Socio-economic Determinants of Smallholder Farmers' Adoption of New Tea Varieties in Rungwe District

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Abstract

Despite the strategic importance of tea production in Tanzania, existing studies have inadequately addressed the socio-economic determinants influencing smallholder farmers' adoption of new tea varieties in Rungwe District. This study investigates the key socio-economic factors driving adoption of clonal tea seed varieties among smallholder tea farmers in the region. Employing a cross-sectional research design and an exploratory sequential mixed-methods approach, the study sampled 267 smallholder tea farmers using simple random sampling to ensure unbiased representation.

Qualitative data were analyzed through thematic content analysis with constant comparison to capture farmers' perceptions and experiences regarding clonal tea varieties. Quantitative data were processed using IBM SPSS, with descriptive statistics used to summarize socio-economic characteristics, and binary logistic regression applied to model adoption behavior.

Findings revealed that age, sex, household size, tea farming experience of the household head, and land size significantly influenced adoption of new tea seed varieties ($p < 0.005$), with corresponding Wald statistics of 19.368, 4.556, 9.740, 4.995, and 9.872 respectively. The study highlights notable variation in adoption patterns and production outcomes among smallholder farmers.

It is recommended that the Rungwe District Council, Tea Board of Tanzania, and Tanzania Tea Research Institute intensify awareness campaigns and extension services on clonal tea varieties to enhance adoption and ensure the long-term sustainability of tea production in Rungwe District.

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1.0 **Introduction**

Agricultural production is the backbone of several countries' economies, especially developing countries. Worldwide, tea is among the potential cash crops for the nations and livelihoods of the rural farming community (Deka and Goswami*,* 2021). It is estimated that tea is produced in more than 40 countries, with China, India, Sri Lanka, and Kenya being the biggest producers (Munishi *et al*.,2017). Together, these countries represent 75% of world tea production. In Africa, Tanzania is ranked the 4th tea producer, after Kenya, Malawi, and Rwanda, and 13th worldwide (Arhin *et al*., 2024).

The crop in Tanzania was originally introduced by German settlers in 1902 at the Agricultural Research Centre in Amani and Rungwe, and later in 1926, it was commercialized in Usambara and Njombe (Madembwe et al., 2023). Shortly after independence in the early 1960s, the Ministry of Agriculture introduced smallholder farmers to tea production, and by 1985, smallholder farmers contributed 30% of tea production. Currently, the crop is grown in five regions of Tanzania: Iringa (Mufindi District), Mbeya (Rungwe District), Njombe (Njombe District), Tanga (Muheza), and Kagera (Bukoba District) regions (Munishi et al., 2017). Tea production in Tanzania has fluctuated mainly due to several factors. The decline in quantity produced was associated with a sharp drop of more than 40% in price, poor extension services, limited access to credit, low levels of farmers' associations, and limited market access, which significantly affected household earnings, as over 80% of income depends on tea production (Dogeje, 2023). These issues are believed to have impacted the livelihoods of smallholder tea farmers due to the close link between livelihoods and tea farming (Arhin et al., 2024).

To overcome this, the Tea Board of Tanzania (TBT), in collaboration with the Tea Research Institute of Tanzania (TRIT), has taken several efforts to improve tea production. These efforts include the launch of an innovative, comprehensive training program to boost the tea industry, focused on investment and input purchase financing mechanisms for cost minimization. According to the TBT (2024) report, the key aspects of the training included the optimal use of fertilizer and the implementation of selective herbicides for effective weed control practices that are critical for maximizing crop yield and quality. Another key aspect of the training was the creation of awareness on the adoption of eight clonal tea planting varieties, which are renowned for fetching higher prices at auctions due to their superior quality. The training was conducted in Rungwe involving 30 tea cooperatives, Korogwe and Bumbuli 20 tea cooperatives, and Tanga Muheza 10 tea cooperatives (Madembwe et al.,2023). These initiatives also seek to empower both smallholder tea farmers and large-scale tea producers with knowledge on modern cultivation techniques, cost-effective processing techniques, and direct access to the market.

1.1 Problem statement

Despite these efforts by the government, the rate of adoption of these eight clonal tea varieties introduced in Tanzania is still very low (Dogeje,2023). This low rate of adoption of tea clonal varieties calls for appropriate measures to prevent its possible impact on smallholder tea farmers who depend on tea production for their earnings. Previous studies indicate that tea production is essential for smallholder livelihoods, and socio-economic factors significantly influence smallholder tea farmers' adoption of tea varieties and other innovations in tea production (Shitaye et al., 2024). For example, research by Mugumaarhama et al. (2021) and Addai (2022) found that education and age negatively affect the adoption of farming technologies, with older and more educated farmers being less likely to adopt innovations. Similarly, Addai (2020), Shitayi et al. (2024), and Zondo and Ndoro (2024) reported that farmers' membership in associations, access to credit, age, and land size positively influence the adoption of farming technologies. Conversely, Ateka et al. (2018), Anang and Ayambila (2020), Gogoi et al. (2020), and Gunapala and Dissanayeke (2022) observed that education, land size, and access to information about innovations positively affect adoption, while household size and agricultural experience negatively impact the decision to adopt new technologies.

It is evident, based on the above understanding of the gap in the literature, that determinants of adoption of innovation vary across locations due to differences in local contexts, cultural values, and geographical factors (Fisher et al.,2018). Therefore, the socio-economic determinants of tea adoption of new clonal tea varieties remain unknown, at least in the context of the study area. Likewise, socio-economic factors that influence smallholder farmers' adoption of new farming innovations are difficult to generalize as they are affected by different location-specific cultures, traditions, and innovation dissemination models (Akyoo, 2024).

The driving force for this paper is to analyze socio-economic determinants of smallholder farmers clonal tea varieties adoption decisions.The study is unique it has addressed weakness in adoption studies as reported by Munguia (2021) who suggested that there is a potential need for research to conduct a detailed assessment of the discrepancies that exist in defining and measuring the different variables presented in the different conceptual models and how they have been interepreted and used in subsequent empirical studies.The study is unique by focusing on the tea industry (the largest cash crop production) in Tanzania, where the sector is considered moderately production intensive. Moreover, unlike other review papers (Addai (2020), Shitayi et al. (2024), and Zondo and Ndoro (2024) that studied the adoption of one specific agricultural technology, this review in its distinctiveness, is a general adoption of eight (8) clonal tea variaties as an organized topic for overall understanding, and for policy making at different levels and to different stakeholders. The study results may increase our understanding as well as supporting policymakers in advancing applicable policy interventions aimed at achieving sustainability in agriculture, particularly in the tea sector. Also, this study serves as a framework for other developing tea growing countries. It will add to the body of knowledge specifically on the theory of agricultural technology adoption and seeks to build themes of framework for the determinants of farmers' adoption decision.Therefore, it is important to gather empirical evidence from diverse backgrounds. Such information is useful for policymakers, researchers, and development partners, especially those involved in helping tea farmers adopt useful innovations introduced by the Tea Board of Tanzania and the Tea Research Institute of Tanzania. This paper offers empirical evidence on the socio-economic factors that influence smallholder tea farmers' adoption of new tea varieties in Rungwe District.

1.2 Theoretical Framework

The paper is unpinned by Diffusion and adoption of innovation theory, which describe how the adoption and diffusion of innovations happen in stages until an individual chooses to use an innovation (Rogers et al., 2014). The adoption and diffusion of innovation theory guides the analysis of adoption and provide a method to investigate the impacts of different factors in the adoption process. According to Munguia *et al.*(2021), key elements that should be used in adoption models for agriculture include: assessment of the performance of the proposed new technology (e.g, relative advantage, both economic and non-economic) in relation to the existing technology or practices in place, the process of learning about this advantage, the interaction between individual decision making and external influences, and characteristics of potential adopters affecting their attitudes towards the technology.

In the context of this study, the term innovation refers to new practices promoted by the Tea Board of Tanzania and the Tea Research Institute of Tanzania. This study assumes that various socio-economic factors such as age, sex, education, land size, access to credit, experience in tea farming, membership in tea associations, access to extension services, and awareness of new tea varieties affect smallholder tea farmers' adoption of these varieties. Hence, the goal of this study is to examine the socio-economic factors that influence smallholder tea farmers' adoption of new tea varieties in Rungwe District.

2.0 Methodology

The study was conducted in Rungwe District due to its significant population of smallholder tea farmers in the area and the introduction of eight new tea varieties by the Tea Research Institute of Tanzania (TRIT). The district is also a major producer of tea in Tanzania (Madembwe *et a*l.,2023), and the Tea Board of Tanzania (TBT) created awareness of eight

clonal tea varieties to 30 tea cooperatives in the area, compared to those of Korogwe and Bumbuli (20 cooperatives) and Tanga Muheza (10 cooperatives. A cross-sectional research design was adopted to analyze socio-economic determinants of smallholder tea farmers' adoption of new tea varieties. The cross-sectional research design was adopted as it allows data collection at a single point in time and measures outcome and exposures in the study respondents at the same time (Bernard, 2017).

The unit of analysis was smallholder tea farmers engaging in tea production. The study adopted a mixed research approach whereby, exploratory sequential research approach was adopted, with data collection and analysis starting with qualitative data followed by quantitative data collection and analysis. The approach was adopted to enable integration of results from qualitative data and quantitative data in order to expand the scope and improve the quality of the results as proposed by Courtney (2017). The first stage of qualitative data collection involved qualitative data collection involved Focus Group Discussions (FGDs) and Key Informants Interviews (KIIs). Six FGDs with participants ranging from eight to ten were conducted in Nsongola, Lufingo, Makuyu, and Bujeja Villages, involving participants who were knowledgeable in tea production and aware of new clonal tea varieties. Ten KIIs were purposively selected based on their position in tea farmers' associations, knowledge of the new eight tea varieties. The KIIs include Ward Executive Officers (WEOs), four Village Executive Officers (VEOs), Rungwe District Agricultural, Irrigation and Cooperative Officer (DAICO).

The second stage of data collection involved quantitative data collection whereby data collection involved household survey was conducted, whereby 267 households were involved out of 800 farmers in the study villages. The sample size was estimated using a simplified formula by Yamane (1973) as cited by Israel (2013). A proportionate sampling technique was used to obtain respondents from the four villages.

Table 1: Proportionate sampling by using the formula:

$$\text{Proportion} = \frac{\text{Cluster Sample (Location)x Desired Sample Size}}{\text{Total population}}$$

For this study, this becomes:

$$\text{Nsongola} = \frac{285 \times 267}{800} = 95 \text{ respondents}$$

$$\text{Lufingo} = \frac{180 \times 267}{800} = 60 \text{ respondents}$$

$$\text{Makuyu} = \frac{172 \times 267}{800} = 57 \text{ respondents}$$

$$\text{Bujeja} = \frac{163 \times 267}{800} = 55 \text{ respondents}$$

Qualitative data were analyzed through thematic content analysis, in which data were condensed, coded, and organized into themes based on the study objective.The transcripts were analyzed within the content such as words, phrases, themes and characters. Thereafter, themes were coded by systematically going through the selected codes, applying the coding scheme and assigning codes to relevant elements. Finally, the data were analyzed to identify patterns, trends and relationships. Socio-economic determinants of smallholder tea farmers' adoption of new tea varieties were analyzed using a binary logistic regression model because the dependent variable was dichotomous, that is, represented by 0 for non-adoption of new tea varieties and 1 for adoption of new tea varieties. The criteria for inclusion of the variables in the binary logistic regression model were based on a theoretical review and an empirical literature review. The binary logistic model was specified as follows:

$Logit\ (p_i) = log\ (p_i/1-p_i) = b_0 + b_1x_1 + b_2x_2 + \ldots + b_{12}x_{12} + \mu_i$ (Agresti and Finlay, 2009)

Where:

Logit (pi) = ln (odds (event), that is, the natural log of the odds of an event occurring

pi= prob (event), that is, the probability that respondents adopt new tea varieties.

$1\text{-}p_i$= prob (nonevent), that is, the probability that the respondent will not adopt new tea varieties.
b_0 = constant of the equation,
b_1 *to* b_{12} = coefficients of the independent (predictor, response) variables,
k = number of independent variables,
x_1 *to* x_{11}= independent variables entered in the model.

Table 2: Measurement of Variables entered in the Binary Logistic Regression Model

Variable Definition	Unit of Measurement	Assumed Influence
X_1 = Age of the tea farmer	Years	+
X_2 = Sex of the tea farmer	1 if male-headed household, 0 if otherwise)	+
X_3 =Education of a tea farmer	Years of schooling (measured in years)	+
X_4 = Land Size	Land size (measured in acres)	+
X_5 = Access to credit	1=access and 0 =no access	+
X_6= Experience in tea farming	Years in tea farming	+
X_7 =Tea association membership status	1 if active, 0 if otherwise	+
X_8 = Access to extension services	Frequency of visit by extension officer),	+
X_9 = Household size	Number of adult people in the Household	+
X_{10} =Land ownership	1 if owned, 0 if otherwise	+
X_{11} = Awareness of new tea	1 if aware of new tea varieties, 0 if otherwise	+

30. Results and Discussions

3.1 Socio-economic Characteristics of Respondents

The findings on household socio-economic characteristics in Table 1 depict that the mean age was 42 years. This suggests that most of the tea farmers were young. The results suggest that tea farming is labour labour-intensive activity that requires people of an active age. As observed by Kabayiza (2023), the level of adoption of innovations in tea farming tends to increase with the optimum age group and starts to drop with an increase in Age. The Mean years of schooling was 7.0 years. The results suggest that most tea farmers were likely to adopt new tea varieties as they were literate enough to attend training on new varieties introduced by the Tea Research Institute. These results correspond to the previous studies as reported by Zondo and Ndoro (2024), who found that education had a great contribution to the adoption of innovations by farmers.

Table 3: Household's Socio-economic Characteristics (n=267)

Variable	Standard Deviation of the Means and Means
Age	42 (14.5)
Education	7.0 (2.8)
Household Size	4.3 (2.1)
Land Size	4.8 (3.3)
Frequency of extension officer visits	1.6 (1.3)

Experience in tea farming	11.7 (6.8)

*The numbers in brackets are standard deviations of the means, and the numbers outside of brackets are the means

The mean household size was 4 household members. This implies that the tea farming household had enough family members to supply labour to enable them to adopt new tea varieties. A similar result was reported by Aleka et al. (2018) and Anang and Ayambila (2020), who reported that a higher number of active family members was one of the predictors for the adoption of innovations by smallholder farmers.
The mean land size was 4.8 ha. This suggests that smallholder farmers had enough land, and hence they are likely to adopt innovations introduced by extension officers. The mean frequency of extension visits was 1.6 visits. These findings suggest that smallholder tea farmers had at least one contact with extension officers. Studies by Tanui et al. (2012), Ekwang (2021), Arhin *et al*. (2024), Ateka *et al*. (2019), Diana (2024), Mushtag and Goswami (2024), and Sahu *et al*. (2023) reported that households with more frequent contact with extension officers had more chances of adopting innovations introduced by extension officers.

The mean years in tea farming was 11.7 years. Experience in tea farming is very important to smallholder farmers as this implies that they have a wealth of experience in testing different innovations brought by extension officers. Previous studies by Anang and Ayambila (2020), Gogoi *et al*. (2020), Gunapala and Dissanayeke (2022), Muhandirana and Thayaparan (2022), and Nyairo et al. (2022) reported that most of the farmers who adopted innovation were those who had long experience in farming the respective crop.

Table 4: Demographic Characteristics of Respondents (n=267)

Characteristics		**Frequency**	**Percent**
Sex	Male	227	85
	Female	40	15
Tea association membership	Member	200	75
	Non-memner	67	25
Access to credit	Access	195	73
	No access	72	27
Awareness of new tea seed varieties	aware	215	81
	Not aware	52	19

The results indicate that 85% of the heads of the household were male. This implies that most farmers who had adopted new tea varieties were male, as in most cases, cash crops like tea are in most cases male crops. Most of the respondents were members of the tea association. The reasons for this are that most innovation brought by extension officers is channeled to farmers through their association. Similar results were reported in a previous study by Adda (2022), Kimathi et al. (2021), Arhin et al. (2023), and Kipkogei et al. (2024).
The results further indicate that 73% of smallholder tea farmers had access to credit. This suggests that most of the tea farming community can access credit, which is essential for financing inputs like new tea seed varieties, and influences them to adopt new tea varieties. These findings are consistent with previous studies reported by Kimuthia et al. (2017), Munishi et al. (2017), Mugumaarhama et al. (2021), Mushtag and Goswami (2024), and Shitaye et al. (2024). On the other hand, most tea farmers (81%) were aware of new tea varieties, while only a few (19%) were not aware of new tea seed varieties.

3.2 Determinants of Smallholder Tea Farmers' Adoption of New Tea Varieties

The study used a binary logistic regression model to identify the factors influencing smallholder tea farmers' adoption of new tea varieties, as shown in Table 5. The results indicate that five out of ten variables included in the model were significant predictors of adoption ($p < 0.05$). Age was the most influential predictor among these, with a significance level of ($p = 0.000$).

Likewise, the results in Table 5 show that the Hosmer and Lemeshow Test had a Chi-Square statistic of 7.017 ($p = 0.541$). This indicates that the overall model effectively predicted the

outcomes, as the Hosmer and Lemeshow test's Chi-square value was not statistically significant, as explained by Field (2013). The Nagelkerke pseudo R2 statistic, which represents the adjusted Cox and Snell Pseudo R2, was calculated at 0.357. This suggests that approximately 35.7% of the variability in smallholder tea farmers' outcomes could be explained by the ten independent variables included in the binary logistic model.

Furthermore, the overall model demonstrated strong predictive power, as indicated by the significant Omnibus chi-squared statistic ($p = 0.000$). The Wald Statistic for household age was among the variables included in the model, with a value of 19.368 and a significant association at $p \leq 0.005$. Household size was the second most influential variable, with a Wald statistic of 9.764 and a significant relationship at $p \leq 0.001$. These results suggest that larger household sizes increase the likelihood of smallholder tea farmers adopting new tea varieties.

Table 5: Socio-economic Determinants of Smallholder Tea Farmers' Adoption of New Tea Varieties (n=267)

Variables	Coefficient (B)	S.E.	Wald	Sig.	Exp(B)
Age of the household head	0.096*	0.014	19.368	0.000	1.074
Household head sex	0.338*	0.210	4.556	0.012	2.312
Household head's years of schooling	-0.004	0.060	0.005	0.941	0.996
Household membership in an association	-0.259	0.342	0.568	0.451	0.773
Household Land Size	1.254**	0.391	9.872	0.002	0.239
Household access to credit	0.236	0.412	0.301	0.583	0.798
Household access to extension services	0.283	0.172	2.674	0.102	1.325
Household awareness of new tea varieties	0.021	0.018	3.833	0.028	0.781
Experience in tea farming	0.004**	0.003	4.995	0.013	0.879
Household size	0.305**	0.102	9.744	0.003	1.341

Omnibus Tests of Model Coefficients (Chi-square = 154.412; sig. = 0.000); Cox & Snell R Square = 0.357; Hosmer and Lem show Test (Chi-square 7.017) sig. = 0.541); Nagelkerke R Square = 0.357; * and ** indicate levels of significance at 1%, and 5% respectively.

The results indicate that the age of the household head emerged as the most influential predictor affecting the likelihood of smallholder tea farmers to cultivate new tea varieties. This finding was statistically significant at $p = 0.000$, with an Exp (B) value of 1.074. The Wald statistic of 19.368 suggests a significant contribution of the age of smallholder tea farmers in predicting their adoption of new tea varieties. The odds ratio indicates that when the age of the household head of smallholder tea farmers increases by one year, the odds ratio becomes 1.074. This suggests that older smallholder tea farmers are 1.074 times more likely to adopt new tea varieties. This result implies that there is a need to introduce age specific training on the economic benefit of clonal tea varieties. It also implies that adult smallholder tea farmers have a higher propensity to adopt new tea seed varieties, likely due to their accumulated experience in tea farming. Experienced smallholder tea farmers are more inclined to adopt new tea seed varieties as they possess a deeper understanding of tea production costs and disease-resistant varieties. The qualitative results during FGDs, supported the quantitative results. During FGDs it was reported that most tea farmers who have adopted new tea seed varieties are older tea farmers.

> *"… Most of those tea farmers who have adopted new tea seed varieties are adult people with several years in tea farming, as they have experienced many seed trials……"* (FGDs in Nsongola Village, 30th October, 2024).

Previous studies conducted by Muchangi (2016), Ateka et al. (2018), Arhin et al. (2024), and Kipkogei et al. (2024) noted a strong relationship between the age of farmers and their adoption of innovation.

The results presented in Table 5 showed the statistical significance of the sex of household heads ($p = 0.012$), indicating that sex is a significant predictor of household adoption of new tea seed varieties. Specifically, the findings reveal that male household heads were 2.312 times more likely to adopt new tea seed varieties. This suggests that male household heads exhibit a higher level of commitment, and tea farming proves to be an attractive and lucrative employment option that draws their interest in adopting new tea seed varieties. This call for gender sensitive strategies in agriculture to attract women in adoption of innovations. Similar results have been reported in other studies, such as those conducted by Tran and Goto (2019), Addai (2022), AKR et al. (2022), Deka et al. (2022), and Muhandirama and Thayaparan (2022).

In addition to that, the results indicate that with every one-hectare increase in land size, the odds ratio also increases by 1.254. This implies that households with larger land holdings are 1.254 times more likely to adopt new tea varieties. This also implies that smallholder tea farmers with greater land holdings have a higher chance of adopting new tea seed varieties. These results were supported by the results from the Focus Group Discussions (FGDs), which indicate that...

> *"…Most of the farmers who were early adopters of new tea seed varieties were those with a large number of hectares grown with tea…"* (FGD in Lufingo Village, 17th October 2024).

The Key Informant Interviews (KIIs) conducted in Makuyu and Bujeja villages echoed the importance of land size as a criterion for distributing new tea seed varieties to tea. This result is consistent with findings in the study conducted by Muchangi (2016); Aleka et al. (2018); Gogoi *et al*. (2020); Houeninvo and Quenum (2020), and Gogeje (2023), which highlighted the significant influence of land size on smallholder farmers' adoption of innovations.

The Household tea farming experiences also emerged as a significant factor influencing household adoption of new tea seed varieties. The odds ratio of 0.879 suggests that households with more experience in tea farming were 0.879 times more likely to adopt new tea seed varieties. This can be attributed to the higher experience in participating in seed testing trials with the Tea Research Institute for a number of years. In most cases extension officers tend to work close with experience farmers in the knowledge stage in order to create awareness. In the diffusion of innovation theory, knowledge, persuasion and decision stages depends on the tea smallholder farmers awareness and experiences. Similar findings were reported by Muhandirama and Thyaparan (2022); Xie et al. (2022); Zhou et al. (2023); Businge et al. (2024) and Obi et al. (2024), who reported that households with more experience in farming were more inclined to adopt new tea seed varieties.

Furthermore, household size had a significant and positive effect on the adoption of new tea seed varieties. The results indicated that when household size increased by one member, the odds ratio was 1.341, meaning households with more members were 1.341 times more likely to adopt new tea seed varieties. This suggests that households with larger families are more inclined to adopt new seed varieties because they have more labor available for farming activities while still maintaining enough members to support other non-farm income pursuits. This aligns with the observations made by Muchangi (2016), Anang and Ayambila (2020), Gogoi et al. (2020), and Mushtag and Goswami (2024), who noted that farmers who adopted innovations were those with larger family sizes.

4.0 Conclusions and Policy Recommendations

This study demonstrated variations in clonal tea varieties adoption and socioeconomic factors of the sampled tea farmers. Consequently, there were significant variations in clonal tea varieties production among small-scale farmers. The study therefore recommends the

adoption of these and other recommended clonal tea varieties for improved tea productivity at the farm level. The policymakers should therefore put the necessary measures in place to persuade the farmers to adopt recommended clonal tea varieties for improved tea productivity. The study established that the tea farming experiences household size, sex, age and adequate land size, and confidence of land ownership have a pivotal role in enhancing the adoption of recommended clonal tea varieties at the farm level. Tea farmers should therefore be encouraged to interact with experienced tea farmers to embrace clonal tea farming. On the other hand, the Rungwe District Council, Tea Board of Tanzania, Tea Research Institute of Tanzania should collaborate in reviewing land use policies and land tenure systems to avail adequate agricultural land and for clonal tea farming. There is a need for Rungwe District Council, Tea Board of Tanzania, Tea Research Institute of Tanzania to ensure age specific training is conducted to support youth to adopt clonal tea variaties.

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Conflict of Interest
The author declare no conflict of interest

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Policy Brief: Enhancing Adoption of Clonal Tea Varieties Among Smallholder Farmers in Rungwe District

Purpose

To identify and analyze the socio-economic factors influencing smallholder farmers' adoption of eight clonal tea seed varieties introduced by the Tea Board of Tanzania (TBT) and the Tea Research Institute of Tanzania (TRIT), and to recommend actionable policy interventions for improved uptake and productivity.

Key Findings

The significant predictors of adoption are listed below:

- Age: Older farmers more likely to adopt (Wald = 19.368, $p < 0.001$)
- Sex: Male-headed households 2.3× more likely to adopt ($p = 0.012$)
- Land Size: Larger landholdings positively correlated with adoption ($p = 0.002$)
- Tea Farming Experience: More experienced farmers showed higher adoption ($p = 0.013$)
- Household Size: Larger households more inclined to adopt ($p = 0.003$)
- Non-significant Factors: Education level, access to credit, extension services, and association membership did not significantly predict adoption in this context.
- Model Strength: Nagelkerke $R^2 = 0.357$; Hosmer-Lemeshow test confirms model fit ($p = 0.541$)

Implications

The implications of adoption are as follows:

- Adoption is uneven across demographic and landholding profiles, leading to disparities in productivity
- Male dominance in adoption suggests gendered access to resources and decision-making.
- Experience and land access are critical levers for scaling adoption.

Policy Recommendations

1.Targeted Awareness Campaigns

- Develop age-specific training modules to engage both youth and experienced farmers.
- Promote peer-to-peer learning through farmer field schools and demonstration plots.

2. Gender-Inclusive Strategies

- Design interventions that empower women farmers through tailored extension services and credit access.

3. Land Tenure Reform

- Collaborate with local authorities to review land use policies and secure tenure for smallholders to encourage investment in clonal varieties.

4. Extension Service Enhancement

- Increase frequency and quality of extension visits, focusing on varietal performance and market benefits.

5. Association Strengthening

- Reinforce farmer associations as platforms for innovation dissemination, input access, and collective bargaining.

Strategic Partners

The following are key strategic partners

- Tea Board of Tanzania (TBT)
- Tea Research Institute of Tanzania (TRIT)
- Rungwe District Council
- Farmer Associations and Cooperatives
- Development Partners in Agricultural Innovation