FACTORS INFLUENCE THE ADOPTION OF IMPROVED AGRICULTURAL PRACTICES AMONG SMALLHOLDER FARMERS IN THE RIPAT PROGRAM. A CASE OF MOROGORO MUNICIPALITY, Tanzania

Abstract:
Maize plays a significant role in securing food insecurity mostly in developing countries such as Africa, especially in Tanzania where it is a main dietary staple for most people. This research assesses the factors influencing corn production levels among small-scale farmers who benefit from the RIPAT SUA Project in Morogoro, Tanzania. The project aims to improve maize production and food security through improved agriculture practices such as fertilizer use and intercropping methods. This study employed a cross-sectional design with 110 smallholder farmers. Information was collected through semi-structured questionnaires and analyzed using descriptive and bivariate probit regression models. Findings reveal that household income, farm size, farmer experience, and training play a crucial role in adopting improved agriculture practices. Notably a significant finding is that a higher income household income increases the chances of using fertilizer by 16.9% (p= 0.015) and receiving training improves the likelihood of adopting intercropping by 8.47% (p = 0.007). However, education alone does not have a noticeable impact signifying that specialized training could be more effective in improving adoption rates among small farmers with limited formal education. The research findings conclude that increased training opportunities, specifically for farmers with minimal education, and matching access to credit availability with agricultural investment. This measure will assist small-scale in boosting productivity, eventually supporting the sustainable growth of agriculture in Tanzania.
Keywords: Maize productivity, Food security, Smallholder farmers, Agriculture practices, Bivariate Regression.

1. Introduction:

Maize production is significant in securing food for small-scale farmers in sub-Saharan Africa, especially in countries like Tanzania in East Africa (Utonga, 2022; Santpoort, 2020). This highlights the significance of this corn among crucial agriculture systems and households' food security in Morogoro municipality. Despite being vital, maize production faces numerous challenges like climate, financial constraints, inability to access advanced technologies, and economic restrictions (Kasoma et al., 2021; Adenle et al., 2018; Farooq et al., 2022).

The Rural Initiatives for Participatory and Agriculture Transformation (RIPAT) SUA Project, was conducted between 2017 to 2021, aimed to oppose these setbacks and enhance maize production output in households in Morogoro Municipality. The project collaborated with Regional Community and Development Associations (RECODA) and Sokoine University of Agriculture (SUA), focused on impacting agriculture practices, increasing the availability of agriculture supplies, and upgrading the maize farming expertise of farmers.

In a global context maize, provides an estimated 30% of calories is consumed by 4.6 billion people, and is considered to be a staple crop in over 125 developing countries where the majority of producers are smallholder farmers (Nyirenda et al., 2021)**.** Parallel calories are consumed in both Eastern and Southern African regions (Ekpa et al., 2019)**.** However in Sub – Sahara Africa (SSA), zone the average maize yield remains to be low with a production level of 2 tons per hectare which is five times less than the yield potential as determined by the climate and soil that prevails in Sub -- Sahara Africa (SSA) producing zone *(*Aramburu-Merlos et al., 2024*).* which is contrary to potential standards emphasized with a World Agriculture Production (WFP), average level of 5.8 tons per hectare *(*Dukhnytskyi, 2019**).** This yield gap troubleshoots the urgent need for initiatives such as the RIPAT SUA project to boost maize production and food security at the household level.

East African regions such as Tanzania have pursued different efforts to increase maize production. For instance, The Water Efficient Maize for Africa (WEMA), project has focused on creating maize varieties that can withstand drought and pests in Africa (Daniel Otunge et al., 2010). The Innovation and Inclusion Industrialization project in the Agro-processing Value chain in Maize aims to determine innovation and inclusion and challenges Small and Medium Enterprises (SMEs) participation in agro-processing value chains(Brief, 2020). The Rural Initiatives for Participatory Agriculture Transformation (RIPAT) SUA in Morogoro Municipality is based on these regional initiatives and customizes interventions to accommodate the specific requirements of small-scale farmers in the areas.

In the case of this study, the study opts to use a bivariate probit regression model to assess different factors that trigger the use of improved agriculture practices among households in Morogoro municipality, specifically in Magadu, Mlimani, and Kauzeni wards. Through the use of this econometric approach, the researcher focuses on considering possible connections among various adoption choices, allowing for a profound understanding of how specific initiatives impact farmers' decisions and agriculture in general. This approach allows for a classier view by taking into account individual household factors as well as possible influence at the ward level.

Numerous studies have troubleshoot the significance of improved practices in enhancing agriculture methods to boost maize productivity and food security in Tanzania, specifically small-scale farming practices, (Milheiras et al., 2022; Jin et al., 2022; Mushi et al., 2022). Nevertheless, the specific influence of agriculture initiatives in projects like RIPAT SUA on the adoption of improved practices as well as how they contribute to boosting productivity are yet unknown.

Therefore, the study focuses on how RIPAT SUA attempts to fill the gap by examining how socio-economic characteristics such as education level, Household income, and access to agriculture services, influence the chance of adopting improved practices. By contributing to Sustainable Goals (SDGs) such as SDG 2 Zero Hunger, and SDG 1 No Poverty, the Tanzania National Agricultural Policy of 2013 aims to promote national food security, safety, and nutrition enhanced through production, accessibility, and utilization of sufficient and quality of food Also, with Agricultural Sector Development Program phase II, with aims to transform the agricultural sector (crops, livestock, and fisheries) towards higher productivity, commercialization level, and smallholder farmer income for improved livelihood food security and nutrition (URT, 2016). The study provides important information on how initiatives like the RIPAT SUA Project can help close productivity gaps and promote resilience, handling problems of low yield, and improving livelihoods. Additionally, this research addresses a significant knowledge gap regarding the socio-economic effects of agriculture projects, aiding in creating policies and programs that advance sustainable agriculture and food security in Tanzania and across East Africa.

2.0 Literature Review.

Agriculture is the economic backbone for rural livelihood in East Africa, particularly in Tanzania, where maize is an important staple food crop ensuring food security. Nevertheless, maize production to fulfill the demand is hindered as past decade studies conducted and revealed that numerous obstacles play a role such as climate variability, economic crises, diseases, and pests (Gwaka & Dubihlela, 2020). Agriculture efforts like the RIPAT SUA Project focus on improving food security particularly maize production through enhanced agriculture practices such as fertilizer use and intercropping to promote productivity and resilience to smallholder farmers

Production theory paves a structure on how agriculture outputs are influenced by resources and socio-economic factors. Some related factors are land size, farming experience, income, and training contribute to a significant role in the acceptance of better techniques for high production levels (Onuwa et al., 2023). Yet previous studies highlight that access to income enhances fertilizer investment, and technical training significantly aids skills adoption in agriculture practices respectively (Tesfay., 2020; B. Li et al., 2023). Despite these findings limited studies investigated how these factors interplay to affect maize production and food security.

This research intends to scrutinize the socio-economic factors that influence the practical implementation of the RIPAT SUA Project, to provide suitable guidelines for promoting sustainable agriculture practices and food security.

3.0 Methodology

3.1 Study Area

The study on which this paper is based was conducted in the Morogoro Region, located in the Mid-eastern part of Tanzania specifically in Morogoro Municipality which is located along the slopes

of Uluguru Mountain. The district is found at the latitude 6°49’20” S and longitude 37°40’0” E. The agriculture profile of Morogoro Municipality is arable land is 11,844ha out of 4,623,005ha of Morogoro region, The nature of the soil in mountains area is mainly Oxisols which are general in nitrogen and phosphorus, in valley and low land areas are generally characterized by fertile alluvial soils. Morogoro Municipality is famous for producing food and cash crops, especially Maize 6.6%, paddy 5.8%% other crops 11.8%, region peas 16.9%, and sugarcane 59.4%% (Mtunguja, 2022). Morogoro municipal district was purposively selected because it is one of the districts where the RIPAT SUA project was implemented. The study will focus on Maize farmers since maize is the first step crop produced and consumed because of its high carbohydrate content, maize is a major source of calories. Also, maize is the dominant annual crop grown in the Morogoro region and it had a planted area 1.5 times greater than paddy, despite of increase in area of production but the yield has dropped over the years since 1994/1995 (Security et al., 2007). The study looks at important factors in Morogoro Municipality's maize production. Age, land size, maize output, income, education, agricultural experience, and marital status are a few of these. These variables included are important for agricultural practices and results as both factors work together to influence farming methods and results, highlighting the complex nature of farming success.

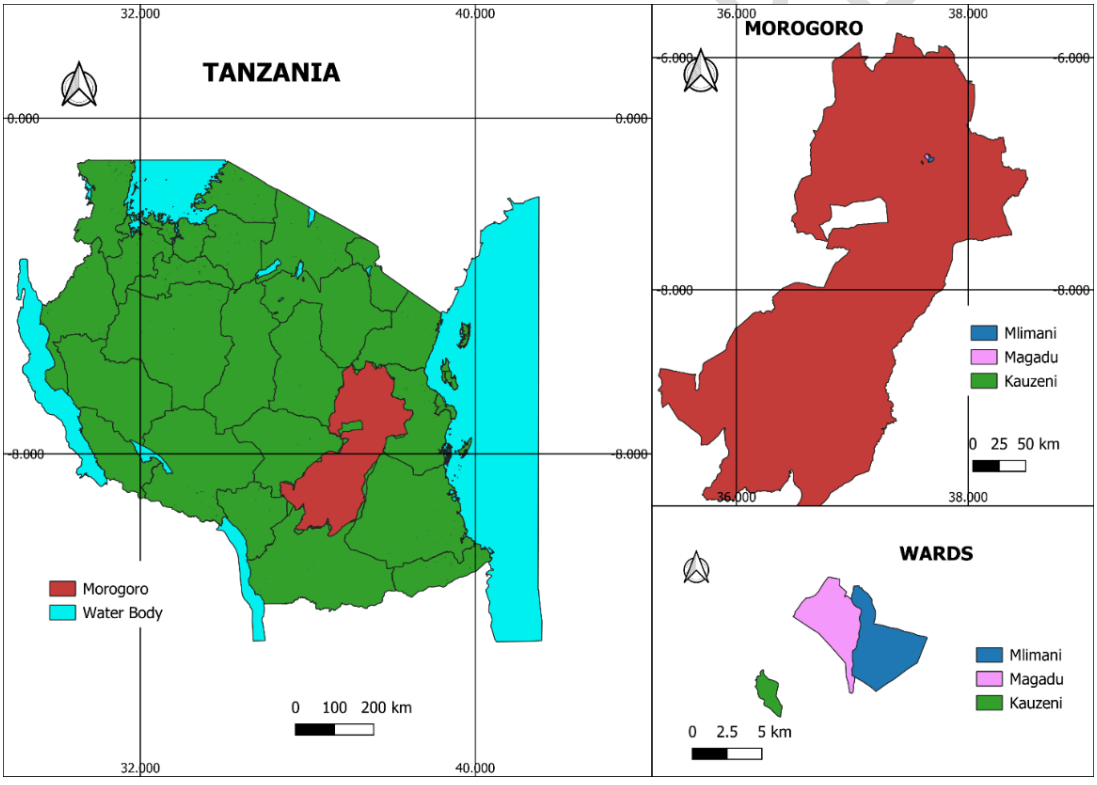

Figure 1. Location of the study Morogoro Municipality.

3.2 Research Design

The study adopted a cross-sectional design. (Setia, 2018) states that the design is associated with the benefits of its use in that the researcher's measure involves collecting particular information at a given time from respondents, and also allows the researcher to check how someone is exposed

to a certain thing and what happens as a result. The design provides a snapshot of ideas, opinions, and information on activities performed by the RIPAT-SUA project, factors affecting the performance of the RIPAT-SUA project, and the effects of the project intervention on food security. However, the limitation of this design is the inability to establish causality between variables since data is collected at once. Hence to tackle this limitation the study performs a strong statistical analysis to investigate correlations among variables and identify potential confounding factors.

3.3 Sampling Procedure and Sample Size.

A purposive selection procedure was used to select 110 farmers who are beneficiaries of the RIPAT-SUA project because targeted farmers received interventions from the RIPAT-SUA Project. According to the human population census of 2022, Morogoro municipality has a total population of 471 409 while the project was implemented in two districts Morogoro municipality and Mvomero. The project was implemented for 250 farmers in Morogoro municipality which will also be taken as the study population.

Sample size.

The study used Yamane's formula of 1967 to determine its sample size. The precision level used is 7% statistically for the objectives of the study, this degree of precision guarantees that the projected sample size is reliable and statistically significant.(Stadtländer, 2009).

$$n = \frac{N}{1 + N(e^2)}$$

Where:

n = Sample size**,**

N = Population size (250), and

e = Level of precision (7%)

$$\boldsymbol{n} = \frac{250}{1 + (250\, x(0.07)^2)}$$

n = 112.3595505617 ~ 113

3.4 Data Collection

A structured Questionnaire with both open-ended and close-ended questions was used to collect Quantitative data from the beneficiaries of the RIPAT SUA Project. The types of data to be collected include the contribution of the RIPAT project on food security, farmers' participation in the project, challenges faced during project implementations, and way forward in addressing challenges facing the implementations of agriculturally based projects.

The data that were collected using a questionnaire were analyzed using (STATA MP Version 17) software. Data cleaning was done to ensure the quality of the data. Descriptive statistics were used to analyze quantitative data; frequencies and percentages were generated to quantify the information. Moreover (Cameron, 2007; Li et al., 2019) the Bivariate probit model is utilized to

compute two binary outputs which can be mathematically described as two unobserved continuous latent variables. In this case study, smallholder farmers' adoption of fertilizer user measure is represented by Y_1^*, and their application of the intercropping system is represented by Y^*_2. The two latent variables that are not observed can be represented by equations (1) and (2).

Model specification

In the Bivariate Probit model, two equations are estimated jointly, each corresponding to one of the binary decisions:

$Y_1^* = X_1\beta_1 + €_1$ ---------- (1),

$Y^*_2 = X_2\beta_2 + €_2$ ---------- (2).

Where:

Y_1^* represents the latent variable for fertilizer use

Y_2^* represents the latent variable for intercropping practices

X_1 and X_2 are vectors of the explanatory variables for fertilizer use and Intercropping practices respectively

$€_1$ and $€_2$ are the error terms, used to follow a bivariate normal distribution with zero means, unit variance, and correlation *p.*

The collective distribution of both ($€_1, €_2$) errors has a variance of 1 and mean of 0. A vector of the independent variables with estimators β common to both outcomes is called variable x1. Equations (3) and (4).

$Y_1 = 1$ if $y^*_1 > 0$, otherwise $Y_1 = 0$ ---------- (3)
$Y_2 = 1$ if $y^*_2 > 0$, otherwise $Y_2 = 0$ ---------- (4).

4.0 Results and Discussion

4.1 Social Demographic Information of the Respondents.

The information displays participants' demographics in the RIPAT SUA Project, which aims to increase smallholder farmers' food security by encouraging appropriate agriculture inputs.

Table 1: Demographic information of the respondents (n= 110)

Respondents' characteristics	Category	Frequency	Percent (%)
Age	20 – 35	39	34.8
	36 – 45	17	15.2
	46 – 55	25	22.3
	55+	29	25.9

Gender	Male	42	38.2
	Female	68	61.8
Marital status	Married	89	80.9
	Single	5	4.5
	Divorced	11	10.0
	Separated	5	4.5
Household size	1-3	43	39.1
	4-6	59	53.6
	7+	8	7.3
Education level	Primary education	99	90.0
	Secondary education	10	9.1
	Collage/University Education	1	0.9

Age of respondents:

Results show that the majority of household heads were youth (34.8%) ranging from 20 to 35 remaining groups. The finding is consistent with Assenga and Kayunze, (2020) who found that the population was characterized by a young population. A few (15.2%) of the heads were in the age range of 36 to 45. The lower percentage of mature youth in a sample may be attributed to the tendency of matured populations to face the transition phase of their lives to migrate to urban to secure employment and low wages. These challenges can be addressed by improving access to education and employment opportunities can help to mitigate the challenges faced by youth.

Gender and Martial status of respondents:

Results show that the majority of respondents are female (61.8%). According to Assenga & Kayunze, (2020), gender plays an important role in household food security for both men and women with the implication that women contribute to agriculture through cultivators, and entrepreneurs in rural production. This is also, supported by Oduniyi and Tekana, (2020), who stated that rural females can engage in different agricultural activities such as gathering food, trading, and processing small agricultural produce which generate income. Concerning marital status (80.9%) of the households' heads were married; the rest had various marital statuses as seen

in Table 1 according to Assenga and Kayunze, (2020) married people are more likely to be food secure than single, divorced, and separated.

Education level of respondents

Results show that the majority of respondents fall under primary education (90%), compared to the rest of secondary education with 9.1% and college education with 0.9% the overall results imply that people with low education levels inhibit the majority of rural households in Tanzania. This result is supported by the study by Ngcamu & Chari, (2020); and Isaya et al., (2018) who found that the majority of rural people have low education which might affect food security negatively with the implication that education is vital in rural people as it fosters development in rural development as it is a key factor in rural people community.

Household size of respondents:

Results show that the majority of respondents fall under 4-6 members (53.6%). This household size is within the country's average of 4.7 members (Eurostat, 2023). According to Mwalukasa (2018), household size is important, which implies that some agricultural activities can be done by other members and enhance production. This is also supported by Ntwalle (2019), who argues that large household sizes are more likely to diversify due to an increase in labor availability.

4.2 Bivariate probit Analysis of Adoption of improved Agricultural Practices: Factors influencing Fertilizer Use and Intercropping.

The study utilizes a Bivariate Probit Regression model to evaluate the factors that influence smallholder farmers' decision to adopt improved agricultural practices, such as using fertilizer and intercropping. The study consists of seven key important factors. The model underscores the connection between adoption decisions and demonstrates the notable impact of factors such as access to credit, household income, extension services, and training on the likelihood of adoption.

Model Diagnostic Test:

Ensuring model robustness, the multicollinearity was checked using VIF diagnostic with a mean of 1.61, indicating low multicollinearity among predictors.

List 1: Result of Model Diagnostic Test

Variable	VIF	1/VIF
Access to credit	3.10	0.322141
Land Size	1.76	0.568226
Household income	1.74	0.574698
Extension Services	1.51	0.660578
Education	1.06	0.940805
Experience	1.04	0.962164
Training	1.02	0.977427
Mean VIF	1.61	

Household income in Table 2 highlights has a positive impact on fertilizer consumption, indicated by (a coefficient of 0.398 and a p-value of 0.044) a significant at the 5% level. This entails those

farmers with higher income levels were more likely to use fertilizer compared to farmers with lower income levels. The possible reason is that farmers with higher income levels can pay for the expenses related to fertilizer use, which enhances household output. This result is in agreement with Varma & Wadatkar, (2024) who argued that richer farmers often implement sustainable techniques by combining mineral and organic fertilizers to improve soil fertility and crop yields while lowering reliance on pricey chemical fertilizers. Similar, to Akol et al., (2023), who argued that African farmers opt for suitable agriculture methods such as the use of organic manure which offers better health production and soil health over chemical fertilizer which destroys the land fertility

Farm Size in Table 2 highlights has positive impact on intercropping practices indicated by (a coefficient of 0.348, $p = 0.098$) a significant at the 10% level. This entails those farmers with larger farmer sizes are more likely to engage in intercropping than those with smaller plots, because large farms offer flexibility, permitting farmers to undergo diverse cropping patterns, which can attribute productivity and land use efficiency. In keeping with these findings Werf, (2023) argued that greater biodiversity and natural pest management are made possible by a larger land area, which also makes crop variety and intercropping easier to execute. Similar to Bene et al., (2022) who argued that larger farm sizes can successfully support the simultaneous cultivation of various species, intercropping improves agriculture diversification and sustainability while optimizing resource use and ecological advantage.

Results reveal that farming experience has a favorable and statistically significant effect on intercropping adoption at the 10% level (coefficient; 0.972, p-value: 0.077). This suggests that compared to farmers with less experience, more experienced farmers are more motivated to use intercropping, demonstrating the need for knowledge in handling intricate farming systems. Findings show that experienced farmers can perfectly manage complex intercropping practices, leading to increased resilience and productivity, helping to minimize risk and maximize land utilization. This finding is consistent with Dugassa, (2023), who suggested that experienced farmers can enhance production and resilience through intercropping by mitigating risk associated with pests and optimizing resource allocation. Just like Huss et al., (2022), who suggested that having skills in agriculture can help farmers make the most out of their land, increase productivity, and enhance resilience in intercropping methods, thus reducing the chance of scarcity of resources and crop failure. Conversely, farming experience has a negative statistically significant effect on fertilizer use with (coefficient -0.79, p-value: 0.087), highlighting those experienced farmers do not prefer the use of chemical fertilizer over organic farming techniques. The disparities impact of experience may be affected by experienced farmers tend to choose sustainable methods, which insist on minimizing the use of chemical fertilizer and effectively managing various cropping systems to enhance food security and resource utilization. This result aligns with S et al., (2024) observed that the use of natural inputs in farming practices enhances soil health, reduces costs, and aligns with experienced farmers' priorities for sustainable and chemical–free agriculture. Similar to Zhou et al., (2022) who argued that experienced farmers opt for organic fertilizers which improve soil structure and crop yield, insisting that traditional fertilization suggestively increase

yields then organic incorporation enhances soil quality, highlighting a suitable preference for sustainable practices among farmers.

Concerning Training from the project; the results reveal that training has benefits and a greatly important effect on the adoption of intercropping at the 1% significance level (coefficient: 0.847, p-value: 0.006). This entails that trained farmers have a much higher chance of embracing intercropping. This highlights the important function of farmers' training programs in advancing sustainable agriculture practices which offer necessary skills and knowledge. As observed by Mosonsieyiri et al., (2021), providing training to farmers gives them the technical know-how needed to implement intercropping systems, leading to increased crop yields and greater sustainability on the farm. Similar training enhances the adoption and upkeep of Sustainable Land Management technologies, to encourage the adoption of Sustainable Land Management among a variety of smallholder farmers, training might provide an affordable solution.

Concerning Access to credit the project results reveal that in access to credit, there is a strong influence of adoption among farmers with intercropping at the 10% significance level (coefficient; 0.941, p-value: 0.094). This result entails that the ability of farmers to adopt intercropping is attributed to easier getting credit access, as it allows farmers to invest in various crop systems and required inputs. Also, access to credit enables farmers to get funds to purchase seeds and the necessary resources needed for implementing the techniques. This confirms the point made by Shadrack Akporawo et al., (2022) who argued that having access to credit in agriculture greatly boosts small-scale farmers' ability to produce more, contributing to better food security and household welfare also, facilitating the purchase of essential agricultural inputs and embracing modern technologies ultimately improves income stability and eradicates poverty. Similar to Obagbemi et al., (2022) access to credit enables farmers' production system to purchase appropriate inputs like fertilizer and seeds ultimately increasing production and income stability.

Table 2. Factors that influence Fertilizer use and Intercropping Adoption among Smallholder Farmers: A Bivariate Probit Regression: (N=110).

Fertilizer Use	Coef.	Robust St.Err.	t-value	p-value	Sig
Education	-0.346	0.404	-0.86	0.392	
Experience	-0.79	0.462	-1.71	0.087	*
Access credit	-0.072	0.428	-0.17	0.867	
Farm Size	-0.203	0.132	-1.54	0.124	
Household Income	0.398	0.198	2.01	0.044	**
Extension services	0.253	0.305	0.83	0.407	
Training	-0.267	0.253	-1.06	0.291	
Constant	-3.084	2.468	-1.25	0.211	
Intercropping					
Education	0.191	0.401	0.48	0.634	
Experience	0.972	0.514	1.89	0.059	*
Access to credit	0.941	0.562	1.68	0.094	*
Farm Size	0.348	0.21	1.65	0.098	*
Household Income	0.343	0.231	1.49	0.137	

Extension Services	0.051	0.363	0.14	0.889	
Training	0.847	0.31	2.73	0.006	***
Constant	-5.547	3.039	-1.83	0.068	*
athrho	-0.039	0.182	-0.22	0.829	
Mean dependent var	0.8		SD dependent var		0.402
Number of obs	110		Chi-square		26.879
Prob > chi2	0.02		Akaike crit. (AIC)		267.285

*** p<.01, ** p<.05, * p<.1

4.3. Marginal Effect of Bivariate Probit Model on factors that influence agriculture practices.
By utilizing the bivariate probit model, table 3, below reveals the marginal effect of different factors on the adoption of agriculture practices. The study investigates how education, credit access, Land size, experience, extension services, household income, and training affect the likelihood of smallholder farmers' adopting certain practices. The findings insist on the importance of having access to credit.

Table 3. Marginal Effect of Bivariate Probit Model on Factors that Influence Agriculture Practices

variable	dy/dx	Std. err	z	P>z
Education	-0.093	0.14	-0.66	0.507
Experience	-0.024	0.135	-0.18	0.856
Access to Credit	0.07	0.155	0.45	0.652
Farm Size	-0.028	0.044	-0.64	0.521
Income Household	0.169	0.076	2.22	0.027
Extension Services	0.089	0.108	0.82	0.411
Training	0.009	0.089	0.1	0.918

Based on the marginal effects findings in Table 3, reveal that a household's income has a statistically significant positive impact (P =0.027), with a marginal effect of 16.9%. This suggests Households with high incomes are more likely to adopt agriculture practices under study. This highlights that financial capability directly supports farmers' ability to invest in improved farming techniques, which aligns with research by Kurgat et al., (2020), indicating that having access to financial resources may boost agriculture investment by adopting specific practices that may not always result from them unless other factors such as awareness or training, are taken into consideration. Similarly, smallholder farmers' freedom in resource allocation may be restricted by responsibilities associated with financial resources, as indicated by research from Lazaro & Alexis, (2021). While training significantly influenced the intercropping according to the bivariate probit model result (Table 2), its impact was not demonstrated statistical importance (Table 3). This variation could designate that training effectiveness may be affected by other factors such as household income or experience, rather than just having a straightforward, independent impact. Hence, while training programs can be beneficial, they might not be sufficient on their own to promote adoption without supporting factors like financial aid or extension services.

5.0 Conclusion and Recommendation:

The findings display that the age, gender, marital status, education level, and household size of smallholder farmers are vital factors influencing agriculture practices and food security results. The majority of participants were youthful, women, married, and had elementary schooling, mirroring, the demographic of rural areas in Tanzania. Limited educational attainment and extensive family sizes, point to the available workforce for farming, underscoring the importance of education and empowerment initiatives in enhancing food security.

The analysis of the adoption of improved agriculture techniques using a bivariate probit model reveals that, household income, farming experience, farm size and training significantly influence farmers' choices to adopt fertilizer use and intercropping. Interesting, increased household income was found to have impact on fertilizer usage suggesting that farmers with money are more likely to spend on fertilizer to enhance productivity. On the other hand, intercropping was significantly influenced by farm size and training, emphasizing the importance of large farms and agriculture education in promoting varied cropping methods. Additionally, farmers with experience were more motivated to incorporate intercropping, emphasizing the significance of hands-on experience in handing intricate agriculture practices.

Despite the efforts made by the RIPAT SUA Project to encourage smallholder farmers to adopt improved agriculture practices, such as fertilizer and intercropping, the findings entail further improvements needed to increase efficiency and productivity. According to the research, while training had a significant impact on the bivariate probit model, it had no significant impact on the marginal effect suggesting that training by itself may not be enough to drive adoption without additional resources. The RIPAT SUA Project should adopt a comprehensive approach that includes not just only expanding training programs but also ensuring alignment with financial assistance and extension services, specifically for farmers with limited education, and synchronizing with available credit programs. This well-synchronized approach would help farmers effectively embrace and maintain better agriculture practices ultimately assisting increased productivity and food security.

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