Factors Influencing Farmers' Decision on the Choice of Maize Seed Varieties in Kilosa and Mvomero Districts, Morogoro, Tanzania

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Abstract: *A study was conducted with a sample size of 208 farmers to assess the factors influencing their choice of maize seed varieties in the Kilosa and Mvomero districts of the Morogoro region in Tanzania. The researchers utilised a binary logistic regression model for the analysis. The results indicated that farmers' decisions were significantly influenced by the expected yield (p = 0.012) and were marginally influenced by household size (p = 0.061). The study underscored the need for policymakers to prioritise creating networks that connect farmers to agricultural experts and extension services as well as addressing barriers to accessibility, such as affordability and availability of certified maize seeds. The stakeholders, including government and non-governmental organisations, can design targeted strategies that enhance seed adoption. Comprehensive agricultural policies that incorporate these insights can lay the base for a more resilient and prosperous agricultural sector in the region. The study showcases the important role of training and education in empowering farmers to make informed decisions regarding maize seed selection. The study also points to the importance of community engagement in the dissemination of information about new seed varieties and agricultural practices. Establishing farmer groups or cooperatives can create platforms for knowledge sharing, enabling farmers to learn from each other's experiences and successes. This collective approach not only strengthens the farmers' capacity to adapt to changing agricultural challenges but also fosters a sense of community and shared purpose.*

Keywords: Certified, Farmers Choice, Maize Seeds, Logistic Regression Model, Morogoro Region

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1. Introduction

Agriculture is the foundation of many economies worldwide, especially in emerging nations. Smallholder farmers play a crucial role in ensuring food security, generating income, and maintaining overall economic stability in the Sub-Saharan region (Barrett, 2012; IFAD, 2019). Among various crops, maize serves both as a cash crop and a staple food for most Tanzanians, whether in rural or urban areas. However, despite its importance, maize productivity remains low. This is largely due to the limited adoption of certified maize seeds, which are known to enhance yields and provide resistance to drought and disease (Lyimo *et al*., 2014).

In Tanzania, access to improved seeds is challenging, especially among smallholder farmers attributable to various socio-economic factors, including limited access to information, inadequate infrastructure, and financial constraints that hinder their ability to invest in improved agricultural practices. Moreover, the scarcity of extension services results in a knowledge gap regarding the benefits of adopting certified seeds, which affects farmers' decision-making processes. Despite the potential advantages of using certified maize seed varieties, such as increased resilience to climate variability and higher yields, many smallholder farmers in Tanzania continue to rely on traditional seed sources, which leads to suboptimal production outcomes (Lyimo *et al*., 2014). The available information shows that only about 27 percent of the maize seeds grown in Tanzania are certified seeds the remainder is non-certified (AECF, 2016). Yet, choosing the right maize seed variety is crucial for boosting crop production, farmer incomes, and improving food security (Erenstein, 2003).

Understanding the determinants influencing the adoption of these seeds is key to developing targeted interventions that can enhance not only maize productivity but also the livelihoods of smallholder farmers. Factors such as farmer education, market access, and socio-cultural attitudes towards modern agricultural practices can be important in shaping seed selection decisions (Wulandari *et al*., 2024). By investigating these elements, policymakers can better support farmers in transitioning towards more sustainable agricultural systems that contribute to food security and rural development (ibid). Importantly, enhancing the adoption of certified maize seeds aligns with broader agricultural policies and strategic plans for strengthening food systems and promoting resilience against environmental shocks. These include, among others, the National Agricultural Policy (URT, 2013); the Tanzania Agriculture Sector Development Programme (ASDP) (URT, 2017); and the National Climate Change Response Strategy 2021 - 2026 (URT, 2021). As Tanzania seeks to bolster its agricultural sector in the face of growing challenges, including climate change and population growth, addressing the barriers to certified seed adoption must become a priority. This approach will foster sustainable agricultural practices, support achieving self-sufficiency, and improve economic stability for vulnerable farming communities throughout the country and beyond.

Certified seeds typically exhibit superior traits, including disease resistance, improved yield potential, and adaptability to local environmental conditions (FAO, 2010; 1997; Gruère & Sengupta, 2011). However, the adoption of certified seeds is not uniform and is influenced by many factors (Melesse *et al*., 2023; Kassie *et al*., 2015). Factors such as access to credit, availability of extension services, and robust seed distribution networks play critical roles in determining the extent of certified seed adoption (Asfaw *et al*., 2013). Regions with well-established cooperative societies often observe higher rates of certified seed use, as these entities can facilitate group purchasing and provide education on seed management practices (Zeller *et al*., 1998). In areas where local customs emphasise seed saving or recycling over purchasing new seeds, even the most resilient and high-yielding certified varieties may struggle for acceptance. Policymakers and agricultural stakeholders must therefore engage in tailored interventions that acknowledge these local contexts and address barriers faced by farmers in adopting certified seeds. Ultimately, enhancing the adoption of certified seeds is not only a matter of improving agricultural productivity but also a pathway to achieving food security and economic stability for vulnerable populations. As global agricultural conditions evolve amidst climate change and market fluctuations, promoting certified seeds remains a critical strategy for sustainable development in rural areas (World Bank, 2014; FAO, 2017).

This research aims to shed light on the intricate decision-making processes of smallholder farmers in the Kilosa and Mvomero districts of the Morogoro region in Tanzania, providing a foundation for more informed and contextually relevant strategies to enhance maize production and improve the well-being of the farming communities.

2. Methodology

2.1 Study Area

The study was purposefully conducted in selected areas of the Kilosa and Mvomero districts of the Morogoro region. The Kilosa district is situated between longitudes 36°30' East and 38° West, and latitudes 6° South and 8° North. It shares its eastern border with the Mvomero district, which is located between latitude 6°19'0" South and longitude 37°22'59" East. According to rankings, Kilosa, Kilombero, and Mvomero are among the top maize-producing districts in the region. Therefore, conducting the study in Kilosa and Mvomero was cost-effective due to their proximity.

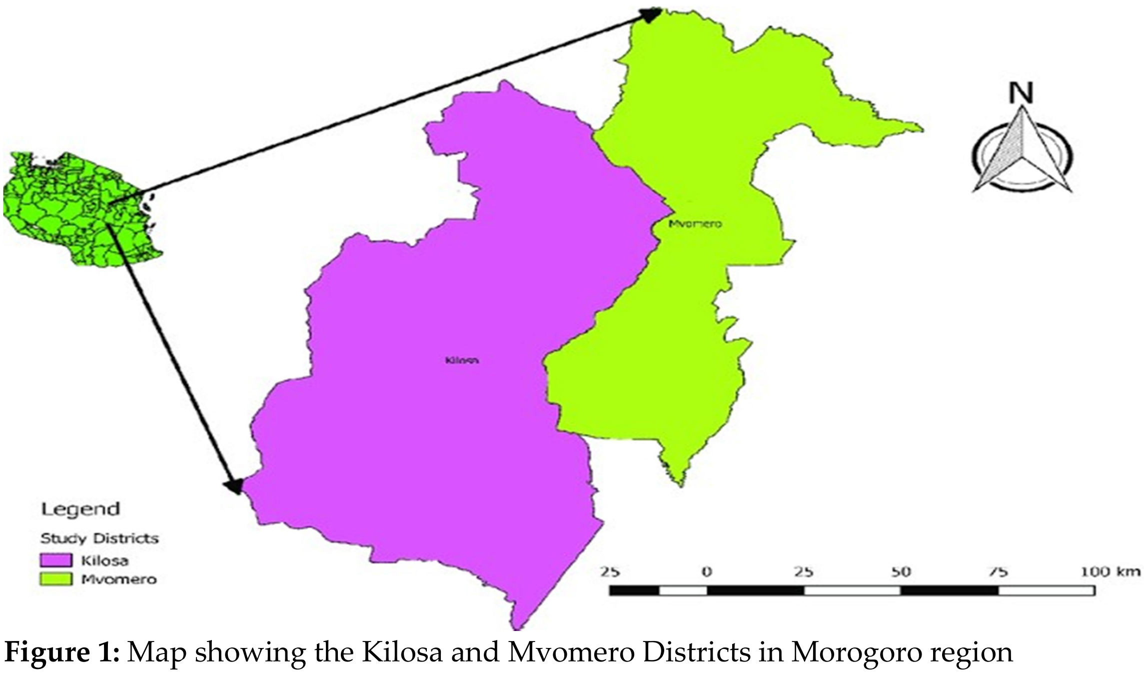

Figure 1: Map showing the Kilosa and Mvomero Districts in Morogoro region

2.2 Sampling Procedure and Sample Size

The target population for this study consists of maize farmers who primarily cultivated maize for their livelihoods. A simple random sampling method was employed to select maize-producing households in various villages, with the assistance of ward agricultural and extension officers who helped identify these households. Household heads who were available at the time of the survey were included in the sample. Ultimately, a total of 208 maize-producing households were surveyed. The sample was estimated using the Yamane (1967) formula shown in Equation (1).

$$n = \frac{N}{1 + N(\varepsilon^2)} = 208\ households \quad (1)$$

Where; n = the number of households, N = the total population of maize farmers and ε = the desired margin of error (0.05).

2.3 Research Design

The study employed a cross-sectional design, a common research methodology that allows for data collection from a diverse population at a single point in time. This approach is particularly beneficial for assessing the prevalence of specific characteristics or behaviours within a defined population, as it provides a snapshot of the variables of interest (Creswell & Creswell, 2018). By using a cross-sectional design, researchers can efficiently collect data that reflects the current state of household characteristics and the factors influencing farmers' choices, avoiding the resource-intensive and time-consuming nature of longitudinal tracking (Levin, 2006).

In our study, the questionnaire served as the primary tool for data collection, allowing for the systematic gathering of quantitative information. This method can effectively capture many variables, including demographic information, economic factors, and social influences that affect farmers' decision-making processes. The use of structured questionnaires also facilitated the comparison of responses across different households, enhancing the reliability and validity of the findings (Dillman *et al*., 2014).

Moreover, the cross-sectional design is suited for exploratory research, where the goal is to identify potential relationships and trends within the data. It enables researchers to establish correlations between various factors and farmers' choices, to inform future studies and policy recommendations (Babbie, 2013). However, it is important to note that while cross-sectional studies can reveal associations, they do not provide insights into causality due to the simultaneous measurement of variables (Trochim, 2006). This limitation underscores the need for a cautious interpretation of the results and highlights the potential for further research using longitudinal designs to explore causal relationships over time.

The binary logistic regression model assumes that the dependent variable is dichotomous, representing the selection of one maize seed variety over another. Key assumptions include the independence of observations, the linearity of the logit transformation, and the absence of multicollinearity among the explanatory variables (Hosmer and Lemeshow, 2000). One of the primary strengths of binary logistic regression is its ability to estimate the probability of an event occurring based on various predictor variables, which may include socioeconomic factors, agronomic practices, and environmental conditions influencing seed selection (Rusliyadi *et al*., 2021).

This capacity allows analysts to derive insights into the most significant factors influencing farmer decisions, thereby aiding in the development of targeted agricultural policies and interventions (*ibid*). Furthermore, the model's interpretability, in terms of odds ratios, makes it easier for stakeholders to understand the relative influence of different factors. Hence, there are some significant restrictions to take into account, though. First, in real-world situations, the binary regression model may not always hold since it presupposes a linear relationship between the independent factors and the log chances of the dependent variable (Adem *et al*., 2014). If the actual relationships are nonlinear, this restriction may cause misunderstandings. Furthermore, the model is sensitive to sample size; smaller datasets may not accurately represent the larger population and can produce unstable estimates. While the model can illuminate the factors influencing decisions, it cannot account for unobserved variables that might affect farmers' choices, potentially leading to omitted variable bias (Maddala, 1983).

2.4 Model Specification

To identify the factors that influence farmers' preferences for certified maize seed varieties, the study used a logistic regression model with maximum likelihood estimation techniques. The response variable in this analysis represents the farmers' selection between certified and non-certified maize seed varieties. To establish a clear distinction, we assigned a value of "1" to indicate the probability of farmers choosing certified maize seeds and a value of "0" for non-certified seeds. For farmers who choose certified maize seed varieties its cumulative logistic probability function can be expressed as in Equations (2) through (6).

$$P_i = E(y = 1/X_i) = \frac{1}{1 + e^{-Z_i}} \tag{2}$$

$$P_i = \frac{1}{1 - e^{-Z_i}} \tag{3}$$

$$P_i = \frac{1}{\frac{e^{Z_i} + 1}{e^{Z_i}}} = 1 \times \frac{e^{Z_i}}{e^{Z_i} + 1} \tag{4}$$

$$P_i = \frac{1}{1 + e^{-Z}} = \frac{e^{Z}}{1 + e^{Z}} = \frac{e^{Z_i}}{e^{Z_i} + 1} \tag{5}$$

$$P_i = \frac{e^{Z_i}}{e^{Z_i} + 1} \tag{6}$$

where P_i = the likelihood of a farmer to select certified seed varieties, e = natural logarithm base, and $(1 - P_i)$ represents the likelihood of farmers not using certified maize seed varieties as represented in Equations (7) and (8).

$$1 - P_i = 1 - \frac{e^{Z_i}}{e^{Z_i} + 1} = \frac{(e^{Z_i} + 1) - e^{Z_i}}{e^{Z_i} + 1} = \frac{1}{e^{Z_i} + 1} \tag{7}$$

$$1 - P_i = \frac{1}{1 + e^{Z_i}} \tag{8}$$

Thus, the odds ratio for farmers who choose to use certified maize seed varieties can be delivered by dividing Equation (6) by Equation (8), as expressed in Equation (9) through (11).

$$\frac{P_i}{1-P_i} = \frac{\frac{e^{Z_i}}{1+e^{Z_i}}}{1-\frac{e^{Z_i}}{1+e^{Z_i}}} = \frac{\frac{e^{Z_i}}{1+e^{Z_i}}}{\frac{1+e^{Z_i}-e^{Z_i}}{1+e^{Z_i}}} \quad (9)$$

$$\frac{P_i}{1-P_i} = \frac{e^{Z_i}}{1+e^{Z_i}} \times \frac{1+e^{Z_i}}{1} = e^{Z_i} \quad (10)$$

$$\frac{P_i}{1-P_i}(odds\ ratio) = \frac{1-e^{Z_i}}{1-e^{-Z_i}} = e^{Z_i} \quad (11)$$

The natural logarithm of Equation (11) is then used to estimate the logit model as in Equation (12).

$$\omega_i = ln\left(\frac{P_i}{1-P_i}\right) = lne^{Z_i} = Z_i = \beta_0 + \beta_1 X_1 + \cdots. + \beta_n X_n + \varepsilon_i \quad (12)$$

where; ω_i= the logarithm of odds ratio, X_n = the explanatory variables used, $\beta_0 \ldots. \beta_n$ = the coefficients to be estimated, and ε_i = the error term.

The binary regression model employed in this study provided a robust framework for analysing the determinants of farmers' choice for improved maize seed varieties. By utilising logistic regression, we could estimate the likelihood of farmers opting to use certified seeds based on several predictor variables. The choice of logistic regression is particularly advantageous due to its capacity to model binary outcome variables and its interpretation in terms of odds ratios, allowing for a clear understanding of the influence of each factor on maize seed selection (Hosmer and Lemeshow, 2000).

The independent variables incorporated in the model included socio-economic factors, such as the farmer's age, education level, farm size, household size, yield, and location-specific variables, notably the district and distance to the farm. This methodology has been employed in several prior studies to investigate the decision-making processes in agriculture. For example, Nchembi (2017) used a similar method to assess Factors Influencing the Use of Improved Maize Seed Technology in Kilosa District in Tanzania, highlighting the importance of socio-economic, institutional and technological aspects as key factors in ensuring the use of improved maize seed varieties.

Recognizing the benefits of combining both quantitative and qualitative approaches to understand farmers' behaviours and preferences, this analysis was situated within the broader literature. Ultimately, the outputs of the Binary Logit regression model facilitated the development of targeted recommendations for extension services and policymakers. This opened up opportunities for more effective strategies to promote the adoption of improved maize varieties, enhance food security, and strengthen farmer resilience.

2.5 Data Analysis

2.5.1 Analysis of factors influencing farmers' selection of maize seed varieties

The logistic regression model, as presented in Equation (13), was utilized because the response variable had binary outcomes. Specifically, it indicated whether a farmer chose certified maize seeds (1) or non-certified seeds (0). The independent variables included in the model were age, sex, education, farm size, household size, membership in formal groups, yield, distance, and district.

$$Y_i = \beta_0 + \beta_1 age + \beta_2 Sex + \beta_3 educ + \beta_4 f_{size} + \beta_5 H_{size} + \beta_6 F_{grp} + \beta_7 yield + \beta_8 D_{Districts} + \beta_9 Distance + \varepsilon_i \quad (13)$$

where; Y_i = farmer's choice of maize seed variety (1 = used certified seeds and 0 = did not use certified seed), β_1- β_9 = coefficients of parameters to be estimated and ε_i = the error term.

2.5.2 Description of the model variables

Table 1 provides a detailed overview of the variables used in the Binary Logit Regression model to estimate the factors influencing the choice between certified and non-certified maize seed varieties among smallholder farmers in the study areas. The table also outlines the expected signs of the estimated coefficients, giving insights into the anticipated relationships between these variables and the likelihood of using certified maize seeds. By systematically organizing and clarifying these elements, Table 1 lays the groundwork for understanding the analytical framework applied in this study.

Table 1: Description of the study variables and expected sign of relationship with dependent variable

Variables	Codes/Units	Expected Sign
Age	Number of years	+
Sex	1= Male, 0= female	+/-
Education	Number of years	+
Household size	Number of people in Household	+/-
Maize plot size	Number of acres	+
Yield	Amount of kg expected	+
Formal Groups	1=Yes, 0= otherwise	+
Distance	Number of minutes taken to reach a seed supplier	+/-

3. Results

3.1 Respondents' Profile

The findings presented in Table 2 compare certified and non-certified households across various characteristics. Among certified households, 74% were male-headed, a proportion which was slightly higher than the 71% for non-certified households. Certified households tended to have a marginally younger average age of 49 years compared to 50 years for non-certified households. They also had larger average household sizes, with an average of 5 members, and larger average plot sizes averaging at 3.4 acres, compared to 2.9 acres owned by non-certified households. Educational attainment differed between the two groups. A higher percentage of certified households, at 86%, only had primary education, while 76% of non-certified household farmers fell into this category.

Table 2: Household characteristics for the sample households in study area

Characteristics	Maize seed variety used	
	Certified: n=106	**Non-certified: n=102**
Demographic:		
Male (% within category)	74	71
Female (% within category)	26	29
Average age of household head (years)	49	50
Average household size (number)	5	4
Education:		
Primary education	86	76
Ordinary level	5	11
High school level	0	1
Adult education	1	0
University	0	1
Diploma	2	0
No formal education	6	11
Membership to farmers groups:		
Yes (% within category)	13	20
No (% within category)	87	80
Land use rights and ownership:		
Average plot size (acres)	3.4	2.9
Fully owned (% within category)	86	88
Rented (% within category)	12	11
Long-term lease (% within category)	2	1

Conversely, non-certified households had a slightly higher representation in secondary and higher education, with 11% completing secondary education and a small percentage (1%) achieving university degrees or diplomas. Membership in farmers' groups was lower among households using certified maize seeds, at 13%, compared to 20% for farmers using non-certified seeds. Land ownership patterns were similar, with most individuals owning their entire plots. Households using certified seeds reported a 12% higher rate of renting land as compared to those using non-certified seeds.

3.2 Selection of Maize Seed Varieties

The study found that 51% of farmers in the surveyed districts chose certified maize seed varieties. This preference might have been influenced by their perception of certified seeds as being of higher quality, providing improved yields, and offering greater disease resistance. However, it is important to note that 49% of farmers continued to use non-certified seeds. This indicates that a substantial portion of the farming community in the study areas has not adopted certified varieties. Possible reasons for this choice may include cost considerations, a preference for traditional seeds, or concerns about the availability of certified seeds (Figure 1).

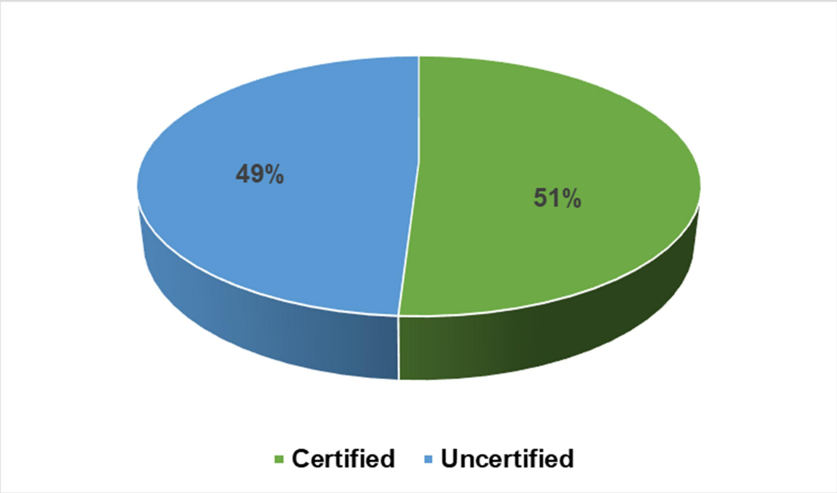

Figure 1: Proportion of farmers by selected maize seed variety

3.2.1 Results of the Logit regression model

The results from the Logit regression model (Table 3) indicate that, among the eight variables examined, only three exhibited statistically significant influences: yield, household size, and formal group membership. The results of the binary logit regression indicate that the odds ratio for the "age of the household head" was 0.9972. This suggests that as the age of the household head increases, the likelihood of choosing certified seeds slightly decreases. However, this finding is not statistically significant, as the p-value is 0.800. Regarding the sex of the household head, the odds ratio is 0.8499, which implies that if the head of the household is female, there is a lower chance of using certified seeds. Nonetheless, the results show that gender was not a significant factor in seed selection in this context, as indicated by the p-value of 0.649, demonstrating no significant association. Educational attainment of the household head showed a more favourable odds ratio of 1.5511, meaning that the likelihood of using certified seeds increased with each additional year of formal schooling. However, the p-value of 0.442 indicates a lack of statistical significance. This suggests that while education appeared to promote the use of certified seeds, its effect was not strong enough to draw clear conclusions.

The household size variable has an odds ratio of 1.1507 and a p-value of 0.061, indicating that it is marginally significant at the 10% level. This suggests that larger households may be more likely to adopt certified seeds, possibly due to having more available labour or pooled resources. In terms of maize plot size, the odds ratio of 1.0763 points to a positive, albeit non-significant relationship (p-value = 0.199), suggesting that larger plot sizes may encourage the utilization of certified seeds, potentially due to higher returns on investment. Strikingly, the expected maize yield, with an odds ratio of 1.000 and a p-value of 0.012, shows a statistically significant relationship with seed choice. This indicates that farmers with higher yield expectations are more likely to choose certified seeds, reflecting an understanding of the potential financial benefits of improved seed quality.

Table 3: Factors influencing the choice between certified and non-certified maize seed varieties

Variable	Odds Ratio	Std. Err	Sig.
Yield	1.0000	0.0002	0.012**
Household size	1.1507	0.0863	0.061*
Age	0.9972	0.0111	0.800
Plot size	1.0763	0.0616	0.199
Education	1.5511	0.8854	0.442
Sex	0.8499	0.3035	0.649
Farmers groups	0.5634	0.2274	0.141
Districts	1.0110	0.3170	0.972
Distance	0.9994	0.007	0.972
Cons	0.4142	0.4060	0.369
Log likelihood	139.1554		
N	208		

**Significant at 5%, and *Significant at 10%

Membership in formal groups yielded an odds ratio of 0.5634 and a p-value of 0.141, suggesting that non-member farmers are less likely to adopt certified seeds. Although the odds ratio indicates a negative association, the statistical evidence remains weak, suggesting that the significance of group membership is uncertain in this case. The distance to the seed supplier has a negligible odds ratio of 0.9994 and a high p-value of 0.972, illustrating that the travel time to obtain seeds does not significantly affect the choice between certified and non-certified seeds. Finally, the district of residence shows an odds ratio of 1.0110 and a p-value of 0.972, meaning that geographical location does not significantly influence the likelihood of adopting certified seeds based on this dataset. Overall, the log-likelihood of -139.15554 indicates the model's fit. Many factors, especially education and expected yields, influence the adoption of certified seeds, although further exploration is needed due to some non-significant results. Future research should focus on a causal analysis or identify other influencing factors such as economic stability, market access, and extension services available to farmers.

4. Discussion

The results of this study align with numerous empirical examples from other areas that highlight the positive influence of household size and plot size on the adoption of certified seeds. The research conducted by Kanu *et al*. (2021) in Nigeria, for example, underscored the significance of social capital and resource sharing in larger households, revealing that such households were more likely to uptake improved agricultural practices, including the use of certified seeds, due to collective decision-making and resource pooling. Similarly, Nwachukwu (2017) found that larger farm sizes were positively associated with the uptake of new technologies, advancing the argument that farmers with more land are better positioned to invest in certified seeds that promise higher returns. According to Nwachukwu (2017), other factors significantly affecting adoption of technology were cultural values, institutionalized land tenures, poverty, literacy level, technology complexity, agricultural extension services, age and sex.

As such, it is essential to consider the socio-economic context in which smallholder farmers operate. In many developing countries, farmers face substantial risks associated with agriculture such as price fluctuations, climate variability, and pest outbreaks. Consequently, the marginally significant relationship observed between household size and the adoption of certified seeds can be interpreted through the lens of risk management strategies. Larger households, as suggested by the study, often exhibit greater labour flexibility that can be advantageous when employing intensive farming practices and subsequently adopting certified seeds to mitigate risks related to crop failure (Chete, 2021). However, it is critical to recognize that access to information and extension services influences adoption decisions. According to a study by Mchomvu (2015), for example, farmers who attended Farmer Field Schools (FFS) had high level of knowledge than those who did not attend. Consequently, the former obtained higher average annual paddy yields than the latter farmers. This suggested that FFS as an approach was effective in dissemination of improved paddy technologies in study area.

Thus, even under favourable household conditions and plot sizes, the availability and effectiveness of extension services can significantly determine success. The non-significant relationship between maize plot size and the adoption of certified seeds can be contrasted with the findings of Ruzzante *et al*. (2021) and Mutanyagwa *et al*., 2018, which demonstrate that technologies in the improved varieties category were adopted more readily on larger farms, casting doubt on the scale-neutrality of these technologies. However, the interplay between plot size and external factors shapes innovation adoption in complex ways. While larger plots can provide economies of scale and a greater potential return on investment from innovations, the real-world impact often depends on the farmer's ability to navigate market forces, access crucial financial resources, and effectively manage their operations (Jones *et al*., 2022).

The results of our study also indicate a crucial link between farmers' expectations of maize yield and their choice to utilize certified seeds. This finding resonates with the conclusions of other previous studies (e.g. Mbah *et al*., 2023; Kassie *et al*., 2014; Abro *et al*., 2019; Feleke & Zegeye, 2006), which highlighted that yield expectations significantly influence seed selection in agricultural practices. Farmers often make decisions based on expected profitability and risk (*ibid*). When they anticipate a higher return on investment from certified seeds, they are more likely to adopt the practices (Mbah *et al*., 2023). The statistical significance of the expected maize yield variable (p = 0.012) underscores the importance of education and access to extension services in enabling farmers to understand and appreciate the benefits of certified seeds. As seen in the work of Bitama *et al*. (2024), farmers who receive information about the economic advantages of certified seed are more likely to adopt these varieties, leading to improved agricultural productivity. This aligns with the notion that enhanced knowledge and awareness can bridge the gap between potential yield improvement and practical seed choice. Moreover, the odds ratio of 1.000 suggests that for each unit increase in expected yield, the probability of selecting certified seeds remains constant, reinforcing the premise that yield expectations may serve as a foundational consideration in farmer decision-making. This can be compared with the findings of Jin *et al*. (2022) who show that farmers' behaviour perceptions and compatibility perceptions positively impact their intention to adopt agricultural technology. It is also imperative to consider the socio-economic contexts within which these decisions are made. Access to markets, credit facilities, and the overall agricultural policy framework play significant roles in determining seed choices (Ullah, *et al*., 2020). For instance, many studies have acknowledged that farmers in regions with robust extension services and supportive policies are more likely to adopt certified seeds, capitalizing on their benefits to alter their yield expectations and outcomes (Rayhan *et al.,* 2023; Louwaars & de Jonge, 2021).

In summary, the findings from the Kilosa and Mvomero districts present promising insights regarding household and plot sizes as influential factors in adopting certified seeds. It illuminates a complex interplay of socio-economic factors that persist in shaping these choices among smallholder farmers in Tanzania. Future research should delve deeper into understanding the multifaceted influences on seed selection, particularly focusing on the roles of knowledge dissemination, access to resources, and market dynamics to create targeted interventions that enhance seed adoption and ultimately improve agricultural productivity. In addition, the findings reflect the intricate relationships between farmer perceptions and seed choices and underscore the necessity of integrating agricultural education and supportive policies to enhance the adoption of certified seeds. Future research should investigate these dynamics, especially in various regional contexts, to determine effective strategies to enhance certified seed adoption and improve agricultural productivity.

5. Conclusion and Policy Implications

The conclusions drawn from the study highlight the importance of certain socio-economic and perceptual factors in influencing farmers' seed selection in the Kilosa and Mvomero districts in Tanzania. The marginally significant relationship between household size and the likelihood of adopting certified seeds indicates that policies aimed at enhancing family capacity, such as access to training and resources, may effectively promote certified seed usage. This underscores the necessity for targeted interventions that consider the dynamics of family structure in agricultural decision-making.

Moreover, while the relationship between maize plot size and certified seed use was not statistically significant, it suggests that larger-scale farming operations could benefit from improved access to quality seeds. Policymakers should explore ways to incentivize farmers to expand their plot sizes through supportive measures such as land access policies, improved irrigation infrastructure, and access to credit facilities. This could potentially lead to greater returns on their investments in certified seeds.

The significant association between expected maize yield and the likelihood of utilizing certified seeds emphasizes the need for informational campaigns that educate farmers about the benefits of certified seeds. By enhancing farmers' awareness of expected yield advantages, agricultural extension services can play a crucial role in facilitating a shift towards more sustainable and productive farming practices.

The findings indicate several important policy implications. First, it is essential to develop programs that provide technical assistance and resources to larger households, thus improving their capacity to adopt certified seeds. Second, creating incentives for land consolidation and cooperative farming could enhance productivity and encourage farmers with smaller plots to use higher-quality seeds. Lastly, ongoing investment in farmer education about the benefits of certified seeds, especially regarding yield expectations, is vital to fostering an environment that supports their use. Overall, incorporating these recommendations into agricultural policy frameworks can help improve seed adoption rates, ultimately leading to increased agricultural productivity and enhanced food security in the region.

Acknowledgments

The authors would wish to express their gratitude to the Africa Economic Research Consortium (AERC) for the financial support provided for this study.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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