Investigation of Status and Determinants of Rural Household Food Security in Morogoro Rural District.

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Abstract
Food security remains a critical challenge in rural areas, particularly in Morogoro Rural District, where households face various socio-economic and environmental pressures. Therefore, this study examines the determinants of food security in Morogoro Rural District using a cross-sectional research design. A sample size of 377 households was selected, and data were collected through structured questionnaires. The analysis employed a Probit model to identify key factors influencing food security. The results revealed that household income, gender of the household head, climate change, and household size significantly affect food security, with higher income, male-headed households, and larger household sizes being positively associated with food security, while climate change negatively impacts it. These results suggest that economic stability, gender empowerment, and climate resilience are crucial for enhancing food security, while household dynamics also play a significant role. The findings highlight the need for targeted interventions that address these determinants to improve food security in rural areas.

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1. Introduction

Rural food security is a critical concern in developing countries, particularly in regions where a significant portion of the population relies heavily on agriculture for their livelihoods (Abu & Soom, 2016; Kitole et al. 2024; Kazungu & Kumburu, 2023). Morogoro Rural District in Tanzania is one such area where the livelihoods of the rural population are intricately tied to agricultural productivity (Nicoletis et al., 2019; Kitole & Sesabo, 2024). The district, like many others in sub-Saharan Africa, faces numerous challenges in maintaining adequate levels of food security, which is essential for the well-being and economic stability of its inhabitants (Mutea et al., 2019). Understanding the determinants of food security in this district is crucial for formulating effective policies and interventions that can address the underlying issues and improve the food security situation for these rural communities.

Food security in rural areas remains a significant challenge in many developing countries, particularly in sub-Saharan Africa. Despite efforts to improve agricultural productivity and food access, a large number of rural households continue to struggle with food insecurity (Mutea et al., 2019). This is especially concerning in regions like Morogoro Rural District, where agriculture is the primary source of income and food for most households. The persistent challenge of food insecurity in these areas highlights the need for a deeper understanding of the factors that influence food security, including both socio-economic and environmental variables.

According to recent reports by international organizations, the global state of food security is alarming. The FAO, IFAD, WFP, and WHO estimate that between 690 and 783 million people worldwide faced hunger in 2022, with rural populations, particularly women, disproportionately affected (World Bank, 2023). Furthermore, the report indicates that 2.4 billion people did not have access to nutritious, safe, and sufficient food throughout the year, a situation that is projected to worsen, wood security in Tanzania, including poor agricultural infrastructure, unreliable markets, limited access to agricultural credit, and a scarcity of agro-dealers in rural areas. Additionally, fluctuating food prices, adverse weather conditions, and inadequate irrigation and drainage systems further exacerbate the food security situation (URT, 2019). These challenges are compounded by global climate change, which is associated with dry spells, low rainfall, and increased pest and disease outbreaks, all of which negatively impact agricultural productivity and food availability (Masuku et al. 2023). Despite various government initiatives, such as the Tanzania Agriculture and Food Security Investment Plan (TAFSIP) and the Agricultural Sector Development Programme (ASDP II), food security remains a significant challenge, particularly in rural districts like Morogoro.

In Tanzania, efforts to address food insecurity have included numerous initiatives aimed at improving agricultural productivity and food availability. Programs such as the Tanzania Agriculture and Food Security Investment Plan (TAFSIP) 2011/2012 to

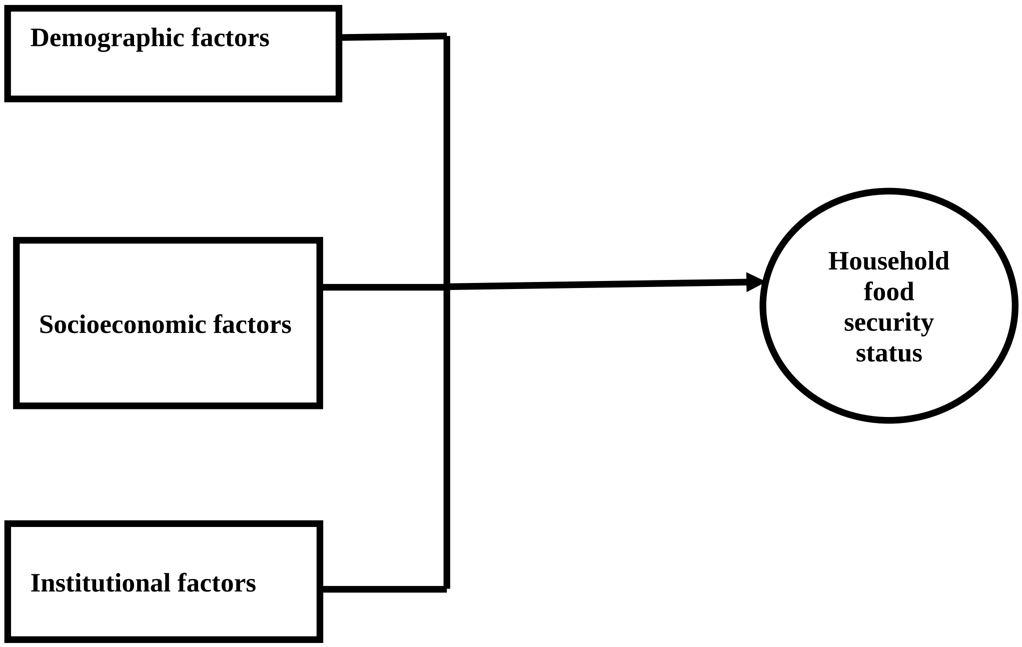
2020/2021 and the Agricultural Sector Development Programme (ASDP II) 2017/2018 to 2022/2023 have focused on enhancing household income, food security, and overall economic growth in line with national development goals Despite these efforts, the problem of food insecurity persists, particularly in rural areas where access to resources and infrastructure is limited. The government's ongoing initiatives, such as the Building a Better Tomorrow initiative for youth in agribusiness and the EU-funded AGRICONNECT program, aim to further address these challenges by promoting private sector involvement, job creation, and food and nutrition security.

Despite the various studies conducted on food security in Tanzania, significant gaps remain in the understanding of the specific factors influencing food security in rural districts like Morogoro. Many studies have overlooked the role of climate change and food prices as critical determinants of household food security (Lukiko & Cosmas, 2023; Ngongi & Urassa, 2014; Mwanga, 2019). Furthermore, most of these studies have relied on a single indicator to assess food security, which fails to capture the multidimensional nature of the issue (Perez et al., 2017). This study aims to fill these gaps by investigating the status and determinants of rural household food security in Morogoro Rural District, using a comprehensive approach that considers multiple indicators and the unique challenges faced by this region. By doing so, it seeks to provide insights that can inform more effective policies and interventions to improve food security in Tanzania's rural areas.

2. Conceptual Framework

Figure 1 illustrates a conceptual framework where household food security is the dependent variable influenced by various independent factors, including household income, age, gender, household size, education level, farm ownership, food storage facilities, food market prices, and climate change. These independent variables are linked to specific dimensions of food security: vulnerability (e.g., climate change), food availability (e.g., farm ownership, storage facilities, food prices), food utilization (e.g., age, household size, gender, education), and food access (e.g., income). Each dimension reflects the different aspects that contribute to or hinder household food security.

Figure 1: conceptual framework



3. Methodology

The study was conducted in Morogoro Rural District, located in the Morogoro region of Tanzania, specifically focusing on the wards of Mkulazi, Kibungo, Kibuko, and Kasanga. The district, one of nine in the region, is situated in the northeastern part of Morogoro, bordered by Bagamoyo and Kisarawe Districts to the east, Kilombero District to the south, and Mvomero to the north and west. Covering an area of 12,457 square kilometers, Morogoro Rural District comprises 31 wards and 151 villages, with a population of 387,736 across 102,120 households, as per the 2022 national census. Given the large study area, a cluster sampling technique was applied, with the wards serving as clusters and one village selected from each to form the sample. A sample size of 377 households was determined using Yamane's formula (1967) based on the total number of households in the selected wards (6,836) and a margin of error of 5%. This methodological approach ensured that the study could effectively capture the diverse characteristics of the population within the district.

3.1 Analytical model

This study employed probit model to estimate determinants for food security among households in Morogoro rural district. Therefore, for Probit model, the study considered an equation which describes the food security status such that:

$$y_i^* = \beta w' + \mu_i \quad where\ \mu_i \sim (0, \delta^2) \qquad (1)$$

y_i^* is the dependent variable which assume unobservable status, β represents the independent variable, w' represents the coefficient of the independent variable and μ_i is the error term with standard normal distribution. Basing on this function, the probit model is delivered to analyse determinants for household food security. Since y_i^* is unobservable, what we observe is $y_i$which takes only two values as described in equation 2

The likelihood of household to be food secured is herein presented by unobservable factors through the dependent variable as follows:

$$Food\ security = \begin{matrix} 1\ if\ food\ secured^* > 0 \\ 0\ if\ food\ insecured^* < 0 \end{matrix} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Therefore, the probability that a household is food secured is based on the assumption that the probability density function of e_i assumed being $f(\mu_i)$ which results in the creation of new parameter

$$Prob(y_i = 1|x|) = \int_{-\infty}^{x'\beta} f(\mu_i)du = F(x_i'\beta) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$Prob(y_i = 1|x|) = 2\pi^{-\frac{1}{2}} \exp\left((-\beta x_i)^{\frac{2}{2}}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Now, based on the variables used in this study the Probit model is therefore presented as;

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 D_i + \mu_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Of which the β_0 is the constant term while β_1Y and β_2 are the parameters that will be estimated in the probit equation. On the other hand, X_i are the covariates while $D_i$represents group of all dummy variables used in this study. Now, since the Probit model is well addressed under the marginal effects which help to explain the extent of household food security, then equation 5 is therefore transformed in order to get the marginal of variations in the repressors as shown at equation 6:

$$\frac{dy}{dx_i} = \beta_i \emptyset(\beta_1 + \beta_n) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Moreover, variables used in the analysis of this study have been presented at Table 1 with the detailed description and their measurement.

Table 1 variables measurements and their expected signs

S/NO	Variable name	Measurement	Expected sign
1	Education level	Continuous, Years of schooling	Positive
2	Age of the household head	Continuous, Years	Negative/positive
3	Monthly income	Continuous, TSH	Positive
4	Sex	Dummy, 1if male; 0 otherwise	Uncertain
5	Household size	Continuous, Total number of family members	Positive

6	Climate change	Dummy, 1 if yes; 0 otherwise	Negative
7	Food prices	Dummy, 1 if high; 0 if normal	Uncertain
8	Farm ownership	Dummy, 1 if yes; 0 if otherwise	Positive
9	Food storage facilities	Dummy, 1 if yes; 0 if otherwise	Positive
10	Household food security status (dependent variable)	Dummy, 1 if food secure; 0 if food insecure	

4. Results and discussion

The results presented in Table 2 provide a comprehensive overview of the demographic characteristics of the respondents in the study, offering insights into gender distribution, marital status, household size, and the geographical distribution of the sample across the selected wards in Morogoro Rural District.

The gender distribution among respondents is markedly skewed, with males comprising the majority at 74.50% (281 respondents) compared to 25.50% (96 respondents) who are female. This significant gender disparity suggests that men may be more likely to be the heads of households or the primary respondents in this context, which could reflect cultural norms or societal structures within the study area.

Table 2: Description of respondents' characteristics

Variables	Attributes	Number of respondents	Percentage
Sex	Male	281	74.50%
	Female	96	25.50%
	Total	**377**	**100.00%**
Marital status	Married	212	56.34%
	Single	165	43.66%
	Total	**377**	**100.00%**
Household size	0-3 members	75	20.00%
	4-6 members	136	36.00%
	7 – 10 members	111	29.50%
	11 and above members	55	14.50%
	Total	**377**	**100.00%**
Residence	Mkulazi wards	156	41.43%
	Kibungo wards	73	19.32%
	Kibuko wards	99	26.21%
	Kasanga wards	49	13.04%
	Total	**377**	**100.00%**

Source: Field data (2024)

Marital status is another important characteristic, with the data showing that a slight majority of the respondents are married, accounting for 56.34% (212 respondents). The remaining 43.66% (165 respondents) are single. This balance between married and single respondents could have implications for household dynamics, economic decision-making, and social responsibilities within the study area. Married individuals might be involved in

more collaborative decision-making processes, which could affect various aspects of household management, including resource allocation and participation in community activities.

Household size varies considerably among respondents, with the most common household size falling within the 4-6 members range, representing 36.00% (136 respondents) of the sample. Following this, households with 7-10 members make up 29.50% (111 respondents), while smaller households with 0-3 members account for 20.00% (75 respondents). The smallest category, households with 11 or more members, comprises 14.50% (55 respondents). These variations in household size could reflect differences in family structure, economic status, and resource needs. Larger households might face greater demands in terms of food, education, and healthcare, which could influence their economic behavior and vulnerability to external shocks.

The geographical distribution of respondents across the four selected wards shows that the largest proportion of the sample resides in Mkulazi wards, with 41.43% (156 respondents). Kibuko wards follow with 26.21% (99 respondents), Kibungo wards with 19.32% (73 respondents), and Kasanga wards with 13.04% (49 respondents). This distribution indicates a concentration of respondents in Mkulazi wards, which might suggest that this area has a higher population density or more households involved in the activities relevant to the study. The varying proportions of respondents from each ward could also reflect the economic, social, or infrastructural differences across these areas, which may influence the outcomes and interpretations of the study. Overall, the demographic characteristics of the respondents highlight the diversity within the sample in terms of gender, marital status, household size, and geographical location.

Table 2 Descriptive statistics of the variables included in the model.

Variable names	Observations	Mean	Std deviation	Min	Max
Age	377	42.62865	12.37775	22	90
Gender (1=male)	377	0.795756	0.403639	0	1
Farm ownership (1=yes if possesses)	377	0.933687	0.249191	0	1
Household's income	377	93538.44	81116.44	15,000	650,000
Education level	377	7.02122	3.490043	0	13
HH size	377	3.925729	1.41977	1	9
FS facilities (1=yes)	377	0.535809	0.4993788	0	1
Climate change (1=if affected)	377	0.806366	0.3954705	0	1
Price of food stuffs (1=high)	377	0.6551724	0.4759437	0	1
HH food security status (1=food secure)	377	0.530505	0.499713	0	1

Source: Field data 2024

The descriptive statistics presented in Table 2 offer valuable insights into the characteristics of the sample used in the study, providing a foundation for understanding the variables included in the model. The average age of respondents is approximately 42.63 years, with a standard deviation of 12.38 years, indicating a wide age range among

participants, from as young as 22 to as old as 90. This variation suggests that the study captures perspectives from both younger and older adults, which could influence the outcomes related to farm ownership, income, and other socioeconomic factors.

Gender distribution is heavily skewed, with the mean value of 0.796 indicating that around 79.6% of the respondents are male. This reflects a significant gender imbalance in the sample, which could be due to cultural or social factors that prioritize male involvement in the activities being studied. The presence of a binary variable (1=male) allows for an analysis of gender differences in the model. Also, farm ownership is common among respondents, with 93.4% of the sample indicating that they possess farms. The high mean value of 0.934 suggests that farming is a prevalent activity in the study area, likely forming a critical part of the household economy and influencing other variables such as income and food security.

Household income varies widely, with an average income of 93,538.44 TZS and a substantial standard deviation of 81,116.44 TZS, reflecting significant income disparities within the sample. The income range, from as low as 15,000 TZS to as high as 650,000 TZS, highlights the economic diversity among households, which may be linked to differences in farm productivity, employment opportunities, and access to resources.

Education levels among respondents show an average of 7.02 years of schooling, with a standard deviation of 3.49 years. This indicates that, on average, respondents have completed primary education, though there is considerable variation, with some having no formal education and others having up to 13 years of schooling. Additionally, household size averages around 3.93 members, with a standard deviation of 1.42, and ranges from 1 to 9 members. This relatively small household size may reflect demographic trends or socio-economic conditions in the study area. The household size can impact household income, food security, and the ability to adapt to climate change.

Access to financial services (FS facilities) is relatively low, with only 53.6% of respondents indicating they have access. The binary variable (1=yes) shows a near-even split, suggesting that financial inclusion is an important issue in the region, potentially affecting households' economic stability and capacity to invest in farm improvements or cope with economic shocks. On the other hand, a significant portion of the respondents, 80.6%, report being affected by climate change, indicating widespread awareness or experience of climate-related impacts. This high percentage underscores the relevance of climate change as a critical factor influencing agricultural productivity and household food security in the region.

The perception of high food prices is prevalent among respondents, with 65.5% indicating that they consider food prices to be high. This perception could reflect actual market conditions or the economic pressures faced by households, influencing their purchasing power and food security status. Finally, the food security status of households is fairly balanced, with 53.1% of respondents reporting that they are food secure. This suggests

that nearly half of the households experience some level of food insecurity, which may be influenced by factors such as income, farm ownership, and the impacts of climate change.

Factors that determine food security status of the households

The Probit model analysis reveals that household income is a crucial determinant of food security, with a coefficient of 0.2981 and a p-value of 0.000, indicating a strong and statistically significant positive relationship. This suggests that as household income increases, so does the likelihood of being food secure. The significance of this finding underscores the importance of economic stability in ensuring that households have sufficient resources to purchase adequate and nutritious food, especially in contexts where other factors, such as high food prices, may challenge access to food.

Table 3 Probit model results on determinants of food security

Food security status	Coefficients	Robust standard error	P>Z
Age	0.0116	0.0120	0.338
Sex (1=male)	0.0174***	0.0013	0.000
Farm ownership (1=yes)	-0.0353	0.4587	0.941
Household income	0.2981***	0.006	0.000
Educational level	0.0261	0.0230	0.244
Price of food stuffs	0.3200*	0.2388	0.065
Climate change (1=highly affected)	-0.5331***	0.0041	0.000
HH size	0.3934**	0.0507	0.043
FS facilities (1=yes)	-0.4613	0.3781	0.442
Constant	-5.6323	0.0034	0.000
Model strength			
Observation	377		
Pseudo R^2	0.5308		

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Gender also plays a significant role in determining food security, with male-headed households showing a positive coefficient of 0.0174 and a p-value of 0.000, signifying a highly significant relationship. This result indicates that male-headed households are more likely to be food secure compared to female-headed ones. This finding may reflect underlying gender disparities in resource access, economic opportunities, and household decision-making power, which could place female-headed households at a disadvantage in achieving food security. The significance of this factor highlights the need for targeted interventions that support female-headed households, potentially through economic empowerment programs and greater access to resources.

The impact of climate change on food security is starkly negative, with a coefficient of -0.5331 and a p-value of 0.000, indicating a strong and statistically significant relationship. Households that are highly affected by climate change are significantly less likely to be food secure. This result emphasizes the vulnerability of rural households to climate

variability, which can disrupt agricultural productivity and reduce food availability. The significance of this relationship calls for urgent action to implement climate adaptation strategies that can help mitigate the negative effects of climate change on food security, such as promoting climate-resilient agricultural practices and diversifying income sources.

Household size also emerges as a significant factor, with a positive coefficient of 0.3934 and a p-value of 0.043. This indicates that larger households are more likely to be food secure, which could be due to the pooling of resources and contributions from multiple income earners within the household. The significance of this finding suggests that larger households may have advantages in managing food security, although this could vary depending on the overall economic stability and resource distribution within the household. This result points to the complexity of household dynamics in influencing food security outcomes, suggesting that larger households may benefit from economies of scale or more diversified income streams.

4.2.2.2 Testing for model strength and model assumptions.

Table 4 multicollinearity test by variance inflation factor

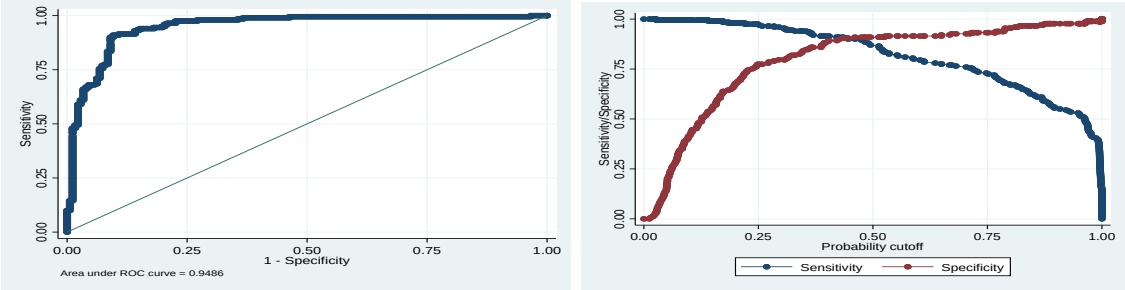
Variables	VIF	1/VIF
Sex	1.02	0.976475
Age	1.18	0.845878
Farm ownership	1.12	0.898258
Income	1.34	0.729755
Education level	1.04	0.958072
Price	1.02	0.984796
Climate change	1.11	0.898258
HH size	1.14	0.876174
FS facilities	1.37	0.729755
Mean VIF	1.17	

Source: Author's findings, 2024

Roc curve (sensitivity against specificity)

The ROC curve plots sensitivity against specificity across a range of cut-off values from zero to one (0-1), offering a visual representation of the model's diagnostic ability. The area under the ROC curve (AUC) is a key metric that reflects the model's predictive power, indicating how well it distinguishes between positive and negative outcomes. In this case, Figure 5 shows an AUC of 0.9486, which suggests that the model has a high level of accuracy and is highly effective in making reliable predictions. This near-perfect AUC value demonstrates the model's strong ability to correctly classify outcomes, reinforcing its robustness in predictive tasks.

Figure 5 Roc curve (sensitivity vs specificity)



5. Discussion

The findings from this study provide critical insights into the determinants of food security among households in Morogoro Rural District, highlighting the complex interplay between economic, demographic, and environmental factors. Household income emerged as a significant determinant of food security, a result that aligns with existing literature which consistently underscores the importance of economic resources in ensuring adequate food access Mutea et al. (2019) The positive and significant relationship between income and food security suggests that households with higher incomes are better positioned to secure enough food, even in the face of challenges such as fluctuating food prices or adverse climatic conditions. This finding reinforces the argument that enhancing household income, whether through increased employment opportunities, better wages, or diversified income sources, is crucial for improving food security (Mustapha et al, 2018; Kitole et al. 2023; Mumuni & Aleer, 2023; Mutea et al. 2021).

Gender also plays a significant role in determining food security, with male-headed households more likely to be food secure than female-headed ones. This finding is consistent with research that points to gender disparities in access to resources, decision-making power, and economic opportunities Matavel et al, (2022). Female-headed households often face structural barriers that limit their access to land, credit, and other essential resources, which can negatively impact their food security. The significant positive effect of being male on food security status suggests that gender inequalities remain a critical issue in rural areas, where traditional gender roles and norms may further exacerbate these disparities. This result underscores the need for targeted interventions aimed at empowering women, particularly in rural contexts, by improving their access to resources and economic opportunities, which could help bridge the food security gap between male- and female-headed households (Theodory & Kitole, 2024; Ningi et al, 2021)

The impact of climate change on food security is another key finding of this study, with households highly affected by climate change being significantly less likely to be food secure. This negative relationship highlights the severe vulnerability of rural households to the adverse effects of climate change, such as erratic rainfall, prolonged droughts, and other extreme weather events, which can disrupt agricultural production and reduce food

availability Kazem et al. (2023). The significant impact of climate change on food security supports the growing body of evidence that emphasizes the need for robust climate adaptation strategies. These strategies could include promoting climate-resilient agricultural practices, improving access to climate information, and supporting the diversification of livelihoods to reduce dependence on climate-sensitive activities Miron et al. (2023). Addressing climate change impacts is essential not only for enhancing food security but also for ensuring the long-term sustainability of agricultural systems in rural areas (Mustapha et al. 2018; Utouh & Kitole, 2024; Mekonnen et al. 2021).

Household size also emerged as a significant determinant of food security, with larger households being more likely to be food secure. This finding may seem counterintuitive at first, as larger households could be expected to have higher consumption needs, potentially making them more vulnerable to food insecurity. However, it is possible that larger households benefit from economies of scale, where shared resources and collective efforts contribute to greater food security Abu (2016). Additionally, larger households may have more members contributing to income, thereby enhancing their overall economic stability and ability to secure sufficient food. This result suggests that household composition and internal resource distribution play a crucial role in determining food security outcomes, pointing to the need for a nuanced understanding of household dynamics in food security interventions (Dimoso & Andrew, 2021; Kitole et al. 2024; Kayunze, 2009)

Therefore, the findings from this study underscore the importance of addressing economic, gender, and environmental factors in efforts to improve food security in rural areas. Enhancing household income, empowering women, and implementing climate adaptation strategies are critical components of a comprehensive approach to food security. Moreover, understanding the role of household dynamics, including the benefits of larger household sizes, can further inform targeted interventions aimed at reducing food insecurity. These insights contribute to the broader discourse on food security, emphasizing the need for integrated and context-specific solutions that address the diverse challenges faced by rural households.

6. Conclusions

The findings of this study highlight the multifaceted nature of food security in Morogoro Rural District, revealing that household income, gender of the household head, climate change, and household size are significant determinants. Household income emerged as the most critical factor, with higher income levels strongly associated with improved food security. This underscores the essential role of economic stability in ensuring that households can access sufficient and nutritious food. The significant gender disparity, where male-headed households are more likely to be food secure, points to persistent inequalities that need to be addressed to enhance food security for all households. Furthermore, the negative impact of climate change on food security emphasizes the vulnerability of rural households to environmental changes, while the positive effect of

larger household sizes suggests that household dynamics and collective resource management are important considerations in food security outcomes.

Given these findings, several recommendations can be made to improve food security in the study area. First, it is crucial to implement economic development initiatives that increase household income, such as supporting small-scale enterprises, providing access to credit, and promoting employment opportunities in rural areas. These efforts should be designed to enhance the economic resilience of households, enabling them to better cope with fluctuations in food prices and other economic challenges.

Second, addressing gender disparities is vital for improving food security, particularly for female-headed households. Policymakers should focus on empowering women by increasing their access to land, financial services, and education. Programs that promote gender equality in agricultural practices and resource management can help bridge the food security gap between male- and female-headed households. Additionally, initiatives that involve men in gender-sensitivity training could foster more equitable decision-making processes within households.

Third, the significant impact of climate change on food security necessitates the development and implementation of robust climate adaptation strategies. These strategies could include promoting climate-smart agriculture, enhancing access to climate information services, and supporting diversification of livelihoods to reduce dependency on climate-sensitive agricultural practices. By building resilience to climate change, households can better withstand the adverse effects of environmental changes on their food security.

Finally, the positive association between larger household sizes and food security suggests that policies and programs should consider household dynamics when designing interventions. Support for cooperative farming, community-based food distribution systems, and other collective efforts can leverage the strengths of larger households in managing food resources effectively. Additionally, providing targeted support to smaller households, which may be more vulnerable to food insecurity, could help ensure that all household types are adequately supported.

Therefore, improving food security in Morogoro Rural District requires a comprehensive approach that addresses the economic, gender, environmental, and household factors identified in this study. By implementing targeted interventions and policies that consider these diverse determinants, stakeholders can contribute to reducing food insecurity and promoting sustainable development in the region.

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