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Modeling the Predictors of Poverty in Agricultural Households in Uganda: Application of Multilevel and Interaction Methods

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This study aimed to model the predictors of poverty in agricultural households in Uganda. The study's specific objectives were to examine the effect of individual predictors of poverty and analyze the contribution of community predictors of poverty in agricultural households. The study utilized data from the Uganda National Household Survey (UNHS, 2019/20) obtained from the Uganda Bureau of Statistics. A sample of 13,732 households was randomly selected from the total weighted sample representation of 11.3 million households involved in agricultural activities. A logit model was used in the analysis and estimates were provided using multilevel and interaction methods. Key findings suggest that poverty in agricultural households was positively and significantly influenced by the gender of the household head, marital status of the household head, income stability of the household, age of the household head and livestock ownership. Additionally, regional differences accounted for 17.9 % of the variations in poverty levels in Uganda and understanding such regional differences and their influence on poverty levels can assist policymakers and organizations in designing targeted interventions and policies to reduce poverty levels among households. Such measures can address the specific challenges faced by different regions and promote more equitable development across the country. However, poverty in agricultural households was negatively and significantly influenced by residence status, savings account ownership and household size. Based on the study's findings, the key policy recommendations were that; the government should continue implementing gender-focused interventions to address gender disparities among women empowerment programs that involve access to resources including land, equal access to employment opportunities and equal access to education to reduce poverty among women. Regarding income instabilities in agricultural households due to price fluctuations, the government should empower farmers to form farmer groups where they can collectively increase their bargaining power to avoid price fluctuations.

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INTRODUCTION

Poverty is a global issue that requires significant attention from both local and international communities. There is a strong commitment to eradicating poverty by 2030, as outlined in one of the 17 Sustainable Development Goals (SDGs) (United Nations, 2019). Moreover, poverty is number one on the global agenda and all the nations including Uganda aim to end extreme poverty in its all forms. Poverty encompasses various dimensions, including social, economic, and political aspects, but it is commonly understood in its socioeconomic context. It refers to the inability of households to access necessities such as food, clothing, education, health and shelter, thus hindering their ability to lead a decent life within society (Ngestrini, 2019). Evaluating poverty involves measuring whether individuals or households possess the means to meet these essential needs and is characterized by the lack of resources and capabilities required for a decent standard of living (Ngestrini, 2019).

According to World Bank (2022), the poverty, & shared prosperity report states that extreme poverty had been cut by at least half in 2015 globally, and poverty increased with the low rate of economic growth since then. The global agenda of eliminating extreme poverty by 2030 may not be as smooth as it was expected. About 9 percent of the world's population is extremely poor and

surviving on less than 1.9 dollars, this is about 698 million citizens of the total world population who are in a state of extreme poverty. The proportion of extremely poor people increased approximately by 50 million because of the outbreak of the pandemic that came along with the world economic crisis in a space of 2019 to 2020 (Elena Suckling, & Zach Christensen, 2021a). The proportion of the extremely poor reduced in 2021 when the world economy began to recover, but currently still there are more who are in the state of poverty than those who lived in poverty in 2019, with approximately 8 million more citizens (Elena Suckling, & Zach Christensen, 2021b).

According to Alkire, (2015a), the report on global Multidimensional Poverty Index (MPI) from 105 countries show that 1.3bn citizens are multidimensional poor with a representation of 23%. This is almost quarter of the number of people in the one-hundred and five states for which the index was estimated. The multidimensional poor keeps increasing in low-income countries, but Sub-Saharan Africa and Southern Asia have more people of this category than any other region around the globe (83%) of the total population of the dimensional poor (Alkire, 2015). Rural areas have more people who are multidimensional poor compared to urban areas, and rural areas account for 1.1bn people who are poor while urban areas account for only

0.2bn people and the differences between rural and urban multidimensional poverty continue to exist in Sub-Saharan African countries (Alkire, 2015).

According to Development Initiatives (2020b), there were rising differences in poverty due to regional differences since 1990, the report further indicated that national poverty reduced since the 1990's but the reduction rate was different across regions. In the last 30 years, the Ugandan government has achieved significant strides in its efforts to reduce poverty. According to Development Initiatives (2020), the national poverty line suggests that there is a decline in the general poverty trend although levels were found to be higher. The report also indicated a rise of 1.7 % in the proportion of citizens who were poor from 2012 to 2016, and the rate was even higher when the portion of the population who were extremely poor was at approximately 41.7% by 2016 when 1.90 US dollars is considered as an international poverty line measure. The report further suggested that poverty had reduced over the period but the number of Ugandans who were at risk of being poor again had risen.

Therefore, focusing on the agricultural sector is imperative to increase the income of the households as well as facilitate transformation and rapid economic growth (International Monetary Fund, 2012). According to Development Initiatives (2020b), poverty in Uganda has shown regional disparities since 1990. While national poverty levels decreased overall, the reduction rate varied across regions. Eastern Uganda experienced an increase in poverty from 24.3% in 2000 to 35.7% in 2017, while Northern and Western Uganda saw a decrease in poverty since 1990. Additionally, the poverty rate rose from 10.7% in 2000 to 12.7% in 2017. The agricultural sector in Uganda employs about 70% of the workforce and nearly 90% of the working poor. Therefore, focusing on the agricultural sector is crucial for increasing household income and facilitating economic growth (GoU, 2018). For this reason, it is therefore critical for policymakers to understand the major predictors of poverty in

agricultural households in Uganda and tackle them accordingly. However, previous studies on poverty in Uganda have used conventional regression models that assume similar effects of poverty predictors across regions. This overlooks the regional variations in poverty caused by different drivers. Multilevel modeling, on the other hand, considers these variations and allows for the separation of regional-level effects from individual effects. Unfortunately, multilevel analysis has been rarely used in poverty analysis in Uganda. Therefore, this study aimed to explore the hierarchical data structure and analyze the data at different levels of analysis (individual and regional units) and examine the differences in agricultural poverty caused by regional characteristics.

EMPIRICAL LITERATURE REVIEW

According to the study on theories of Poverty in Ghana by Addae-korankye (2019), individual incapacities account for their poverty status; distortions in cultural beliefs; economic, social and political setups, differences in geographical setups and cumulative and cyclical interdependencies. Furthermore, this study provided details on the specific variables that contribute to poverty which include discrimination in jobs, limited schooling, inequalities, and discrimination in accessing employment, housing benefits, banks, skills, and joining politics, lack of investment in infrastructure, especially water and waste disposal. All such variables proposed by the study are grouped according to the theory of Individual incapacities, the theory of Cultural setups, distortions in economic, political, and social theory, Geographical differences theory and Cumulative and Cyclical Interdependencies theories (Addae-korankye, 2019).

The analysis of the economic theories of poverty by Davis, & Sanchez-Martinez (2014) it highlighted the major drivers of poverty based on the review of the existing economic theories that included the classical theory, the theory of neo-classicals, the theory of Keynesians, Marxists (radical theories) and social exclusion, social

capital and eclectic theories of poverty. The study further described poverty as associated with several factors including behavioral or decision factors, lack of access to assets, incentives and credit markets, limited human capital development, discrimination and demographic differences. The study also looks at macroeconomic and social factors as the drivers of poverty including unemployment, low savings, low investment, low aggregate demand and consumption, high levels of inflation, social exclusion and lack of social capital.

Poverty theories using Comparative Analysis by Sameti M. et al. (2012), stressed the major factors of poverty and grouped such theories into three categories; that is factors related to individuals, factors related to structures and factors related to neighborhood. They further suggest that poverty is related to an individual's ability especially when they are provided with opportunities to help them achieve success. Poverty is also on the other hand related to neighborhood factors in the sense that some people are motivated by what is happening in the environment they live. Furthermore, poverty differs by differences in behaviors, beliefs and values of the society. A literature review on poverty and urban development indicators by Hasan (2002) indicated that poverty is attributed to a lack of provision of basic services especially water and sanitation, garbage removal systems, transport systems, lack of health care and hazardous living conditions, lack of education and vocational training and inadequate law enforcement on bribes and harassment. Poverty is also promoted by conditions that come along with capitalism, social and economic structures (Sameti M. et al., 2012). The study asserts that if people cannot find employment, they are prone to poverty. Individual and or Household Drivers of Poverty

Gender and Poverty

According to the study carried out on the determinants of poverty at the household level in Kenya by Studies (2001), male-headed households have a higher likelihood of being poor compared to female-headed households. On the

other hand, gender was found to be a significant driver of poverty where male-headed households have less chances of being poor and the reason behind this finding is due to differences in access to land, credit, technology, and extension services which are not easily accessed by females (Campenhout et al., 2016) Marital Status and Poverty

In their study, Bergant et al. (2022) find that marital status is a significant driver of poverty, and the study highlights that consumer units where both adults are married are approximately 8% less likely to be poor than households headed by an individual who is single and has never been married. The study carried out on poverty and its dynamics in Uganda using a new set of poverty lines indicated by Campenhout et al. (2016) indicated that marital status has a significant effect on poverty among households. The study further argues that households whose heads have never married were less poor compared to households headed by widows, the study also argues that divorced-headed households are also more likely to be successful compared to households headed by widows.

Education and Poverty

Results from the study carried out on poverty and its dynamics in Uganda using a new set of poverty lines indicated by Campenhout et al. (2016), recognise that there are differences in poverty levels of the households due to differences in education. Investment in education is fundamental to economic growth and it helps in reducing poverty and upgrading individual welfare by getting them out of poverty including the community in terms of both the social and economic status (Pervez, 2014). Education is important and has potential as it lowers crimes, terrorism, and child labour due to the role it plays. It allows people to afford the basic needs of life and therefore reduces their participation in crimes and other illegal activities (Chevrier, 2017). The other indirect way education reduces poverty is through improving income which enables the population to afford basic needs in easier ways

that improve their standards of living (Pervez, 2014).

Household Size and Poverty

A study by Fusco & Islam (2017) find out that the poverty of a household may be affected differently due to varying age groups from the number of children. Findings by Garza-Rodriguez et al. (2021) also shows that family size is a significant predictor of poverty and highlights that poverty is higher in families of above five members compared to families with one member. According to Orbeta (2005), the extent to which family size is related to poverty can be demonstrated through family size and incidence of poverty. The study also highlighted that the incidence of poverty increases with the increase in family size. Demographic characteristics indicate that larger families, which had a higher dependency ratio as a result of a large number of ageing members and a big number of children who are not productive had a high likelihood of being poor in terms of income compared to small families with less ageing members and children (Northeast China, 2022).

Age of the Household Head

Literature shows that age has a significant relationship with poverty and studies by Junfeng, & Bin (2017) indicate that it has a significant impact on rural poverty arguing that the elderly and middle-aged people had a low probability to be poor. According to the study on determinants of poverty in Mexico using quantile regression analysis by Garza-Rodriguez et al. (2021), age was found to be a significant factor in poverty and poverty is higher at a young age since at this stage, there is no productive activities being done, poverty reduces in middle age and again increases at an old age. The study further highlights that experience is very minimal and poverty reduces with the increase in the experience of working.

Community and Environmental Drivers of Poverty

Region and Poverty

According to Alemayehu, (2001b), there is a significant difference in poverty due to regional differences in the United States and households that are in the Midwest have a high risk of falling into poverty. There is a significant difference in poverty due to regional differences and people from the Central region, Eastern region and Western region have less chance of being poor as compared to those from the Northern region (Okurut, 2002). The study further highlights that those from the Central region were about 3.5 better off than those of the Northern region, those of eastern being 3.5 times better off than those of the Northern region, those of western being 3.1 times better off than those of northern region. Literature on poverty and region shows a significant relationship between the two, for instance, a study by Campenhout et al. (2016) on poverty and its dynamics in Uganda highlights a clear relationship between region and poverty levels and further states that northern region has a big number who are chronically poor compared to other regions like the western and central. In another study on the determinants of poverty in Mexico using quantile regression analysis by Garza-Rodriguez et al. (2021), the region where people live has a significant impact on poverty levels.

Place of Residence, Location, Distance to the Market and Poverty

A study carried out by Alemayehu, (2001b) in Kenya and found that the likelihood of being poor is lower in urban places of Kenya than in rural areas. The study on the drivers of poverty in rural households by Eyasu, (2020) in North-Western Ethiopia indicated that how long one takes to get to the market has a positive relationship with household poverty. Location affects access to social services especially safe water, where poor people were found to be spending more time fetching water compared to the non-poor who spent less time fetching water (Campenhout et al., 2016). The study on the analysis of spatial determinants of poverty in rural Uganda by Muhumuza, (2007) showed a significant negative

correlation between population density and poverty.

METHODOLOGY OF THE STUDY

Data Source

Uganda National Household Survey dataset was used in this study and was obtained from the Uganda Bureau of Statistics (UNHS, 2020). The analysis was based on those households whose major economic activity was agriculture. An extract of the data for only those households who were involved in agriculture was used for the purpose of this study.

Study Population and Sample

This study was based on the households whose representatives were available at the time data was collected and only those families whose major activity is agriculture were included in this study (UNHS, 2020). A sample of 13,732 households was randomly selected from the total weighted sample representation (population) of 11.3 million households whose economic livelihoods were derived from agriculture.

Diagnostic Tests

Skewness and Kurtosis Tests for Normality

The kurtosis and skewness test for normality for residuals was established to choose the best model between the logit and probit models.

Heteroscedasticity Test

To provide estimates that are free from heteroscedasticity, the robust command was added to the regression command in Stata; vce (robust). The analysis provided estimates with robust standard errors which were free from heteroscedasticity.

Model Specification

In this study, multilevel and interaction model approaches were used in multivariate analysis in which the response category was a binary outcome. This was a dummy variable where 1 represented those that fall into the category of Poor and 0 for Non-poor. Therefore, in the reclassification of variables poverty status had two categories that is, Poor and Non-poor. In understanding the drivers of poverty, a logistic model was applied since the outcome variable (poverty status) was binary.

In the Logistic Regression Model P is the probability of success/probability of one being poor.

$1 - P$ is the probability of not being poor.

The odd of poverty is given by,

$$\text{Odds} = \frac{P}{1-P} \quad \dots\dots\dots (1)$$

Let us take

$$P = \frac{e^M}{1+e^M} \quad \dots\dots\dots (2)$$

And M = linear predictor that includes all independent variables

$$\text{Then} \quad P(1 + e^M) = e^M$$

$$P + Pe^M = e^M$$

$$P = e^M - Pe^M$$

$$P = (1 - P)e^M$$

$$\frac{P}{1-P} = e^M$$

$$\ln\left(\frac{P_{ij}}{1-P_{ij}}\right) = M \quad (3)$$

$$M = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{2k}$$

For a level 1 model then;

$$\ln \left(\frac{P_{ij}}{1-P_{ij}} \right) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki} \quad (4)$$

$$\beta_0 = \text{Constant}$$

β_1, β_2 up to β_k are the coefficients of the fixed effects model

With interaction terms, the level 1 effect model becomes

$$\ln \left(\frac{P_{ij}}{1-P_{ij}} \right) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{ij} X_{2i} + \dots + \beta_k X_{ki} + \beta_j X_{ki} X_{kj} \quad (5)$$

$X_{1i} X_{2i} \dots X_{ki} X_{kj}$ are the interaction terms of the model.

The Random (level II) effect model.

The random effects model provides estimates and takes into account regional differences. This is also called level II estimates.

$$\ln \left(\frac{P_{ij}}{1-P_{ij}} \right) = X_{ij} \beta + V_j \quad (6)$$

With interaction then

$$\ln \left(\frac{P_{ij}}{1-P_{ij}} \right) = X_{ij} X_{ik} \beta + V_j \quad (7)$$

Where X_{ij} = Matrix of Covariates

$X_{ij} X_{ik}$ = interaction terms

β = matrix of the Unknown regression coefficients

V_j is Random effect due to regional differences.

This measures the difference in poverty and it gives the total variations of poverty as a result of regional differences. It assumed that there are many households from the same region so it is important to understand the variations in poverty levels that can be accounted for by regional differences. Additionally, according to a study on testing for Interaction in multiple regressions by Allison (1977) it is suggested that in response to recent challenges, the practice of including product terms in multiple regression models to investigate the outcome variable is important.

Moreover, other literature suggests the same on interacting variables through non-additive methods to assess their joint impact on the outcome variable of interest as studied by Rogers, (2002), and Balli, & Sørensen, (2013).

Study Variables

The outcome variable of this study was Poverty Status; this is a binary option variable that took on 1 to be a poor household and 0 to be a non-poor household. The independent variables included household head sex, household head age,

household head level of education, marital status, household size, status of income, ownership of livestock and ownership of bank saving account as individual-level factors; place of residence and region of birth as environmental or demographic factors (see Table 1)

Table 1: Description of the Study Variables

variable	Definition
Household head Sex	
Female headed	Dummy variable (1 for female headed household, 0 otherwise)
Household head Marital status	
Married	Dummy variable (1 for married, 0 otherwise)
Divorced/widow/separated	Dummy variable (1 for divorced/widow/separated, 0 otherwise)
Single	Reference category
Household head Education level	
Primary education	Dummy variable (1 for primary education, 0 otherwise)
Secondary education	Dummy variable (1 for secondary education, 0 otherwise)
Post-secondary education	Dummy variable (1 for post-secondary education, 0 otherwise)
No formal education	Reference category
Region	
Eastern	Dummy variable (1 for eastern, 0 otherwise)
Northern	Dummy variable (1 for northern, 0 otherwise)
Western	Dummy variable (1 for western, 0 otherwise)
Central	Reference category
Residence status	
Rural	Dummy variable (1 for rural household, 0 otherwise)
Income stability	
Unstable income	Dummy variable (1 for unstable incomes, 0 otherwise)
Bank saving accounts	
Own bank saving accounts	Dummy variable (1 for bank saving accounts ownership, 0 otherwise)
Livestock ownership	
Own livestock	Dummy variable (1 for livestock ownership, 0 otherwise)
Household size	
Household size	Continuous variable
Household head age group	
Age	Continuous variable
Education and region	
Primary education Central	Dummy variable (1 for primary education from central, 0 otherwise)
Secondary education Central	Dummy variable (1 for secondary education from central, 0 otherwise)
Post-secondary central	Dummy variable (1 for post-secondary education from central, 0 otherwise)
No education East	Dummy variable (1 for no formal education from east, 0 otherwise)
Primary education East	Dummy variable (1 for primary education from east, 0 otherwise)
Secondary education East	Dummy variable (1 for secondary education from east, 0 otherwise)
Post-Secondary East	Dummy variable (1 for post-secondary education from east, 0 otherwise)
No education North	Dummy variable (1 for no formal education from north, 0 otherwise)
Primary education North	Dummy variable (1 for primary education from north, 0 otherwise)
Secondary education North	Dummy variable (1 for secondary education from north, 0 otherwise)
Post-Secondary North	Dummy variable (1 for post-secondary education from north, 0 otherwise)

variable	Definition
No education west	Dummy variable (1 for no formal education from west, 0 otherwise)
No education central	Reference category
Education and Residence Status	
No education & Rural	Dummy variable (1 for no formal education from rural, 0 otherwise)
Primary education & Rural	Dummy variable (1 for primary education from rural, 0 otherwise)
Secondary Education & Rural	Dummy variable (1 for secondary education from rural, 0 otherwise)
Post-Secondary & Rural	Dummy variable (1 for post-secondary education from rural, 0 otherwise)
No education & central	Reference category

Re-classification of Variables

Poverty status was classified into five categories according to the UNHS (2020) dataset: very poor, poor, neither poor nor rich, rich and very rich. However, poverty status was re-categorized into two groups for this study and for understanding the problem. Therefore, this study considered poverty status as the dependent variable and was coded 1 for Poor Households (poor and very poor categories) and 0 for Non-Poor Households (neither poor nor rich, rich, and very rich). It's however important to note that some other variables were re-classified along with data processing and analysis for a better understanding of poverty and its drivers.

RESULTS AND DISCUSSION

Table 2: Skewness and Kurtosis Tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj_chi2(2)	Prob>chi2
Residuals	18,326	0.000	0.000	0.000	0.000

Table 2 shows that both the skewness and the kurtosis are not asymptotically normally distributed with respective probability values (0.000 and 0.000). The joint probability value is also 0.000 which indicates that the residuals are not normal. For this reason, the binary outcome variable, poverty status is a logistical distribution and a logistic regression model was used in the analysis as was proposed in the methodology section.

Heteroscedasticity Test

The results are presented at various levels of analysis. The analysis was based only on the individuals who were available in the households at the time data was collected and for only agricultural households or individuals whose major activity is agriculture (UNHS, 2020). For national representative results, the data was weighted using survey sampling weights.

Diagnostic Tests

Skewness and Kurtosis tests for Normality

The kurtosis and skewness test for normality for residuals was established to choose the best between the logit and probit models.

To provide estimates that are free from heteroscedasticity, robust command was added to regression command in Stata; `vce (robust)`. The analysis provides estimates with robust standard errors which are homoscedastic.

Drivers of Poverty among Agricultural Households

To establish the effect of each independent variable (factor) on poverty status in Uganda, both fixed (level I estimates) and random effects (level II estimates) regression models were fitted with the interaction of some selected variables. In the

analysis using the logistic regression model, the use of robust standard errors was very important to provide estimates that are free from heteroscedasticity problems. The marginal effects

of the logistic model were presented and the reported significance level of estimated parameters was 5% (0.05).

Table 3: Predictors of Poverty: Level I Estimates

Variable	dy/dx	Robust Standard Error.	z-statistic	P-value
Farmer group				
In farmer group	0.022	0.007	2.92	0.004
Household head sex				
Female headed	0.041	0.009	4.39	0.000
Household head Marital status				
Married	0.093	0.008	11.28	0.000
Divorced/widow/separated	0.098	0.012	7.83	0.000
Household head Education level				
Primary education	-0.001	0.020	-0.05	0.960
Secondary education	-0.045	0.026	-1.71	0.087
Post-secondary education	-0.045	0.031	-1.42	0.155
Region				
Eastern	-0.010	0.016	-0.58	0.565
Northern	0.015	0.017	0.92	0.357
Western	-0.015	0.016	-1.02	0.307
Residence status				
Rural	-0.030	0.013	-2.28	0.022
Income stability				
Unstable income	0.246	0.003	80.07	0.000
Bank saving accounts				
Own bank saving accounts	-0.101	0.020	-4.98	0.000
Livestock ownership				
Own livestock	0.111	0.006	20.20	0.000
Household size				
Household size	-0.063	0.005	11.73	0.000
Household head age group				
Age	0.017	0.006	2.73	0.006
Education and region				
Primary education Central	-0.023	0.021	-1.13	0.259
Secondary education Central	-0.020	0.027	-0.75	0.454
Post-secondary central	0.047	0.030	1.56	0.118
No education East	0.023	0.025	0.92	0.357
Primary education East	-0.005	0.016	-0.27	0.786
Secondary education East	-0.004	0.022	-0.16	0.857
Post-Secondary East	0.011	0.027	0.43	0.669
No education North	0.048	0.025	1.89	0.059
Primary education North	-0.020	0.017	-1.17	0.241
Secondary education North	0.027	0.023	1.15	0.250
Post-Secondary North	0.061	0.026	2.39	0.017
No education west	0.041	0.025	1.59	0.112
Education and Residence Status				
No education & Rural	0.042	0.020	2.08	0.038
Primary education & Rural	0.034	0.018	1.90	0.057
Secondary Education & Rural	0.054	0.023	2.31	0.021
Post-Secondary & Rural	0.017	0.032	0.54	0.589

Table 3 shows that the effect of gender of household head that is engaged in agriculture is significant at a 5% level of significance. The probability of falling into poverty increases by 0.04 (4%) for female-headed households. Females have a higher probability of falling into poverty, women are less employed in other sectors than men. Also, women have less control over the ownership of household assets and are more involved in unpaid domestic work compared to men and this explains why they are poor. This finding is consistent with a study by Campenhout et al. (2016) which found that gender is a significant predictor of poverty where male-headed households have less chance of being poor compared to female-headed households.

Marital status has a significant effect on poverty, the probability of falling into poverty increases by 0.09 (9%) for agricultural household heads who are married, those who are divorced/widowed or separated, poverty increases by 0.1 (10%). Similar findings are from the study on poverty and its dynamics in Uganda using a new set of poverty lines indicated by Campenhout et al. (2016) who found out that marital status has a significant effect on poverty among households. The study further revealed that households whose heads had never married were poorer compared to households headed by widows and other groups. In both studies the probability of falling into poverty increases for those who are married and ever been married. Except for statistical significance, this study disagrees with a study by Bergant et al. (2022) which suggests that consumer units where both adults are married are approximately 8% less likely to be poor than households headed by an individual who are singles and have never been married.

The information presented in Table 3 demonstrates that as the age of individuals in agricultural households in Uganda increases by one year, there is a corresponding increase in the likelihood of falling into poverty by 0.02 (2%). In other words, poverty levels rise as the age of the household head or members increases in agricultural households in Uganda. The research

results regarding age align with the study conducted by Adeoti (2014) which revealed that as individuals get older, poverty tends to increase. However, this effect is particularly pronounced in the higher age group where the likelihood of experiencing poverty rises significantly after the age of sixty. This can be attributed to factors such as being deemed unemployable and a decrease in physical energy, which hinders the ability to handle demanding agricultural tasks.

There is a positive effect between income instability and poverty status where the probability of falling into poverty increases by 0.25 (25%) for those individuals whose incomes are unstable. The implication is that poverty reduces as the incomes of individuals become more stable and from this study, it is statistically significant at a 5% level. The findings of this study align with a study conducted by Reardon et al. (1992) which found a significant impact of income stability on poverty levels. The study further revealed that individuals with stable incomes have a lower risk of experiencing poverty, highlighting the importance of income stability in mitigating poverty risks.

Table 3 also shows that poverty reduces by 0.1 (10%) for those individuals who own savings accounts and save in commercial banks. This is because individuals with accounts in banks are at the disposal of obtaining agricultural loans from commercial banks and they have higher chances of increasing their productivity. This is the case because they have a high capacity to purchase agricultural inputs to be used in their farms. These findings are in line with the findings from a study on whether banks matter by Burgess, & Pande (2005) which revealed that having a bank account reduces the likelihood of falling into poverty since it's directly related to credit access in agricultural households.

The likelihood of experiencing poverty among individuals who own livestock was found to rise by 0.1 (10%), and this increase is considered statistically significant at a 5% level. This significance is indicated by the probability value being less than 0.05. Those engaged in livestock

farming are more susceptible to poverty compared to those who do not practice it. This empirical evidence is supported by the livestock profile report from the Uganda Investment Authority (2009) which highlights the heavy reliance on livestock in the Karamoja region of Uganda. This region is also identified as one of the poorest areas in Uganda, as reported by the Uganda Bureau of Statistics (UNHS, 2020).

The size of agricultural households has an impact on the likelihood of experiencing poverty. Specifically, an increase in household size reduces the probability of being poor by 0.06 (6%) and this finding is statistically significant at a 5% level, indicated by a probability value less than 0.05. This suggests that larger households have a lower risk of falling into poverty compared to smaller households. However, there are differing views on this matter. Some studies argue that household size is not a significant driver of poverty. According to Muhumuza (2007), larger households tend to have higher levels of poverty incidence due to a higher dependency ratio, which strains available resources. Residence status has a statistically significant effect on poverty at 5% level. In rural areas, the likelihood of agricultural

households experiencing poverty decreases by 0.03 (3%). These findings are in tandem with the study conducted by Campenhout et al. (2016), which revealed higher poverty rates in rural areas of Uganda compared to low poverty levels in urban areas.

The level of education has a notable impact on poverty within agricultural households residing in rural areas. Results indicate that the probability of rural household heads without any formal education falling into poverty increases by 0.04 (4%). Furthermore, residing in a rural area amplifies the probability of falling into poverty for individuals who have attended primary education and secondary education, by 0.03 (3%) and 0.05 (5%) respectively. These findings strongly support the assertion that education level plays a significant role in determining the likelihood of poverty within rural agricultural households (Alkire, 2015a). The evidence suggests that higher education levels in rural areas are associated with a decreased probability of falling into poverty, as education opens opportunities for employment, income generation, entrepreneurship, and access to resources and this is statistically significant at 5% level.

Table 4: Predictors of Poverty: Level II Estimates

Variable	dy/dx	Robust Standard Error.	z-statistic	P-value
Farmer group				
In farmer group	0.015	0.015	1.02	0.306
Household head sex				
Female headed	0.040	0.013	2.98	0.003
Household head Marital status				
Married	0.095	0.009	10.55	0.000
Divorced/widow/separated	0.097	0.012	8.10	0.000
Household head Education level				
Primary education	-0.002	0.011	-0.16	0.871
Secondary education	-0.018	0.012	-1.51	0.130
Post-secondary education	-0.042	0.030	-1.41	0.159
Residence status				
Rural	-0.031	0.015	-2.13	0.033
Income stability				
Unstable income	0.234	0.009	28.90	0.000
Bank account saving				
Own account and save	-0.085	0.025	-3.42	0.001
Livestock ownership				
Own livestock	0.121	0.011	10.90	0.000
Household size				

Variable	dy/dx	Robust Standard Error.	z-statistic	P-value
Household size	0.017	0.007	1.92	0.050
Household head age				
Age	-0.057	0.009	-7.73	0.000
Education and region				
Primary education Central	-0.034	0.020	-1.73	0.084
Secondary education Central	-0.042	0.012	-3.54	0.000
Post-secondary central	0.041	0.029	1.41	0.158
No education East	0.014	0.016	0.90	0.368
Primary education East	-0.010	0.012	-0.79	0.428
Secondary education East	-0.027	0.015	-1.72	0.085
Post-Secondary East	0.004	0.024	0.16	0.869
No education North	0.032	0.018	1.85	0.064
Primary education North	-0.009	0.009	-0.98	0.320
Secondary education North	0.022	0.013	-0.99	0.072
Post-Secondary North	0.042	0.025	1.80	0.087
No education west	0.032	0.017	1.86	0.063
Education and Residence Status				
No education & Rural	0.042	0.016	2.72	0.007
Primary education & Rural	0.041	0.014	2.96	0.003
Secondary Education & Rural	0.041	0.015	2.87	0.004
Post-Secondary & Rural	0.019	0.027	0.71	0.475
Sub region	0 .179142	0 .1061401		
Var (cons)				

According to the information provided in Table 4, it is worth noting that the level II estimates from the random effects regression model reveal that 17.9% of the variations in poverty levels in Uganda can be attributed to regional differences. Additionally, Table 4 demonstrates a significant disparity between the level II estimates and level I estimates. This disparity can be attributed to clustering effects resulting from regional differences. As a result, certain socioeconomic and demographic variables lose their significance, as the differences in poverty are primarily influenced by regional disparities rather than population, socioeconomic, and demographic differences alone.

However, despite the impact of regional variations, other factors such as the sex of the household head, marital status, residence status, stability of household income, possession of bank savings accounts, ownership of livestock, household size, age of the household head, primary and secondary education from central, no education, primary education and secondary education attainment from rural areas are

significant even after accounting for regional differences.

SUMMARY OF THE FINDINGS

According to the findings presented at the bivariate level, females in agricultural households tend to experience higher poverty rates compared to males. The study also reveals that poverty levels in agricultural households decrease as family size increases, as a smaller percentage of people with larger families are considered poor. Additionally, poverty is more prevalent among individuals aged 55 years and above compared to other age groups.

The study aimed to find out the individual-related predictors of poverty in agricultural households in Uganda and results suggest that having a stable source of income in agricultural households is associated with lower poverty levels. With stable incomes, the likelihood of falling into poverty decreases. Moreover, poverty decreases with higher levels of education, as obtaining more education enables individuals to get away from poverty. Married individuals, on the other hand,

were found to have higher poverty rates compared to other groups. Owning livestock in conjunction with other agricultural activities increases the likelihood of experiencing poverty. The study highlights the benefits of owning a bank account and having access to bank borrowing is associated with a reduced likelihood of experiencing poverty.

At the multivariate level, the study finds that certain variables have statistically significant effects on poverty levels in agricultural households. These variables include income stability, residence status, ownership of livestock, having bank savings accounts, gender, household size, age, residence status (specifically in rural areas), and the interaction between education and region (specifically secondary education in the northern region).

Consequently, the null hypothesis that these variables have no significant effect on poverty status in agricultural households is rejected at a 5% level of significance. However, when controlling for regional factors, it is found that within-individual characteristics are highly significant, as regional-level characteristics only account for 17.9% of the variations in poverty in Uganda. Furthermore, the hypothesis that the effect of education level on agricultural household poverty is not modified by region and residence status is rejected at a 5% level of significance. Therefore, it can be concluded that the effects of education level on poverty are indeed modified by region and residence status.

CONCLUSIONS

Level II estimates were so critical especially with observations that are nested within the regions (hierarchical data structure). The study showed that 17.9% of the variations in the poverty level is accounted for by regional differences. This implies that the differences between regions in Uganda have an impact on the poverty levels observed in the country.

When conducting a study on poverty levels, researchers often analyze various factors that contribute to poverty as social economic and

demographic factors including regional disparities. In this case, the study has found that 17.9% of the variations in poverty levels can be attributed to regional differences. This means that nearly one-fifth of the differences in poverty rates across different areas in Uganda can be explained by regional characteristics. By identifying and understanding these regional differences and their influence on poverty levels, policymakers and organizations can develop targeted interventions and policies to address the specific challenges faced by different regions.

On the other hand, the stability of an individual or household's income has been found to play a significant role in poverty levels. Fluctuations and lack of income stability can contribute to a higher likelihood of experiencing poverty. Place of residence, whether rural or urban, has been identified as a significant factor influencing poverty levels. People living in rural areas may face different challenges and have fewer opportunities compared to those in urban areas, affecting their poverty status.

Owning bank savings accounts is identified as a factor that drives poverty levels. Access to formal financial services, such as savings accounts, can provide individuals with a safety net and opportunities for economic advancement.

Gender is shown to have a statistically significant effect on poverty levels. Gender disparities and inequalities, such as limited access to resources, education, and employment opportunities, can contribute to higher poverty rates among certain gender groups, especially women. Age has been identified as a variable with a statistically significant effect on poverty levels. Different age groups may have varying vulnerabilities and access to resources, impacting their poverty status.

The interaction between residence status (rural and urban) and education is statistically significant. This suggests that the effect of education on poverty levels differs based on whether an individual resides in a rural or urban area. The interaction between education,

specifically secondary education, and region (particularly in the north) has a statistically significant effect on poverty levels. This indicates that the impact of secondary education on poverty varies across different regions, with specific attention to the northern region.

These deductions provide insights into the complex and multidimensional nature of poverty and highlight the importance of considering various factors when analyzing and addressing poverty levels. Policymakers, researchers, and organizations can utilize these findings to develop targeted interventions and strategies aimed at reducing poverty and promoting inclusive development.

Policy Recommendations

Based on the findings of the study on the predictors of poverty in agricultural households in Uganda, the following policy recommendations can be drawn.

Evidence suggests that being female headed household increases the probability of being poor. Government should invest heavily in women empowerment programs and provide access to resources including land, equal access to employment opportunities and equal access to education to reduce poverty.

Results from the study indicated that income instability in agricultural households increases the probability of being poor. Government should empower farmers to form farmer groups where they can collectively increase their bargaining power to avoid price fluctuations. Additionally, the Government should establish marketing platforms that enable farmers to get information on available prices in the market to reduce income instabilities due to locational price differences and fluctuations.

The study revealed that income stability has got potential to reduce poverty and the government should implement programs that promote stable incomes for agricultural households. This may include providing support in terms of sourcing other income-generating activities to farmers.

Given that poverty in agricultural households is more common in rural areas, targeted rural development initiatives are necessary. These initiatives should focus on improving infrastructure, access to basic services, agricultural productivity, and market linkages in rural areas. Promoting diversification of income sources and providing training and support for rural entrepreneurs can also help reduce poverty in rural agricultural households.

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