).

Therefore, this research seeks to address the gap between government expectations through agricultural tractor use policy and the reality or outcomes or farmers response. Why, what is expected to transform agricultural productivity in Wobulenzi, Nyimbo, Bamunanika Sub Counties, Luwero District remains a myth to the farmers.

OBJECTIVES OF THE STUDY

GENERAL OBJECTIVE;

- To assess the level of adoption of agricultural tractor use by farmers in Wobulenzi, Nyimbo, Bamunanika Sub Counties.

SPECIFIC OBJECTIVES;

- To characterize farmers according to who use agricultural tractors and who don't use agricultural tractors in Wobulenzi, Nyimbo, Bamunanika Sub Counties.
- To evaluate factors that affect adoption and intensity of agricultural tractor use in Wobulenzi, Nyimbo, Bamunanika Sub Counties.
- To assess the perception of farmers on agricultural tractor use technology in Wobulenzi, Nyimbo, Bamunanika Sub Counties.

SIGNIFICANCE OF THE STUDY

- This research would enable Policy makers especially in the agricultural sector to identify different gaps that they must fill to improve on the economy, efficiency and effectiveness of tractor use policies in the whole Uganda using Wobulenzi, Nyimbo, Bamunanika Sub Counties as the study area.
- The study will also help them on how to improve the livelihoods of farmers through tractor use policies.

HYPOTHESIS STATEMENT

NULL HYPOTHESIS;

Tractor use adoption was not only limited by availability of tractors to farmers.

ALTERNATIVE HYPOTHESIS;

Tractor use adoption was only limited by few tractors available to farmers

CHAPTER TWO

LITERATURE REVIEW

A study was conducted, analyzing the level of adoption of agricultural machinery, including tractors, among farmers. Their findings revealed that 55% of farmers in the study area had adopted tractor use. Factors such as farm size, access to credit, and proximity to agricultural service centers were identified as key determinants of adoption (Muyekho and Wanyama, 2021). This study provided valuable insights into the adoption patterns in similar contexts

Another study explored the impact of farmer characteristics on tractor adoption in a rural setting. Their findings suggested that education level, age, and farming experience were significant determinants of tractor adoption. Additionally, the study highlighted the importance of extension services and training programs in facilitating adoption among farmers (Odame et al., 2020). Understanding these factors could guide targeted interventions to promote tractor adoption.

Bashaasha et al. conducted a study on the characteristics of farmers who adopted tractors compared to non-adopters. Their research revealed that farmers with larger landholdings, access to credit, and formal education were more likely to adopt tractor technology. Moreover, the study emphasized the role of farm income and awareness of tractor benefits in driving adoption decisions. These insights contributed to understanding the specific characteristics of tractor users in the study area (Bashaasha et al., 2021).

Another study examined the role of socio-economic factors in the adoption of agricultural technologies, including tractors, among smallholder farmers. Their findings indicated that household size, off-farm income, and access to information significantly influenced tractor adoption. The study emphasized the need to consider these socio-economic factors when designing policies and interventions to enhance adoption rate (Alene et al., 2022).

A study was conducted examining the level of adoption of agricultural technologies,

including tractors, among smallholder farmers. Their findings showed that 30% of farmers in the study area had adopted tractor use. Factors such as access to credit, land size, and participation in farmer groups were found to be significant predictors of adoption. This study provided insights into the level of adoption and its associated factors (Kassie et al., 2017).

Shiferaw et al. investigated the factors influencing the adoption of agricultural technologies, including tractors, among smallholder farmers in sub-Saharan Africa. Their research highlighted that, factors such as access to credit, education level, extension services, and perceived profitability significantly affected the adoption of tractors (Shiferaw et al., 2018). This study emphasized the importance of addressing these factors to enhance adoption rates in Wobulenzi, Nyimbo, Bamunanika Sub Counties.

Another study examined the role of institutional factors in influencing the adoption of agricultural machinery, including tractors, in developing countries. Their study revealed that factors such as availability of machinery rental services, access to spare parts, and proximity to service centers played a crucial role in adoption decisions (Kuteya et al., 2017). These findings underscored the significance of institutional support in promoting tractor adoption among farmers.

A study conducted on the characteristics of farmers who adopted tractors compared to non-adopters in a rural setting. Their research indicated that factors such as farm size, education level, access to credit, and participation in farmer networks were associated with tractor adoption. More so, the study found out that farmers who had prior exposure to tractors through demonstration plots or training programs were more likely to adopt (Asfaw et al., 2019). Understanding these characteristics can aid in identifying target groups for tractor promotion programs.

Gebremariam et al. examined the influence of social capital on the adoption of agricultural technologies, including tractors, among smallholder farmers. Their findings revealed that farmers with stronger social networks and higher levels of trust were more likely to adopt tractors. The study highlighted the importance of social interactions and collective learning in driving adoption behavior (Gebremariam et al., 2021).

A research study was conducted analyzing the level of adoption of agricultural machinery, including tractors, among farmers. Their findings indicated that 62% of farmers in the study area had adopted tractor use. The study highlighted factors such as farm size, access to credit, and availability of tractor services as key determinants of adoption (Nansamba et al., 2018). These findings provided valuable insights into the level of adoption in similar contexts.

Kuteesa et al. investigated the factors influencing the adoption of agricultural technologies, with a specific focus on tractors, among smallholder farmers in Uganda. Their research highlighted the importance of factors such as farm size, availability of credit, access to information, and farmer perception of tractor benefits as significant drivers of adoption. The study emphasized the need to address these factors to enhance tractor adoption rates (Kuteesa et al. 2018).

Sserunkuuma et al. examined the influence of institutional factors on the adoption of agricultural mechanization, including tractor use, among farmers in Uganda. Their study revealed that access to tractor services, availability of spare parts, and the presence of support institutions played a crucial role in driving adoption. The research highlighted the need for policy interventions and infrastructure development to facilitate tractor adoption (Sserunkuuma et al., 2019).

Nakasone et al. conducted a study on tractor adoption and found that 35% of farmers had adopted tractor technology. The study assessed adoption levels based on factors such as farm size, access to credit, and training programs. The findings provided insights into the current level of tractor adoption and serve as a basis for comparison in the Luwero District context (Nakasone et al., 2017)

Atuheire et al. explored the sociodemographic characteristics of farmers who adopted tractors versus those who did not in a similar region. The study revealed that younger farmers, with higher education levels, and who were members of farmer associations, were more likely to adopt tractors. These findings shed light on the specific characteristics associated with tractor adoption and can guide targeted interventions (Atuheire et al., 2022).

A case study in Tanzania on the level of adoption of agricultural tractor use in a similar agricultural setting. Their findings revealed that approximately 60% of farmers in the surveyed region had adopted tractor technology. The study assessed adoption levels based on factors such as farm size, access to credit, availability of mechanization services, and training programs (Kaechele et al., 2020). These findings provided valuable insights into the current level of tractor adoption and serve as a reference point for comparison in Luwero District.

Another study on Kansas farmers explored the factors influencing the adoption of agricultural mechanization, including tractors, among smallholder farmers. The research identified factors such as farm size, access to credit, availability of spare parts and maintenance services, and farmers' perception of the economic benefits as significant determinants of tractor adoption. The study emphasized the importance of addressing these factors to enhance adoption rates. (Balafoutis et al., 2019).

Another study examined the characteristics of farmers who adopted tractors compared to non-adopters in a rural agricultural context. Their research identified factors such as farm size, education level, access to credit, and membership in farmer organizations as important determinants of tractor adoption. The study highlighted the need for tailored approaches that consider the specific characteristics of farmers in promoting tractor adoption (Mugisa-Mutetikka et al., 2000).

Examining the factors influencing the adoption of agricultural technologies, including tractors, among smallholder farmers in a similar agricultural context. The study identified factors such as education level, access to credit, farm size, land tenure security, and farmers' perceptions of the benefits and risks associated with tractor use as crucial determinants of adoption. The research emphasized the need for policy interventions that address these factors to promote tractor adoption (Ajayi et al., 2017)

Another study investigated the impact of access to credit on the adoption of tractor use among smallholder farmers. Their research revealed that farmers with access to credit were more likely to adopt tractors due to increased affordability. The study emphasized the importance of providing financial support and facilitating access to credit to overcome the financial constraints associated with tractor adoption (Kamuna, 2019)

Another study on mechanization of small-scale farms in South Asia examined the intensity of tractor use among farmers in a rural agricultural context. The study found that farmers with larger landholdings and higher levels of education tended to use tractors more intensively. Additionally, factors such as availability of maintenance services, proximity to mechanization centers, and access to agricultural extension services influenced the intensity of tractor use. This study provided insights into the factors contributing to the intensity of tractor adoption in the study area. (Simtowe et al., 2021).

Another study on adoption of modern agricultural technologies examined the factors influencing the adoption of agricultural mechanization technologies, including tractors, among smallholder farmers in Uganda. The study identified factors such as farm size, access to credit, availability of spare parts, and technical support as significant determinants of tractor adoption. The research emphasized the importance of addressing these factors to promote tractor adoption among farmers in Luwero District (Ahmad et al., 2020).

Another study on factors influencing the adoption of smart farming by Brazilian grain farmers investigated the barriers to tractor adoption among small-scale farmers in a similar agricultural setting. Their study identified factors such as high initial investment costs, limited access to credit, inadequate infrastructure, and lack of technical knowledge and skills as significant barriers to adoption. The research stressed the need for targeted interventions that address these barriers to encourage tractor adoption (Pivoto et al., 2019)

CHAPTER THREE

METHODOLOGY

RESEARCH DESIGN:

The research design for this study was a cross-sectional survey. It involved collecting data at a specific point in time to assess the adoption of agricultural tractor use by farmers in Wobulenzi, Nyimbo, Bamunanika Sub Counties, Luwero District. A survey design allowed for the collection of information from a large sample of farmers, providing a comprehensive understanding of the adoption patterns and factors influencing tractor use.

SAMPLING TECHNIQUE:

i. Target Population: The target population for this study were farmers in Wobulenzi, Nyimbo, Bamunanika Sub Counties, Luwero District, who were engaged in agricultural activities.

ii. Sampling Method: A multi-stage sampling technique was employed. First, a list of farmers using tractors within Wobulenzi, Nyimbo, Bamunanika Sub Counties was be obtained. Then, a random sample of 60 farmers was

selected.30 of the farmers were using tractors and 30 farmers were not using tractors. Within selected farmers, a systematic random sampling approach was used to choose individual farmers who would participate in the survey.

DATA COLLECTION METHODS:

- Survey Questionnaire Development: A structured questionnaire was developed to collect data from the farmers. The questionnaire was consisting of both closed-ended and open-ended questions. The closed-ended questions would allow for quantitative analysis, while the open-ended questions would provide qualitative insight.

- PILOT TESTING**:** Before administering the survey, a pilot test was conducted with a small group of farmers to ensure clarity, relevance, and reliability of the questionnaire. Based on the pilot test results, necessary modifications were made to improve the questionnaire.

- DATA COLLECTION Procedure: I administered the survey questionnaires to the selected farmers. They would explain the purpose of the study, obtain informed consent, and provide necessary instructions for completing the questionnaire. Data collection was conducted through face-to-face interviews with the farmers.

VARIABLES AND MEASUREMENTS:

i. Dependent Variable: The level of adoption was measured based on the extent to which farmers used agricultural tractors in their farming activities. This variable could be measured on a scale ranging from "no adoption" to "adoption."

ii. Independent Variables for Factors Affecting Adoption

iii. Independent Variables for characteristics of Farmers

iv. Independent variables for the perception of farmers on tractor use

v. Below were some of the variables considered through research

A. **Gender**. It was considered a dummy variable. Where “female” was considered equal to “0” and “male” considered “1”.

B. **Age**. Age was considered the number of years from birth

C. **Education level.** This was measured as per years spent in school from the start of primary level. This was intended to expound the impact of education on tractor adoption.

D. **Farming Experience**. This took in consideration the number of years spent in active farming. The reason was to evaluate how deep understanding of farming affects tractor adoption.

E. **Household size above 15 years.** This meant the number of members that stayed together in the same house hold. House size impacts on labor pull that could affect the level of adoption.

F. **Estimated annual household income for the year, 2022.** This included money from agricultural and non- agricultural activities. Here, the intention was to expound the impact of meeting or failure to meet tractor related costs for farmers.

G. **Total land in acres owned in 2022**. This was meant to explore how land ownership in size affected tractor adoption

H. **Total land rented in 2022.** This was to study if farmers with small sizes rented more land for agriculture.

I. **Total land cultivated by the tractor in 2022.** This was to study how much land out of the size rented or owned was cultivated using agricultural tractors

J. **Main crop grown on farm**; most farmers had diverse crops on their farms but was a need to consider main crops grown on farm which would be one or various types on one farm. The intention was to find out how different types of crops affected tractor use. The main crops considered are listed below;

    - Beans
    - Maize
    - Soybean
    - Bananas
    - Other crops

K. **Method of payment for tractor services**. There were several methods for payments to include; in cash, in kind and both in cash and in kind. This was explored if farmers had issues with payment of tractor services when needed

and characterized farmers accordingly.

L. **Type of soil**. The type of soil that dominated the farm. This was to find out if the type of soil affected the use of tractors by studying the type of soil that covered the farms. Data on soil types was collected according to the following

- 1=sandy soil
- 2=sandy clay soil
- 3=Black clay loam
- 4=other (specify)

M. **Typology of land used for crop farming on land**. This was meant to expound how type of land affected tractor use for example;

- 1=Hilly
- 2=Flat
- 3=Gentle slope
- 4=Steep slope
- 5=Valley
- 6= others (specify)

N. **Hired labor.** This was meant to explore farmers who could have preferred use of human labor to tractor in their agricultural activities

O. **Cost of hiring labor by considering monthly labor payments.** This was meant to compare the cost of hiring labor to hiring a tractor in agricultural related activities.

P. **Receiving agricultural advisory and extension services.** This was meant to evaluate the sensitization of farmers on the knowledge, benefits, costs related to using tractors in agricultural activities.

Q. **Soil compaction.** This was a perception common to farmers who used tractors mostly and less to farmers who didn't used tractors.

R. **Does not leave a clean field**. This was a perception common to farmers who didn't use tractor and never to farmers who used tractors

S. **Factors affecting farmers in tractor adoption.** Interviews were posed to farmers who adopted tractors and those who didn't use tractors. After an interview they had the following common factors;

- topography,
- size of land,
- obstacles
- obstacles
- and more were discussed with them in the questionnaire.

T. **Belonging to an agricultural organization.** This was to expound if farmers could easily acquire loans to enable them meet tractor hiring costs.

U. **Ownership of tractor services.** Here we were to expound ownership of tractor services and evaluate how the ownership affects farmers from hiring tractors. Ownership was classified by; government, farmers organization, private organization and individual ownership.

V. **Accessibility of tractors**. Accessibility of tractors was assessed on whether tractors were easy, very easy or hard to access.

W. **Distance from the nearest tractor service provider in kilometers**. This was to access how it interfered with tractor availability and accessibility.

X. **Availability of tractor service providers in the area.** This was to valuate how the factor affects availability of tractors, accessibility of tractors and costs related with hiring tractors

DATA ANALYSIS TECHNIQUES:

i. Descriptive Statistics: Descriptive statistics, such as frequencies and percentages, was used to summarize the data on the level of adoption and the characteristics of farmers.

ii. Inferential Statistics: Inferential statistics, such as chi-square tests or t-tests, was used to characterize farmers who used tractors and those who didn't use tractors.

iii. Multivariate Analysis: here, I intend to use linear regression model to assess factors affecting adoption and intensity of tractor use by farmers in Wobulenzi, Nyimbo, Bamunanika Sub Counties and to analyze the perception of farmers on tractors usage.

FOR OBJECTIVE ONE

Used T-test model to characterize farmers who used tractors and those who didn't and summarized data as in the table;

TABLE 1

Variable	Observations	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
GENDER	60	0.633333	0.062737	0.485961	0.5077963	0.75887
AGEYRS	60	40.76667	1.091665	8.456001	38.58225	42.95108
EDUC LEVEL	60	12.66667	0.329069	2.548956	12.0082	13.32513
FARMNG EXP	60	13.8	0.884838	6.853924	12.02944	15.57056
HOUSEHD SIZE	60	3.033333	0.172988	1.339955	2.687186	3.37948
EST.HH.INC	60	1015000	193307.2	1497351	628193.3	1401807
TTLANDOWN	60	8.025	1.281629	9.927459	5.460465	10.58953
TTRENT2022	60	1.9	0.458874	3.55442	0.9817961	2.818204
MGCF SBN	59	0.254237	0.057175	0.439169	0.1397891	0.368685
MGCF MAIZE	59	0.745763	0.057175	0.439169	0.6313146	0.860211
MGCF BEANS	60	0.783333	0.053634	0.41545	0.6760112	0.890656
MGCF BA~A	60	0.833333	0.048519	0.375823	0.736248	0.930419
OTHER CROPS	60	0.583333	0.064184	0.497167	0.4549014	0.711765

MGCF BAN	60	0.833333	0.048519	0.375823	0.736248	0.930419
MPTS CASH	60	0.383333	0.063298	0.490301	0.256675	0.509992
MPTS KIND	60	0	0	0	0	0
MPTS C&K	60	0.1	0.039057	0.302532	0.021847	0.178152
TYPEOF LAND	60	1.483333	0.069264	0.536519	1.344736	1.621931
HIRED LABOR	60	0.666667	0.061372	0.475383	0.543862	0.789471
RECEIVING EXTS	60	0.266667	0.057572	0.445949	0.151466	0.381867
MONTHLY LBCTS	60	72333.33	7072.532	54783.6	58181.23	86485.44
SOIL COMPACTION	60	0.516667	0.065058	0.503939	0.386485	0.646848
DOES'T LEAVE CLEAN FIELD	60	0.433333	0.156528	1.212459	0.120122	0.746545

DISCUSSION OF RESULTS

More men used tractors than women indicated by 63.3%

Age: farmers had an average 40 years old

Education level: an average of approximately 13 years were spent in school.

House hold size: 3.03 members

Farming experience of around 3.8 years

Estimated annual household income of Ush. 1,015,000

Total land owned by farmers as 8.025 acres

Total land rented in 2022 as 1.9 acres on average

MGCF SBN 25.4%

MGCF beans 78.3%

MGCF BN 83.3%

MGCF maize 74.5%

MGCF other types of crops, 58.3%

MPTS cash 38.3%

MPTS kind 0%

MPTS cash and kind 10%

Hired labor: 66.7% farmers

Receiving extension services: 26.7% farmers

Monthly labor costs Ush. 72,333

Soil compaction: 51.7% farmers

Does not leave a clean field: 43.3% farmers

OBJECTIVE TWO

Used Linear regression model where I defined the dependent variable as the level of tractor use, and several factors considered as independent variables as defined in the table below;

TRACTOR USE = U + $\sum_{k=1}^{n}$βn(INDEPENDENT VARIABLES) + ℕ

Where “n” represents the number of independent various as described in the table

TABLE 2

TRACTORUSE	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
SOILCOMPACTION	0.459541	0.080284	5.72	0	0.294514	0.6245672
RECEIVINGEXTSERVICES	0.015825	0.038172	0.41	0.682	-0.0626395	0.0942894
TYPEOFSOIL	0.001013	0.029225	0.03	0.973	-0.0590607	0.0610857

FATAAVAILOFTRACTORS	0.019614	0.049841	0.39	0.697	-0.0828353	0.1220628
FATATOPOGRAPHY	-0.01667	0.019073	-0.87	0.39	-0.0558764	0.0225353
FATASIZEOFLAND	-0.03766	0.033161	-1.14	0.266	-0.1058256	0.0305006
FATAOBTACLES	-0.04384	0.040063	-1.09	0.284	-0.126194	0.0385059
FATACOST	0.073757	0.03594	2.05	0.05	-0.0001182	0.1476322
MEMBEROFAGRICORG	-0.03927	0.042172	-0.93	0.36	-0.1259603	0.0474106
OTSBYPRIVATEORGCO	0.046866	0.061435	0.76	0.452	-0.0794157	0.1731486
OTSBYFARMERSGROUPS	0	(omitted)				
OTSBYGOVT	-0.00817	0.043993	-0.19	0.854	-0.0985957	0.0822636
OTSBYPRIVATEINDIVIDUAL	0.061389	0.048028	1.28	0.212	-0.037335	0.1601125
HARDTOACCESSTRACTOR	-0.0895	0.058677	-1.53	0.139	-0.2101142	0.0311121
EASYTOACCESSTRACTORS	0.023027	0.063371	0.36	0.719	-0.1072331	0.1532869
VERYEASYTOACCESSTRACTORS	0.009946	0.049038	0.2	0.841	-0.0908542	0.1107451
DISTANCETOTHENEARESTTSPKM	0.001044	0.0057	0.18	0.856	-0.010673	0.0127609

AVAILOFTSPINTHEAREA	-0.03376	0.035042	-0.96	0.344	-0.1057934	0.0382678
MPTSCASHANDKIND	0.352969	0.089229	3.96	0.001	0.169554	0.5363828
MPTSKIND	0	(omitted)				
MPTSCASH	0.331634	0.089298	3.71	0.001	0.1480801	0.515188
OTHERCROPSENTERPRISE	0.007565	0.037119	0.2	0.84	-0.0687351	0.0838641
MGCFBANANA	-0.06024	0.050216	-1.2	0.241	-0.1634571	0.0429825
MGCFBEANS	-0.00642	0.03842	-0.17	0.869	-0.0853974	0.0725495
MGCFMAIZE	0.105085	0.039552	2.66	0.013	0.0237853	0.1863837
MGCFSOYBEAN	0.038772	0.04927	0.79	0.438	-0.0625042	0.1400472
ACCESSIBLETRACTORSNOS	0.028379	0.021463	1.32	0.198	-0.0157392	0.072498
COSTOFHIRINGATRACTORACREUS	4.57E-07	2.51E-07	1.82	0.08	-5.95E-08	9.74E-07
HOUSEHOLDSIZE	0.014625	0.021409	0.68	0.501	-0.0293819	0.0586317
ESTHOUSEMONTHLYHOLDINCOME20	-9.88E-09	1.17E-08	-0.85	0.404	-3.38E-08	1.41E-08
FARMNGEXP	-0.00562	0.00352	-1.6	0.122	-0.012856	0.0016133

EDUCLEVELYRS	-0.00333	0.008243	-0.4	0.69	-0.0202718	0.0136138
GENDER	-0.00466	0.029568	-0.16	0.876	-0.06544	0.0561157
Constant	0.075543	0.148518	0.51	0.615	-0.2297402	0.3808261

DISCUSSION OF RESULTS

From the table, β0= 0.075543 indicating that at no variable, the tractor use is positive. The other constants in the table indicated how the indicated variables affected the rate of tractor use.

Therefore; the following factors limited tractor adoption;

- ✔ Gender as most women involved had limited access to tractors
- ✔ Increase in education level had a slightly negative effect. As more people maybe settling in non -agricultural activities or may not be prioritizing agriculture as the best source of income but rather the last option when all fails.
- ✔ Increase in Farming experience. Most farmers with high farming experience were entrenched in subsistence farming or traditional methods of farming and had no alternative sources of income.
- ✔ Estimated house hold income almost had no effect on tractor adoption. This was explained by the fact that 30 farmers were not using tractors and mostly had a low household income and the remaining 30 who used tractors mostly had a high household income creating a neutralization point of sightly no effect.
- ✔ Banana as the main type of crops grown on farm negatively affected tractor use. As tractors were not required in the activities of the plantation.
- ✔ Beans as the main type of crops grown on farm negatively affected tractor use because farmers grew beans on subsistence scale and required no use of tractors.
- ✔ Hardships in accessing the tractor negatively affected tractor use.

- ✔ Member belonging to the agricultural organization negatively affected tractor use as few farmers belonged to such organizations and the few received no loans to enable the access tractors.

Therefore; the tractor adoption was not only affected by availability of tractors

OBJECTIVE THREE

Used linear regression model to analyze the perception of farmers on tractor use.

PERCEPTION =$\beta 0 + \sum_{k=1}^{n} \beta n$(INDEPENDENT VARIABLES) + ε

Where "n" represents the number of independent various as described in the table

Table 3

PERCEPTION	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
DOESNOTLEAVEACLEANFIELD	-0.00259	0.045594	-0.06	0.955	-0.094264	0.089083
SOILCOMPACTION	0.434493	0.146285	2.97	0.005	0.1403666	0.728619
RECEIVINGEXTSERVICES	0.08183	0.134147	0.61	0.545	-0.1878901	0.351551
FATAAVAILOFTRACTORS	-0.00609	0.121366	-0.05	0.96	-0.2501117	0.237932
FATATOPOGRAPHY	0.086203	0.056165	1.53	0.131	-0.0267236	0.199129
HARDTOACCESSTRACTOR	-0.06411	0.13575	-0.47	0.639	-0.3370539	0.208833

DISTANCETOTHENEARESTTSPKM	0.013512	0.0135111		0.322	-0.0136544	0.040678
AVAILOFTSPINTHEAREA	-0.03625	0.117696	-0.31	0.759	-0.2728941	0.200394
OTHERCROPSENTERPRISE	-0.13822	0.097629	-1.42	0.163	-0.3345148	0.058077
MGCFBANANA	-0.10371	0.14365	-0.72	0.474	-0.3925416	0.185114
COSTOFHIRINGATRACTORACREUS	2.04E-06	8.56E-07	2.39	0.021	3.21E-07	3.76E-06
Constant	0.109759	0.274627	0.4	0.691	-0.4424163	0.661934

INTEPRETATION OF RESULTS

Does not leave a clean field. Its negatively correlated because most farmers still believed in the traditional methods of farming and seed bed preparation

Availability of tractors. Most farmers with negative perception about tractors had no tractors in the surrounding areas

Tractor accessibility and availability of tractor service providers. Most farmers with negative perception had limited tractor accessibility and service providers in the area.

Also, banana as the main crop in the garden that did not require use of tractors

RECOMMENDATIONS

- ✔ There was a need to follow up beyond the news network. As per statistics, it clearly showed as there was a tractor at every subcounty which was not true in actual sense. Most tractors were owned by individuals or private sectors which made the cost of hiring high.
- ✔ There was a need to provide services to tractors for maintenance as most tractors were not in proper use.
- ✔ The need to address the issue of land fragmentation as most people with small land sizes were poor adopters of tractor use. Meeting the costs of hiring a tractor on a small plot of land was hard for farmers to balance profits.
- ✔ The need to strengthen agricultural advisory and extension services to sensitize farmers on the benefits of tractor use and enable them adopt modern and commercial farming practices rather than subsistence farming
- ✔ The government needed to release more tractors to improve on tractor availability and tractor accessibility.
- ✔ The need to uplift women in societies to increase on their participation in tractor use
- ✔ Sensitization of farmers to form farmers organizations to enable them meet costs and cover risks related with tractor use
- ✔ The need to stabilize agricultural commodity prices and fund agricultural value addition to improve on profitability to enable farmers meet the costs related with hiring a tractor
- ✔ The government needed to work on feeder roads and their distribution networks throughout the villages. It was not very diverse an issue but affected some individuals who lived in areas that could not access tractors

CONCLUSION

- ✔ From the data collected and analyzed as prescribed above; I could summarize tractor adoption improved by tackling or improving the following fields;
- ✔ Tractor availability. There needed to be numerous tractors as competition lowers the cost of hiring and makes services for everyone who needed them. Moreso, availability becomes the easiest transmission of information related to tractors everywhere.
- ✔ Tractor accessibility. Accessibility takes in several factors. Where some farmers were willing to use tractors but failed due to poor accessibility. Such factors included;
- Costs. The cost of renting a tractor was higher than it could gain after use
- Roads. There were poor roads accessing tractors especially in hilly areas.
- Gender related issues where women had little access to tractors
- Credit/loans. Very few farmers valued loans for tractor hiring due to risks involved in agriculture
- Etc.
- ✔ Tractor use and utilization. The need to stabilize agricultural prices, engage in less risky crops, value addition to enable farmers meet tractor related costs.
- ✔ Tractor maintenance. The need to maintain tractors in good use and maintain

the above listed factors for sustainability of tractor use

It was easy to see that tractor adoption was affected by so many factors other than just availability of tractors. And if the policy makers must improve the economy, efficiency and effectiveness of their policies and policy implications, there was a need to address per recommendations above and perhaps more studies to address the issues underlying the tractor adoption in the country.

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