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Socio-Economic and Demographic Determinants of Food Poverty among Household Heads: Evidence from a Zanzibar Household Budget Survey

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ABSTRACT

Introduction: Food poverty and insecurity among household members have negative consequences on nutritional quality and may result in inadequate nutrition, endangering the physical, emotional, and financial well-being of household members. In 2024, Zanzibar was classified as IPC Phase 3 (Food Crisis) in five regions of the island. Previous studies in Tanzania often used food consumption score and food insecurity experience as measure of food consumption and hence food poverty. It was inadequate, and food consumption for an adult per month or per day (in kilocalories) was used.

Material and Methods: 2788 household heads of HB Survey were used. Objective of the study was to investigate the socio-economic and demographic variables that affect household heads' access to food in Zanzibar. Fixing 2200kc as baseline consumption (equal to 1571.1091 TSH), food poverty was estimated among adults in Zanzibar. Stratum was based on areas and weighted with occupancy. Two stage stratified design binary logistic model was executed, and AUC under ROC curve was used to evaluate the exactness of the model.

Results: Descriptive statistics on covariates of poverty were determined, and food poverty and non-food poverty were estimated. There are significant differences in employment status, food poverty, pre-primary schooling, and age groups in the data, but no significant difference was found between rural and urban areas in terms of food poverty.

Conclusion: Household size, educational level of householder, total monthly expenditure, and location were the significant correlates found influencing poverty.

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INTRODUCTION

Food insecurity is a global issue and a significant indicator of inequality and poverty within communities [1]. Access to adequate food is a basic human right [2] and crucial for well-being and development. However, many people lack access to sufficient food, impacting their health and well-being [3]. Food insecurity affects both low-income individuals and those above the poverty line [4]. Food poverty is defined as the inability to obtain or consume an acceptable amount of food according to societal standards [5]. Food insecurity affects both low-income individuals and those above the poverty line [4]. Food poverty is defined as the inability to obtain or consume an acceptable amount of food according to societal standards [5].

The Food Consumption Score (FCS) is often used to evaluate food security [7,8,9]. Food insecurity and undernutrition are linked to various health risks [10]. Climate change, population growth, and price inflation exacerbate the global food shortage [11]. The FAO measures food poverty using food insecurity experience scales [12]. Data indicates that approximately 828 million people worldwide suffer from hunger, with 349 million experiencing acute food insecurity and 49 million at risk of famine [13]. In developing nations, a substantial portion of income is allocated towards food, further contributing to poverty rates [14]. Despite advancements in eradicating food insecurity, many

nations still struggle with severe food poverty, including Tanzania [13].

Between October 2022 and February 2023, 1.1 million people in Tanzania were expected to experience severe acute food insecurity [15]. Inequality has worsened Tanzania's progress in economic, social, and human development [13]. Children under the age of five have a significant prevalence of chronic malnutrition, with 32% being stunted. Overweight and obesity rates, as well as anemia in children and women of childbearing age, aggravate the situation. Additionally, food insecurity in pregnant women is widespread in Tanzania [16].

In Zanzibar, between October 2022 and February 2023, approximately 147,000 individuals were predicted to face severe food shortages and were categorized under IPC Phase 3 (Crisis) [15]. Roughly 594,000 individuals fell under IPC Phase 2 (Stressed) and would need assistance to safeguard their livelihoods [16]. According to the report [16], the proportion of acute food insecurity in Zanzibar was projected to increase to 151,000 individuals, resulting in a total of 745,000 people living in IPC Phases 2 and 3. This is concerning for achieving the 2030 Sustainable Development Goals (SDGs).

MATERIAL AND METHODS

Area of Study

In order to thoroughly analyze the socio-demographic factors influencing food poverty among household heads in both Unguja and Pemba islands, shown in Fig.1, which have a combined population of approximately 1,625,589 people, the study used secondary data from the 2019/2020 Household Budget Survey of Zanzibar, an archipelago off the coast of Tanzania [17].

Material

STATA 16 was used to examine socio-economic and demographic determinants among household heads in Zanzibar. Two-stage stratified design based on logistic regression was used to determine based of the 2788 household heads in Zanzibar.

Data Source

This research adopted the secondary data obtained from the Household Budget Survey (HBS) 2019/2020 of Zanzibar, which was generated by the Office of Chief Government Statistician (OCGS). These data are used for academic purposes only to explore the prevalence of food poverty status and explore socio-economic and demographic determinants of food poverty in Zanzibar.

The Targeted Population

The targeted population for this study was heads of households within Zanzibar among 1.626 million people [17] who were included in the survey. The inclusion criteria include head of households, who were estimated about 2,788 household heads who lived in Zanzibar during the survey.

Sampling Procedures

The study employed the 2019/2020 Household Budget Survey in which two-stage stratified sampling design was adopted. The study used sample design,

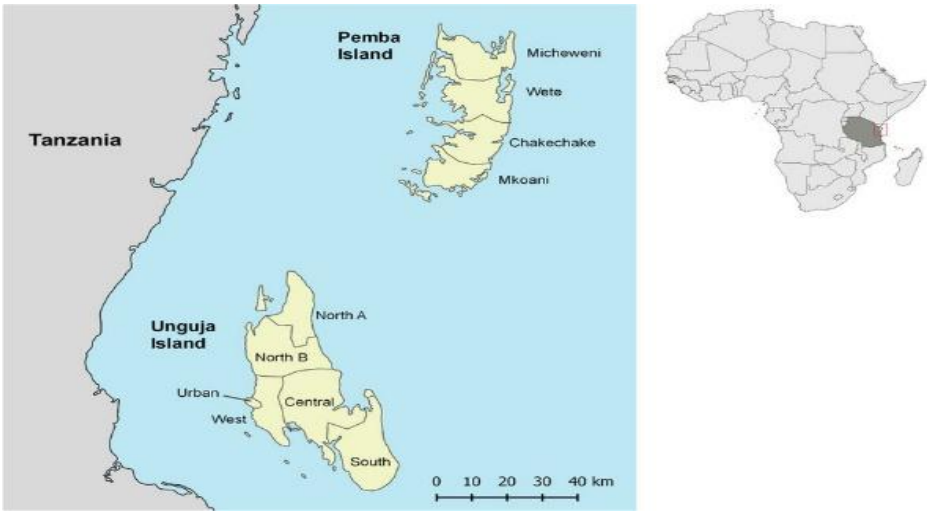


Fig. 1. Study Area (Map of Pemba and Unguja Island's districts and locater map of Tanzania and Zanzibar shaded on the right), Source: ([18], p.13)

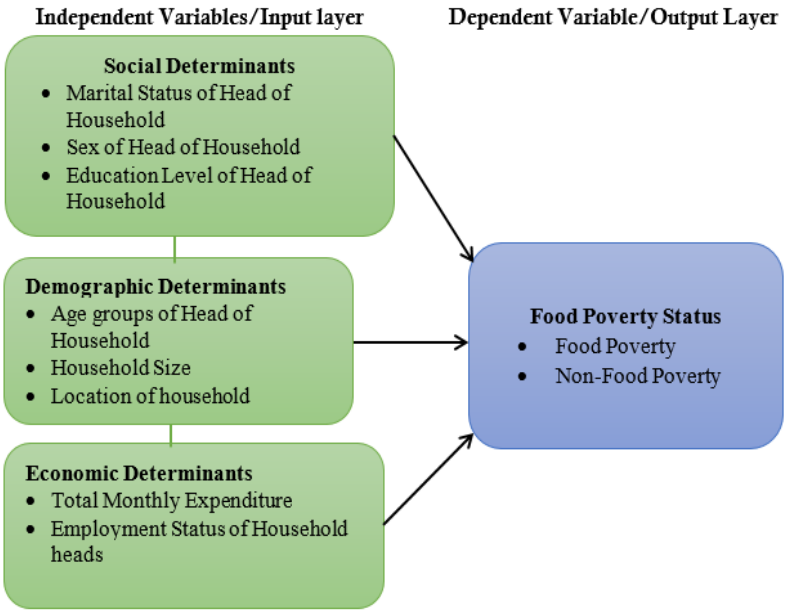


Fig. 2. Conceptual Framework (Source: Researcher, 2024)

which in the initial stage of the sampling design was used to pick enumeration areas from 11 districts in Zanzibar using the Probability Proportional to Size (PPS) approach. Systematic random sampling was used in the second stage to select households within the strata either urban or rural. The design used allows the study to obtain a representative sample of households from different geographical areas of Zanzibar.

Weighting Procedure

The data have to be multiplied by a sampling weight, or expansion factor, in order for the sample estimates from the 2019/2020 HBS to be representative of the population. The fundamental weight for each sample household was generated by multiplying the probabilities at each sampling stage, and it was equal to the inverse of the household's likelihood of selection. In order to determine the associated overall probability and related weight, the sampling probabilities at each stage of selection were kept in an Excel spreadsheet together with the data from the sampling frame for each sample enumeration area. The general likelihood of being chosen as sample households in the 2019–2020 HBS was shown as:

$$p_{hi} = \frac{n_h \times M_{hi}}{M_h} \times \frac{m_{hi}}{M'_{hi}} \qquad (1)$$

Where:
p_{hi} = household sample selection likelihood for the i^{th} sample EA in stratum h.
n_h = Samples enumeration areas chosen in stratum h for the 2019–20 HBS.
M_h = Total number of households in the stratum h enumeration area sample frame.
M_{hi} = Total households in the stratum h frame for the i^{th} sample enumeration area.
m_{hi} = Sample households chosen in the i^{th} sample enumeration area in stratum h.
M'_{hi} = Total number of households included in stratum h of the i^{th} sample enumeration area.

Each sampling stage is represented by one of the two components of this probability of selection. As the inverse of this probability of selection, the fundamental sampling weight, also known as the expansion factor, was computed. The weight was expressed more simply as follows, using the probability's prior expression:

$$W_{hi} = {M_h \times M'_{hi}}\Big/{n_h \times M_{hi} \times m_{hi}} \qquad (2)$$

Whereby:
W_{hi} =basic weight for the sample households in stratum h of the i-th sample EA

The difference between the number of households listed in each sample EA and the equivalent number from the sampling frame determines the weights for each stratum.

Take Weight of Non-response into Consideration

The sample households' weight W'_{hi} in the *i-th* sample EA in stratum h was expressed as follows:

Table 1. Distribution of Food Poverty Status

Food Poverty Status	Measurement
Food Poverty	Kilo calories per equivalent adult per day < 2200kc (Tsh. 1571.109088396)
Non-Food Poverty	Kilo calories per equivalent adult per day >= 2200kc (Tsh 1571.109088396)

Source: [17]

$$W'_{hi} = W_{hi} \times \frac{m'_{hi}}{m''_{hi}} \quad (3)$$

Whereby:

m'_{hi} = total number of valid (occupied) sample households chosen in the i^{th} sample enumeration area in stratum h

m''_{hi} = total sample household completions for the i^{th} sample enumeration area in stratum h, including replacements

The total number of households included in each sample EA and the number of household interviews that were ultimately conducted, including replacements, were updated to this file after the listing and data collection for the HBS. For each EA, the reserve sample of households was used to replace the original sampled households that could not be contacted.

Ethical Consideration

After obtaining clearance and approval, the research was conducted following ethical guidelines, utilizing 2019-2020 Household Budget Survey data from the Office of Chief Government Statistician. Confidentiality and welfare of information were ensured, and plagiarism was checked before submission; no household member identification was published.

This study's ethics approval was granted by [The Institutional Research Review Ethics Committee (IRREC) of University of Dodoma] (63rd meeting completed on May 23, 2023). Before being included in the study, informed consent was sought from all observations in the Household Budget Survey data sets.

Conceptual Framework

A conceptual framework is a crucial research tool that helps with data collecting by visualizing the relationships between variables [25]. It makes interactions between demographic elements clear in demographic studies. A recent study highlighted the usefulness of a framework to improve comprehension of variables by using it to explain socioeconomic and demographic impacts.

Response Variable

Food consumption per equivalent household heads per day is either above or below 2200 kilocalories (Kcal) for adequate energy/non-food poverty or food poverty, respectively. Non-food poverty is determined by the number of staple foods needed to meet the daily minimum calories requirement of 2,200 Kcal, or roughly Tsh. 1571 [26,27]. The price of basic food that gives at least 2,200 Kcal per day is used to calculate non-food poverty.

Study Explanatory Variables

Total monthly consumption, total monthly expenditure, age of head of household, marital status of head of household, sex of head of household, household size, location of household, employment status, and education of the household head are demonstrated in Fig.2.

Analysis Methods

Adjusted Wald test used to test the hypothesis of food poverty proportions among socio-demographic determinants among household heads in Zanzibar.

The traditional logistic regression model is inappropriate for assessing data from complex sample schemes, as shown in equation 3.1 of the references [19], such as the Household Budget Survey 2019-2020. The study employed the two-stage stratified design based binary logistic regression model on socio-economic demographic factors of food poverty status in Zanzibar. The categories of the Y_{hjik} represents the dichotomous dependent variable with two outcomes either non-food poverty and food poverty with 1 and 0 outcomes, respectively developed threshold by [20], x_{hjik} represents the matrix of socio-economic and demographic determinants, and α_0, α_1, α_2,α_3, α_4, α_5, α_6,α_7 are coefficients estimated.

$$\ln\left(\frac{\Pr(Y_{kij})}{1-\Pr(Y_{kij})}\right) = \alpha_0 + \alpha'_{kij}x'_{kij} + \omega \quad (4)$$

Food Consumption per equivalent adult adjusted by price differences

Food consumption per equivalent adult adjusted by price difference was used as measurement of food

Table 2. Descriptive Statistics

Food-Poor				
Variable	**Minimum**	**Maximum**	**Mean**	**Standard deviation**
Household Size *(Number)*	1.00	18.00	8.18	3.18
Total Monthly Expenditure *(Tshs)*	33,105.95	850,580.40	296,690.60	142,747.80
Total monthly Consumption *(Tshs)*	14,768.15	625,830.40	254,856.90	111,174.10
Food Consumption per equivalent adult per day (*kilo-calories)*	401.94	2,197.73	1,818.06	325.38
Non-Food Poverty				
Variable	**Minimum**	**Maximum**	**Mean**	**Standard deviation**
Household Size *(Number)*	1.00	16.00	5.16	2.52
Total Monthly Expenditure *(Tshs)*	24,589.29	10,000,000	543,916.40	426,966.50
Total monthly Consumption *(Tshs)*	45,436.90	3,204,494	453,584.2	295,400.20
Food Consumption per equivalent adult per day (*kilo-calories)*	2,203.68	45,067.90	6,156.59	4,085.46

Source: Author's computation (2024) on Zanzibar HBS 2019/2020.

Table 3. Proportion Test of Food Poverty on Socio-economic and Demographic Determinants

Socio-Economic & Demographic	**Categorization**	**Adjusted Wald Test**	
		F value	**p-value**
Employment status of household heads	Employee Self-Employee Unemployed Dependents Retired Other (Specify)	F (5, 14) = 26.33	< 0.0001
Educational attainment of household heads	Pre-primary education Adult education Incomplete primary education Complete primary education Incomplete secondary education Complete secondary education Others (specify)	F (5, 14) = 11.31	0.0002
Sex of household heads	Male Female	F (1, 18) = 9.37	0.0067
Age groups of household heads	19 – 64 65 and above	F (1, 18) = 36.35	<0.0001
Location of Household	Rural Urban	F (1, 18) = 3.19	0.0909

Source: Author's computation (2023) on Zanzibar HBS 2019/2020.

poverty, i.e., food poverty line. If a head of household's food consumption falls short of the recommended calorie intake and they consume fewer than 2200 kcal per day or Tanzania shillings 1571.109088396, it is considered to live in food poverty [17], as illustrated in Table 1.

RESULTS AND DISCUSSION

Using a two-stage stratified designed based binary logistic regression model to identify the significant determinants of food poverty among household heads in Zanzibar, the results at the 5% level of significance in which the p-values were less than 0.05 revealed that household size, some educational attainment of household heads, total monthly expenditure, and location (urban with rural reference) were significant determinants of food poverty among household heads in Zanzibar.

Descriptive Statistics for Covariates of Food Poverty

From the survey conducted, household heads who belonged to the category of food poor, the average household size was 8.18 with the standard deviation of 3.18, and with the 1 and 18 household members minimum and maximum values, respectively. On the side of those who were not poor, the mean household size was 5.16 with the standard deviation of 2.52, and with the 1 and 16 household members minimum and maximum values, respectively. The size of the household has repercussions on household food security because the larger household members were mostly shown on food poor since the average is higher compared to non-food poor due to the fact that a head of household fails to meet food requirements in a big

Table 4. Two-Stage Stratified Design-Based Logistic Regression Estimates

Food Poverty Status	Variable Description	Odds Ratio	Robust Std Error	t	P>|t|
Intercept	Constant term	764.8635	867.5825	5.85	<0.0001
Sex of household head	Female *ref: Males*	1.204964	.7657242	0.29	0.773
Education attainment of head of household	Incomplete Primary Education	.1191654	.1178757	-2.15	0.045
	Complete Primary Education	.1506066	.1224028	-2.33	0.032
	Incomplete Secondary Education	.3224256	.2730791	-1.34	0.198
	Complete Secondary Education *ref: Adult Education*	.4183115	.4577723	-0.80	0.436
Total Monthly Expenditure	Total Monthly Expenditure *(Tsh)*	1.000017	2.53e-06	6.55	<0.0001
Household size	Household size *(Number)*	.4857893	.0289175	-12.13	<0.0001
Employment Status household head	Employed	.6840163	.2866423	-0.91	0.377
	Unemployed	.1889914	.0742671	-4.24	<0.0001
	Dependents	.1021207	.0896751	-2.60	0.018
	Retired	1.101764	1.136097	0.09	0.926
	ref: Self Employee				
Group age of household head	65 and high *ref: 15-64*	1.09152	.7882725	0.12	0.905
Location of household	Urban *ref: rural*	2.368429	.6883978	2.97	0.008
Marital Status of household heads	Divorced	.7507355	.274096	-0.79	0.443
	Separated	.6246854	.3694158	-0.80	0.437
	Widowed	2.878434	2.324006	1.31	0.207
	ref: Married				

Source: Author's computation (2023) on Zanzibar HBS 2019/2020

family. Again, from the survey conducted, respondents who lived below the food poverty line were asked to indicate their amount of money they spent monthly. The results indicate that the average monthly amount of expenditure of a head of household was Tsh. 296,690.60 with the corresponding Tsh. 33,105.95 and Tsh. 850,580.40 for minimum and maximum amounts of money spent on food consumption monthly, respectively, with the standard deviation of 142,747.80. Non-food poverty household heads spent an average monthly expenditure was Tsh. 543,916.40 ranging from 24,589.29 to 10,000,000 with the standard deviation of 426,966.50.

Furthermore, Table 2 indicated that the average monthly consumption of the food-poor household was Tsh. 254,856.90, ranging from Tsh. 14,768.15 to Tsh. 625,830.40, correspondingly, the middling monthly consumption of heads of households who were non-food poverty was Tsh. 453,584.20, ranging from Tsh. 45,436.90 to Tsh. 3,204,494. The average daily kilocalories accessible per equivalent adult for those who were food poor is 1,818.06 kilo-calories, with daily calories availability ranging from 401.9388 kilo-calories to 2,197.73 kilo-calories per head of household per day in the household with the standard deviation of 325.38. On the other hand, household heads who were non-food poor had the average daily consumption of 6,156.59 kilo-calories with the lowest and the highest values of 2,203.68 and 45,067.90 kilo-calories per day and the standard deviation of 4,085.46.

Testing of Proportional Equality of Socio-Economic and Demographic Determinants on Food Poverty

In Table 3 modified Wald test results for equality with multiple comparisons are presented. The results of each comparison show whether the employee category and the other categories, self-employed, unemployed, dependents, retired, and other (specify), proportions on food poverty are equal. The null hypothesis, which was applied to each comparison, presupposed that there was no difference between the employee category and the compared categories. The F-statistic, which is the test statistic here, is 26.33. There are five and fourteen degrees of freedom for the F-statistic. The null hypothesis is rejected based on the probability value of <0.0001, which shows that. The decision provided strong proof that the two proportions of employment status and food poverty were statistically distinct.

Furthermore, the F-statistic for the corrected Wald test was 11.31, and its probability value was 0.0002. Under the food poverty proportions, the results show that there are significant differences between pre-

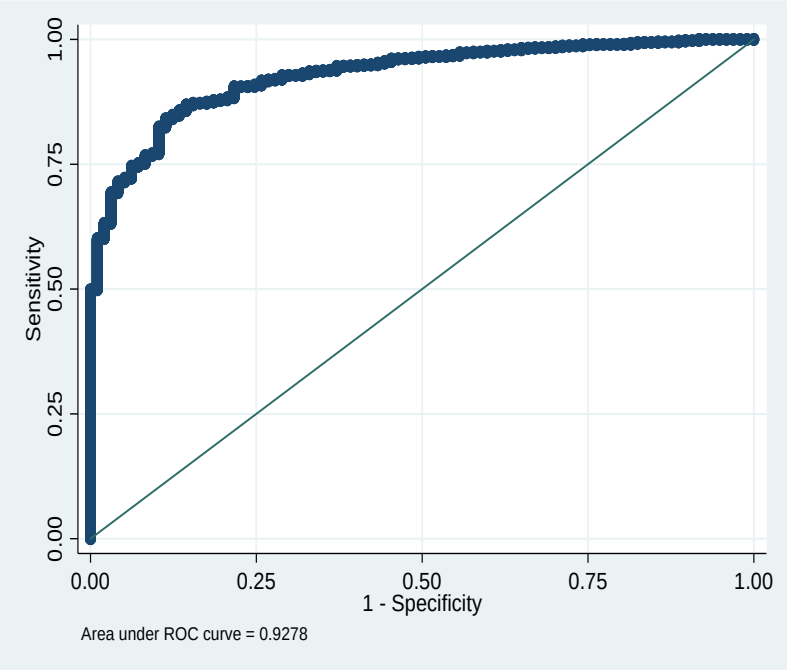


Fig. 3. Relative Operating Curve (Source: Author's computation (2024) on Zanzibar HBS 2019/2020)

primary schooling and the other categories of educational attainment gives strong evidence against the null hypothesis. The results of an adjusted Wald test to determine whether two proportions, males' food poor and females' food poor. The assumption being tested proportion of males' food poor is equal proportion of females' food poor. The F-statistic is the test statistic in this situation. The F-statistic is 9.37, according to the results, the F-statistic's degrees of freedom are provided as [1,18].

The stated probability value of 0.0067 is less than the tolerance level of 0.05. The Wald test found strong evidence to reject the null hypothesis. It suggests that proportions of female food poor and male' food poor are statistically different from each other test of equality is provided in Table 3 for the comparison of the proportion of people who are food insecure between the age groups of 15 to 64 and 65 and older. The F-statistic is reported as 36.35 for the adjusted Wald test, with a probability value of <0.0001 which is less than 0.05. This provides compelling evidence at 5% level of significance that proportion of those who were food-poor for both age 15-64 and 65 and older was not equal. The probability value is 0.0909, and the F value is 3.19, which is higher than the 5% level of significance. This implies that there isn't enough solid statistical evidence to rule out the null hypothesis. In other words, there is no significant difference between the proportion of food-poor household heads living in rural and urban areas.

Socio-Economic and Demographic Determinants of Food Poverty Among Household Heads

According to Table 4 some education attainments were statistically significant; the odds ratio for individuals who did not complete primary school was 0.12. This means that, when compared to those with adult education as heads of households, those with incomplete primary education had a 0.12 lower log-odds of suffering food poverty. At the 0.05 significance level, the p-value of 0.045 suggests that this association is statistically significant. The calculated odds ratio for household heads who completed primary school is 0.15. Individuals who have completed primary education have a 0.15 decrease in the log-odds of experiencing food poverty as compared to those who have adult education. The p-value of 0.032, however, indicates that this association is statistically significant. The study is also supported by [21], this research claims that some academic attainment of the household heads has a relatively good impact on the household food security status.

Furthermore, the study results go parallel with the study by [22] in Africa Household on social and economic elements of food insecurity the results discovered education of head of households affects the food insecurity status in households. There was an extremely statistically significant relationship between total monthly expenditure and food poverty status at 0.05 significance level since the p-value was <0.001, but the result reveals that one Tanzanian shilling increase in

monthly total expenditure, the log odds of being food poor will increase by 1.000017. The findings differed from those of [21] who investigated the determinants impacting family food security in developing countries and discovered that food expenditure had significant relationship with household food security status at 1% level of significance.

Household size showed it is statistically significant at 5% level of significance since p-value is <0.0001 result exposes that one unit increase in household size the log odds of being food poor will decrease by 0.49. This study findings statistically relate with the one by [23] where household size being the significant factor of among the determinants of food security in Sekyere Afran Plains, Ghana District. Location of households has an odds ratio of 2.37, indicating that a log-odds greater than one indicates that head of households located in urban area have greater log odds of experiencing food poverty than heads of households whose households are located in rural areas. This is similar to one done by [24] on the determinants that affect food security status at the household level in Pakistan. Her study exposed that households located in urban areas were negatively and significantly related to household food insecurity.

Relative Operating Characteristic Curve for Two-stage stratified designed based Binary Logistic Result

The ROC curve, represented by the AUC, illustrates the two-stage stratified two-stage stratified designed based logistic regression model's capacity to forecast food poverty. Fig.2's AUC of 0.9278 (92.78%), with 0.00% for completely inaccurate predictions and 1.00 for flawless predictions (Fig.3), shows remarkable accuracy in identifying food poverty. Comparable AUC values for groups experiencing food and non-food insecurity indicate better outcomes with higher AUC values.

CONCLUSION

In 2023, Zanzibar was classified as being in IPC Phase 3 (Crisis) because it was estimated that 147,000 people (8% of the population being studied) living in five regions of the island would face severe food shortages from October 2022 to February 2023. Additionally, 594,000 people (or 34% of the population being studied) were classified as being in IPC Phase 2 (Stressed), meaning they needed assistance to protect their livelihoods and reduce the risk of disasters. With the inclusion of Phases 2 and 3 of the IPC, an additional 745,000 people would be affected, increasing the number of people experiencing acute food insecurity to 151,000. This is not conducive to achieving the 2030 Sustainable Development Goals (SDGs), as reported in [15].

The Adjusted Wald test results for equality with multiple comparisons are presented. The null hypothesis is that there is no difference between the employee category and the compared categories. The F-statistic is 26.33 with 5 and 14 degrees of freedom; the null hypothesis is rejected based on the probability value of <0.0001. This shows that the two proportions of employment status and food poverty are statistically distinct. The F-statistic for the corrected Wald test was 11.31, and its probability value was 0.0002. The results show significant differences between pre-primary schooling and other categories of educational attainment. The adjusted Wald test results show that the proportions of male and female food-poor are statistically different from each other, with an F-statistic of 9.37 and a probability value of 0.0067.A test of equality for the comparison of food insecurity between age groups 15 to 64 and 65 and older shows an F-statistic of 36.35 and a probability value of <0.0001, providing evidence that the proportions are not equal. There is no significant difference between the proportion of food-poor household heads living in rural and urban areas, with a probability value of 0.0909 and an F value of 3.19.

A two-stage stratified designed based binary logistic regression model was used to determine the significant determinants of food poverty among household heads in Zanzibar at the 5% level of significance. The results showed that household size, educational attainment of household heads, total monthly expenditure, and location (urban with rural reference) were significant factors.

Recommendations: To improve food security in Zanzibar, it is necessary to implement measures such as job development, entrepreneurial support, sustainable livelihoods, and vocational training to increase household income levels and expand economic opportunities. The government and NGOs should also create initiatives specifically designed for rural communities. Education and family planning play important roles in managing food resources and reducing poverty. Customized interventions can significantly increase the level of food security in rural communities.

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CONFLICT OF INTEREST

The authors declare there is no conflict of interest for this research.

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