



Modelling Determinants of Multidimensional Poverty in Rural Tanzania

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Abstract

Many studies that model determinants of poverty in Tanzania, until recently, are based on monetary (income) approach only. Therefore, this study aimed at covering the existing gap in multidimensional perspectives. The study aimed at modelling determinants of multidimensional poverty (MP) in rural Tanzania. The study used 2015/16 Tanzania National Household Demographic Survey data. The study adopted analytical techniques that are based on Multidimensional Poverty Index (MPI) and Binary logit regression model. Specifically, the study adopted the Alkire-Foster (2011) methodology to examine multidimensional poverty index (MPI) that used as dependent variable in modelling determinants of multidimensional poverty

The findings from Alkire and Foster estimates showed that, the overall multidimensional poverty incidence for the year 2015/16 was 74.43% of the whole rural area population, suggesting that, majority of the households in rural Tanzania were multidimensionally poor with multidimensional poverty index of 0.388.

On the other hand, binary logit regression model findings showed that age, education attainment, sex, marital status, ever use family planning are among the paramount determinants of multidimensional poverty in rural Tanzania and suggested that male-headed households have higher probability of being multidimensionally poor, while increase in the age, education level of the household head and being married decreases the probability to be multidimensionally poor significantly. Moreover, the binary logit regression model estimates showed that, people who use family planning methods are 0.79 times less likely to be multidimensional poor at 5% level of significance. Indicating that, the use of family planning decreases the probability of becoming multidimensionally poor.

Keywords: *Alkire-Foster (2011) Methodology, (Multidimensional Poverty Index (MPI), Binary Logit Regression Model*

1 Introduction

Eradicating poverty in all its forms is one of the global community commitments and their implementation frameworks are aimed at fighting against poverty. Globally, multiple deprivations in basic needs are increasing, as a total of 1.3 billion people are living in multidimensional poverty (World Bank, 2018). This figure exceeds the estimated 1.44 billion people who live on \$1.90 a day and thus supports the fact that multidimensional poverty considers more factors in adjudging who is poor than in one dimensional measure (OPHI-report, 2021).

World Bank Group, (2020) indicates that a total of 1.45 billion people from 103 countries are multidimensional poor, where 72% of them live-in middle-income countries. Hence, united national (UN) initiated the 2030 Agenda for Sustainable Development Goals so as to complete the task of ending poverty in all its forms. According to Hendrick C, (2021) it was estimated about 481 million population of Africa in 2019 were living in extreme poverty, while the figure increased to 490 million people (36% of the total population) in 2021 with an increase of over 9 million. Hence, statistics shows that, Africa as a whole is not on target to meet its Sustainable Development Goal 1 of eradicating Poverty by 2030. According to this, the Africa Union initiated the 2063 Agenda to complete the task of ending poverty in all its forms in Africa. Unfortunately, however, while the population of extremely poor people realized to be reduced at the global level, it remains regionally uneven and on the increase in sub-Saharan Africa with Tanzania being the worst hit (Alkire et al., 2020).

According to Alkire et al., (2015) poverty can occur in dimensions other than monetary ones, such as in health and education areas. Hence uni-dimensional approach fail to detect poverty in other critical areas and more so may results the risk of under-reporting of poverty and failing to provide adequate policy responses. Hence, many studies are examining poverty across a number of dimensions so as to run away this risk. In Tanzania, poverty is habitually conceptualized by using monetary approach(uni-dimensional approach), however, in many literatures the social dimension of poverty such as lack of access to basic human needs (food, water, clothing, shelter, sanitation, healthcare, and education) have been identified and discussed extensively (Sen, 2004 , World Bank Group, 2020 ; Alkire et al., 2020; UNDP, 2019). Modelling poverty by using traditional approach (monetary approach) is dominated in many sub-Saharan Africa countries even though there is a

rapid and wide growing need to adopt multidimensional perspectives (UNDP, 2019, Alkire et al., 2020).

In Tanzania, there little or no studies attempt to model poverty and its determinants in regards to multiple deprivations. For example, according to NBS (2019) poverty report on a recent 2017/2018 House Budget Survey, a person in Tanzania is considered to be in extremely poor if his/her monthly income falls below poverty line of TZS 49,320 consumption per adult in a month. However, according to many literatures it is revealed that, poor household may suffer from multiple deprivations of indicators (World Bank Group, 2020 & UNDP, 2019). Therefore, the use of monetary approach as experienced in Tanzania is not merely enough to capture true nature of poverty but might bring a risk of identifying a person as poor while not and vice versa. Therefore, this study intends to fill the existing methodological gap in the current approach by the use of Multi-dimensional approach. Moreover, the study intended to examine determinants of multidimensional poverty of household in Tanzania .This was achieved through the following objectives; assess deprivation level of multidimensional poverty by Alkire and Foster methodology and identify the determinant of multidimensional poverty in rural Tanzania by using binary logit regression model.

2 Methodology

2.1 Study area.

The study was conducted in rural area of the United Republic of Tanzania located within sub-Saharan Africa countries at Eastern Africa regional between longitude 29° and 42° East and Latitude 1° and 12° South. The population of Tanzania as per 2012 census was 44,928,923 with 21,869,990 and 23,058,933 being males and females respectively (NBS, 2013). Recently, as per 2022 census there are 61,741,120 people (NBS, 2022). This study area was chosen because many household are living in rural area and are extremely affected by incidence poverty compared to urban area ones. For example according to Tanzania Demographic and Health Survey (THDS 2015-16) report there were 64880 households with 48104 and 16776 households living in rural and urban areas respectively.

2.2 Research design

The study used quantitative research design to model determinants of multidimensional poverty in rural Tanzania. Cross-sectional dataset from Tanzania Demographic and Health Survey (TDHS 2015-16) was used because are rich in variables of the study especially the family planning variables. The descriptive statistics and inferential statistics were used as data analysis technique tools,.

2.3 Target population

The target population was the households lived in rural areas in Tanzania and who participated in the Tanzania Demographic and Health Survey (THDS 2015-16). This area was selected due to higher domination of incidence of poverty (31.3%) than in urban areas (15.8%)

2.4 Data Analysis technique

2.4.1 Descriptive Statistics Analysis

The study used frequency tables, bar graphs and pie chart to describe variables. Data was coded, summarized, and processed using the STATA 16 statistical package and Excel. The frequency table, bar graphs and pie chart was produce to describe the study variable.

2.5 Inferential Statistics analysis

2.5.1 Chi-square Test

A chi-square test at 5% level of significance was used to examine the association between Multidimensional poverty index (dependent variable) and each independent variable.

2.5.2 Logit Regression Model

The study modelled the determinants of household multidimensional poverty (MP) by adopting Binary logit regression model . A binary dependent variable is generated based on the computation of the deprivation score to indicate the multidimensional poverty status of a household. The multidimensional poverty status of a household was defined by the multidimensional poverty cut-off of at $k= 0.33$ adopted from Global MPI (Alkire S. et al. 2015). In order to uncover the determinant of MP, the multidimensional poverty index (MPI) of a household was modelled as a function of characteristics of the household head and the household. Since the response variable Y (MPI) is a binary variable with categories “poverty poor and poverty not poor”, this study employed binary logistic regression to examine the determinants of MPI of households in Tanzania.

The dependent variable, Multidimensional Poverty Index (MPI) was defined by the rule;
 $Y_i(MPI) = 1$ if $C_i \geq 0.33 \Rightarrow$ The household is multidimensional energy poor

$Y_i(MPI) = 0$ if $C_i < 0.33 \Rightarrow$ The household is not multidimensional energy poor.

The age, sex, education attainment, marital status and ever use family planning was treated as model explanatory variables.

Binary Logistic Model was expressed by;

$$\text{Logit}(Y_i) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \mu_i$$

Where,

Y_i = Multidimensional poverty index (MPI) of each household;

μ_i = stochastic error term of the model which takes into account unobserved factors that affects MPI

$\beta_1, \beta_2, \beta_3, \beta_4,$ and β_5 = regression coefficients;

X_1 = Age of the household head, X_2 = Sex of the household head X_3 = Education attainment of the household head X_4 = Marital status of the household head X_5 = Ever use family planning

2.5.3 Diagnostics for the Logistic Regression

The study used two tests namely Link test and Hosmer- Lemeshow goodness-of-fit test to examine the accuracy of the binary logit regression model

2.5.4 Description of variables used in the study.

Table 1: Description of variable

Type of variable	Name of variable	Scale	Responses
Dependent	Multidimensional poverty index(MPI)	Binary	0 = non poor 1 = poor
Independent	Age of the head of household	Scale	
	Sex of the head of household	Nominal	1 = male 2 = female
	Education attainment of the head of household	Ordinal	1 = no education; 2 = primary education; 3 = secondary education ;4 = higher education and 5 = don't know
	Marital status of the head of household	Nominal	1 = never married; 2 = widow; 3 = divorced; 4 = married or living together
	Ever use family planning method		Nominal-1 = no and 2 = yes

2.5.5 Alkire and Foster (AF) Approach for modeling multidimensional poverty

The study applied Alkire and Foster (AF) Approach to determine the multidimensional poverty Index (MPI) among household of Tanzania and was treated as a dependent variable of binary logistic model in modelling determinants of multidimensional poverty. This was achieved by first identifying the poor and non-poor by using dual cut-off and determine multidimensional poverty index household through the aggregate of multiple deprivation scores (c) of ten non-monetary

indicators from three poverty dimensions (Education, Health and Standard of living) for each household. The Household was considered as multidimensional poor if the weighted sum of its deprivations is higher than a defined poverty cut off ($C_i > k$). The deprivation score of each household (C_i) is calculated by:

$$C_i = w_1I_1 + w_2I_2 + w_3I_3 + \dots + w_dI_d \dots\dots\dots(1)$$

where, $I_i = 1$ if the household is deprived in indicator i and 0 otherwise, and w_i is the weight attached to indicator i with

$$\sum_{i=1}^d w_i = 1 \dots\dots\dots(2)$$

The multidimensional poverty index (MPI) was the calculated as product of Multidimensional poverty incidence (H) and Multidimensional poverty intensity (A) .But Multidimensional poverty incidence (H) is given by;

$$H = \frac{q}{n} \dots\dots\dots(3)$$

While Multidimensional poverty intensity (A) was expressed as;

$$A = \frac{\sum_{i=1}^q C_i(k)}{q} \dots\dots\dots(4)$$

Where,

H=head count ratio /percentage of poor households/ incidence of poverty,

A= Multidimensional poverty intensity,

q=number of multidimensional poor people

n=Total population.

C_i =is the deprivation score of each poor person.

Therefore, The adjusted headcount ratio (or aggregate MPI) was expressed as;

$$MPI = H * A = \frac{q}{n} \times \frac{\sum_{i=1}^q C_i(k)}{q} = \frac{\sum_{i=1}^q C_i(k)}{n} \dots\dots\dots(5)$$

Table 2: Dimension, indicators and deprived condition

Dimension and its weight	Indicator and its weight	Deprived conditions
Education (1/3)	Years of schooling (1/6)	The household is considered deprived if no household member has completed five years of schooling
	School attendance (1/6)	The household is considered deprived if any school-aged child is not attending school up to class 8
Health (1/3)	Nutrition (1/6)	The household is considered deprived if any adult or child for whom there is nutritional information is malnourished in the household
	Child mortality (1/6)	The household is considered deprived if any under-five child has died in the family
Living standard (1/3)	Cooking fuel (1/18)	Members of the household are considered deprived if the household cooks with solid fuels: wood, charcoal, crop residues or dung
	Sanitation (1/18)	Members of the household are considered deprived if the household's sanitation facility is not improved or it is improved but shared with another household
	Safe drinking water (1/18)	Members of the household are considered deprived if the household does not have access to safe or safe drinking water is more than a 30-minute walk from home round trip
	Electricity (1/18)	Members of the household are considered deprived if the household has no electricity
	Flooring (1/18)	Members of the household are considered deprived if

		the household has a dirt, sand or dung floor
	Assets (1/18)	Members of the household are considered deprived if the household does not own more than one of: radio, tv, telephone, bike, motorbike or refrigerator and does not own a car or truck

Source: Adopted and modified from (Alkire S. et al. 2015) ; Alkire & Jahan, (2018) ; OPHI (2017

3 Findings and discussions

3.1 Findings

3.1.1 Descriptive statistics

The finding from Table 3 shows that 74 % of the household lived in rural areas do not use family planning methods while only 26 % of the households use. The male household sampled for the study were 79% while only 21% were female.

Table 3 : Descriptive statistics of the explanatory variables used in the model

Variable	Variable	Total	Percent (%)
Age			
Sex	Male	38,454	79(%)
	Female	9,650	21(%)
	TOTAL		
Ever use family planning	No	35,983	74(%)
	Yes	12,121	26(%)
	Total	48104	
Education attainment	No education	19,786	41(%)
	Primary educ.	23,620	49(%)
	Secondary educ.	4,552	9 (%)
	Higher educ.	128	0.7(%)
	Don't know	15	0.3(%)
	TOTAL		
Marital status	Never married	6,457	26 (%)

	Widow	1,622	6 (%)
	Divorced	1,708	7 (%)
	Married	15,260	61 (%)
	TOTAL		

3.1.2 Inferential statistics

3.1.2.1 Association between Multidimensional Poverty Index (MPI) and Other Variables

A Chi-Square test of independence was carried out to examine the association between MPI and each independent variable (sex of household head, education attainment of household head, marital status of household head and ever use family planning methods). The observed association between MPI and each independent variable were statistically significant since the p-value of the Pearson chi-square test statistics of all variables obtained were less than 5% level. Hence according to Pearson chi-square test results (Table 4), those explanatory variables were therefore the major determinants of multidimensional poverty for household living in rural Tanzania in 2015/16 at 5% significant level

Tabl.1; shows the chi square test between the MPI and Independent (explanatory) variables

Variable	Variable	Non poor	Poor	Total	P-value	Cramer's (V)	χ^2
Sex of the head of household	Male	11,544	26,910	38,454	0.000	0.0312	47.0287
	Female	2,554	7,096	9,650			
	TOTAL	14,098	34,006				
Ever use family planning	No	10,149	25,834	35,983	0.000	0.562	83.758
	Yes	3,949	8,172	12,121			
	Total	14,098	34,006	48104			
Education attainment of the head of household	No education	4,130	15,656	19,786	0.000	0.2419	2.8e+03
	Primary educ.	7,160	16,460	23,620			
	Secondary educ.	2,706	1,846	4,552			
	Higher educ.	96	32	128			
	Don't know	4	9	13			

	TOTAL	14,096	34,003				
Marital status of the head of household	Never married	2,411	4,046	6,457	0.000	0.0622	96.9488
	Widow	463	1,159	1,622			
	Divorced	478	1,230	1,708			
	Married	4,871	10,389	15,260			
	TOTAL	8,223	16,824				

Source: Calculation based on data from TDHS 2015/16

3.1.3 Findings and discussion from Alkire and Foster Approach estimates

The deprivation status at a national level as modeled by Alkire and Foster Approach at a cut-off of $K=33.3\%$ was as follows (Table 5)

Table 5: Multidimensional Poverty Indices at National level.

Cut- off point (%)	Multidimensional Poverty Indices estimates		
	Incidence poverty(H)	Intensity poverty (A)	Multidimensional poverty Index (MPI)
$K=33.3$	74.43%	52.15%	0.388

Source: Calculation based on data from TDHS 2015/16

Results in Table 5 indicate that, the rural Tanzania's multidimension poverty incidence (H) and multidimensional poverty intensity (A) for the year 2015/16 at poverty cu-off of $k=33.3\%$ was 74.43% and 52.15% respectively whose product give a national multidimensional poverty index (MPI) 0.388 .This is the value of dependent variable that was used to model determinants of multidimensional poverty in rural Tanzania.

3.1.4 Binary logit regression model findings : Interpretation of the model estimates:

At a variable of head of household Sex, the findings indicates that female headed households are 1.22 times more likely to be multidimensional poor compared to male at 5% level of significance

Similary the model shows that, p with primary education are 0.46 times less likely to be multidimensional poor compared to people with no education at 5% level of significance

Secondary education: Odds ratio=0.13, this indicates that people with Secondary education are 0.13 times less likely to be multidimensional poor compared to people with no education at 5% level of significance

Higher education: Odds ratio=0.06, this indicates that people with higher education are 0.06 times less likely to be multidimensional poor compared to people with no education at 5% level of significance.

Age of the head of the household

Age: Odds ratio=0.99, this indicate that one unit change in household age decrease the like hood of being multidimensional poor by 0.99 times at 5% level of significance

Marital status of the head of the household

Reference category= Never married

Widow: Odds ratio=0.61 this indicates that widow people are 0.61 times less likely to be multidimensional poor compared to people who are never married at 5% level of significance

Married/living together: Odds ratio=0.82 this indicates that married people are 0.82 times less likely to be multidimensional poor compared to people who are never married at 5% level of significance

Heard about family planning methods,

Reference category= No

Yes: Odds ratio=0.79 this indicates that people who heard about family planning methods are 0.79 times less likely to be multidimensional poor compared to people who did not heard about family planning methods at 5% level of significance.

Table 6; Binary logit regression model results;

Variable	Response	Odds ratio (OR)	P- value	OR 95% CI	

Age		0.9938	0.000	0.9919	0.9957
Sex	Male (Reference)				
	Female	1.2248	0.000	1.133	1.3239
Education level	No education(Reference)				
	Primary	0.4624	0.000	0.4270	0.5007
	Secondary	0.1253	0.000	0.1135	0.1383
	Higher	0.06401	0.000	0.0426	0.0962
	Don't know	0.4502	0.187	0.1377	1.4721
Marital status	Never married(Reference)				
	Widow	0.6141	0.000	0.5370	0.7023
	Divorced	0.8829	0.053	0.7781	1.0018
	Married	0.8186	0.000	0.7634	0.8778
Heard about family planning methods	No (Reference)				
	Yes	0.7874	0.000	0.7401	0.8378
Constant		8.1343	0.000	7.0264	9.4169
		Number of obs = 25,044 LR chi2 = 2272.84 Prob > Chi2 = 0.000 Pseudo R2 = 0.0717 Log likelihood = -14714.958			

The Binary logit regression model results indicates that people who use family planning methods are 0.79 times less likely to be multidimensional poor compared to people who do not use family planning methods at 5% level of significance .Hence , family planning use matters at large as determinant MPI. This results is supported by the study done by Adepoji & Akinluti, (2017) in rural Nigeria which showed that the ever use of family planning decreases the probability of being poor by 1.22 . At 5% level of significance and If all factors are kept constant, the odds ratio for head of household marital status shows that, widow people are 0.61 times less likely to be multidimensional poor compared to people who are never married.

Similarly the married people are 0.82 times less likely to be multidimensional poor compared to people who are never married In additional to that, the odds ratio for female headed household Indicates if we hold other variables to be constant female headed household is 1.22 times more

likely to be multidimensional poor compared to male household head at 5% level of significance .At the same time, Head of household attained primary education is 0.46 times less likely to be multidimensional poor compared to the one with no education .Similarly, Household head with higher education is 0.06 times less likely to be multidimensional poor compared to the ones with no education at 5% level of significance. In general speaking these findings on education reinforce the necessarily of eradicating poverty through redesigning and restructuring the education policies and curriculums that focus on rural area socio-economic activities

3.1.5 Discussion of key findings

3.1 Discussion of the key findings

The results shows that the multidimensional poverty incidence was 43%, the multidimension poverty intensity was 52.15% and the MPI was 0.388. Moreover the results shows that the independent variable (Age, sex, marital status, education attainment and heard about family planning methods) had a great influence in MPI. This is due to the fact that all of them have a significant effect on MPI at 5% level significance this also been supported by other studies done by Sulaimon, (2022) in Oyo state Nigeria, and Chen, (2019) in Taiwan who reported about age, sex, marital status education attainment, to be associated with mutidimensioanal poverty at rural area Furthermore binary logistic regression model results revealed that, people who did not use family planning are more likely to be multidimensional poor compared to those who use it. This finding is supported by the study done by Adepoji & Akinluti, (2017) in rural Nigeria which showed that those who ever use of family planning are 1.22 times less of being multidimensionally poor.

3.1.6 Robustness test for poverty cut offs

The study employed the robustness test for determining characteristics of multidimensional poverty index, headcount ratios and intensity of deprivations by using different poverty cutoffs (Alkire S. et al. 2015).

3.1.7 Diagnostic of Binary Logit Regression Model

3.1.7.1 Goodness of fit test results

Goodness of fit test results (table 4.5) shows that the p-value = 0.00 is less than $\alpha=0.05$, implies that, the model fits well as found by the study of Sulaimon, (2022) in Oyo state Nigeria, and Chen, (2019) in Taiwan. Therefore, the overall model was significant and hence its covariates had a direct significant impact on Multidimensional poverty (Chi-square value = 2272.84, and p-value is 0.0000 less than $\alpha=0.05$). Similarly, Hosmer- Lemeshow goodness-of-fit test was used to test if the model described the outcome variable effectively. The findings indicated that the model is a good fit since there was a large p-value showing no existing of significant difference between the observed and the predicted values of the outcome. Since the p value (=0.6977) is larger (greater than 5%) therefore, the null hypothesis was rejected; indicated that there is no significant difference between the observed and the predicted values of the outcome.

3.1.7.2 Model Specification Error Test results

The binary logit regression model fitted was tested for checking specification error by using a link test. The model specification showed to be correct because no misspecification errors were observed to exist since the linear predicted value squared is insignificant at 5% level (p-value = 0.893), and the predicted value is very significant at 5% level (p value=0.000); the model contains those variables that should be in the model and the variables have been entered in the correct functional form

CONCLUSION AND RECOMMENDATION

3.2 Summary

The study estimated multiple deprivations by modelling multidimensional poverty index (derived from ten indicators include years of schooling, school attendance, child mortality, nutrition, assets ownership, access to electricity, access to safe drinking water, sanitation, flooring and source of cooking fuel.) in rural Tanzania with Alkire-Foster methodology. The results from Alkire-Foster method showed that 70.69% of Tanzanian's lived in rural areas for the year 2015/16 found to be multidimensionally poor with, average intensity of 52.15% and the multidimensional poverty index of 0.388. On the other hand, MPI was observed to be higher for female headed household (0.4189) as compared to male headed household (0.3803). Furthermore household living in western zone were observed to be more multidimensionally poor as compared to other zones.

Moreover, the national censored headcount ratios indicated that majority of Tanzanians who were multidimensional poor were deprived in standard of living dimension which was (56.6%) followed by health dimension (23.2%) then education dimension (20.2%).

The logit regression model results showed observed all explanatory variables were statistically significant at 5% level of significance simply because their p-values were less than 0.005 each.

3.3 Conclusion and recommendation

3.3.1 Conclusion

The results from Alkire-Foster method showed 70.69% of Tanzanian's lived in rural areas are multidimensionally poor whereby they are deprived in all three dimensions whereas the rural

Tanzania headcount ratios for the year 2015/16 was 74.43%, average intensity stood at 52.15% and the multidimensional poverty index was 0.388.

In the binary logistic model, the age, sex, education attainment, marital status and ever use family planning use have significant effect in MPI. The low use of family planning among rural households in Tanzania as shown in the study increases the probability of been poor. The multidimensional poverty levels in the rural areas of Tanzania clearly demonstrates the fact that it is not only the proportion of poor households that matter, but the intensity of poverty experienced in these households, in the formulation and design of policies and programmes for effective targeting.

3.3.2 Recommendation

The study results shows that the use of family use planning in Rural Tanzania matters as have a direct effect on the poverty of household. hence government and non-government organizations are recommended to increase efforts on educations and design family planning and reproductive health program to people in rural areas regarding family planning so as to reduce poverty among household.

The researcher recommend government to formulate policies that focus in improving the social services such as infrastructures, quality of education, improvement of health sector and electricity in rural areas which will improve the living standard of people. Moreover further studies should consider the combination of both monetary and non-monetary indicators so as to realize meaningful analysis of poverty.

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