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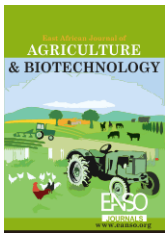

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Original Article

Stochastic Frontier Analysis of Technical Efficiency of Smallholder Maize Farmers in Morogoro Municipality: A Reflection from RIPAT Program

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Keywords: *Maize Production, RIPAT SUA Project, Stochastic Frontier, Technical Efficiency, Morogoro Municipality.*

ABSTRACT

This study looks into the elements that influence maize production and technical efficiency among households participating in the RIPAT SUA Project in Morogoro Municipality, using stochastic frontier analysis for the 2022 – 2023 season. The focus was on socio-economic characteristics, land size, seed usage, use of fertilizer extension services, training from the project, and education. The primary objective was to examine the factors influencing maize production and efficiency by evaluating socioeconomic aspects and specific agricultural techniques. A total of 110 households were surveyed with standardized questionnaires. Socioeconomic data was collected, key variables were evaluated and key variables were analyzed using descriptive statistics and stochastic frontier analysis. The results reveal that land size harms productivity ($\beta = -0.436$, $p < 0.001$), whereas improved seed usage has a positive impact ($\beta = 0.401$, $p = 0.016$). Education level ($\beta = -1.168$, $p = 0.002$) and agriculture experience ($\beta = -0.016$, $p = 0.049$) considerably reduce technical inefficiency, insisting on the importance of education interventions. Additionally, 40% of households have access to VSLA, revealing financial problems. While 94.55% of households got training, only 18.18% received extension services which could hamper the best productivity. Every household reported owning land and using seeds highlighting that they had the necessary materials for maize production. Regarding technical efficiency, Magadu ward high score of 5%, while Kauzeni has the lowest at 1.9% suggesting significant disproportions in productivity among wards. These findings emphasize the importance of focused initiatives to improve agriculture productivity through enhancing farmer education and training, experience, and increased access to finance. These strategies are critical for improving maize productivity and addressing food security issues among households participating in programs like the RIPAT SUA initiative hence will increase agricultural efficiency and contribute to more farmer-sustainable farming methods throughout the region.

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INTRODUCTION

Agriculture remains the cornerstone sector for most developing countries, particularly in sub-Sahara Africa which plays a crucial role in economic development, food and nutrition security, and poverty reduction (Anang, & Ayambila, 2020; Tenaye, 2020; Tanumihardjo et al., 2020) The agriculture sector in Tanzania includes different sub-sectors like fishing, livestock keeping, hunting, and forestry which play an important pillar in the country's economy and are sources of livelihood for its citizens (Anne. g., & m., 2020 and Miho, 2018). Also, the agriculture sector will contribute 28 percent of the GDP, about 75 percent of raw materials, and 25 percent of export earnings in 2021 (URT, 2021). Therefore, agriculture continues to be the most important sector, which serves as the main sector fighting against food insecurity and the income-generating sector.

In Tanzania, maize is produced in almost all the regions where 45 percent of arable land is used to cultivate maize followed by paddy and sorghum (Djurfeldt et al., 2020; Miho, 2018). Maize production contributes to 70 percent of the cereal produced in the country and is consumed in both rural and urban areas, but still, the production faces numerous challenges such as climatic conditions, and failure to meet financial capacity for the production process by farmers where the majority are 80 percent are smallholders farmers, and it is used for both subsistence and cash crop whereas 65 – 80 percent is produced and consumed within the households and 35 percent for commercial purpose Anne. g., & m. (2020). To facilitate the increase of maize production various organizations (International and Local), and philanthropic foundations have put a lot of effort into project interventions to address these challenges. This is done to achieve Sustainable Development Goal Two zero hunger (SDG2) by 2030 which aims to provide food security and improved nutrition for all remains a challenging undertaking, even with the concerted efforts of global and local organizations (AATF, 2010).

Despite many interventions that have been implemented around the region to improve food security Sub – Sub-Saharan Africa remains the world's most insecure with almost one-fourth of people over 230 million being undernourished (Gassner et al., 2019). In the past decades' studies conducted on food security have intensified that there is an increase in food insecurity which is caused by many factors including natural hazards, conflicts, economic crises, disease, and politics (Gwaka, & Dubihlela, 2020). In light of this, it is critical to consider initiatives aimed at enhancing food security particularly maize production throughout the region. This research aims to offer insight into regional dynamics within the larger context of food security in Sub-Saharan Africa by

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exploring the factors impacting the effectiveness of maize production interventions at the household level.

Tanzania is one of the nations in Sub-Saharan Africa that is facing difficulties related to maize production due to pests, drought, and infestation by insects. A third of Tanzanians experience food insecurity, which is made worse by the country's 3% annual population growth rate, which is expected to triple by 2050 (Kuntosch, & König, 2018). The mechanisms that produce and distribute food are under tremendous strain as a result of this demographic growth. This demographic pressure attributed to the impact of climate change, highlights the need for effective interventions to boost maize productivity. Tanzania's agriculture industry, which is not only a major economic engine for the nation but also a major force behind rural development, intensifies this problem (Snyder et al., 2020; Mtui, 2023). However, the picture of maize production level is further complicated by Tanzania's agricultural systems' exposure to climate change.

Maize production is made worse by climate change-related phenomena such as irregular rainfall patterns, protracted droughts, and a rise in the frequency of extreme weather events. These phenomena have a direct influence on agricultural productivity. This makes it imperative to investigate the variables influencing the effectiveness of maize production initiatives in Tanzania, especially in areas such as Morogoro Municipality. By undertaking regional agricultural issues and increasing livelihoods, these interventions—like the Rural Initiatives for Participatory Agriculture Transformation (RIPAT) SUA—play a critical role in enhancing food security, particularly maize production. Morogoro is therefore a useful case study to comprehend the complexities of food security dynamics and the efficiency of project interventions in reducing these difficulties.

Innovative approaches have proven crucial in reducing food insecurity among rural small-scale farmers in Morogoro Municipality, where agricultural issues continue to persist. The Rural Initiatives for Participatory Agriculture Transformation (RIPAT) SUA project is one example of such an intervention. RIPAT SUA promoted food security through sustainable farming techniques, intending to close the gap in agricultural technology and improve rural farmers' standard of living. From 2017 to 2021, Research Community and Organizational Development Associates (RECODA) carried out the project in association with Sokoine University of Agriculture (SUA). RIPAT SUA focused on educating smallholder farmers on crop production techniques and animal management (including hen, goat, and pig) as well as giving them access to suitable agriculture seeds for beans, bananas, maize, and potatoes. The project aimed to boost agricultural output, promote self-sufficiency and ultimately improve food security by equipping farmers with the required tools and knowledge.

As one of the main interventions of the RIPAT SUA Project, we particularly concentrate on maize production in our study. The research aims to improve maize productivity in the study area by emphasizing new technology practices such as the application of organic manure, quality seed, and access to credit through Village Saving and Loan Associations (VSLA). In Tanzania, maize is especially important when it comes to food security. As a staple crop, maize is essential to the country's ability to feed its people. Tanzania is a maize-dependent country, with small-scale agriculture accounting for around 80% of the country's maize production, mostly in rainfed, low-input environments. Moreover, between 65 and 80 percent of the maize produced is eaten by the households that generate it (Wilson & Lewis, 2017).

Increased production of maize directly impacts household food security in the study region because of the crop's pivotal position in Tanzanian agriculture and consumption patterns. Through the implementation of enhanced agricultural techniques made possible by the RIPAT SUA Project, households can increase the output of maize, thereby mitigating the risk of food scarcity and improving overall nutritional results. As, the effectiveness of such intervention aims to improve

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food security, particularly maize production. Several studies have underlined the importance of maize production for food security in Tanzania, where small-scale, rainfed agriculture provides a large amount of the country's maize output, (Jin et al., 2022; Kilombele et al., 2023; Ahmad, & Msinde, 2023). The RIPAT SUA Project has introduced new agricultural technology practices such as the usage of applied fertilizer, improved seeds, access to extension services, and access to loans through Village Saving and Loan Associations (VSLA), to boost maize yield. However, the impact of these interventions on maize production efficiency and household food security is uncertain, particularly in light of varied socioeconomic and demographic characteristics. This study intends to analyze the effectiveness of the RIPAT SUA Projects' interventions in boosting maize productivity and food security in the study area, by analyzing how different factors influence the technical efficiency of maize production.

To improve food security globally, in sub-Sahara Africa and Tanzania specifically, the research aims to contribute to valuable knowledge by examining key factors affecting the performance of project intervention on maize production to households based on these three wards (Magadu et al., Kauzeni) context where the intervention was conducted. The result of the research will contribute much to stakeholders, to create a focused future and efficient interventions with better outcomes.

THEORETICAL FRAMEWORK.

This study was guided by the theory of Production. The theory describes the relationships between inputs and outputs in the production process. It describes how inputs of production are converted into semi or finished goods. The ratio between factors of production and the amount of output produced is known as technical efficiency. Technical efficiency shows how many factors of production are needed to produce one unit of output (Felipe, & Adams, 2005)

The use of the Theory of Production is especially relevant in the context of donor-funded programs such as RIPAT SUA. By tackling noted inefficiencies common in many developing countries, these projects seek to improve technical efficiency in food production (Balana et al., 2022). Increasing food availability, accessibility, stability, and utilization all essential components of food security is the ultimate aim of such initiatives.

The distribution of quality seeds or farming equipment, for example, is a practical example of how RIPAT SUA initiatives correlate with the theory's emphasis on technological efficiency. Through the provision of superior inputs and technologies, the project seeks to maximize resource utilization and augment agricultural output for farmers.

Enhancing agricultural production's technical efficiency with RIPAT SUA interventions makes a unique contribution to every aspect of food security. Such as increased production makes food more readily available, guaranteeing a consistent supply of food in communities. Increased productivity can reduce production costs, allowing households to purchase and have access to food at a lower rate. Furthermore, surplus output brought about by higher efficiency improves food stability by acting as a safeguard against future disruptions or shortages. Finally, extra food can be sold to raise money for homes and improve their level of food security.

The Theory of Production has been used in several studies to analyze how agricultural interventions affect food security, offering empirical evidence for its applicability in comparable situations (Squires, & Gaur, 2020). The theoretical framework for this study served as a guide for the design of the data collection tools, the variables that were chosen, and the interpretation of the findings. The study intends to shed light on how RIPAT SUA interventions affect food security outcomes in Morogoro Municipality by using this perspective.

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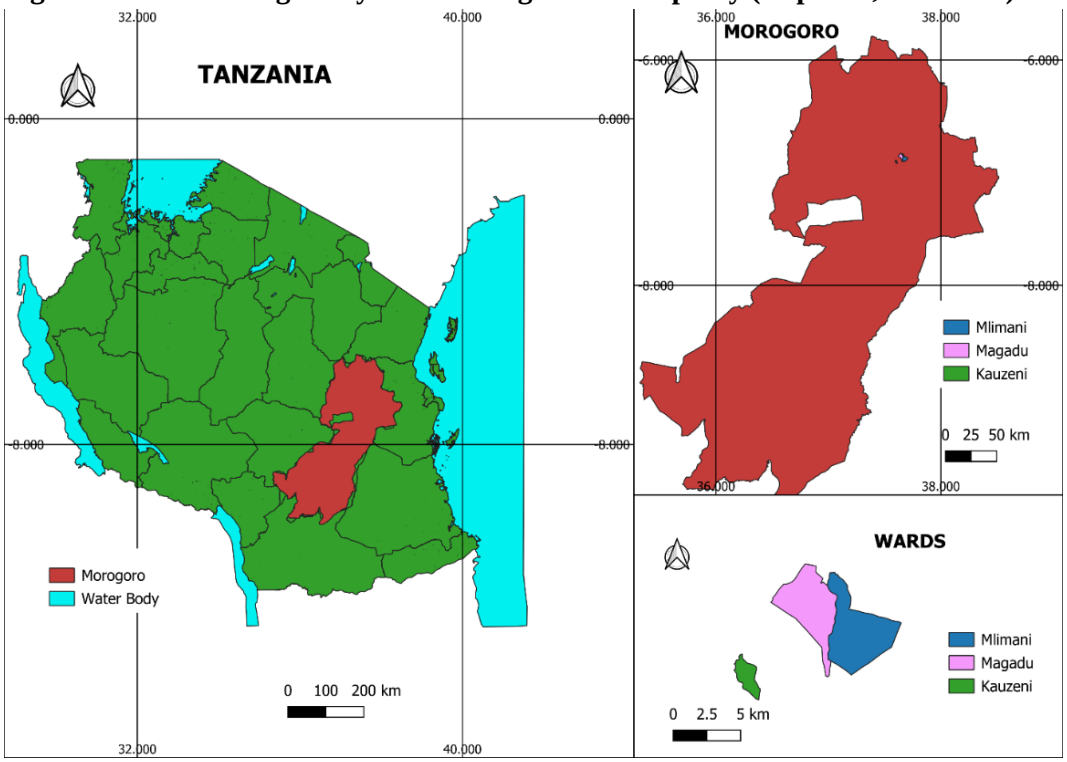
It's crucial to recognize any potential drawbacks or objections to using production theory in this situation, though. The theory's assumptions might not fully account for the complexity of smallholder agricultural settings, and the target population's socioeconomic situation might have an impact on how applicable the theory is. However, this study seeks to offer a nuanced understanding of the relationship between food security outcomes and technical efficiency in food production by admitting these constraints (Gollin, 2014)

METHODOLOGY

Study Area

The study on which this paper is based was conducted in the Morogoro Region, which is 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's arable land is 11,844ha out of 4,623,005ha of Morogoro region. The nature of the soil in the mountains area is mainly Oxisols which are general in nitrogen and phosphorus, valley and lowland areas are generally characterized by alluvial soils which are fertile in nature. Morogoro Municipality is famous for producing both food and cash crops, especially Maize 6.6%, paddy 5.8% other crops 11.8%, region peas 16.9% and sugarcane 59.4% (URT, 2020). 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 (URT, 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: The Showing Study Area Morogoro Municipality (Raphael., et al 2024).



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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.

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

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.

Data Analysis

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; specifically, frequencies and percentages were generated to quantify the information. Moreover, stochastic frontier Analysis was used to assess the technical efficiency of socio-economic and technological factors on maize production of RIPAT SUA project beneficiaries on the chances of the desirable option of the outcome variable food security occurring at the $p < 0.05$ level of significance, which corresponds to a 95% Confidence Interval (C.I.).

This study uses the stochastic frontier production function model which has the advantage that it allows for simultaneous estimation of individual technical efficiency of the respondent farmers as well as determinants of technical efficiency (Battese, G.; Coelli, 1995). Technical efficiencies and their determinants were determined using a one-step maximum likelihood estimates (MLE) approach, as described by Battese, G., &Coelli, (1995). This involves integrating the model for technical efficiency impacts into the production

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function. This study applies the flexible trans-log specification to the stochastic frontier production function and uses a log-likelihood ratio test to evaluate if it reduces to the Cobb-Douglas function. The trans-log model is defined as follows.

The Model Equation is;

$Ln(Y_i) = \beta_0 + \beta_1 \ln(X1_i) + \beta_2 \ln(X2_i) + \beta_3 \ln(X3_i) + \beta_4 \ln(X4_i) + \beta_5 \ln(X5_i) + \beta_6 \ln(X6_i) + \beta_7 \ln(X7_i) + \beta_8 \ln(X8_i) + Vi - Ui$

Whereas *Ln (Yi)* = Ln-Maize product in kilogram per Acre

Ln (X1i) to ln(X8i) represent natural logarithms of the input variables (land, seed, fertilizer, Education, Experience, Age, Income, and access to credit) for the ί-th farmer

β_0 is the intercept and $\beta_1$to β_8 are coefficients associated with each input?

V_i is the stochastic error term capturing random noise, assumed to be normally distributed V_i ~N(0, ϑ²v)

U_i is the non-negative error representing technical inefficiency, assumed to follow a half-normal distribution U_i ~N|0, ϑ²v|.

This model specification makes it possible to measure each input's effect on output and to compare each farmer's technical efficiency.

RESULTS AND DISCUSSION

The results from the table were carried out to identify resources accessible by households and project-related interventions. This method supports identifying resource availability and intervention handling gaps, critical to increasing agriculture productivity.

Table 1: Resources Accessible among Households Involved in the Project to Enhance Productivity (n= 110)

Accessible resources	Categorical	Frequency	Percentage
Access to VSLA.	Yes	44	40%
	No	66	60%
Training	Yes	104	94.55%
	No	6	5.45%
Extension services	Yes	20	18.18%
	No	90	81.82%
Land Ownership	Yes	110	100%
	No	0	0
Usage of seeds	Yes	110	100%
	No	0	0

The findings in Table 1, reveal different resources available among households participating in the RIPAT SUA project. Specifically, just 40% of respondents reported having access to Village Saving and Loan Associations (VSLA), displaying the majority of respondents lack financial resources, which could influence their agriculture productivity. In contrast, 94.55% of households have received training programs, signifying a significant commitment to improving agriculture practices. Nevertheless, access to extension services remains partial, with only 18.18% profiting from such support, which may limit their ability to implement progressive agriculture techniques effectively. Significantly, all households reported land ownership and seed usage, suggesting they possess the essential resources for maize production. This finding is consistent with the work of (Landa, 2018; Konte, & Tetteh, 2023) who emphasized that access to training and financial resources significantly enhances productivity.

Stochastic Frontier Analysis of Maize Productivity, Determining Factors Affecting the Performance of RIPAT SUA Project Intervention on Maize Production among the Households in the Study Area

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The stochastic frontier production function model was used in an empirical study to evaluate the technical efficiency of maize producers in the 2022–2023 growing season. The model included eight independent factors that are believed to have a significant impact on maize productivity: income, VSLA access, education, experience, land size, fertilizer use, and seed consumption. The sections that follow provide more specific information on the stochastic frontier analysis results with a Log likelihood value of -118.02179, Wald chi-square was (3) = 33.91, and probability of chi-square value of p > 0.000

Table 2: Stochastic Frontier Analysis Results of Factors Affecting Maize Production (n=110)

Ln-Maize /Acer	Coefficient	Std. err.	z	P>z
Ln-Maize /Acer				
Ln-improved seed	0.401002**	0.1657888	2.42	0.016
Ln-Land	-0.4368293*	0.0808325	-5.4	0.000
Ln-fertilizer	-0.0027613	0.173239	-0.02	0.987
_cons	5.269686	0.4247313	12.41	0.000
Inefficiency				
Age	0.0154689	0.0082762	1.87	0.062
Education	-1.167877**	0.3844243	-3.04	0.002
Experience	-0.0157653**	0.0080131	-1.97	0.049
Income	-0.0743504	0.0893929	-0.83	0.406
Training	-0.1197319	0.5077138	-0.24	0.814
Extension	0.1340994	0.1985647	0.68	0.499
Access to VSLA	0.0934543	0.1516446	0.62	0.538
_cons	2.394375	1.247702	1.92	0.055
/lnsigma2	-0.6919603	0.1348551	-5.13	0
/lgtgamma	-5.584153	.	.	.
sigma2	0.5005938	0.0675076		
gamma	0.0037429	.		
sigma_u2	0.0018737	.		
sigma_v2	0.4987201	.		

Note: *is significant at 1%, ** is significant at 5%.

In Table 2, the land variable is significant at the 1% level of significance. The results show that the coefficient for this variable is negative, which matches the expected sign. Farmers with larger land holdings may struggle to sustain total productivity. The -0.436 coefficient indicates that each extra unit increase in land size reduces maize productivity by 0.436 units. This means that farmers with larger landholdings may be less efficient, most likely because they struggle to manage and invest in all parts of their land efficiently. As land size grows, resource utilization efficiency may decrease, resulting in lower productivity per unit of land. This finding is consistent with studies undertaken by (Jayne et al., 2022; Makate et al., 2019). Who discovered that larger landholdings can contribute to agricultural inefficiency? The RIPAT SUA Project should consider focusing on intensive rather than extensive agricultural practices to maximize output on current land, rather than just expanding farmed area.

The improved Seed variable in Table 2 reveals that the seed coefficient is positive and significant at the 5% level, consistent with the expected direction. A positive coefficient suggests that increasing the usage of improved seed per acre improves farm productivity. The coefficient of 0.401 indicates that a 1-unit increase in seed amount results in a 0.401-unit rise in maize yield. This finding shows that households that use more seeds are likely to be more productive. This variable's relevance emphasizes the need to provide farmers with appropriate access to excellent seeds, as it is strongly correlated with greater maize productivity. This finding is consistent with earlier research, which

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emphasizes the importance of seed quality and quantity in increasing agricultural productivity (Mutungi et al., 2019; Edson, & Akyoo, 2021).

The Determinants of Technical Inefficiency in Maize Production

Various factors were incorporated into the one-step stochastic frontier estimation approach to analyze the causes of technical inefficiency. The findings revealed three significant variables at a 5% level that influence the technical inefficiency of maize production among the RIPAT SUA project households. The interpretations for the other variables were done as follows:

The education variable is statistically significant at the 5% level. Education serves as a proxy for knowledge and skill acquisition. Higher levels of education indicate better access to information and contemporary agricultural techniques, especially in rural areas where traditional farming methods may prevail. The negative coefficient indicates that increased education reduces the inefficiency of maize-producing farmers. According to the study's findings, a 1% increase in the family head's education level reduces farmers' technical inefficiency by 1.16%. This finding supports the premise that investment in farmer education might lead to improved management of farming operations and resources, resulting in increased overall output. Unlikely outcomes are documented in studies such as those conducted by (Isidore et al., 2018; Msangya, 2019), who emphasize the relevance of education in improving agricultural efficiency. The RIPAT SUA Project should explore including instructional sessions for farmers as part of its productivity-boosting plan. This strategy could help to improve farming techniques and resource management, resulting in more efficient and productive agricultural operations.

The variable Experience has a negative coefficient of -0.015, indicating significance at the 5% level. This suggests that decreased technical inefficiency is linked to increased agricultural expertise. There is a 0.015% reduction in inefficiency for every 1% gain in farming experience. This finding strengthens the idea that more seasoned farmers are more adept at resource management and practice optimization, which increases maize production efficiency. This result is in alignment with several studies which agree that Tanzanian farmers with experience gain from subsidies for agricultural inputs and extension services, which increase the efficiency of maize production by improving their ability to manage resources (Malimi, 2023; Anang, & Ayambila, 2020).

Technical Efficiency from the SFA Model:

Technical efficiency is defined as the ratio of the observed output (Y) to the corresponding frontier output (Y*) conditional on the levels of inputs used by the firm. In the context of the stochastic frontier production function Equation, technical efficiency is given by

Equation: $TEi = exp\ (-\hat{u}\ i)$

Farmers' technical efficiency Table 3: reveals the technical efficiency and inefficiency among the farmers with considerable variation across the sample. The maximum technical efficiency score is 0.05, indicating that most farmers are operating almost efficiently. Furthermore, the minimum technical efficiency score is 0.002 implying that some farmers are completely inefficient with poor potential productivity. This emphasizes the importance of intensive efforts to improve efficiency through education, better resource management, and adopting best farming practices. Addressing these inefficiencies has a substantial potential to boost productivity and the livelihoods of the farmers included in the study area.

Table 3: Descriptive Statistics of Technical Efficiency of each Smallholder Farmer (n=110).

Variable	Obs	Mean	Std. Dev.	Min	Max
efficiency	110	.012	.007	.002	.05

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Wards technical efficiency Table 4: reveals the technical efficiency among the wards based on the maximum score. Magadu ward has a high technical efficiency of 5% implying that few farmers in the wards are showing a bit higher potential by obtaining high productivity compared to Kauzeni ward with the lowest maximum technical efficiency of 1.9% indicating low performance which leads to low productivity across its farmers. In contrast, the Mlimani ward reveals a moderate level of maximum technical efficiency of 2.7%, reflecting an intermediate level of performance. The differences in maximum technical efficiency suggest that Magadu ward is operating better in terms of efficiency compared to Mlimani and Kauzeni facing great inefficiencies which calls for more effort to boost their technical efficiency.

Table 4: Summary Statistics of Technical Efficiency among Wards (n=110)

Kauzeni ward	N	Mean	SD	Min	Max
efficiency	38	0.009	0.003	0.004	0.019
Magadu ward					
efficiency	50	0.014	0.009	0.002	0.05
Mlimani ward					
efficiency	22	0.012	0.005	0.004	0.027

CONCLUSION AND RECOMMENDATION

Conclusion and Recommendation:

The study focused on assessing the technical efficiency of maize production among beneficiaries of RIPAT SUA project households and identifying the socioeconomic and farm-specific factors influencing this efficiency. A stochastic frontier analysis model was used for the investigation which revealed that the farmers' technical efficiency varied significantly, with a mean efficiency score of 53.7%. These efficiency ratings suggest significant room for improvement. The resources available in facilitating maize production among households' results reveal that 40% of the majority have access to Village Saving Loan Associations (VSLA), while a significant majority received training, whereas access to extension services was very low with only 18.18% benefit. Importantly the majority reported owning land and using improved seeds. These results reveal that financial restriction and training play a vital role in enhancing agricultural productivity in the study area.

The results from stochastic analysis explained that land area, education level, and seed consumption have a considerable effect on maize productivity. The negative impact of increasing land size on production indicates that the farmers may struggle to manage and invest efficiently across big plots. Level of education, experience, and increased improved seed usage, on the other hand, have a beneficial impact on productivity, projecting the significance of knowledge and quality inputs in improving agricultural efficiency.

Despite the effort injected by RIPAT SUA projects to boost food security specifically on maize production through the adoption of appropriate training, agriculture inputs, and techniques, the results show that more needs to be done to improve the efficiency and productivity of the participating farmers. Firstly, the project should add more effort to training programs to boost knowledge and skills, especially targeting those with only primary education. Secondly, the project should seek partnerships with seed companies to provide quality seed at affordable prices to farmers. Thirdly the project should emphasize more on intensive land practices that maximize output on small plots of land and lastly, experience considerably reduces inefficiency, thus the project should investigate building peer-learning platforms where experienced farmers can share their knowledge with younger or less experienced farmers.

REFERENCE.

AATF. (2010). Mitigating the Impact of Drought in Tanzania. *The WEMA Intervention, 0.*

Article DOI : https://doi.org/10.37284/eajab.7.2.2397

http://www.aatf-africa.org/userfiles/WEMA-TZ-policy-brief1.pdf.

Ahmad, A. K., & Msinde, J. (2023). *Impacts of Sustainable Agricultural Practices on Food Security, Nutrition, and Poverty among Smallholder Maize Farmers in Morogoro region, Tanzania*. *4*(2022), 1091–1104.

Anang, B. T., & Ayambila, S. N. (2020). Participation in Agricultural Extension and Labor Productivity: A Case Study of Smallholder Farmers in Ghana. *International Journal on Food System Dynamics*, *11*(3), 297– 306. https://doi.org/10.18461/ijfsd.v11i3.55

Anne. G., G., & M., K. (2020). Resource Use Efficiency in Maize Production by Small-Scale Farmers in Two Districts of Mwanza Region, Tanzania. *International Journal of Regional Development*, *7*(1), 27. https://doi.org/10.5296/ijrd.v7i1.17162

Balana, B. B., Ogunniyi, A., Oyeyemi, M., Fasoranti, A., and Edeh, H. (2022). COVID-19, food insecurity and dietary diversity of households: Survey evidence from Nigeria. *Food Security*, *February 2020*. https://doi.org/10.1007/s12571-022-01312-w

Battese, G.; Coelli, T. (1995). |EEEiiI/ECONOM. *Journal of Econometrics*, 325–332.

Commission, T. H. E. P., Salaam, D. A. R. E. S., & Office, R. C. S. (n.d.). *The United Republic Of Tanzania Morogoro Region Socio-Economic Profile*.

Djurfeldt, A. A., Hall, O., Isinika, A., Msuya, E., & Yengoh, G. T. (2020). Sustainable agricultural intensification in four Tanzanian villages—a view from the ground and the sky. *Sustainability (Switzerland)*, *12*(20), 1–20. https://doi.org/10.3390/su12208304

Edson, S. A., & Akyoo, A. M. (2021). Implication of quality uncertainty on market exchange: The case of seed industry in Kilolo district, Tanzania. *Emerald Open Research*, *2*, 31. https://doi.org/10.35241/emeraldopenres.13447.3

Felipe, J., & Adams, G. F. (2005). A Theory of Production. The estimation of the Cobb-Douglas function: a retrospective view. *Eastern Economic Journal*, *31*(3), 427–445. http://www.jstor.org/stable/40326423%5Cnhttp://college.holycross.edu/RePEc/eej/Archive/Volume31/V31N3P427_445.pdf

Gassner, A., Harris, D., Mausch, K., Terheggen, A., Lopes, C., Finlayson, R. F., & Dobie, P. (2019). Poverty eradication and food security through agriculture in Africa: Rethinking objectives and entry points. *Outlook on Agriculture*, *48*(4), 309–315. https://doi.org/10.1177/0030727019888513

Gollin, D. (2014). Smallholder agriculture in Africa. An overview and implications for policy. *IIED Working Paper. IIED, London*, *October*, 1–20.

Gwaka, L., & Dubihlela, J. (2020). The resilience of smallholder livestock farmers in sub-Saharan Africa and the risks embedded in rural livestock systems. *Agriculture (Switzerland)*, *10*(7), 1–11. https://doi.org/10.3390/agriculture10070270

Isidore, M. M., Cihinda, M., Cisabu, M., & Murhebwa, M. M. (2018). *Education and Agricultural Productivity in Democratic Republic of Congo: The Case of South-Kivu Province*. *7*(1), 7– 12. https://doi.org/10.11648/j.ijeedu.20180701.12

Jayne, T. S., Wineman, A., Chamberlin, J., Muyanga, M., & Yeboah, F. K. (2022). Changing Farm Size Distributions and Agricultural Transformation in Sub-Saharan Africa. *Annual Review of Resource Economics*, *14*, 109– 130. https://doi.org/10.1146/annurev-resource-111220-025657

Jin, Y., Lin, Q., & Mao, S. (2022). *Tanzanian Farmers' Intention to Adopt Improved Maize Technology: Analyzing Influencing Factors Using SEM and fsQCA Methods*.

Article DOI : https://doi.org/10.37284/eajab.7.2.2397

Kilombele, H., Feleke, S., Abdoulaye, T., Cole, S., Sekabira, H., & Manyong, V. (2023). *Maize Productivity and Household Welfare Impacts of Mobile Money Usage in Tanzania*.

Kuntosch, A., & König, B. (2018). Linking system perspectives with user perspectives to identify adoption barriers to food security innovations for smallholder farmers – evidence from rural Tanzania. *Food Security*, *10*(4), 881– 896. https://doi.org/10.1007/s12 571-018-0821-4

Landa, E. (2018). Influence of Training on Employees Performance in Public institution in Tanzania. *International Journal of Human Resource Studies*, *8*(2), 324. https://doi.org/10.5296/ijhrs.v8i2.13136

Makate, C., Mango, N., & Makate, M. (2019). Socioeconomic status connected imbalances in arable land size holding and utilization in smallholder farming in Zimbabwe: Implications for a sustainable rural development. *Land Use Policy*, *87*(May), 104027. https://doi.org/10.1016/j.landusepol. 2019.104027

Malimi, K. (2023). *Agricultural input subsidies, extension services, and farm labour productivity nexus: Evidence from maize farmers in Tanzania*. *February 2022*, 874–898. https://doi.org/10.1111/1477- 9552.125 37

Miho, A. (2018). *Comparing technical efficiency of maize smallholder farmers in Tabora and Ruvuma regions of Tanzania: a frontier production approach*. *7*(9), 180–197. https://doi.org/10.18488/journal.1005/2017.7 .9/1005.9.180.197

Msangya, B. W. (2019). *On Boosting Farmers' Livelihoods: A Case of Mvomero District, Tanzania*. 89–97.

Mtui, J. (2023). Agriculture-led Industrialization for Inclusive Growth in Tanzania. *Tanzanian Economic Review*, *13*(1), 156–182. https://doi.org/10.56279/ter.v13i1.149

Setia, M. S. (2018). *Methodology Series Module 3 : Cross-sectional Studies Methodology Series Module 3 : Cross-sectional Studies*. *May 2016*. https://doi.org/10.4103/0019-5154.182410

Snyder, K. A., Sulle, E., Massay, D. A., Petro, A., Qamara, P., & Brockington, D. (2020). "Modern" farming and the transformation of livelihoods in rural Tanzania. *Agriculture and Human Values*, *37*(1), 33–46. https://doi.org/10.1007/s10460-019-09967-6

Squires, V. R., & Gaur, M. K. (2020). Food security and land use change under conditions of climatic variability: A multidimensional perspective. *Food Security and Land Use Change under Conditions of Climatic Variability: A Multidimensional Perspective*, *March*, 1–355. https://doi.org/10.1007/978-3-030-36762-6

Stadtländer, C. T. K.-H. (2009). Qualitative, Quantitative, and Mixed-Methods Research. *Microbe Magazine*, *4*(11), 485–485. https://doi.org/10.1128/microbe.4.485.1

Tanumihardjo, S. A., McCulley, L., Roh, R., Lopez-Ridaura, S., Palacios-Rojas, N., & Gunaratna, N. S. (2020). Maize agro-food systems to ensure food and nutrition security in reference to the Sustainable Development Goals. *Global Food Security*, *25*(August), 100327. https://doi.org/10.1016/j.gfs.2019.10 0327

Tenaye, A. (2020). *economies Technical Efficiency of Smallholder Agriculture in Developing Countries: The Case of Ethiopia*. *Fao 2016*, 1–27.

URT. (2007.). *The United Republic of Tanzania Morogoro Region Socio-Economic Profile*.

URT. (2020) Commission, T. H. E. P., Salaam, D. A. R. E. S., and Office, R. C. S. (n.d.). *The United Republic of Tanzania Morogoro Region Socio-Economic Profile*.

Wilson, R. T., & Lewis, J. (2017). The Maize value chain in Tanzania. *Fao*, 14–36.

