



The Heterogeneity of Socioeconomic Factors Affecting Poverty Reduction in Tanzania: A Multidimensional Statistical Inquiry

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Abstract

Persistent poverty poses a formidable challenge for the developing world, and Tanzania is no exception. Despite earnest efforts spanning decades to implement poverty reduction strategies, Tanzania grapples with the complexity of poverty within its households. Leveraging data from the Tanzania Household Budget Survey spanning 2011/2012 to 2019/2020, this study employs Probit, first difference generalized method of moment, and diverse poverty measurement techniques to unravel the dimensions, determinants, and socioeconomic intricacies influencing poverty prevalence among Tanzanian households. Key findings underscore the pivotal influence of age, household size, geographical zones, and income-generating activities on poverty. The study notably illuminates the substantial impact of the COVID-19 pandemic on poverty levels across households nationwide. The study acknowledges the heightened vulnerability of women and advocates for the implementation of gender-sensitive programs, and women's social inclusion for equitable poverty reduction. The study further stresses the importance of prioritizing accessible education and financial inclusion, supported by regional strategies that significantly contribute to poverty alleviation. The establishment of social safety nets is highly imperative to ensure a sustained poverty reduction.

Keywords Poverty · Developing countries · Heterogeneity · Unconditional cash transfer · Social protection · Generalized method of moments (GMM)

Introduction

The issue of poverty has been for a long time at the heart of development efforts among both developed and developing countries (Özpinar and Akdede, 2022; Neway and Massresha, 2022; Qurat-ul-Ann and Mirza, 2021). According to the United Nations Development Programme (UNDP), over 1.3 billion people worldwide live in multidimensional poverty, with 736 million people still living in extreme poverty, equivalent to 10%, which is low compared to 36% in 1990. Additionally, 50% of all people living in poverty are under 18 years of age (UNDP, 2021).

Globally, poverty reduction has been an issue of common concern. The launch of the Millennium Development Goals in 2000 and the Sustainable Development Goals (SDGs) in 2015 heightened the target for ending poverty of all forms across the world (Song et al. 2022; Kitole et al. 2023e). Over the past two decades (1999–2009 and 2009–2019), the world has experienced a significant fall in the number of people living in extreme poverty by over one billion (Neway and Massresha, 2022; World Bank, 2021). However, the COVID-19 pandemic has led to adverse effects on socioeconomic aspects globally leading to the increase in global poverty from 8.4% in 2019 to 9.3% in 2021 (Satapathy et al. 2023; Koudjom et al. 2022). Additionally, more than 71 million people are expected to fall into extreme poverty by the end of 2025 with sub-Saharan Africa and South Asia contributing nearly two-fifths of the total population population (Gerszon et al. 2020; World Bank, 2021).

COVID-19 has negatively impacted on the global economy, and developing countries have experienced extreme economic conditions, thus, increasing the demand and pressure on the government for poverty reduction. In developing countries, Tanzania particularly, the effects of COVID-19

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included job losses among the most vulnerable workers, including women, youth, and those without education. This has had severe impacts on small and micro enterprises especially on their productivity, entrepreneurial capital, and income growth levels even as economies revived slowly. Reports indicate that in June 2020 alone more than 140,000 formal jobs were lost, and some 2.2 million nonfarm informal workers suffered income losses (International Monetary Fund (IMF), 2021). This situation raises important concerns on how to redirect and improve poverty reduction strategies and policies in developing countries especially to target all vulnerable groups including women, low-skilled workers, and urban informal sector workers (Moyer et al. 2022).

Since gaining independence in 1961, Tanzania has made considerable strides in reducing poverty. The poverty index, as reported by the Tanzania's Bureau of Statistics (2021), fell from 34.4% in 2007 to 26.4% in 2019. However, later in 2022, the World Bank alerted that poverty was not reduced as much as the population grew, resulting in an increase in the absolute number of poor people. In 2019, about 14 million people lived below the national poverty line of TZS 49,320 per adult equivalent per month and about 26 million (about 49% of the population) lived below the \$1.90 per person per day international poverty line. Vulnerability is also still high: for every four Tanzanians who moved out of poverty, three fell into it. A large number of nonpoor people living just above the poverty line are at risk of slipping below it (WB, 2021; 2022).

Moreover, Tanzania having large proportion of poor population, the COVID-19 pandemic disrupted income-generating activities and led to a rise in the poverty rate again from 26.4 to 27.2% in 2022 (Joy et al. 2023). The pandemic's economic impact also led to funding shortages for poverty alleviation programs in low-income countries, including Tanzania (Satapathy et al. 2023). For instance, the Tanzania Social Action Fund (TASAF), which heavily relies on development partners for funding, experienced a significant reduction in the number of its beneficiaries (Dimoso and Andrew, 2021). Other developing countries also faced similar challenges which impacted negatively on poverty reduction schemes and increased vulnerability to shocks. Therefore, understanding this intricate relationship is crucial for the ongoing debates on achieving the Sustainable Development Goals, and particularly, the target on ending poverty in all forms in post-COVID-19 (Zhang et al. 2022; UNDP, 2021; Kharas, 2020).

This study significantly contributes to the existing literature by offering a nuanced exploration of poverty reduction in Tanzania, differentiating itself through a comprehensive analysis of the Tanzania Household Budget Survey Data from 2011/2012 to 2019/2020. Unlike prior studies (Melesse et al. 2023; Charales et al. 2023; Franke, 2021; Mfinanga et al. 2021; Koudjom et al. 2022), the present

study goes beyond generic examinations and leverages the specific context of Tanzania post-COVID-19 to uncover evolving dynamics in poverty alleviation. The choice of Tanzania as a focal point is strategic, given its substantial strides in poverty eradication amid recent economic challenges. By providing a detailed understanding of Tanzania's experience, the study offers actionable insights for policymakers and practitioners. The significance lies not only in the lessons tailored to Tanzania but also in the broader implications for countries facing similar socio-economic factors (see Fig. 1), fostering a collective learning experience and contributing to global efforts toward sustainable and inclusive development.

Methods and Data

This study adopts a quantitative research approach, utilizing secondary data sourced from the Tanzania Household Budget Survey (HBS) spanning the period from 2011/2012 to 2019/2020. The analysis focuses on a total of 9463 households to investigate the heterogeneity of socioeconomic factors influencing poverty reduction in Tanzania. The HBS data series serve as a primary information source for estimating poverty and associated characteristics, providing empirical evidence to comprehend the income dimensions of poverty (National Bureau of Statistics (NBS), 2022). The selected 9463 households were extracted from the total population of 9552, following meticulous data cleaning and management procedures facilitated by the use of STATA 15 software. Furthermore, the study encompasses 26 regions in Tanzania Mainland and 5 regions in the Zanzibar archipelago (see Fig. 2).

Moreover, in this study, the TASAF beneficiaries were used as a proxy to capture household poverty status. The reason for the use of this indicator is based on the fact that it captures genuine government-registered poor households, and it helps to understand the impact of TASAF on reducing poverty in the country by examining the behaviors of households that are benefiting from TASAF. Hence, the study aims to understand the dynamics of poverty reduction efforts in Tanzania.

Additionally, the study also uses the Headcount Index (H) and Poverty Gap (P_i) to measure the prevalence and severity of poverty, respectively. The Headcount Index measures the proportion of the population living below the poverty line, while the Poverty Gap measures the depth of poverty by looking at the gap between the average income of the poor and the poverty line. By analyzing how these dynamic factors affect both the prevalence and severity of poverty over time, the study aims to provide insights into the effectiveness of poverty reduction efforts in Tanzania.

Fig. 1 Conceptual framework. Source: adopted from Zhou and Huang (2023) and Mamkwe and Genda (2023)

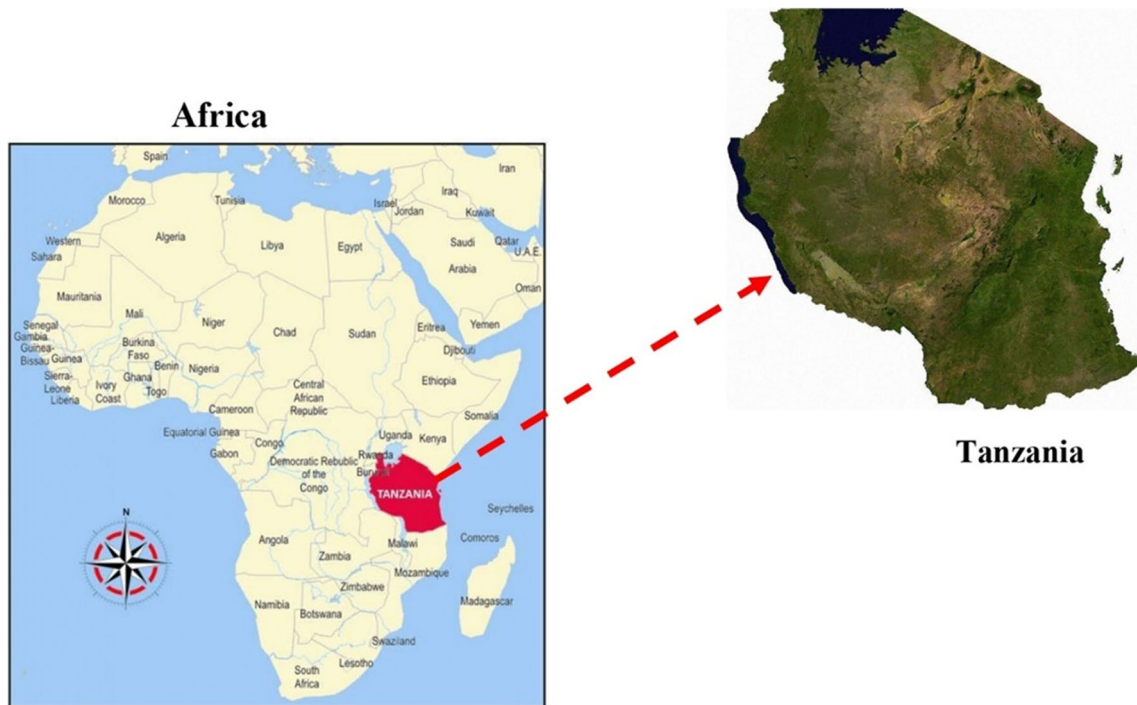
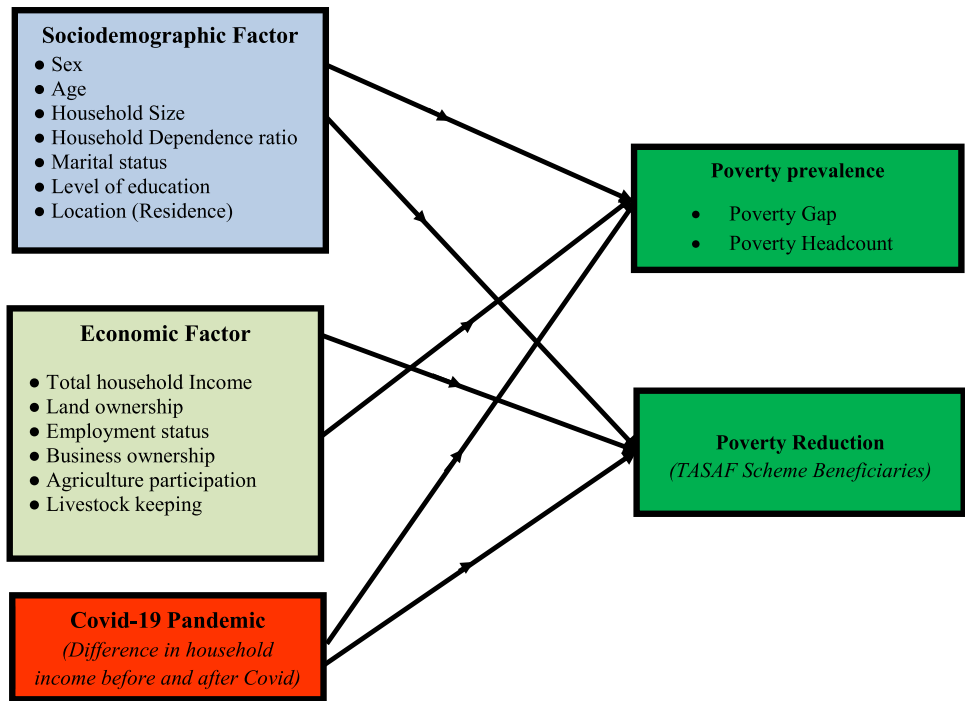


Fig. 2 The map of Tanzania. Source: Kitole et al. (2023c)

$$\text{Head count Index } (H) = \frac{1}{N} \sum_{i=1}^N I(y_i < z) \quad (1)$$

$$\text{Poverty gap } (P_i) = \frac{1}{N} \sum_{i=1}^N \left(\frac{G_i}{z} \right) \quad (2)$$

Estimation Technique

This study utilized two econometric models, the first being a Probit model from the group of limited dependent variable models. The Probit model was chosen because it provides a statistical fit to the data, with the error term symmetrically distributed around zero, as noted by Wooldridge (2009) and Dimoso and Andrew (2021). The model was used to explain the household adoption or beneficiary status of the poverty reduction strategy implemented by the Tanzanian government, known as the TASAF scheme. The model function or equation assumes that household adoption or beneficiary status of TASAF is dependent on a set of socioeconomic and demographic variables. The second model used in this study was the first difference generalized method of moment (F-GMM). The Headcount Index (H) and Poverty Gap (P_i) were used as outcome variables. Specifically, the Headcount Index measures the percentage of the population below the poverty line, while the Poverty Gap measures the extent to which the mean income of the poor falls below the poverty line.

Consider a Probit model that,

$$y_i^* = \beta w' + \mu_i \quad (3)$$

The dependent variable, denoted as y_i^* , is unobservable in this study. The independent variable is represented as β , while the coefficient of the independent variable is denoted as w' . The error term, which follows a standard normal distribution, is represented by μ_i . Since y_i^* is unobservable, we observe y_i , which takes only two values. The aim of this study was to investigate poverty reduction strategies for both beneficiaries and nonbeneficiaries. It is important to note that not all households benefit from poverty reduction strategies, and as such, the dependent variable is unobserved and can be presented as follows:

$$\text{Poverty Reduction Scheme Beneficiaries} = \begin{cases} 1 & \text{if ever benefited}^* > 0 \\ 0 & \text{if never benefited}^* < 0 \end{cases} \quad (4)$$

When $y_i^* = 0$ $y^* = 1$ then $y = 1$ implying that a household has ever benefited from the government poverty reduction schemes. This probability of a household being

ever benefited from this government poverty reduction strategy is explained by the estimated Probit model given assumptions that probability density function of e_i being $f(\mu_i)$ which results in the creation of a new parameter.

$$\text{Prob}(y_i = 1 | x) = \int_{-\infty}^{x'\beta} f(\mu_i) du = F(x'\beta) \quad (5a)$$

$$\text{Prob}(y_i = 1 | x) = 2\pi^{-\frac{1}{2}} \exp\left(-\beta x_i^2\right) \quad (5b)$$

The second and primary econometric model utilized in this study is the F-GMM. The decision to use this model is based on its ability to address endogeneity and heterogeneity that arise from the dynamic nature of the dataset. The F-GMM model is used to capture the dynamic relationship between the exogenous variables, which is stipulated from Eq. 6 to Eq. 9. By utilizing the F-GMM model, the study can consider the lagged effect of poverty reduction schemes on poverty prevalence and the level of poverty gaps. Furthermore, the model can control for unobserved heterogeneity and endogeneity issues that may arise from unmeasured factors affecting poverty reduction schemes. Overall, the F-GMM model is a suitable approach for analyzing the dynamic relationship between poverty reduction schemes and poverty prevalence, and it helps to provide more accurate and reliable results for policymakers and researchers.

Consider,

$$\ln Y_{it} = \varphi \ln Y_{it-1} + \beta X_{it}' + (\omega_i + \varepsilon_{it}) \quad (6)$$

Therefore, by transforming the regressors through the first difference, the fixed effect is removed as it does not vary with time, but the problem of endogeneity remains:

$$\Delta \ln Y_{it} = \varphi \Delta \ln Y_{it-1} + \beta \Delta X_{it}' + \Delta \varepsilon_{it} \quad (7)$$

Now, from Eq. 5, the model becomes,

$$\Delta \mu_{it} = \Delta \omega_i + \Delta \varepsilon_{it} \quad (8)$$

which can also be presented as,

$$\mu_{it} - \mu_{it-1} = (\omega_i - \omega_i) + (\varepsilon_{it} - \varepsilon_{it-1}) = \varepsilon_{it} - \varepsilon_{it-1} \quad (9)$$

Therefore, in Eq. 9, the unobserved fixed effects no longer enter the equation as they are by the assumption of a constant between periods. Moreover, the first differenced lagged dependent variable is instrumented with its past levels and now changes in the explained variables are assumed to be presented by Eq. 7.

Strength and Model Specification for Probit

In this paper, the Linktest and receiver operating characteristic (ROC) curve were utilized to evaluate the accuracy and robustness of the econometric models in predicting poverty levels among 9463 households in Tanzania. The Linktest was used to assess whether the model was correctly specified by regressing the variable of interest on the predictions and prediction square. If the squared prediction term ($_hatsq$) was statistically significant, it indicated that the model was not correctly specified. Conversely, if the squared prediction term was statistically insignificant, it suggested that the model was appropriately specified (Pregibon, 1980). On the other hand, the ROC curve illustrated the trade-off between sensitivity and specificity of the model as the cut-off points

varied from 0 to 1. The results showed high levels of sensitivity and specificity, with the graph being concentrated at the top-left corner, as demonstrated in Fig. 3.

The ROC curve is a graphical representation of the performance of a binary classifier system as its discrimination threshold is varied. It plots the values of 1-specificity (false-positive rate) on the x-axis and sensitivity (true-positive rate) on the y-axis for different cut-off points, ranging from 0 to 1. In this study, Figs. 3 and 4 demonstrate that the ROC curve exhibits high sensitivity and specificity, as indicated by the graph being concentrated at the top-left corner of the plot. This suggests that the classifier system is able to accurately distinguish between positive and negative instances of the target variable, with a low false-positive rate and a high true-positive rate.

Fig. 3 ROC curve. Source: authors' computation (2022)

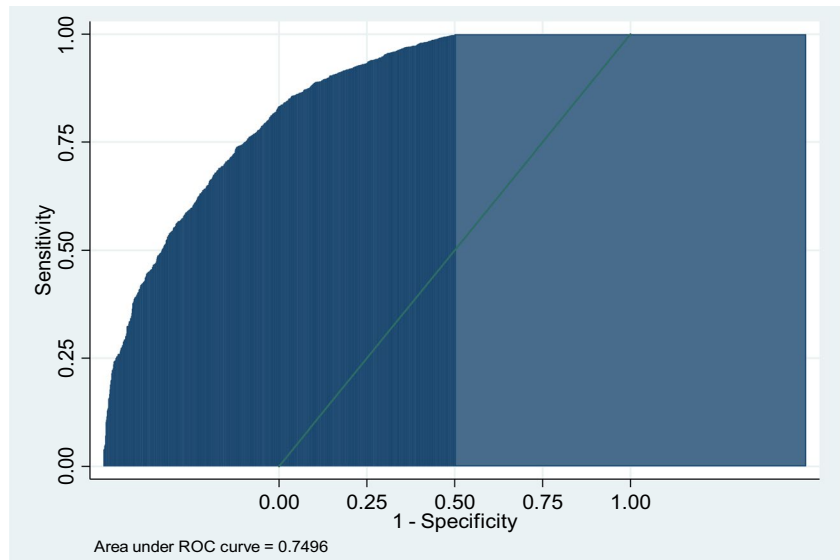
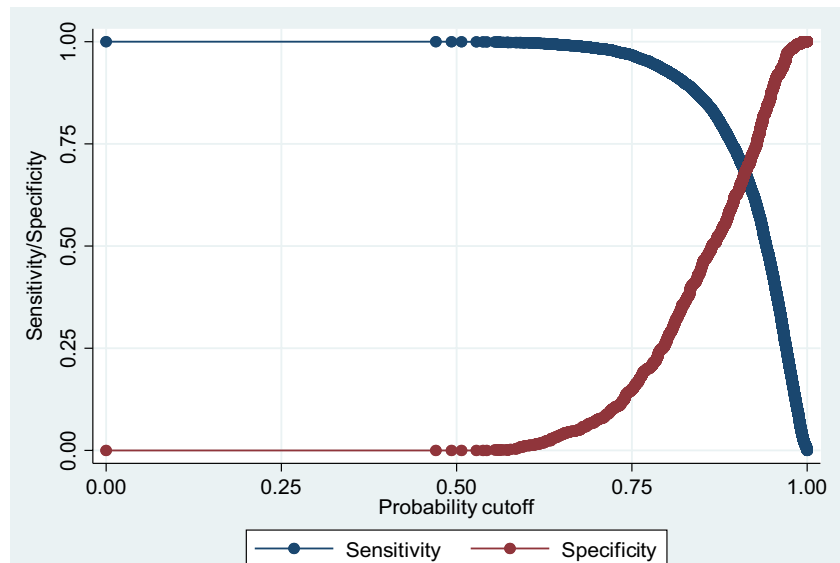


Fig. 4 Sensitivity vs. specificity. Source: authors' computation (2022)



The area under the ROC curve (AUC) is a widely used measure of the overall performance of a binary classifier like the poverty estimation model used in this study. It helps to understand how well the model can distinguish between negative and positive outcomes across its entire range of possible classification thresholds. In this study, the AUC was found to be 0.7496, indicating that the model is moderately accurate in classifying the outcomes. An AUC value of 0.5 means that the model is no better than random guessing, while an AUC value of 1 indicates perfect discrimination between positive and negative outcomes. Therefore, an AUC of 0.7496 suggests that the model is reasonably effective, but there may still be room for improvement in its predictive power.

Based on the results presented in Fig. 2, Fig. 3, and Table 1, the study findings are based on a correctly specified model, as confirmed by the Linktest results. When the variable of interest is regressed on the predictions and prediction square, if the square of the prediction ($_hatsq$) is significant (see Table 1), the model is not correctly specified. However, if it is insignificant, the model is correctly specified (Kitole et al. 2023b; Pregibon, 1980). Therefore, since the Linktest results show $_hatsq$ to be insignificant, the model used in this study is correctly specified.

Empirical Findings

The findings in Table 2 indicate that a significant majority of Tanzanian residents, specifically 70.54%, reside in rural areas, with the urban population constituting only 29.465%. This points to a decline in the rural population since the 2012 national census, which reported that 77% of the Tanzanian population was rural. Moreover, Fig. 4 results highlight the prevailing dominance of males in Tanzanian households, with 72.73% of households headed by males, while only 27.27% are headed by females.

Furthermore, the study observes an improvement in land resource ownership in Tanzania, currently standing at

62.15% (Table 2), with 37.85% not owning land. Despite Tanzania being a key player in the East African region with one of the largest livestock populations (FAO, 2021), only 49.54% of the population owns livestock, while 50.46% does not own any.

The results outlined in Table 2 underscore the ongoing significance of agriculture in Tanzania, serving as a vital sector for both food production and employment, with 71.20% of households actively engaged in agricultural activities. This emphasizes the sector's crucial role in sustaining a substantial portion of the population. Notably, the data indicates that livestock ownership remains relatively low, with only 49.54% of households having any livestock, suggesting that while agriculture is widespread, access to livestock production may be more limited.

Additionally, the findings point to a constrained landscape for business ownership in Tanzania, with only 21.15% of households owning businesses. This implies that the private sector may not yet be a major driver of economic growth or a significant source of employment opportunities. Despite government efforts to promote business development and attract foreign investment, particularly in manufacturing and tourism (UNCTAD, 2021), the observed low levels of business ownership signal a need for further support for entrepreneurship and private sector expansion in the country.

Table 3 reveals key insights into household demographics in Tanzania. On average, a Tanzanian household comprises 4.8 individuals, including 3.9 adults and 0.9 children under five. This signals a slight reduction from the 2012 Household Budget Report, which reported an average of 5.0 individuals per household. Moreover, each household has an average of 0.2 elderly individuals aged over 65. Regarding income, the average household income is Tanzanian shillings 947,836, equivalent to US\$ 411,208. However, it is crucial to contextualize these figures within the backdrop of Tanzania's economic challenges, highlighted by the World Bank's report indicating a contraction from 5.8% in 2019 to 2.0% in 2020. This economic downturn likely contributed to the observed decrease in average household income.

Figure 5 provides a comprehensive overview of the poverty landscape and the distribution of poverty reduction initiatives across various regions in Tanzania. The data highlights Kigoma as the most successful region in leveraging government poverty reduction efforts, boasting 5.74% of total beneficiaries. Following closely are Tanga and Mtwara regions with 5.36% and 5.11%, respectively. Notably, Dar es Salaam, the prominent business hub, records a modest 2.87% of beneficiaries, while Tabora, the country's largest region, lags behind with only 1.75% beneficiaries. The substantial beneficiary count in Kigoma can be attributed to its role as a host for numerous refugee camps from neighboring countries like Burundi and Rwanda, contributing to a regional poverty incidence rate of 48.9% (MoFP, 2016a; 2016b).

Table 1 Specification test results

Testing prediction	Coefficient	<i>z</i>
$_hat$	0.7023114*** (0.2039459)	3.44
$_hatsq$	0.1167493 (0.0784503)	1.02
constant	0.1668364 (0.1265241)	1.32
Pseudo <i>R</i> squared	0.3758	
LR $\chi^2(2)$	85.49	
Prob > χ^2 -square	0.0000	

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: authors' computation (2022)

Table 2 Descriptive analysis

Variable		Frequency	Percentage
Location	Rural	6675	70.54%
	Urban	2788	29.46%
Sex	Male	6882	72.73%
	Female	2581	27.27%
Level of education	No schooling	4740	50.09%
	Some primary	1020	10.78%
	Completed primary	3164	33.44%
	Some secondary	52	0.55%
	Completed secondary	316	3.34%
	More than secondary	171	1.81%
Employment status	Employed	1060	11.20%
	Self-employed	5628	59.47%
	Paid household worker	23	0.24%
	Unpaid household worker	537	5.68%
	Unemployed	421	4.45%
	Retired	244	2.58%
Marital status	Never worked	1550	16.38%
	Never married	510	5.36%
	Married	6825	72.15%
	Divorced	900	9.51%
Land ownership	Widowed	1228	12.98%
	Don't own (no)	3703	39.13%
Livestock ownership	Own (yes)	5760	60.87%
	Don't own (no)	4775	50.46%
Business ownership	Own (yes)	4688	49.54%
	Don't own (no)	7462	78.85%
Agriculture participation	Own (yes)	2001	21.15%
	Don't participate (no)	2725	28.80%
COVID-19-affected households	Participate (yes)	6738	71.20%
	Affected (yes)	1373	14.51%
	Not affected (no)	8090	85.49%

Source: authors' computation (2022)

Table 3 Summary statistics

Variable	Mean	Standard deviation	Minimum	Maximum
Adult equivalent to household size	3.921424	2.30811	0.72	29.16
Household size	4.853535	2.910977	1	38
Age of head of household	47.065884	15.74102	13	112
Household income	947,836	2,337,818	38,807.4	151,000,000
Children under 5 years	0.9406108	1.138971	0	14
Children between 5 and 14 years	2.154391	1.98279	0	23
Adult (15 years and 64)	2.699144	1.511055	0	19
Elderly more than 65 years	0.2292085	0.5137968	0	5

Source: authors' computation (2022)

The results presented in Table 4 highlight regional disparities in the distribution of poverty reduction schemes in Tanzania. The Lake zone emerges as the focal point, claiming the highest share at 26.44% of all beneficiaries, closely

followed by the Southern Highland zone with 20.58%. In contrast, the Western zone, encompassing Kigoma and Katavi regions, reports the lowest proportion of beneficiaries, standing at only 9.25%. These findings underscore an

Fig. 5 The Distribution of Poverty beneficiaries under Tanzania Social Action Fund across regions. Source: authors' computation (2022)

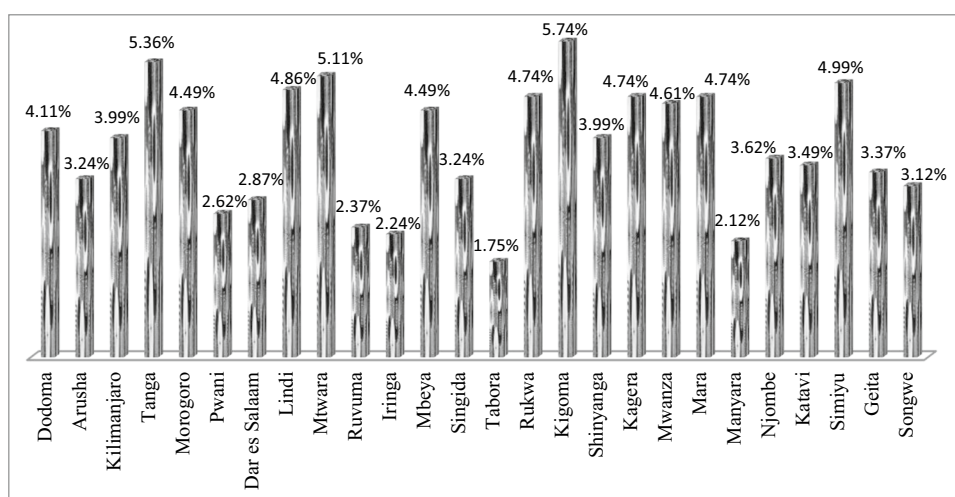


Table 4 Proportion of poverty reduction strategies across zones in Tanzania Mainland

Coastal zone	Central zone	Lake zone	Northern zone	Southern Highlands	Western zone
9.07%	19.95%	26.44%	14.71%	20.58%	9.25%

Source: authors' computation (2022)

uneven allocation of poverty reduction strategies, with certain regions reaping greater benefits than others. The prevalence of poverty in the Lake zone could be attributed to factors such as environmental degradation, climate change, and heavy reliance on rain-fed agriculture. Conversely, the prosperity of poverty reduction initiatives in the Southern Highlands zone may be linked to its fertile soils. Nevertheless, the minimal presence of beneficiaries in the Western zone signals a compelling need for intensified government efforts to address poverty in these regions.

The findings presented in Table 5 underscore gender and educational disparities in the distribution of poverty reduction strategies in Tanzania. Notably, there is a disproportionate benefit to males, constituting 53.74% of beneficiaries compared to females at 46.26%. However, this disparity may imply that male-headed households are grappling with higher poverty levels than their female-headed counterparts. Additionally, the results reveal a substantial majority of beneficiaries lacking formal education, standing at 69.71%, while those with education beyond secondary school make up only 1% of beneficiaries. This suggests that formal education plays a crucial role in poverty reduction, as individuals with higher educational attainment may have increased opportunities to break free from the cycle of poverty.

Figure 6 delineates the income inequality landscape in Tanzania, elucidating the Gini coefficient's measure. The latest assessment for 2020 discloses a Gini coefficient of

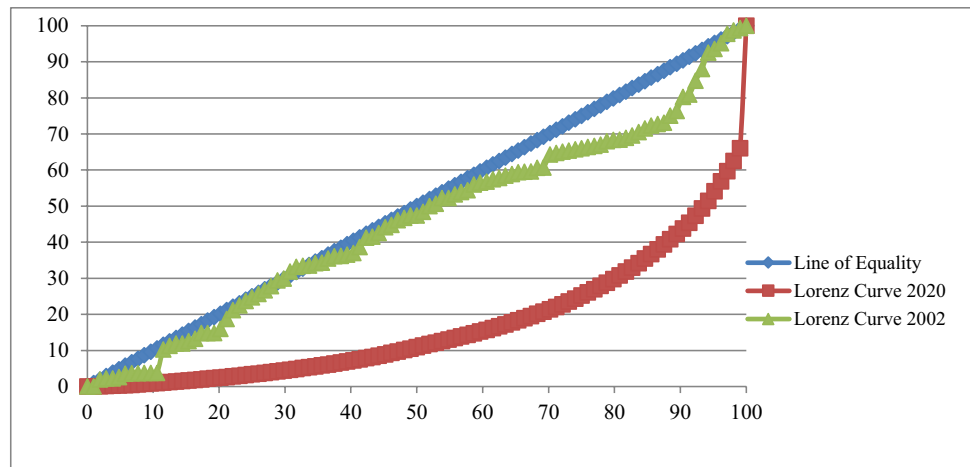
0.543672, equating to 54.3672%. This reflects a substantial 12.1672% surge from the World Bank's 2018 Gini estimate for Tanzania (Kharas, 2020; Knoema, 2021) and a

Table 5 Poverty reduction strategies across different socioeconomic groups

Socioeconomic group	Benefit from poverty reduction strategy		Total
	Benefit	Never benefit	
Sex			
Male	431 (53.74%)	6451 (74.48%)	6882 (72.73%)
Female	371 (46.26%)	2210 (25.52%)	2581 (27.27%)
Land ownership			
No	234 (29.18%)	3469 (40.05%)	3703 (39.13%)
Yes	568 (70.82%)	5192 (59.95%)	5760 (60.87%)
Livestock ownership			
No	374 (46.63%)	4401 (50.81%)	4775 (50.46%)
Yes	428 (53.37%)	4260 (49.19%)	4688 (49.54%)
Business ownership			
No	684 (85.29%)	6778 (78.23%)	7462 (78.85%)
Yes	118 (14.71%)	1883 (21.77%)	2001 (21.15%)
Marital status			
Never married	23 (2.87%)	487 (5.62%)	510 (5.36%)
Married	441 (54.99%)	6384 (73.71%)	6825 (72.15%)
Divorced	99 (12.34%)	801 (9.25%)	900 (9.51%)
Widowed	231 (28.80%)	997 (11.52%)	1228 (12.98%)
Level of education			
No schooling	559 (69.71%)	4181 (48.27%)	4740 (50.09%)
Some primary	68 (8.49%)	952 (10.99%)	1020 (10.78%)
Completed primary	161 (20.07%)	3003 (34.67%)	3164 (33.44%)
Some secondary	1 (0.12%)	51 (0.59%)	52 (0.55%)
Completed secondary	12 (1.49%)	304 (3.51%)	316 (3.34%)
More than secondary	1 (0.12%)	170 (1.97%)	171 (1.81%)

Source: authors' computation (2022)

Fig. 6 Lorenz curve showing income inequality among households in Tanzania. Source: authors' computation (2022)



notable 16.4% escalation from the 2002 figure, signifying a 743.195% increase in income inequality over the 8-year span. The accompanying Lorenz curve graphically portrays this disparity, manifesting an outward bow that signifies a small fraction of the population commanding a significant share of the country's income. This visual depiction underscores the imperative for policies geared toward mitigating income inequality and fostering a more equitable distribution of income.

Figure 7 illustrates that poverty predominantly permeates rural areas, encompassing an average of 76% of impoverished households. In contrast, other urban locales in Tanzania accommodate approximately 16% of the total impoverished population. Remarkably, Dar es Salaam, the largest and economically pivotal city in the country, witnesses a declining but still noteworthy increase of around 7% in the number of impoverished individuals.

Poverty Incidences in Tanzania 2011/2012 to 2019/2020

Table 6 presents the poverty incidence in Tanzania over an 8-year period from 2011/2012 to 2019/2020, as measured by the poverty gap and headcount indexes.

Table 6 discloses that over the 8-year span from 2011/2012 to 2019/2020, the average headcount index stood at 34.36%, signifying that a substantial portion, approximately one-third, of the population persists below the poverty line. Furthermore, the average poverty gap index registered at 28.20%, indicating that the average income of the impoverished was 28.2% below the poverty line. The squared poverty gap index, which accords greater weight to the income of impoverished households, recorded at 25.20%, underscores that a considerable proportion of the

Fig. 7 Distribution of the poor population by geographical area in Tanzania Mainland. Source: authors' computation (2022)

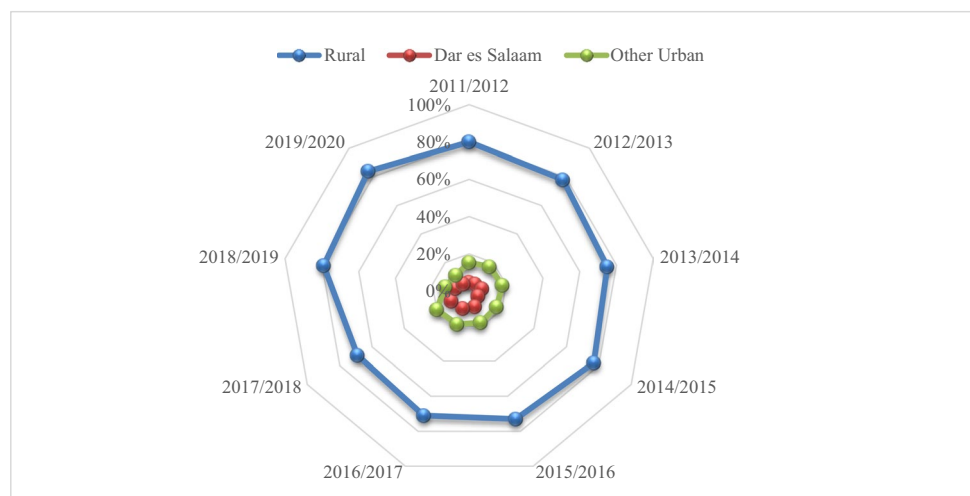


Table 6 Poverty incidence at different measurement in Tanzania 2011/12 to 2019/20

Poverty incidence	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	Average
Headcount Index(H)										
$\frac{1}{N} \sum_{i=1}^N I(y_i < z)$	49.38%	46.10%	34.89%	33.74%	32.64%	27.60%	28.53%	26.8%	29.56%	34.36%
Poverty Gap Index										
$\frac{1}{N} \sum_{i=1}^N \left(\frac{G_i}{z}\right)$	29.10%	29.60%	28.10%	27.80%	29.60%	26.20%	27.80%	26.60%	28.70%	28.20%
Squared Poverty Gap Index										
$\frac{1}{N} \sum_{i=1}^N \left[\frac{G_i}{z}\right]^2$	27.50%	28.20%	25.90%	20.50%	28.20%	23.50%	24.40%	23.20%	25.80%	25.20%

Source: authors' computation (2022)

impoverished populace had income below the poverty line. In essence, these results underscore the persistent and widespread nature of poverty in Tanzania, with a substantial segment of the population grappling with economic challenges.

Heterogeneous Regression on the Determinants of Poverty

To delve into the heterogeneity of poverty measures, particularly the poverty headcount index and poverty gap, the study employs the first difference generalized method of moments (GMM) model. This approach not only scrutinizes the variation in these poverty metrics but also explores the implications, changes, and dynamics of poverty in Tanzania. The changes in the headcount index and poverty gap serve as dependent variables, shedding light on how the outcomes fluctuate in response to the myriad socioeconomic factors influencing poverty prevalence among Tanzanian households. This methodology provides a nuanced understanding of the multifaceted nature of poverty dynamics within the context of Tanzania.

The baseline model, as detailed in Table 7, unveils compelling insights into the predictors of poverty prevalence in Tanzania. The persistent nature of poverty is evident, as past measures strongly influence current levels, illustrating a path-dependent trajectory. Age groups 0–15 and 15–30 exhibit a positive and significant impact on poverty, while the 30–45 age group displays a negative and significant effect, except for the 45–60 age group, which is negative but insignificant. Household economic factors, including per capita income, income from farming, businesses, and pastoralism, emerge as significant contributors to poverty prevalence.

Household size, with a positive and significant coefficient at the 1% level in columns 1 and 3, indicates that an expanding household size correlates with an increase in headcount poverty. The Hansen test assures the model's reliability,

revealing no econometric issues from second-order serial correlation.

Furthermore, the results unveil the heterogeneity of poverty within the country. Households in the East and Coastal zones demonstrate a significant and negative relationship with poverty indicators, underscoring their substantial contributions to the national GDP and well-established economic networks. Notably, the study highlights the significant and adverse impact of COVID-19 on poverty prevalence, with an increase of 46.72% in column 1 and peaking at 59.54% in column 2. These findings align with the socio-economic repercussions of COVID-19 in developing nations like Tanzania, where the pandemic has led to income depletion and heightened susceptibility to poverty.

Poverty Among Unconditional Cash Transfer Scheme Beneficiaries

Employing Probit estimation, this study delves into the nuanced factors influencing poverty prevalence among Tanzanian households from 2011/12 to 2019/20, unraveling insights through marginal effects. As depicted in Table 8, a striking pattern emerges, indicating that households situated in urban areas exhibit a significantly lower likelihood of falling into poverty compared to their rural counterparts. This suggests a heightened vulnerability to poverty among individuals residing in rural settings. Conversely, the study unveils a noteworthy correlation between the gender of the household head and poverty status, revealing that households led by males are more predisposed to poverty than those led by females. These findings align with the research of Joy et al. (2023), showcasing the intricate dynamics of women's contribution to the labor force in Tanzania, surpassing other sub-Saharan African nations. Notably, women in rural areas emerge as pivotal contributors to household income, emphasizing the multifaceted nature of poverty determinants (Zhang et al. 2022; Faharuddin and Endrawati, 2022).

Table 7 Prevalence of poverty among households in Tanzania

Poverty Headcount Index [1]	Poverty Gap [2]	Δ Headcount [3]	Δ Gap [4]	
Constant	0.4314	0.4422	0.3234	0.8910
log Poverty Headcount Index_1	0.3437***			
log Poverty Gap_1		0.2102***		
Log Δ Headcount ₁			0.1965***	
Log Δ Gap ₁				0.3083***
Age groups				
0–15	0.8672**	0.8104***	0.6543***	0.7336***
15–30	0.1049**	0.1373*	0.2938***	0.2852***
30–45	–0.1182*	–0.1597**	–0.0985*	–0.4349**
45–60	–0.1233	–0.0689	–0.01601	–0.0868
65+	0.1516**	0.1347**	0.1327*	0.4898**
Household composition				
Adult equivalent to household size	0.1154**	0.2135	0.0917	0.1768**
Household size	0.1726***	0.1170**	0.2450***	0.2962**
Years of schooling	–0.1580*	–0.1486**	–0.0282	–0.0516
Economic factors				
Per capita income	–0.1676**	–0.1906**	–0.5345**	–0.3333***
Farming income	0.1458**	0.0468	0.1982***	0.285***
Business income	–0.0910	–0.1392**	–0.1868*	–0.4504**
Pastoralists income	0.1389	0.0981	0.3602**	0.3868**
Effects of COVID-19				
COVID-19	0.4672***	0.5954***	0.5631***	0.4731***
Household income levels				
1st quantile	0.2385**	0.1902**	0.1087***	0.5462**
2nd quantile	0.1134**	0.1092***	0.1423**	0.2078*
3rd quantile	–0.1720**	–0.1978**	–0.2105*	–0.3156**
4th quantile	–0.21450*	–0.2349**	0.3668***	–0.4769**
Number of employed household members	0.5674**	0.5907***	0.5348***	0.6135***
Country's zonal economic strength				
Southern zone	0.1804***	0.14605*	0.1196**	0.1103**
Southern Highlands	–0.2216**	–0.2418***	–0.2329**	–0.21464
Central zone	0.5214**	0.4272**	0.3105*	0.0783
West lake zone	0.5244**	0.3913**	0.1439**	0.1568**
Lake zone	0.1621**	0.1902***	0.1633**	0.2463***
Northern zone	0.2221**	0.2475***	0.2014***	0.0678
East and Coastal zone	–0.1538**	–0.11068**	–0.0913**	0.1052**
Gini coefficient		0.0667**	0.0589***	0.04549*
Regional revenues as share of GDP	–0.69346**	–0.5456***	–0.0289***	0.0294***
Number of observations	9461	9461	9461	9461
Time dummies	Yes	Yes	Yes	Yes
F statistics	67.321	54.765	38.893	37.943
Number of groups	59	59	59	59
Observation per group	1	1	1	1
Number of instruments	24	24	24	24
GMM instrumental lag				
AR(1)	0.351	0.359	0.361	0.349
AR(2)	0.527	0.548	0.556	0.548
Hansen test	0.435	0.489	0.401	0.492
Prob > F	0.000	0.000	0.000	0.000

Δ indicating a change

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: authors' computation (2022)

Table 8 Poverty among unconditional cash transfer scheme beneficiaries

Variables	Probit		Marginal effects	
	Coefficient	<i>z</i>	$\frac{dy}{dx}$	<i>z</i>
Residence (urban)	−0.1977432** (0.058536)	−3.38	−0.0237386*** (0.00702)	−3.38
Sex of household head (male)	0.3071825*** (0.0527309)	5.83	0.0412031*** (0.00785)	5.25
Household size	−0.0148022 (0.0327644)	−0.45	−0.001777 (0.00393)	−0.45
Age square	0.0002612** (0.0017531)	8.45	0.0003765** (0.000028)	8.24
Age	0.0161644*** (0.0013901)	11.63	0.0019405*** (0.00017)	11.5
Marital status (Unmarried)	0.0812366** (0.0309733)	2.62	0.0097523** (0.00372)	2.62
Adult equivalent	0.0655843 (0.0418697)	−1.57	−0.0078732 (0.00501)	−1.57
Land ownership (Own land)	−0.0338521 (0.0486122)	−0.70	−0.0040383 (0.00524)	0.70
Livestock ownership	0.0426155 (0.0436771)	0.98	0.0051117 (0.00524)	0.98
Income	2.40e-07 ¹ *** (4.00e-08)	6.01	2.89e-08 ² (0.00000)	6.34
Business ownership	−0.0935094* (0.0524268)	−1.78	−0.0117049* (0.00682)	−1.72
COVID-19	0.214605*** (0.0255)	3.87	0.2329*** (0.0309)	3.85
Agriculture participation	0.2027412*** (0.0547973)	3.70	0.0227927*** (0.00575)	3.96
Education (No schooling)	0.0578511** (0.0213058)	5.67	0.0069449** (0.00255)	5.72
Employment status	−0.0225382** (0.0094911)	−2.37	−0.0027057** (0.00114)	−2.38

Standard errors in parentheses

¹2.40e-07 = $2.40 \times 10^{-7} \approx 0.00000024$

²2.89e-08 = $2.89 \times 10^{-8} \approx 0.0000000289$

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: authors' computation (2022)

Intriguingly, the results presented in Table 8 challenge the conventional wisdom surrounding household size as a poverty indicator in many developing countries. Contrary to common beliefs, an additional household member is associated with a 0.1777% reduction in the likelihood of falling into poverty. These findings resonate with Charles et al. (2023), highlighting the complexity of household dynamics and their varying impacts on poverty. Interestingly, this contrasts with the findings of Dimoso and Andrew (2021) as well as Salem and Bayat (2018), underscoring the nuanced relationship between household size, income, and poverty. Moreover, as the head of the household ages by 1 year, the probability of experiencing poverty increases by 0.19405%, shedding light on the vulnerability of older

individuals to economic hardships compared to their younger counterparts.

Marital status emerges as a crucial factor, with unmarried individuals facing a higher likelihood of poverty than their married counterparts. The support system within married couples seemingly plays a role in mitigating poverty risks. Surprisingly, livestock ownership, often seen as an economic asset, increases the likelihood of poverty. This aligns with the findings of Kitole et al. (2023d), highlighting the challenges faced by pastoralists, one of the poorest population subgroups. The study underscores the financial burden associated with livestock keeping, including costly veterinary and medical expenses. Consistent with Song et al. (2022) and Zhou and Huang (2023), these results emphasize

the intricate relationship between livestock ownership and poverty incidence.

Participation in agriculture, a dominant sector in Tanzania, surprisingly increases the likelihood of household poverty. Despite employing nearly 70% of the labor force, the agricultural sector contributes only 26.7% to the country's GDP, indicating inefficiencies and poverty within the sector. This sheds light on the need for comprehensive reforms to enhance the economic viability of agriculture.

The study's most significant revelation lies in the impact of COVID-19 on household poverty. Affected households face a staggering 21.4605% higher likelihood of falling into impoverishment. The pandemic disrupts productivity and imposes additional medical costs, aligning with Kitole et al. (2022a) and Debebe and Zekarias (2020) which underscores multifaceted ways in which health crises contribute to poverty in developing countries.

Lastly, education emerges as a pivotal factor in poverty dynamics. Households led by heads with no formal education exhibit a higher likelihood of experiencing poverty compared to those with formal education or training. This underscores the transformative power of education in alleviating poverty and building robust human capital for self-employment and employment opportunities.

Conclusion

In conclusion, this study unravels the intricate tapestry of factors influencing poverty in Tanzania. The path-dependent nature of poverty, evidenced by the strong predictive power of past measures, underscores the need for targeted, dynamic interventions. Age groups, household economic indicators, regional disparities, and the profound impact of the COVID-19 pandemic emerge as pivotal determinants of poverty prevalence. The Probit model highlights the role of education in reducing poverty, while also revealing unexpected dynamics such as the inverse relationship between household size and poverty likelihood. Urban residence proves significant in poverty mitigation, urging policymakers to address rural–urban disparities. Gender dynamics in poverty, exacerbated by the vulnerability of male-headed households, call for gender-sensitive poverty alleviation initiatives. Livestock ownership and agricultural engagement, while traditionally seen as assets, pose challenges that require nuanced policy considerations.

Policy recommendations stemming from this study are multifaceted and address the diverse facets of poverty dynamics in Tanzania. Firstly, targeted poverty alleviation initiatives should prioritize rural areas, acknowledging and addressing the unique challenges faced by these communities. Gender-sensitive programs, empowering women, are

crucial for equitable poverty reduction. Education should be a national priority, ensuring access for all, irrespective of socioeconomic backgrounds. Financial inclusion, particularly in rural and semi-urban areas, is paramount, necessitating accessible credit and capital for entrepreneurship. Comprehensive livestock-related policies and agricultural reforms should be devised to address challenges associated with ownership and productivity. Regional strategies, considering the varied poverty landscapes, should be incorporated into national poverty reduction plans. In response to the COVID-19 impact, a resilient social safety net should be established, capable of swift adaptation during crises. Collaboration with international partners is imperative to strengthen resilience and resource availability during pandemics.

Despite these comprehensive recommendations, it is essential to acknowledge the limitations of this study. The research relies on retrospective data spanning from 2011/2012 to 2019/2020, potentially missing recent developments. Additionally, the study's scope focuses on household-level analysis, necessitating complementary macro-level assessments for a comprehensive understanding of poverty dynamics. Further research incorporating real-time data, a broader analytical scope, and qualitative insights would contribute to a more nuanced understanding of poverty in Tanzania.

Author Contribution F.A.K was responsible for preparing the manuscript, conducting analyses, and interpreting the results. J.K.S played a significant role in providing feedback and suggestions for improving the work. All authors carefully reviewed and approved the final version of the manuscript.

Availability of Data Data and all materials will be available upon reasonable request.

Declarations

Ethics Approval The study follows all research and academic publication procedural based on the requirements of the journal.

Consent to Participate Not applicable.

Conflict of Interest The authors declare no competing interests.

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