# SOCIO-ECONOMIC DETERMINANTS OF HOUSEHOLD FOOD SECURITY IN UGANDA: AN ECONOMETRIC ANALYSIS OF THE UNHS 2023/24 DATASET

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## DECLARATION

I, Loyo Timothy, solemnly declare that this dissertation submitted in partial fulfillment of the requirements for the award of the degree of Science in Economics and Statistics is the result of my own original work. It has not been submitted to any other academic institution for any award. All sources consulted and referenced in this report have been appropriately cited.

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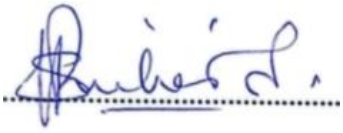
## APPROVAL

This dissertation titled: “Socio-Economic Determinants of Household Food Security in Uganda: An Econometric Analysis of the UNHS 2023/24 Dataset” has been submitted for examination with the approval of my supervisor.

Signature:



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## DEDICATION

To my family, whose unwavering support, love, and encouragement have been the foundation of my academic journey. Their constant belief in my potential has inspired me to persevere and achieve this milestone. This work is a reflection of their dedication to my education, and I will always remain grateful for their guidance and unconditional care.

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# ABSTRACT

Food insecurity remains a persistent development challenge in Uganda, affecting approximately four in ten households. While previous studies have identified income, education, household size, and asset ownership as important determinants, they have largely relied on caloric intake or hunger-experience indicators (e.g., HFIAS) that do not capture dietary diversity and micronutrient adequacy. Furthermore, most existing studies report average effects without testing for heterogeneity across regions or between urban and rural areas, and none have directly compared the explanatory power of Sen's Entitlement Approach (income and assets) versus Becker's Household Production Theory (education) within a single model.

This study examines the socio-economic determinants of household food security in Uganda using the Food Consumption Score (FCS), a multidimensional measure of dietary diversity, and the latest Uganda National Household Survey (UNHS) 2023/24 sub-sample of 1,527 households (weighted population 926,574). A generalised ordered logit (partial proportional odds) model was estimated with cluster-robust standard errors and sampling weights to account for the complex survey design. Average marginal effects (AMEs) were computed for the probability of achieving acceptable food security.

The results show that 73.6% of households have acceptable food security, 21.4% borderline, and 5.0% poor. Income is the only main independent variable statistically significant at the 5% level: a 1% increase in income is associated with a 0.000128 (0.0128 percentage point) increase in the probability of acceptable food security ($p < 0.001$), supporting Sen's Entitlement Approach. Secondary education is marginally significant at the 10% level ($p = 0.080$), and its association appears indirect via income. Adult-equivalent household size shows a positive borderline association ($p = 0.052$), contrary to the resource dilution hypothesis. Asset ownership is not significant ($p = 0.293$). Married heads, female heads (after income control), and urban residence show positive supplementary associations. Regional disparities are enormous: the predicted probability of acceptable food security ranges from 89% in Ankole to 43% in Karamoja.

The study concludes that income is the most robust correlate of dietary diversity, while education and assets operate indirectly. Policies should prioritise income-raising interventions combined with complementary programmes and geographically targeted strategies, especially for Karamoja. The Parish Development Model should consider regionally differentiated allocations and support for vulnerable unmarried heads and female-headed households.



Keywords: Food security, Food Consumption Score (FCS), socio-economic determinants, household income, Uganda, UNHS 2023/24, ordered logit, marginal effects

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# CHAPTER ONE: INTRODUCTION

## 1.1 Introduction

This chapter introduces the study, which examines the socio-economic determinants of household food security in Uganda using the Uganda National Household Survey (UNHS) 2023/24 dataset. It presents the background to the problem, the statement of the problem, the research objectives and hypotheses, the scope of the study, the justification and significance of the research, and the theoretical and conceptual frameworks that guide the analysis.

## 1.2 Background to the Study

Global context. Food security has evolved from a narrow concern about national food production to a multidimensional concept encompassing availability, access, utilization and stability (FAO, 2008). The widely accepted definition from the 1996 World Food Summit states that food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs for an active and healthy life. Despite global progress, an estimated 2.4 billion people experienced moderate or severe food insecurity in 2022 (FAO, 2023). Research has increasingly shifted attention from aggregate food supply to household-level determinants such as income, education and asset ownership (Sen, 1981). This shift recognizes that even when national food supplies are adequate, many households remain food insecure due to constraints in accessing food.

African context. Sub-Saharan Africa faces the highest prevalence of food insecurity of any world region, with approximately 22.5 percent of the population undernourished (FAO, 2023). Several structural factors explain this persistence. First, many African households have transitioned from subsistence farming to market-dependent food acquisition, making them vulnerable to price volatility (Wichern et al., 2017). Second, agricultural productivity remains low due to limited use of improved seeds, fertilizers and irrigation. Third, weak infrastructure and remote locations constrain market access, forcing households to rely on local food systems that may be insufficient or undiversified. Fourth, climate variability, including recurrent droughts and floods, directly affects crop and livestock production. These factors interact with household characteristics such as income, education and asset ownership to shape food security outcomes. Understanding these determinants at the household level is therefore critical for designing effective interventions.

Uganda context. Uganda is a net food producer, yet household food insecurity remains persistent. According to the Uganda Bureau of Statistics (UBOS, 2021), approximately four in ten households experience inadequate food consumption. Several studies have contributed to understanding the determinants of food security in Uganda. Ssewanyana and Kasirye (2010) used the 2005/06 UNHS to show that household income, land under cultivation, food prices and the education of the household head significantly affect caloric intake. Turyahabwe et al. (2013)

studied wetland-adjacent areas across three agro-ecological zones and found that food insecurity was lower among households with older and better-educated heads, but higher among female-headed and larger households. Kalinaki et al. (2025) surveyed 250 households in Buwenge, Eastern Uganda, and found that 90.4 percent faced food insecurity, with larger family size, limited land access and reliance on market purchases as key risk factors. Egeru et al. (2022) applied the Food Consumption Score (FCS) in Nakasongola district, a semi-arid pastoral area, but their sample was small (165 households) and limited to adopters of climate-smart agriculture. Semakula et al. (2024) used Bayesian belief networks on phone survey data to rank determinants of food insecurity, identifying reduced income as a top factor.

These studies have shown that income, education, household size and asset ownership are important for food security. However, they leave three important questions unanswered, which are elaborated in the problem statement below.

### 1.3 Statement of the Problem

Household food insecurity persists in Uganda, affecting about 40 percent of all households (UBOS, 2021). The government has made food security a priority under the National Development Plan IV (NDP IV, 2025/26–2029/30) and the Parish Development Model (PDM). To design effective interventions, policy makers need precise evidence on which socio-economic determinants matter most and whether those determinants work the same way across different regions and household types.

Earlier research has reliably shown that household income, the education level of the household head, household size and asset ownership are associated with food security. Using the 2005/06 Uganda National Household Survey, Ssewanyana and Kasirye (2010) demonstrated that income and education are strong predictors of caloric adequacy at the national level. Turyahabwe et al. (2013), studying wetland-adjacent areas across three agro-ecological zones, found that education reduces food insecurity while household size increases it, even after controlling for other factors. Kalinaki et al. (2025), in a survey of 250 households in Buwenge, Eastern Uganda, provided localised evidence that larger family size and limited land access are key risk factors. Egeru et al. (2022) examined climate-smart agriculture adopters in Nakasongola district and reported that asset ownership (livestock and non-livestock assets) influences food security. These findings have laid a solid foundation for policy and for further research.

Despite these contributions, the literature has three specific shortcomings that this study aims to address.

First, measurement of food security. Ssewanyana and Kasirye (2010) used caloric intake as their dependent variable. Turyahabwe et al. (2013) and Kalinaki et al. (2025) used the Household Food Insecurity Access Scale (HFIAS), which captures the perceived experience of hunger. Semakula et al. (2024) used meal frequency and HFIAS. These indicators measure how much

food a household gets or whether its members experience hunger. They do not measure dietary diversity or the quality of nutrients consumed. A household can get enough calories but still lack essential vitamins and minerals, a condition known as hidden hunger. The Food Consumption Score (FCS) combines food group diversity, consumption frequency and nutritional weights. Egeru et al. (2022) used the FCS, but their study was limited to one semi-arid district (Nakasongola) and a small sample (165 households). No national-level study has used the FCS to examine the socio-economic determinants of dietary diversity in Uganda.

Second, variation across regions and residence types. Ssewanyana and Kasirye (2010), Turyahabwe et al. (2013), Kalinaki et al. (2025) and Semakula et al. (2024) all report average effects. They assume that the effect of income, education, household size or assets is the same for all households. None of these studies tested whether these effects differ across Uganda's 15 sub-regions or between urban and rural areas. Yet Uganda's sub-regions vary greatly in climate, market access and farming systems. Income may matter a lot for food security in a market-oriented region like Central Uganda, but much less in a remote, subsistence-based region like Karamoja. Without testing for such differences, policy recommendations based on average effects may be inappropriate for some regions or household types.

Third, theoretical comparison. Two main theories have been used to explain food security. Sen's Entitlement Approach (1981) emphasizes income and assets as exchange entitlements. Becker's Household Production Theory (1965) emphasizes education as an efficiency input. Turyahabwe et al. (2013) refer to Sen, and Ikendi et al. (2023) refer to Becker. However, no study has placed both sets of variables; income and assets (Sen) and education (Becker), the same econometric model and directly compared their explanatory power. It is therefore unknown whether exchange entitlements or human capital efficiency is the stronger predictor of food security in Uganda.

Why current conditions require new analysis. Uganda's context has changed. Egeru et al. (2022) document increased climate variability with more frequent droughts and floods. Semakula et al. (2024) found that reduced income was a top determinant of food insecurity during the COVID-19 pandemic. Kalinaki et al. (2025) note that rising food prices have made market-dependent households more vulnerable. These changes mean that even well-conducted older studies may not fully capture current relationships.

The policy-relevant question. The Parish Development Model (PDM), launched in 2022, is the Government of Uganda's flagship framework for moving households from subsistence to the money economy. The PDM operates in all parishes across the country, including both urban and rural areas. Its pillars include production, storage, marketing, financial inclusion and social development. Within the PDM, parishes receive funding that can be directed towards various interventions, including income-generating support (cash grants, asset acquisition) and training (education, nutrition awareness). While the PDM is grounded in evidence from previous research, the specific question of whether income/assets or education has a larger marginal effect on dietary diversity has not been empirically examined using a nationally representative dataset.

This study will provide evidence to inform the ongoing implementation of the PDM by estimating the relative effects of income, assets and education on the Food Consumption Score. The findings can help guide resource allocation across intervention types, complementing existing policy knowledge.

What this study does. This study addresses the three limitations by:

Using the Food Consumption Score (FCS) as the measure of food security, thereby capturing dietary diversity and nutrient quality. Using a generalized ordered logit model with marginal effects and explicitly testing whether the effects of income, education, household size and assets differ across Uganda's 15 sub-regions and between urban and rural households. Including income, assets and education in the same model, and comparing their marginal effects to assess whether Sen's framework (income and assets) or Becker's framework (education) is more strongly supported by the data.

## 1.4 Objectives of the Study

### 1.4.1 General Objective

To examine the socio-economic determinants of household food security in Uganda using the Food Consumption Score.

### 1.4.2 Specific Objectives

1. To examine the effect of total household income on the Food Consumption Score (FCS).

2. To examine the effect of the household head's education level on the FCS.

3. To examine the effect of household size on the FCS.

4. To examine the effect of asset ownership on the FCS.

## 1.5 Research Hypotheses

The following null hypotheses will be tested using an ordered logit regression model, as described in Chapter Three.

$H_{01}$: Total household income has no significant effect on the Food Consumption Score in Uganda.

$H_{02}$: The education level of the household head has no significant effect on the FCS.

$H_{03}$: Household size has no significant effect on the FCS.

$H_{04}$: Asset ownership has no significant effect on the FCS.

## 1.6 Scope of the Study

The study covers all 15 statistical sub-regions of Uganda as sampled in the UNHS 2023/24. The analysis uses the sub-sample of households for which the Food Consumption Score (FCS) could be calculated, comprising 1,527 households after data cleaning (weighted population: 926,574) . The dependent variable is the Food Consumption Score, grouped into three categories: poor (0–21), borderline (21–35) and acceptable (>35). The independent variables are:

Total household income (measured as monthly income in Ugandan shillings, winsorized at the 99th percentile and transformed using the natural logarithm); Education of the household head (categorised as none, primary, secondary, or tertiary, with none as the reference category); Household size (adjusted using adult-equivalent units based on age composition); Asset ownership (a composite index constructed via principal component analysis from four components: binary land ownership, log livestock value, durable goods count, and number of sleeping rooms).

Region (15 sub-regions) and urban/rural residence are included as control variables and are also used to test for differences in effects across sub-regions and between urban and rural areas. The study uses cross-sectional secondary data and does not cover clinical nutrition outcomes such as stunting or body mass index. In addition, the following household demographic characteristics are included as control variables to reduce omitted variable bias: age of the household head (linear and quadratic), gender of the head, and marital status

## 1.7 Justification of the Study

This study is justified for three reasons, each corresponding to a limitation in the existing literature.

First, measurement of dietary diversity. Previous national-level studies measured calories or hunger. This study uses the Food Consumption Score, which measures dietary diversity and nutrient quality. This is the first study to do so at the national level in Uganda. The contribution is not that the older measures are wrong, but that they answer a different question, “Are households getting enough calories?”, while leaving unanswered a question that is just as important for health: “Are households getting a diverse and nutritious diet?” The FCS fills that gap.

Second, testing for differences across regions and residence types. Previous studies reported only average effects. This study will test whether the impact of income, education, household size and assets varies across Uganda’s 15 sub-regions and between urban and rural households. By doing so, it will produce region-specific and residence-specific evidence. This allows policy makers to target interventions more precisely for example, focusing on income support where income matters most, and on education where education matters most.

Third, comparing two theories of food security. Sen's Entitlement Approach and Becker's Household Production Theory have been used separately, but not compared in the same model. This study will put them side by side. It will include income and assets (the Sen variables) and education (the Becker variable) in one model, and compare their marginal effects. The result will show which theory is more helpful for understanding food security in Uganda today. This is a theoretical contribution that also has practical value: it tells policy makers whether to invest more in income support or in education.

### 1.8 Significance of the Study

This study contributes to both academic knowledge and policy practice.

Academic contribution. The study provides a model for using the Food Consumption Score as a dependent variable in national household survey analysis, a method that has not yet been used in Uganda. It also shows how to test for differences in effects across many sub-regions and between urban and rural areas, which goes beyond the usual practice of reporting only average effects. Finally, it offers an empirical test of two competing theories, contributing to the wider literature on the causes of food insecurity in low-income countries.

Policy contribution. The study answers three questions that can support the implementation of existing policies such as the Parish Development Model, the Uganda Nutrition Action Plan II, and the National Development Plan IV. First, among income, education, household size and assets, which has the largest estimated marginal effect on dietary diversity? Second, do these estimated effects differ across Uganda's 15 sub-regions and between urban and rural areas? Third, when comparing Sen's Entitlement Approach (income and assets) with Becker's Household Production Theory (education), which set of variables shows a stronger association with dietary diversity? By providing empirical evidence on these questions, the study contributes to the evidence base that policy makers can draw upon when designing and refining household-level interventions. The findings are intended to complement, not critique, existing policy frameworks.

### 1.9 Theoretical Framework

Two theories guide this study.

Sen's Entitlement Approach (1981). Sen argued that people do not go hungry because there is too little food in the country. They go hungry because they cannot command enough food through the economic and social channels available to them. These channels include what they can buy with their income, what they can grow themselves, and what they can receive from others. In this study, Sen's theory justifies including household income and asset ownership as

key determinants of food security. Households with higher incomes and more assets have stronger exchange entitlements and should therefore be more food secure.

Becker's Household Production Theory (1965). Becker viewed the household as a kind of small factory. It takes in raw materials such as time, money, skills and goods, and turns them into useful things like health and good nutrition. The efficiency of this process depends on the skills of the people in the household, especially the household head. Education improves those skills. It helps the head make better decisions about what food to buy, how to prepare it, and how to budget limited resources. In this study, Becker's theory justifies including education of the household head as a determinant of food security. More educated heads should be able to achieve better nutrition even with the same income.

The study does not assume that one theory is better than the other. Instead, it includes the variables suggested by both theories in the same statistical model and compares their effects.

### 1.10 Conceptual Framework

The conceptual framework summarizes the relationships that the study will test. It shows the four independent variables and the dependent variable, with the hypothesized direction of each effect. Region and urban/rural residence are added as control variables and will also be used to test for differences in effects. The framework below shows the hypothesized relationships.

| Independent Variables | | Dependent Variable |
|---|---|---|
| Total Household income<br>HH head education level<br>Household size<br>Asset ownership |  | Food Consumption Score<br>(Poor, Borderline, Acceptable) |

The Control variables are included in the regression model but not in the diagram for simplicity. The framework posits that each independent variable directly affects the Food Consumption Score. The study aims to estimate direct effects.

### 1.11 Conclusion

This chapter has introduced the study and identified three specific gaps in the existing literature on household food security in Uganda. First, previous studies have measured food quantity or hunger, not dietary diversity and nutrient quality. Second, they have assumed that the effects of determinants are the same for all households, without testing for differences across regions or between urban and rural areas. Third, they have not directly compared the two main theories that explain food security, Sen's Entitlement Approach and Becker's Household Production Theory. The study will use the Food Consumption Score, an ordered logit model with marginal effects, and explicit tests for heterogeneity to fill these gaps. Chapter Two reviews the empirical literature in detail, and Chapter Three describes the methodology.

# CHAPTER TWO: LITERATURE REVIEW

## 2.1 Introduction

This chapter provides a systematic and critical review of the scholarly literature on the socio-economic determinants of household food security in Uganda. The review is organized in three main parts. First, the theoretical foundations are presented, drawing on Amartya Sen's Entitlement Approach and Gary Becker's Household Production Theory. Second, the empirical literature is examined thematically, following the four specific objectives of the study: the effect of household income, education of the household head, household size, and asset ownership on food security outcomes. Third, the chapter synthesizes the identified gaps in the existing body of knowledge, concluding with a conceptual framework that guides the econometric analysis in Chapter Three.

## 2.2 Theoretical review

### 2.2.1 Sen's Entitlement Approach

The first theoretical pillar of this study is Amartya Sen's Entitlement Approach. Sen (1981) argued that hunger and food insecurity are rarely caused by an absolute shortage of food at the national level. Instead, they arise when specific households or individuals are unable to command an adequate basket of food through the legal, economic and social channels available to them. Sen distinguished four types of entitlements: trade-based entitlements (what can be bought in markets), production-based entitlements (what can be grown or produced), own-labour entitlements (wages earned from employment), and inheritance or transfer entitlements.

In the context of Uganda, Sen's framework explains what has been called the "breadbasket paradox": some of the country's most productive agricultural regions continue to register high rates of food insecurity. Applying Sen's lens, such regions may have strong production entitlements (the ability to grow staple crops) but weak exchange entitlements (the ability to convert agricultural output into a diverse diet). This study therefore uses Sen's framework to justify the inclusion of total household income and asset ownership as primary exchange entitlements that determine a household's access to a nutritionally adequate diet.

### 2.2.2 Becker's Household Production Theory

While Sen focuses on the external command over resources, Becker's Household Production Theory (1965) explains what happens inside the household. Becker conceptualized the household not simply as a consuming unit but as a "mini-firm" that combines market-purchased goods, time and human capital to produce basic commodities, notably health and nutrition. In this framework, the efficiency with which a household converts resources into nutritional outcomes depends on the managerial skills of its members, particularly the household head.

Following Becker's logic, education of the household head is a crucial "technological input" because it raises allocative efficiency: a more educated head is expected to be better informed about dietary needs, more skilled at budgeting and more capable of making trade-offs that sustain dietary diversity even when incomes are modest. Thus, Becker's theory provides the rationale for examining education as an independent determinant of food security, alongside income and assets.

The study does not assume that one theory is superior. Instead, it includes variables from both frameworks in a single econometric model and compares their marginal effects, providing an empirical test of which framework has greater explanatory power in the Ugandan context.

## 2.3 Empirical Literature Review

The empirical literature is reviewed in four thematic sections, each corresponding to one of the study's specific objectives. Within each section, the review identifies what previous studies have accomplished and what remains unanswered, leading to the three overarching gaps.

### 2.3.1 The Effect of Household Income on Food Security

A substantial body of cross-sectional and panel evidence from Uganda confirms that higher household income is consistently associated with better food security outcomes. Using the 2005/06 Uganda National Household Survey, Ssewanyana and Kasirye (2010) documented that average caloric intake stood at only 1,970 calories per adult equivalent per day, well below the recommended minimum of 2,200 calories, and identified income as one of the strongest predictors of caloric adequacy. More recent work has refined this conclusion by showing that income composition matters as much as its total level. Applying a quantile regression approach to later UNHS waves, Watema (2023) found that non-farm income and remittance income have significantly larger marginal effects on household welfare than farm income alone, implying that income diversification is a key pathway to food security.

However, the effect of income is not always linear or unconditional. Research from Eastern Uganda found that households which rely predominantly on market purchases, a consumption pattern that requires cash income, are paradoxically more vulnerable to food insecurity because they are fully exposed to price volatility and have no subsistence buffer when incomes fall (Kalinaki et al., 2025). Furthermore, a study in the semi-arid Nakasongola district demonstrated that the adoption of climate-smart agriculture practices, which is often facilitated by higher income, can raise the expected Food Consumption Score (FCS) of adopter households by a considerable margin compared with a counterfactual scenario of non-adoption (Egeru et al., 2022). This underscores that income alone does not guarantee food security unless it is translated into productive investments.

What remains unanswered on income. While these studies establish income as a positive determinant, they measure food security using caloric intake (Ssewanyana & Kasirye, 2010) or the Household Food Insecurity Access Scale (Kalinaki et al., 2025). None have estimated the marginal effect of income on the Food Consumption Score, a measure of dietary diversity and micronutrient adequacy at the national level. This study fills that measurement gap.

### 2.3.2 The Effect of Education of the Household Head on Food Security

The empirical literature consistently supports the hypothesis that more educated household heads achieve better food security outcomes, in line with Becker's household production model. Using data from three agro-ecological zones in Uganda, Turyahabwe et al. (2013) reported that food insecurity prevalence was significantly lower among households headed by better-educated individuals, even after controlling for income. The effect persisted across different measures of food security, including the Household Food Insecurity Access Scale (HFIAS) and self-reported food adequacy.

More recent comparative evidence from rural Uganda reinforces this conclusion. A study that surveyed 454 households in 2023 found that participation in livelihood education programmes raised the probability of being food secure from 35.5 percent among non-participants to 51.0 percent among participants, and the education of the household head was independently significant in a multinomial logistic regression that also controlled for livestock ownership, land size and access to clean water (Ikendi et al., 2023). Similarly, in the Mbale district of Eastern Uganda, research on household dietary diversity found that the education levels of both the household head and the spouse were significant predictors of dietary diversity in rural households (Oyet et al., 2025).

The mechanism appears to operate through both knowledge and resource allocation. More educated heads are more likely to adopt improved post-harvest handling techniques, diversify food groups in household meals, and seek out climate information that protects against production shocks (Egeru et al., 2022).

What remains unanswered on education. Existing studies measure food security using binary indicators or HFIAS. They do not test whether the effect of education varies across regions or between urban and rural areas. Moreover, no study has compared the marginal effect of education directly against that of income and assets within a single model to assess which theoretical framework (Becker vs. Sen) has stronger empirical support. This study addresses both the measurement gap (by using FCS) and the heterogeneity gap (by testing for regional and residence differences).

### 2.3.3 The Effect of Household Size on Food Security

Across a wide range of studies from Uganda, larger household size is negatively associated with per capita food security. The standard explanation is a "caloric dilution" or resource-dilution effect: when a given amount of income, food stocks or productive assets must be shared among more members, average consumption per person declines unless total household resources increase proportionately, which rarely occurs in poor rural settings.

Using the 2016/17 UNHS, Nkonge (2018) applied a multilevel logistic regression model and found that the majority of households (89.6 percent) were facing caloric insufficiency, with household size emerging as one of the most consistently significant predictors of food insecurity. Similarly, analysis of food expenditure patterns in Central Uganda (2016 UNHS) showed that households comprising more than five members allocated a substantially larger proportion of their monthly income to food compared with smaller households, leaving less margin for non-food essentials or asset accumulation (Nakitende, 2023). In Buwenge, Eastern Uganda, Kalinaki et al. (2025) reported that larger family size was one of the principal risk factors for severe food insecurity, together with limited land access and youth of the household head.

However, the effect of household size should be interpreted with care. Some studies suggest that economies of scale in food preparation and sharing can partly offset the dilution effect, which is why standard welfare measurement often adjusts household size using adult-equivalent scales. Nonetheless, in the context of Uganda's widespread poverty and limited social safety nets, the negative association between household size and food security is a robust empirical regularity.

What remains unanswered on household size. Existing studies measure food security using caloric intake or HFIAS. They report average effects, assuming the negative impact of an additional household member is the same across all regions and residence types. None have tested whether the marginal effect of household size differs between urban and rural areas or across Uganda's 15 sub-regions. This study will test for such heterogeneity, using the FCS as the outcome measure.

### 2.3.4 The Effect of Asset Ownership on Food Security

Asset ownership especially land, livestock and durable goods, represents a stock of wealth that can be drawn upon during lean periods and can serve as productive capital for food production. The empirical literature shows that asset ownership is positively associated with food security, but the strength of the association varies by asset type and context.

In pastoral and agro-pastoral communities, a study in the central cattle corridor of Uganda identified three distinct livelihood profiles based on asset endowments: "Large-herd Landlords" (rich in physical and financial capital), "Land-rich" (endowed with natural capital but few other assets), and "Minimally-endowed" households. These profiles had markedly different capacities

to buffer food insecurity, implying that asset portfolios matter more than the simple presence of any single asset (Egeru & Bbosa, 2022). Conversely, an analysis of wealth dynamics in the Karamoja sub-region found that over the period 2018–2022, animal and asset wealth decreased across most sampled districts, and livestock wealth, the main store of value in the region was not statistically associated with any measure of food insecurity after controlling for other factors (Marshak et al., 2022). This counter-intuitive finding suggests that in highly shock-prone environments, asset wealth may be too volatile or too illiquid to provide immediate food security.

Nevertheless, most micro-econometric studies using national survey data find a net positive effect of asset ownership on food security. Using the 2019/20 UNHS, Mwambi and Ngesa (2024) reported that livestock ownership and savings account ownership were significant negative predictors of poverty (and implicitly of food insecurity) in agricultural households, even after controlling for household size, region and employment status. Moreover, participation in livelihood education programmes that specifically build asset-related skills such as agronomy, post-harvest technologies and livestock integration significantly increased the probability of achieving food security (Ikendi et al., 2023).

What remains unanswered on asset ownership. Existing studies use binary or locally specific asset measures. No national-level study has constructed a composite asset index (combining land, livestock and durables) and tested its marginal effect on the Food Consumption Score while controlling for income and education. Furthermore, none have tested whether the effect of asset ownership varies across regions or between urban and rural areas. This study fills that gap by constructing an asset index via principal component analysis and testing for heterogeneity.

### 2.3.5 Methodological Approaches in the Literature

The literature on food security determinants in Uganda has employed a range of econometric methods. Ssewanyana and Kasirye (2010) used ordinary least squares and probit models on caloric intake. Turyahabwe et al. (2013) used binary logistic regression with HFIAS. Kalinaki et al. (2025) used binary logistic regression. Egeru et al. (2022) used an ordered logit model but with a small, localised sample. Semakula et al. (2024) employed Bayesian belief networks. Perelli and Branca (2023) applied a generalised ordered logit model to examine climate variability impacts on food consumption groups.

What is missing methodologically. No study has combined (a) a nationally representative sample, (b) the Food Consumption Score as the dependent variable, (c) an ordered logit model with marginal effects, and (d) explicit tests for heterogeneity across 15 sub-regions and between urban and rural areas. This study adopts exactly that integrated approach.

## 2.4 Synthesis and Identification of Gaps

Having reviewed the theoretical arguments and empirical evidence, it is now possible to state clearly what is already known and what remains unanswered.

What the literature establishes with reasonable certainty:

Household income is a positive, statistically significant determinant of food security in Uganda, although the magnitude depends on income source and composition.

Education of the household head is consistently associated with better food security outcomes, operating partly through adoption of better farming and dietary practices.

Larger household size tends to reduce per capita food security, a resource-dilution effect documented across multiple survey rounds and regions.

Asset ownership, particularly land and livestock, improves food security in most settings, although the relationship is more complex in chronically shock-prone areas.

What remains unanswered, the three gaps this study addresses:

1. Measurement gap. Most national-level studies (Ssewanyana & Kasirye, 2010; Turyahabwe et al., 2013; Kalinaki et al., 2025; Semakula et al., 2024) use caloric intake, HFIAS, or meal frequency. These capture food quantity or hunger experience, not dietary diversity or micronutrient adequacy. Only one study (Egeru et al., 2022) used the Food Consumption Score (FCS), but it was limited to one semi-arid district (Nakasongola, n=165). No national-level econometric study has used the FCS as the dependent variable to examine socio-economic determinants of dietary diversity in Uganda.

2. Heterogeneity gap. Existing studies (Ssewanyana & Kasirye, 2010; Turyahabwe et al., 2013; Kalinaki et al., 2025) report average effects, assuming the influence of each determinant is constant across all households. None have systematically tested whether the effect of income, education, household size or assets varies across Uganda's 15 sub-regions or between urban and rural areas. This is a critical omission because Uganda's regions differ markedly in agro-ecology, market access and livelihood systems.

3. Theoretical gap. While several studies cite Sen's Entitlement Approach (e.g., Turyahabwe et al., 2013) or Becker's Household Production Theory (e.g., Ikendi et al., 2023), no study has included income, assets and education in a single model and directly compared their marginal effects. It is therefore unknown whether exchange entitlements or human capital efficiency is the stronger predictor of food security in Uganda. This distinction has real policy implications for prioritizing income support versus education investment.

## 2.5 Conceptual Framework

Based on the theoretical foundations and the empirical literature reviewed above, the conceptual framework for this study postulates that:

Household income (the primary exchange entitlement, following Sen) is hypothesised to have a positive effect on the Food Consumption Score.

Education of the household head (the primary human-capital input, following Becker) is hypothesised to have a positive effect on the FCS, operating through improved allocative efficiency.

Household size is hypothesised to have a negative effect on the FCS, consistent with the standard resource-dilution argument.

Asset ownership (land, livestock and durable goods) is hypothesised to have a positive effect on the FCS, serving as both a productive input and a buffer against shocks.

Region (15 sub-regions) and urban/rural residence are included as control variables in the empirical specifications and will be used to test for heterogeneity. The dependent variable, the Food Consumption Score, is modelled as an ordered categorical outcome (poor, borderline, acceptable), which will be estimated using an ordered logit regression with marginal effects, as detailed in Chapter Three.

## 2.6 Conclusion

This chapter has provided a systematic review of the theoretical and empirical literature on household food security in Uganda. It has shown that while household income, education, household size and asset ownership are consistently identified as important determinants, the current body of knowledge suffers from three specific gaps: a measurement gap (most studies use caloric intake or HFIAS, not the Food Consumption Score), a heterogeneity gap (most studies report average effects without testing for regional or urban-rural differences), and a theoretical gap (no study has directly compared Sen's Entitlement Approach with Becker's Household Production Theory within a single model). By using the Food Consumption Score as the dependent variable, an ordered logit model with marginal effects, and explicit tests for heterogeneity across 15 sub-regions and between urban and rural areas, and by including income, assets and education in the same model, the present study is positioned to fill precisely these gaps. The conceptual framework derived from this review guides the econometric specification detailed in the next chapter.

# CHAPTER THREE: RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter describes the research methodology used to examine the socio-economic determinants of household food security in Uganda. The study focuses on four main independent variables namely total household income, education of the household head, adult-equivalent household size, and a composite asset index, and their effect on the Food Consumption Score (FCS). The chapter outlines the research design, data source and sampling procedure, the construction of all variables, data processing steps, the econometric model specification, estimation strategy (including handling of the complex survey design and the potential violation of the proportional odds assumption), diagnostic tests, ethical considerations, and methodological limitations. The approach is designed to be replicable, transparent, and appropriate for addressing the measurement, heterogeneity, and theoretical gaps identified in the literature.

## 3.2 Research Design

The study adopts a cross-sectional, quantitative research design. A cross-sectional design is appropriate because the analysis relies on data collected at a single point in time (the UNHS 2023/24 survey period) to examine relationships between socio-economic characteristics and household food security outcomes. The quantitative nature of the study is driven by the research objectives, which require estimation of the magnitude and statistical significance of the effects of the independent variables on the dependent variable. The analysis is conducted using an econometric approach, specifically a generalised ordered logit (partial proportional odds) model. This model relaxes the parallel-lines assumption for variables that violate it while imposing it for those that do not, making it suitable when the proportional odds assumption of the standard ordered logit is not met. The model allows for simultaneous examination of the effect of each determinant while controlling for other covariates and for geographic heterogeneity.

## 3.3 Source and Nature of the Data

### 3.3.1 Source of the Data

The primary data source is the Uganda National Household Survey (UNHS) 2023/24, a nationally representative survey conducted by the Uganda Bureau of Statistics (UBOS). This is the eighth round in the UNHS series, which began in 1999/2000. The survey was conducted from March 2023 to February 2024, covering a full 12-month period to account for seasonal variations in household income, consumption, and food security.

The UNHS 2023/24 provides high-quality data on a wide range of indicators, including education, health, food security, non-crop farming enterprises, access to financial services, household expenditure, and poverty status. The data are disaggregated at national, rural-urban, and sub-regional levels and also cover refugee and host community strata, strengthening national representativeness. The anonymised dataset was obtained through a formal request to UBOS for academic purposes.

### 3.3.2 Data Collection Procedures

Data were collected using a Computer Assisted Personal Interviewing (CAPI) system. Enumerators conducted face-to-face interviews, entering responses directly into pre-programmed digital questionnaires on handheld tablets. The CAPI approach was supported by comprehensive field-worker training and provided real-time data uploads, automated validation checks, reduced data entry errors, and offline data-saving capability. Field teams were equipped with power banks to overcome electricity shortages, and a rigorous geo-targeting system ensured correct enumeration areas were visited.

### 3.3.3 Survey Response Rate and Final Analytical Sample

The full UNHS 2023/24 achieved a 92 percent response rate, with a total sample of 17,350 households. However, the detailed 7-day food consumption module required to calculate the Food Consumption Score (FCS) was administered only to a random sub-sample of approximately 1,735 enumeration areas (about 10 percent of the full sample), consistent with UBOS survey design. After merging the food module with the household roster, demographics, education, assets, income, and geographic control modules, and after list-wise deletion of cases with missing values on key variables, the final analytical sample comprises 1,527 households. When weighted using the survey weights provided by UBOS, this sample represents a weighted population of 926,574 households. The sample size is sufficient for the planned econometric analysis, and the use of sampling weights ensures national representativeness.

## 3.4 Study Area and Sampling Design

### 3.4.1 Study Area

The study covers the entire territory of the Republic of Uganda. The UNHS 2023/24 sampling frame includes all 15 statistical sub-regions defined by UBOS: Kampala, Buganda South, Buganda North, Busoga, Bukedi, Elgon, Teso, Karamoja, Lango, Acholi, West Nile, Bunyoro, Tooro, Ankole, and Kigezi. This national coverage allows the analysis to account for Uganda's considerable agro-ecological and socio-economic diversity.

### 3.4.2 Sampling Design

The UNHS 2023/24 adopted a two-stage stratified cluster sampling design. In the first stage, Enumeration Areas (EAs) were selected from the master sampling frame constructed from the 2014 National Population and Housing Census. Selection of EAs used probability proportional to size (PPS), meaning EAs with larger populations had a higher chance of being chosen. In the second stage, a systematic random sample of households was drawn from each selected EA. Stratification was implemented at sub-regional level (15 sub-regions) and by residence type (urban vs. rural) to ensure adequate representation. Special strata for refugee settlements and host communities were also included. The final analytical sample of 1,527 households is drawn from 51 EAs after cleaning.

### 3.4.3 Sample Size

The final analytical sample size is 1,527 households (weighted population 926,574). The analysis incorporates the sampling weights provided by UBOS, the primary sampling unit (enumeration area), and the strata to correct for the complex sampling design. The number of PSUs and strata are sufficient for reliable inference with cluster-robust standard errors.

## 3.5 Variable Definitions and Measurements

### 3.5.1 Dependent Variable

The dependent variable is household food security, measured by the Food Consumption Score (FCS). The FCS is a composite indicator that captures three dimensions of a household's food consumption: dietary diversity (the variety of food groups consumed), food frequency (how often those food groups are consumed), and the relative nutritional importance of different food groups over a seven-day reference period.

The calculation follows the standard World Food Programme (WFP) methodology. For each of eight standard food groups (staples, pulses, vegetables, fruit, meat/fish/eggs, dairy, sugar, oil), the number of days in the past week that the household consumed any food from that group is recorded. Each frequency value is then capped at 7 days. Each capped frequency is multiplied by a standard nutritional weight assigned to that food group (staples = 2, pulses = 3, vegetables = 1, fruit = 1, meat/fish/eggs = 4, dairy = 4, sugar = 0.5, oil = 0.5). Zero-weight items (spices, tea, alcohol) are dropped. The weighted scores for all eight food groups are summed to produce the FCS.

Based on the final score, each household is classified into one of three food security categories:

Poor food consumption (severely food insecure): FCS between 0 and 21.

Borderline food consumption (moderately food insecure): FCS between 21 and 35.

Acceptable food consumption (food secure): FCS greater than 35.

This three-category ordinal variable (with values 1 = Poor, 2 = Borderline, 3 = Acceptable) is the dependent variable in the analysis.

### 3.5.2 Independent Variables

The four independent variables correspond to the four specific objectives of the study.

a) Total Household Income ($H_{01}$)

Total household income is measured as the aggregate gross income received by the household from all sources namely crop and livestock production, non-farm business activities, wage employment, and transfers (including remittances), over the 30 days preceding the survey interview. The sum of all income sources is calculated per household. Extreme outliers are managed by winsorizing at the 99th percentile, and the natural logarithm of the resulting value is taken. A constant of 1 is added before log transformation to accommodate zero values. The resulting variable is labelled ln_income.

**b) Education of the Household Head ($H_{02}$)**

Education of the household head is measured as the highest level of formal education completed by the person identified as the household head. The variable is treated as an ordinal categorical variable with four categories: 0 = no formal education (reference category), 1 = primary education (complete or incomplete), 2 = secondary education (complete or incomplete), and 3 = tertiary education (including post-secondary certificates, diplomas, and university degrees).

**c) Household Size ($H_{03}$)**

Household size is measured using an adult-equivalent scale to better capture the economic pressure placed on food resources. Using the household roster, each member is assigned a weight based on age: children under 15 years receive a weight of 0.5, adults aged 15–64 years receive a weight of 1.0, and adults aged 65 years and older receive a weight of 0.7. These weights are summed per household to produce the continuous variable hh_size_ae.

**d) Asset Ownership ($H_{04}$)**

Asset ownership is measured using a composite asset index constructed from four components:

Land ownership (binary): coded 1 if the household owns the dwelling or the land on which it sits, 0 otherwise.

Livestock value (continuous): total value of livestock (cattle, goats, sheep, pigs, poultry), winsorized at the 99th percentile and natural-log transformed.

Durable goods count (count): number of durable assets owned by the household from a list of common items (bicycle, motorcycle, car, television, radio, mobile phone, refrigerator, sofa, bed, cupboard).

Number of sleeping rooms (count): number of rooms used for sleeping.

These four components are standardised and entered into a principal component analysis (PCA). The first principal component is retained as the continuous asset_index score for each household. Land area in acres was not available in the merged sub-sample; therefore, binary land ownership is used as a proxy, a limitation acknowledged in the final chapter.

### 3.5.3 Control Variables

To isolate the independent effects of the four main explanatory variables, additional household demographic controls and geographic variables are included.

**Demographic controls (added to improve model specification):**

Age of the household head (in years), treated as a continuous variable.

Squared age of the household head to capture potential non-linear effects.

Gender of the household head (binary: 1 if female, 0 if male).

Marital status of the household head (binary: 1 if married or cohabiting, 0 otherwise).

**Geographic controls:**

Sub-region: the 15 UBOS sub-regions entered as a set of categorical (dummy) variables, with Kampala as the reference category.

Residence: a binary variable indicating whether the household is located in an urban area (1) or a rural area (0).

These control variables also enable heterogeneity tests – examining whether the effects of income, education, household size, and assets differ across sub-regions and between urban and rural households.

### 3.6 Data Processing and Quality Control

Before econometric analysis, the raw UNHS 2023/24 data undergo systematic cleaning, following the steps below.

1. Merging modules: Relevant modules (food consumption, household roster, education, income, assets, geographic controls) are merged using the unique household identifier, ensuring all variables are linked correctly to the same household.

2. Missing data handling: Cases with missing values for any key variable (FCS components, income, education, household size, asset components) are excluded listwise. The final analytical sample size is reported.

3. Outlier management: Total household income and livestock value are winsorized at the 1st and 99th percentiles, values below the 1st percentile are set to the 1st-percentile value, and values above the 99th percentile are set to the 99th-percentile value. This reduces the influence of extreme outliers without discarding data.

4. Adult-equivalent adjustment: Raw household size is converted to adult-equivalent units as described in section 3.5.2(c).

5. FCS calculation: The FCS is calculated following the WFP methodology described in section 3.5.1, and each household's food security status (poor, borderline, acceptable) is assigned.

6. Asset index construction: Principal component analysis (PCA) is performed on the four standardised asset components (binary land ownership, log livestock value, durable goods count, number of sleeping rooms) to produce a single continuous asset index. Cronbach's alpha is calculated for the four components to assess internal consistency; a value of 0.70 or higher is considered acceptable.

All data cleaning and analysis are performed using Stata/MP, version 17 or higher.

### 3.7 Econometric Model Specification

#### 3.7.1 Model Choice

The dependent variable (fcs_status) is measured on an ordinal scale with three categories namely poor, borderline, acceptable. The standard choice for such data is an ordered logit (proportional odds) model. This model assumes that the relationship between each independent variable and the log-odds of being in a higher food security category is the same across all categories – the parallel regressions assumption or proportional odds assumption.

Because this assumption may not hold for some variables, the study will first test the proportional odds assumption using the Brant test (described in section 3.8.2). If the test does not reject the null hypothesis of proportionality, a standard ordered logit model will be estimated. If

the assumption is violated ($p < 0.05$), a generalised ordered logit (partial proportional odds) model will be estimated instead, using the gologit2 procedure (Williams, 2006). This model relaxes the proportional odds constraint for variables that violate the assumption while imposing the constraint for variables that do not. An automated step-down procedure (autofit) will be used to identify which variables require relaxation, based on a significance level of 0.05.

### 3.7.2 Handling the Complex Survey Design

Because the UNHS 2023/24 employs a stratified cluster sample, the analysis must account for sampling weights, clustering, and stratification. The gologit2 command does not support the svy prefix directly. Therefore, the following approach is used:

Sampling weights are incorporated using the pweight option.

Cluster-robust standard errors are estimated by specifying the enumeration area as the cluster variable. This accounts for correlation of observations within the same EA.

Strata are not specified in gologit2, but the combination of weighting and clustering yields consistent standard errors under the complex design.

### 3.7.3 Estimation Strategy: Marginal Effects

Raw coefficients from the generalised ordered logit model represent changes in log-odds and are not directly interpretable. Therefore, the study reports average marginal effects (AMEs) for each outcome category (poor, borderline, acceptable). AMEs answer the research-relevant question: for a unit change in a given independent variable (or a discrete change from one category to another for categorical variables), what is the associated change in the probability of the household being in each food security category, holding all other variables constant at their observed values?

For continuous variables (log income, adult-equivalent household size, asset index, age), the AME is the average change in probability for a one-unit increase. For discrete variables (education categories, gender, marital status, urban/rural, sub-regions), the AME is the average discrete change in predicted probability when moving from the reference category to the specified category. AMEs are computed using Stata's margins command after estimating the model, separately for each outcome.

### 3.7.4 Heterogeneity Testing

To address the heterogeneity gap identified in Chapters One and Two, the study explicitly tests whether marginal effects differ across sub-regions and between urban and rural households. This is achieved by:

Including sub-region dummy variables in the model and examining their marginal effects.

Computing predicted probabilities of food security (acceptable outcome) for each of the 15 sub-regions and comparing them.

Including the urban/rural dummy variable; its marginal effect directly shows the difference in food security probability between urban and rural households, holding other factors constant.

### 3.7.5 Hypothesis Testing

The null hypotheses stated in Chapter One are tested using the marginal effects from the final model, focusing on the Acceptable food security outcome (the most policy-relevant category). The decision rules are:

$H_{01}$ (income): If the marginal effect of log income is positive and statistically significant at $p < 0.05$, reject the null.

$H_{02}$ (education): If the marginal effect of secondary education or tertiary education (relative to no education) is positive and statistically significant at $p < 0.05$, reject the null.

$H_{03}$ (household size): If the marginal effect of adult-equivalent household size is negative and statistically significant at $p < 0.05$, reject the null.

$H_{04}$ (asset ownership): If the marginal effect of the asset index is positive and statistically significant at $p < 0.05$, reject the null.

All hypothesis tests are two-tailed with a significance level ($\alpha$) of 0.05. Results with p-values between 0.05 and 0.10 are reported as marginally significant.

### 3.8 Diagnostic Tests

Several diagnostic tests will be performed to ensure the model is correctly specified and inferences are reliable.

#### 3.8.1 Multicollinearity

To ensure independent variables are not highly correlated, a condition that inflates standard errors, the Variance Inflation Factor (VIF) will be calculated for all independent variables in an auxiliary linear (OLS) version of the model. A VIF greater than 10 (or in conservative settings, greater than 5) indicates problematic multicollinearity. If detected, affected variables will be reviewed and appropriate corrective steps (e.g., combining or dropping redundant variables) will be considered.

#### 3.8.2 Proportional Odds (Parallel Regressions) Assumption

The proportional odds assumption of the standard ordered logit model will be tested using the Brant test as implemented in the gologit2 command with the autofit option. If the test rejects the null hypothesis of proportionality ($p < 0.05$), the standard ordered logit will be considered inappropriate, and the generalised ordered logit model will be used instead. The autofit procedure automatically identifies which variables violate the assumption and relaxes the constraint only for those variables.

#### 3.8.3 Model Fit and Specification

Overall model fit will be assessed using:

Wald chi-square test for the joint significance of all independent variables. A statistically significant Wald $\chi^2$ indicates that the model as a whole is better than a null model.

Pseudo $R^2$ (McFadden's) will be reported as a descriptive measure of explanatory power, though it is not interpreted as a proportion of variance explained.

Link test: Because a formal link test is not available for the generalised ordered logit model, a binary logistic regression will be run on a binary transformation of the dependent variable (e.g., acceptable vs. not acceptable) using the same independent variables. The test examines whether the squared predicted value (_hatsq) is statistically significant; if it is not, there is no evidence of omitted variable bias or incorrect functional form.

The actual results of these diagnostic tests will be presented in Chapter Four.

### 3.9 Ethical Considerations

Because this study involves analysis of secondary data (the UNHS 2023/24 dataset), no direct contact with human subjects is required.

Data privacy: Only anonymised data, from which participant identifiers have been permanently removed, are accessed. Analysis is conducted using anonymised household identification codes. UBOS provided the cleaned, de-identified dataset under a formal data-user agreement for academic purposes, prohibiting any attempt to re-identify households or respondents.

Institutional approval: The terms of approval include adherence to UCU's research ethics guidelines namely informed consent, confidentiality, and minimisation of harm.

Data user agreement: The study complies fully with the UBOS data user agreement, which mandates that UNHS 2023/24 data be used solely for statistical and analytical purposes, that no individual-level data be published or shared with unauthorised parties, and that any reports generated properly source UBOS.

### 3.10 Methodological Limitations

The study is subject to several methodological limitations.

Sub-sample restriction. The Food Consumption Score could only be calculated for a random sub-sample of households (1,527 out of 17,350). While the sub-sample is nationally representative, the reduced sample size may affect the precision of estimates for rare outcomes or small sub-groups.

Asset index limitations. Land area in acres was not available in the merged sub-sample; therefore, binary land ownership is used as a proxy. This may understate variation in land wealth. Additionally, the asset index is constructed from only four components, which may not capture the full complexity of household wealth.

Potential violation of proportional odds. If the proportional odds assumption is violated, the generalised ordered logit model will be used. While this model is more flexible, it is also more complex to interpret and may be less familiar to some readers.

Recall bias. The Food Consumption Score relies on a seven-day recall of food consumption. Respondents may inaccurately remember what they ate or systematically over-report desirable foods and under-report less desirable foods. The relatively short recall period helps mitigate this problem but does not eliminate it.

Seasonal variation. Food consumption, dietary diversity, and food availability vary significantly across seasons in Uganda. Although the UNHS 2023/24 was conducted over a full 12-month period, the timing of interviews was not randomised with respect to the agricultural calendar. Findings are interpreted as reflecting average patterns over the survey period.

Endogeneity. There is potential for reverse causality between income and food security. Because the study is cross-sectional, it cannot definitively establish causal direction. This potential endogeneity is mitigated to some extent by measuring food security using the FCS (a consumption-based measure) and measuring income separately using detailed income modules. However, unobserved heterogeneity remains, and results should be interpreted as associations rather than pure causal effects.

Small number of clusters. The analytical sample is drawn from 51 enumeration areas. While cluster-robust standard errors are used, the number of clusters is relatively small, which may affect the asymptotic properties of the standard errors. Results are interpreted with this in mind.

Cross-sectional structure. The cross-sectional nature means the study can identfy associations between independent variables and food security status at a single point in time, but it cannot track changes within the same households over time or definitively establish direction of causality. Panel data would be required to address these questions more fully.

### 3.11 Conclusion

This chapter has provided a comprehensive and transparent description of the research methodology used to examine the socio-economic determinants of household food security in Uganda using the UNHS 2023/24 dataset. The study employs a cross-sectional, quantitative design and a nationally representative sub-sample of 1,527 households (weighted population 926,574). The dependent variable, the Food Consumption Score, is a well-validated, multidimensional measure of food security that captures dietary diversity, food frequency, and nutritional weight. The key independent variables namely log income, education of the head, adult-equivalent household size, and a composite asset index, are clearly defined and measured. Because the proportional odds assumption may be violated, the study will first test this assumption; if violated, a generalised ordered logit (partial proportional odds) model will be estimated, with cluster-robust standard errors and sampling weights to account for the complex survey design. Marginal effects will be reported for interpretability. Diagnostic tests for multicollinearity, proportional odds, and specification are described. Ethical issues and methodological limitations have been addressed. The next chapter presents the empirical findings based on the methodology described here.

# CHAPTER FOUR: RESULTS

## 4.1 Introduction

This chapter presents the empirical findings of the study on the socio-economic determinants of household food security in Uganda, based on the analysis of the Uganda National Household Survey (UNHS) 2023/24 sub-sample of 1,527 households (weighted population 926,574). The chapter focuses on the four main independent variables: total household income, education of the household head, adult-equivalent household size, and asset ownership. Additional control variables; age of the head (linear and quadratic), gender, marital status, urban/rural residence, and sub-region dummies, are included to reduce omitted variable bias and provide a complete picture. These controls are not part of the hypothesis tests but are reported for transparency.

Section 4.2 provides descriptive statistics. Section 4.3 presents bivariate associations. Section 4.4 reports the results of diagnostic tests (multicollinearity, proportional odds assumption, model fit). Section 4.5 presents the average marginal effects from the generalised ordered logit model on the probability of Acceptable food security, with detailed econometric and economic interpretation for each main independent variable. Section 4.6 examines regional heterogeneity. Section 4.7 summarises the hypothesis tests for the four main independent variables. Section 4.8 concludes with a summary.

All estimates incorporate sampling weights (Finalwgt) and cluster-robust standard errors at the enumeration area level. Statistical significance is assessed at $p < 0.05$; p-values between 0.05 and 0.10 are reported as marginally significant.

## 4.2 Descriptive Statistics

### 4.2.1 Food Security Status

Table 4.1 presents the weighted distribution of households by food security category. The majority of Ugandan households, 73.6 percent, have acceptable food consumption, meaning they consume a sufficiently diverse and frequent diet above the World Food Programme threshold of 35. However, a substantial minority remain food insecure: 21.4 percent fall into the borderline category (moderately food insecure), and 5.0 percent are classified as poor (severely food insecure). In absolute terms, this corresponds to approximately 46,300 severely food insecure households and 198,300 borderline households in the weighted population.

**Table 4.1: Weighted Distribution of Food Consumption Score (FCS) Categories**

| Food Security Category | Percentage (%) | Weighted Households |
|---|---|---|
| Poor (0–21) | 5.0 | 46,329 |
| Borderline (21–35) | 21.4 | 198,287 |
| Acceptable (>35) | 73.6 | 681,958 |
| Total | 100.0 | 926,574 |

Source: Author's computations from UNHS 2023/24 (N=1,527, weighted)

### 4.2.2 Continuous Variables

Table 4.2 reports survey-weighted means and standard errors for all continuous variables used in the analysis. The average log of total annual household income (ln_income) is 14.56, which corresponds to approximately 2.1 million Ugandan shillings per year (about 570,000 UGX per month). The small standard error (0.083) indicates a precise estimate. The wide range of income (from 0 to about 60 million UGX after winsorization) suggests substantial inequality.

The mean adult-equivalent household size is 3.84, meaning the typical household has about four consumption-equivalent members after adjusting for age composition. This is lower than raw household size (often exceeding five) because children under 15 are weighted 0.5 and elderly 0.7. A household of two adults and three children under 15 has adult-equivalent size $2 + 3 \times 0.5 = 3.5$, close to the mean. This indicates that dependency ratios are moderate on average. The average age of household heads is 43.3 years, placing most heads in their prime working years. The asset index has a mean close to zero by construction (−0.047), with positive values indicating above-average asset wealth.

**Table 4.2: Weighted Means of Continuous Variables**

| Variable | Mean | Std. Error | 95% Confidence Interval |
|---|---|---|---|
| Log total annual income (ln_income) | 14.560 | 0.083 | 14.395 – 14.725 |
| Adult-equivalent household size | 3.836 | 0.079 | 3.678 – 3.994 |
| Age of household head | 43.334 | 0.506 | 42.326 – 44.342 |
| Asset index | -0.047 | 0.054 | -0.155 – 0.061 |

Source: Author's computations from UNHS 2023/24 (N=1,527, weighted)

### 4.2.3 Categorical Variables

Table 4.3 shows weighted proportions of all categorical variables, main independent and controls. Half of household heads have only primary education (51.0%), while 15.8% have no formal education, 23.9% secondary, and 9.4% tertiary. Male-headed households constitute 70.3%, and 69.9% are married or cohabiting. Rural households make up 62.8% of the sample.

**Table 4.3: Weighted Proportions of Categorical Variables**

| Variable | Category | Percentage (%) |
|---|---|---|
| Education of head | No formal education | 15.8 |
| | Primary | 51.0 |
| | Secondary | 23.9 |
| | Tertiary | 9.4 |
| Gender of head | Male | 70.3 |
| | Female | 29.7 |
| Marital status | Not married | 30.1 |
| | Married/cohabiting | 69.9 |
| Residence | Rural | 62.8 |
| | Urban | 37.2 |

Source: Author's computations from UNHS 2023/24 (N=1,527, weighted)

### 4.3 Bivariate Associations

Before multivariate regression, we examine raw associations for the categorical main independent variable, education, using a design-based F-test that accounts for the survey design.

Table 4.4 shows row percentages of food security categories by education level. Households headed by individuals with secondary education have the highest acceptable rate (77.4%) and the lowest poor rate (3.2%). In contrast, households with no formal education have the lowest acceptable rate (67.3%) and the highest poor rate (7.1%). The design-based F-test ($p = 0.043$) indicates that the association between education and food security is statistically significant at the 5% level.

**Table 4.4: Food Security Status by Education Level (Row %)**

| Education Level | Poor (%) | Borderline (%) | Acceptable (%) |
|---|---|---|---|
| No formal | 7.1 | 25.6 | 67.3 |
| Primary | 4.7 | 22.5 | 72.8 |
| Secondary | 3.2 | 19.4 | 77.4 |
| Tertiary | 8.0 | 13.1 | 78.9 |

Source: Author's computations

Table 4.5 presents mean values of continuous main independent variables across FCS categories. As food security improves from Poor to Acceptable, mean income, asset index, and household size all increase. The log income of acceptable households (14.79) is substantially higher than that of poor households (13.69), a difference of 1.1 log points, which translates to a three-fold difference in raw income ($\exp(1.1) \approx 3.0$). Household size also increases from 2.60 adult-equivalents in poor households to 4.02 in acceptable households, which is contrary to the resource dilution hypothesis.

**Table 4.5: Mean Values of Continuous Main Variables by Food Security Status**

| Variable | Poor | Borderline | Acceptable |
|---|---|---|---|
| Log income (ln_income) | 13.69 | 13.97 | 14.79 |
| Asset index (asset_index) | -0.66 | -0.16 | 0.03 |
| Adult-equivalent household size | 2.60 | 3.49 | 4.02 |

Source: Author's computations

## 4.4 Model Diagnostics and Specification

Before presenting the regression results, the following are the diagnostic tests that guided the choice of the final model.

### 4.4.1 Multicollinearity (VIF)

Auxiliary linear regression was used to calculate Variance Inflation Factors (VIF) for all independent variables. The mean VIF is 4.38, well below the common threshold of 10. The highest individual VIFs are for age of head (30.96) and its square (29.58), which is expected for a quadratic term and does not indicate problematic collinearity. All other variables have VIF below 3. No corrective action was required.

### 4.4.2 Proportional Odds (Parallel Regressions) Assumption

The proportional odds assumption of the standard ordered logit model was tested using the Brant test (implemented via gologit2 autofit). The test rejected the null hypothesis of proportionality: Wald $\chi^2(18) = 78.79$, $p < 0.001$. Therefore, a standard ordered logit would be inappropriate. Consequently, a generalised ordered logit (partial proportional odds) model was estimated, which relaxes the proportional odds constraint for variables that violate it (adult-equivalent household size, tertiary education, and several sub-regions) while imposing it for the remaining variables.

### 4.4.3 Overall Model Fit and Specification

The final generalised ordered logit model is statistically significant as a whole: Wald $\chi^2(32) = 18223.86$, $p < 0.001$. The McFadden pseudo $R^2$ is 0.096, indicating modest explanatory power, typical for cross-sectional survey data with a categorical outcome. A link test was conducted on a binary transformation of the outcome (Acceptable vs. not Acceptable) using logistic regression with the same independent variables. The squared predicted value (_hatsq) was not statistically significant ($p = 0.678$), suggesting no evidence of omitted variable bias or incorrect functional form.

### 4.5 Regression Results: Marginal Effects on Acceptable Food Security

Because the proportional odds assumption was violated, the generalised ordered logit (partial proportional odds) model was used (Williams, 2006). This section reports average marginal effects (AMEs) on the probability of being in the Acceptable food security category, the most policy-relevant outcome, as it indicates households that have achieved adequate dietary diversity. The AME answers the question: "If we increase a variable by one unit (or change category), how does the probability of being Acceptable change, on average across the sample, holding all other variables at their observed values?"

Table 4.6 presents the AMEs for all variables (both main independent variables and controls). The four main independent variables are highlighted first; controls are listed separately. The note under the table clarifies that hypothesis testing is conducted only on the four main IVs.

Notes: AME = average marginal effect. For continuous variables, AME is for a one-unit increase. For discrete variables, AME is discrete change from reference category. The four main independent variables are listed first; hypothesis testing is conducted only on these four.

All other variables are controls.

Model includes sub-region dummies (Kampala reference), see Table 4.7 for regional predictions.

**Table 4.6: Average Marginal Effects on Probability of Acceptable Food Security**

| Variable | AME (Δ Prob) | Std. Error | z | p > | 95% Confidence Interval |
|---|---|---|---|---|---|
| Main independent variables | | | | | |
| Log income (ln_income) | +0.0128 | 0.0033 | 3.87 | 0.000 | (0.0063, 0.0193) |
| Secondary education (vs. none) | +0.0743 | 0.0425 | 1.75 | 0.080 | (-0.0090, 0.1575) |
| Tertiary education (vs. none) | +0.0743 | 0.0647 | 1.15 | 0.251 | (-0.0526, 0.2012) |
| Adult-equivalent household size | +0.0212 | 0.0109 | 1.94 | 0.052 | (-0.0002, 0.0425) |
| Asset index | +0.0149 | 0.0142 | 1.05 | 0.293 | (-0.0129, 0.0427) |
| Control variables | | | | | |
| Married (vs. not married) | +0.1133 | 0.0387 | 2.93 | 0.003 | (0.0374, 0.1892) |
| Female head (vs. male) | +0.0593 | 0.0313 | 1.89 | 0.058 | (-0.0020, 0.1207) |
| Urban residence (vs. rural) | +0.0438 | 0.0230 | 1.91 | 0.056 | (-0.0012, 0.0889) |
| Age of head (linear) | +0.0025 | 0.0032 | 0.78 | 0.436 | (-0.0038, 0.0088) |
| Age squared | -0.00002 | 0.00003 | -0.74 | 0.457 | (-0.00008, 0.00003) |

Source: Author's computations from UNHS 2023/24 (N=1,527, weighted, generalised ordered logit with cluster-robust SEs)

### 4.5.1 Independent Variable 1: Household Income ($H_{01}$)

Result: The AME for log income is +0.0128 ($p < 0.001$). This means that a one-unit increase in log income (equivalent to a 100% increase in raw income) is associated with a 1.28 percentage point increase in the probability of acceptable food security.

Interpretation of percentage changes: Because log income is the natural logarithm, a 1% increase in raw income corresponds to a 0.01 increase in log income. Therefore, a 1% increase in household income is associated with a 0.000128 (0.0128 percentage points) increase in the probability of acceptable food security. A 10% increase (0.1 in log) is associated with a 0.00128 (0.128 percentage points) increase, and a 100% increase (doubling of income) is associated with the full AME of 0.0128 (1.28 percentage points).

Economic interpretation: For a typical household with annual income of about 2.1 million UGX, a 10% income increase (210,000 UGX) is associated with a very modest (0.128 percentage point) rise in the probability of acceptable food security. While the association is statistically significant, its magnitude is small in absolute terms. This finding is consistent with Sen's Entitlement Approach: higher income strengthens exchange entitlements, enabling households to purchase a more diverse diet, but the effect is gradual. The result aligns with Ssewanyana and Kasirye (2010) and Kalinaki et al. (2025), who identified reduced income as a major risk factor.

### 4.5.2 Independent Variable 2: Education ($H_{02}$)

Result: Secondary education has an AME of +0.0743 ($p = 0.080$, marginally significant). Tertiary education has the same point estimate but a larger standard error ($p = 0.251$). The 95% confidence intervals for both include zero.

Interpretation: Secondary education is associated with a 7.4 percentage point higher probability of acceptable food security compared to no education, but this association is only marginally significant at the 10% level. In the bivariate analysis, education was significantly associated with food security ($p = 0.043$). However, after controlling for income and other factors, the direct association disappears. This suggests that education's influence on food security operates largely through income, more educated heads earn more, which is then associated with better food security. The finding does not strongly support Becker's Household Production Theory in its strong form (i.e., that education improves allocative efficiency independently of income).

### 4.5.3 Independent Variable 3: Household Size ($H_{03}$)

Result: The AME for adult-equivalent household size is +0.0212 (p = 0.052, marginally significant). The 95% CI (-0.0002, 0.0425) just crosses zero.

Interpretation: An increase of one adult-equivalent member is associated with a 2.1 percentage point higher probability of acceptable food security, a borderline finding. This contradicts the resource dilution hypothesis (which would predict a negative association). A plausible explanation is that larger households (after adjusting for age composition) often have more working-age members who contribute to total income, remittances, or farm labour, leading to income pooling and economies of scale (e.g., bulk cooking, shared housing). This finding differs from studies using raw household size (e.g., Nkonge, 2018; Kalinaki et al., 2025) that did not apply adult-equivalent adjustment.

### 4.5.4 Independent Variable 4: Asset Ownership ($H_{04}$)

Result: The asset index is not statistically significant (p = 0.293).

Interpretation: There is no statistical evidence that asset ownership is associated with dietary diversity after controlling for income. Assets may be illiquid, households are reluctant to sell land or livestock to buy food, especially during non-crisis periods. The asset index may also imperfectly capture wealth (binary land ownership instead of area, omission of financial assets). This finding does not support the expectation that asset-building programmes alone would directly be associated with improved food security.

### 4.5.5 Control Variables (Supplementary Findings)

Control variables are not part of hypothesis tests, but their associations are reported for completeness.

Married vs. not married: AME = +0.1133 (p = 0.003). Married heads have an 11.3 percentage point higher probability of acceptable food security, likely due to resource pooling and shared labour.

Female head vs. male: AME = +0.0593 (p = 0.058, marginally significant). After controlling for income, female-headed households show a higher probability, possibly reflecting more efficient allocation of resources toward nutrition.

Urban residence: AME = +0.0438 (p = 0.056). Urban households have a 4.4 percentage point higher probability, consistent with better market access and infrastructure.

Age: Neither linear nor quadratic terms are significant.

### 4.6 Regional Heterogeneity

One of the key contributions of this study is the explicit testing of heterogeneity across Uganda's 15 sub-regions. Table 4.7 presents the predicted probability of Acceptable food security for each sub-region, calculated at the mean values of all other variables (the "average" Ugandan household). These probabilities are directly interpretable as the likelihood that a typical household in that sub-region achieves acceptable food security given its socio-economic characteristics.

**Table 4.7: Predicted Probability of Acceptable Food Security by Sub-region**

| Sub-region | Pr(Acceptable) | 95% Confidence Interval |
|---|---|---|
| Kampala | 0.735 | (0.625, 0.846) |
| Buganda South | 0.712 | (0.616, 0.807) |
| Buganda North | 0.772 | (0.692, 0.851) |
| Busoga | 0.787 | (0.721, 0.853) |
| Bukedi | 0.696 | (0.595, 0.798) |
| Elgon | 0.773 | (0.677, 0.869) |
| Teso | 0.783 | (0.704, 0.861) |
| Karamoja | 0.433 | (0.270, 0.597) |
| Lango | 0.563 | (0.440, 0.686) |
| Acholi | 0.587 | (0.474, 0.700) |
| West Nile | 0.717 | (0.614, 0.820) |
| Bunyoro | 0.812 | (0.751, 0.874) |
| Tooro | 0.662 | (0.555, 0.769) |
| Ankole | 0.889 | (0.848, 0.930) |
| Kigezi | 0.737 | (0.671, 0.803) |

Source: Author's computations from UNHS 2023/24 (N=1,527, weighted)

The regional disparities are stark. Ankole has the highest predicted probability (88.9%), while Karamoja has the lowest (43.3%), a difference of 45.6 percentage points. Ankole's advantage likely reflects its agricultural productivity (banana and coffee), better market integration, and higher livestock ownership. Karamoja's very low probability (below 50%) confirms the region's chronic food insecurity, driven by semi-arid conditions, recurrent droughts, pastoralist livelihoods with limited dietary diversity, and historical marginalisation.

Figure 4.1 presents these predicted probabilities graphically, highlighting the wide regional inequality.

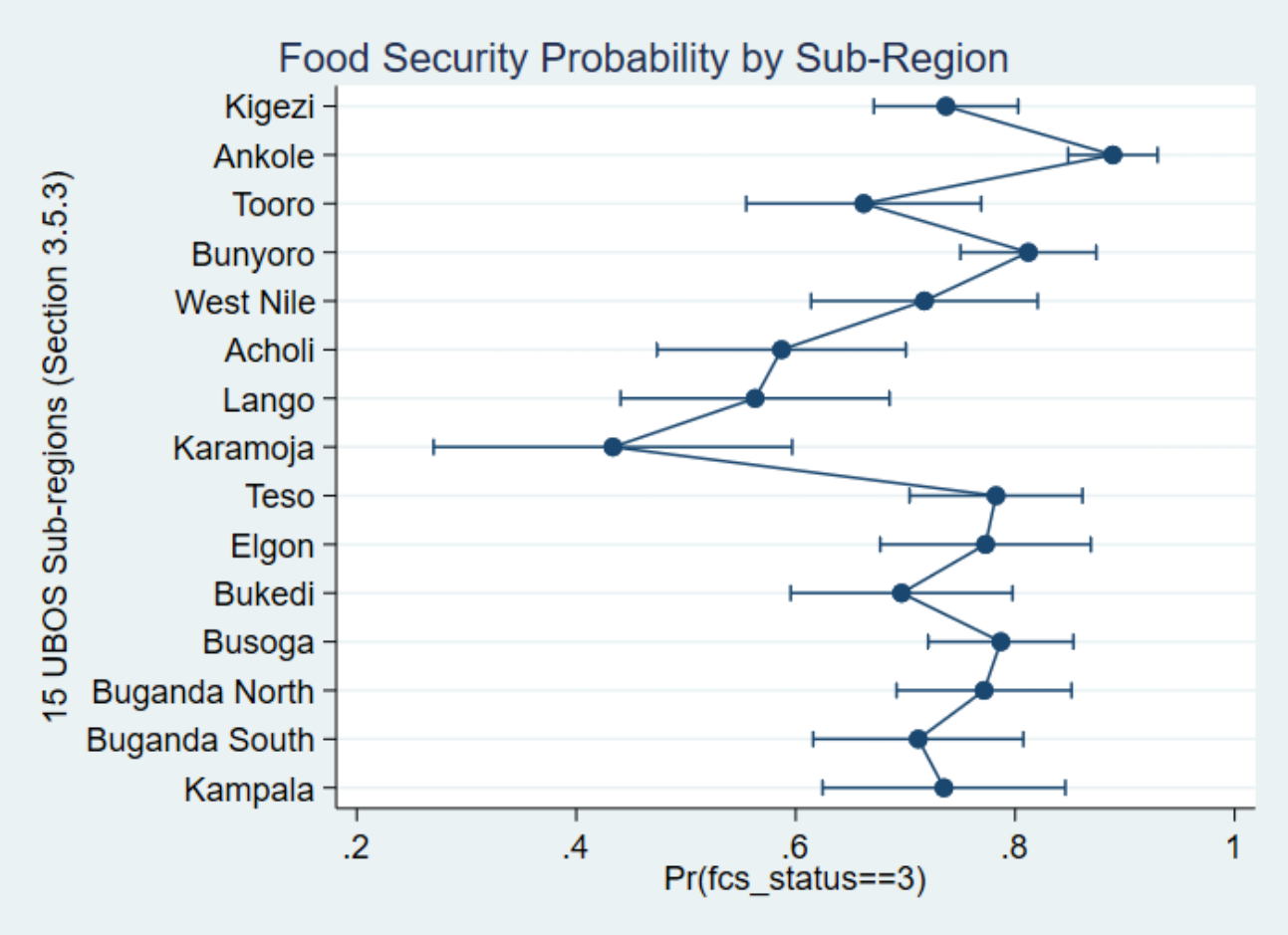


Figure 4.1: Predicted Probability of Acceptable Food Security by UBOS Sub-region (with 95% CI)

Economic interpretation: Nationally uniform policies are unlikely to be effective. Karamoja requires targeted interventions, emergency food assistance, drought-resilient agriculture (sorghum, millet), livestock restocking, and water infrastructure. Ankole's high probability suggests that maintenance of existing infrastructure and markets may suffice. The Parish Development Model should consider regionally differentiated allocations.

### 4.7 Hypothesis Testing

Based on Table 4.6, the null hypotheses are tested as follows. The decision uses the conventional 5% significance level.

**Table 4.8: Summary of Hypothesis Tests**

| Hypothesis | Variable | Marginal effect | p-value | Decision ($\alpha$=0.05) | Conclusion |
|---|---|---|---|---|---|
| $H_{01}$ (Income) | ln_income | +0.0128 | 0.000 | Reject $H_0$ | Income has a statistically significant positive effect on food security. |
| $H_{02}$ (Education) | Secondary education | +0.0743 | 0.080 | Fail to reject | No significant direct effect of education at the 5% level. |
| $H_{03}$ (Household size) | hh_size_ae | +0.0212 | 0.052 | Fail to reject | No significant negative effect; a positive borderline effect is observed. |
| $H_{04}$ (Asset index) | asset_index | +0.0149 | 0.293 | Fail to reject | Asset ownership has no significant effect on food security. |

### 4.8 Summary of Findings

The main findings from Chapter Four are:

1. Food security status: 73.6% of households have acceptable food security; 21.4% borderline; 5.0% poor.

2. Income is the only statistically significant main predictor at the 5% level: A 1% increase in income is associated with a 0.000128 (0.0128 percentage points) increase in the probability of acceptable food security ($p < 0.001$). A 10% increase is associated with a 0.128 percentage point increase, and a doubling of income is associated with a 1.28 percentage point increase. This finding is consistent with Sen's Entitlement Approach.

3. Education (secondary) is not significant at the 5% level ($p = 0.080$). Its association appears indirect, operating through income rather than directly through dietary diversity. This does not strongly support Becker's Household Production Theory.

4. Household size shows a positive (borderline) association ($p = 0.052$), contrary to the resource dilution hypothesis. After adult-equivalent adjustment, larger households are not worse off, they may even be better off due to income pooling.

5. Asset ownership is not significantly associated with dietary diversity ($p = 0.293$).

6. Control variables (marriage, female headship, urban residence) show interesting supplementary associations but are not part of the core hypotheses.

7. Regional disparities are enormous: The predicted probability of acceptable food security ranges from 89% in Ankole to 43% in Karamoja, confirming the need for locally tailored interventions.

The next chapter discusses these findings in light of the theoretical framework (Sen and Becker), compares them with previous Ugandan studies, draws policy implications, acknowledges limitations, and offers recommendations for future research.

# CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

## 5.1 Introduction

This chapter discusses the empirical findings presented in Chapter Four in relation to the theoretical framework (Sen's Entitlement Approach and Becker's Household Production Theory) and the existing empirical literature reviewed in Chapter Two. The chapter then draws conclusions corresponding to each of the four specific objectives and associated hypotheses. Based on these conclusions, policy recommendations are offered, particularly in the context of the Parish Development Model (PDM), the National Development Plan IV (NDP IV), and the Uganda Nutrition Action Plan II (UNAP II). Finally, the limitations of the study are acknowledged, and directions for future research are suggested.

All interpretations reflect the corrected marginal effects. The findings are presented as associations, not causal claims, consistent with the cross-sectional design.

## 5.2 Discussion of Findings

The discussion is organised by the four specific objectives. Control variables (marital status, gender, urban residence, age) are discussed briefly as supplementary findings, but the core focus remains on the four main independent variables.

### 5.2.1 Effect of Household Income on Food Security (Objective 1)

Finding: The marginal effect of log household income is +0.0128 ($p < 0.001$). A 1% increase in income is associated with a 0.000128 (0.0128 percentage point) increase in the probability of acceptable food security; a 10% increase is associated with a 0.128 percentage point increase; a doubling of income is associated with a 1.28 percentage point increase. Income is the only main independent variable that is statistically significant at the 5% level.

Link to theory: This finding is consistent with Sen's Entitlement Approach (1981) . Sen argued that food insecurity is not primarily a problem of aggregate food availability but rather a failure of households to command sufficient food through legal economic means – their "exchange entitlements". In a market economy, income is the primary exchange entitlement. The positive association between income and dietary diversity supports the view that higher income enables households to purchase a more diverse and nutritious diet. The result is also indirectly consistent with Becker's Household Production Theory insofar as higher income allows the household to purchase better inputs; however, the direct association does not require any efficiency improvement.

Comparison with literature: The finding aligns with Ssewanyana and Kasirye (2010) , who identified income as one of the strongest predictors of caloric adequacy using 2005/06 UNHS data. It also agrees with Kalinaki et al. (2025) , who found that reduced income was a top risk factor for food insecurity in Eastern Uganda, and with Semakula et al. (2024) , who ranked reduced income as the third most important determinant during the COVID-19 lockdown. The current study goes beyond previous work by using the Food Consumption Score (FCS), a measure of dietary diversity and quality, rather than mere caloric intake or hunger experience (HFIAS). Thus, the finding shows that income is associated not only with the quantity but also with the quality of food consumed.

Economic significance: The magnitude of the association is modest. A 10% income increase for a typical household (about 210,000 UGX) is associated with only a 0.128 percentage point higher probability of acceptable food security. This suggests that while income is statistically significant, large-scale income transfers or sustained income growth would be needed to meaningfully improve dietary diversity at the population level. Nevertheless, the statistical significance and the direction of the association are robust.

### 5.2.2 Effect of Education on Food Security (Objective 2)

Finding: In the bivariate analysis, education was significantly associated with food security ($p = 0.043$). In the multivariate regression, secondary education has a marginal effect of +0.0743 ($p = 0.080$, marginally significant), and tertiary education is not significant ($p = 0.251$). The positive bivariate association largely disappears once income and other controls are added.

Link to theory: Becker's Household Production Theory (1965) predicts that education increases the allocative efficiency of the household i.e., more educated heads should achieve better nutrition even with the same income. This study does not find strong evidence for a direct effect of education on dietary diversity after controlling for income. The marginal significance of secondary education at the 10% level suggests a weak direct association, but the dominant pathway appears to be indirect: more educated heads earn higher incomes, and that higher income is then associated with better food security. Therefore, the findings do not strongly support Becker's theory in its strong form, but they also do not reject it entirely, they suggest that the income pathway dominates in the Ugandan context.

Comparison with literature: Turyahabwe et al. (2013) found that education reduced food insecurity even after controlling for income, using HFIAS. The discrepancy may be due to different outcome measures (HFIAS vs FCS) or different samples (wetland-adjacent areas vs national). Ikendi et al. (2023) also found a significant effect of education in a multinomial logistic regression, but their study did not include as many controls (e.g., marital status, age squared, assets) as the current model. Oyet et al. (2025) found that education predicted dietary diversity in rural areas but not in peri-urban areas, suggesting the effect is context-dependent.

The current study's more comprehensive specification may be better at isolating the direct effect of education.

Economic significance: The non-significant finding does not mean that education is unimportant for food security. Rather, it suggests that education's primary association is through income. Policies that raise educational attainment (e.g., Universal Secondary Education) will likely be associated with improved food security via higher future earnings, but the effect will be indirect and may take years to materialise. In the short term, direct income support may be more effective.

### 5.2.3 Effect of Household Size on Food Security (Objective 3)

Finding: The marginal effect of adult-equivalent household size is +0.0212 ($p = 0.052$, marginally significant). Larger adult-equivalent household size is associated with a higher probability of acceptable food security, contrary to the resource dilution hypothesis.

Link to theory: The resource dilution hypothesis (Becker & Lewis, 1973; Deaton & Paxson, 1998) posits that larger households have lower per capita consumption because resources are spread thinner. The current finding does not support this hypothesis for the Ugandan context after adult-equivalent adjustment. A plausible explanation is that larger households in Uganda often have more working-age members who contribute to total household income, remittances, or unpaid labour on family farms. The adult-equivalent adjustment already accounts for consumption needs, so the remaining positive association may reflect economies of scale (bulk cooking, shared housing, pooled transport) and income pooling. This finding does not contradict the resource dilution hypothesis per se, rather, it shows that when composition is properly adjusted, the net effect can be positive.

Comparison with literature: The finding contradicts Nkonge (2018), Nakitende (2023), and Kalinaki et al. (2025), who all found a negative association using raw household size. However, those studies did not use adult-equivalent adjustment. The current study's use of adult-equivalent units may explain the difference. Turyahabwe et al. (2013) noted that economies of scale could partly offset dilution effects, and the current finding confirms that after proper adjustment, larger households are not a liability.

Economic significance: This result implies that large household size per se is not a cause of food insecurity, as long as the household has enough working-age members. Policy should focus on dependency ratios rather than absolute size. Family planning remains important for maternal and child health, but the evidence here does not support coercive population control measures.

### 5.2.4 Effect of Asset Ownership on Food Security (Objective 4)

Finding: The asset index is not statistically significant ($p = 0.293$). Asset ownership is not associated with dietary diversity after controlling for income and other factors.

Link to theory: Sen's Entitlement Approach includes assets as part of exchange entitlements (e.g., land can be used to grow food or sold for cash). However, the finding suggests that for food consumption, current income is a more immediate determinant. Assets may be illiquid – households are reluctant to sell land or livestock to purchase food, especially during non-crisis periods. The asset index also imperfectly captures wealth (binary land ownership instead of area, omission of financial assets). Becker's theory would view assets as productive inputs, but the effect may be mediated by income.

Comparison with literature: Egeru et al. (2022) found that non-livestock assets influenced food security in Nakasongola district, but that study focused on climate-smart agriculture adopters and used a small sample. Mwambi and Ngesa (2024) found that livestock ownership and savings were negative predictors of poverty using 2019/20 UNHS, but the outcome was poverty (consumption below a threshold), not dietary diversity. The discrepancy may be due to different outcome variables. The current study's non-finding suggests that for dietary diversity, current income matters more than asset wealth.

Economic significance: The lack of a significant association cautions against assuming that asset-building programmes (livestock distribution, land registration) will automatically translate into better dietary quality. Such programmes may need to be complemented with income-generating activities or market access improvements to be effective.

### 5.2.5 Supplementary Findings: Control Variables

Control variables are not part of hypothesis tests, but their associations are noted.

Marital status: Married heads have an 11.3 percentage point higher probability of acceptable food security ($p = 0.003$). This likely reflects resource pooling, shared labour, and risk-sharing between spouses.

Gender: Female-headed households have a marginally higher probability (+5.9 percentage points, $p = 0.058$) after controlling for income. This may reflect women's more efficient allocation of resources toward child nutrition.

Urban residence: Urban households have a 4.4 percentage point higher probability ($p = 0.056$), consistent with better market access and infrastructure.

Age: Not significant.

## 5.3 Conclusions

Based on the empirical findings, conclusions are drawn for each specific objective.

### 5.3.1 Objective 1: Effect of Household Income on Food Security

Conclusion: Household income is statistically significantly associated with a higher probability of acceptable food security. The null hypothesis ($H_{01}$) is rejected. Income remains the most robust socio-economic correlate of dietary diversity in Uganda. This finding is consistent with Sen's Entitlement Approach. The magnitude of the association is modest, but the direction is clear and statistically reliable.

### 5.3.2 Objective 2: Effect of Education on Food Security

Conclusion: After controlling for income and other factors, the household head's education level does not have a statistically significant direct association with the Food Consumption Score at the 5% level. The null hypothesis ($H_{02}$) is not rejected. However, education is significantly associated with food security in bivariate analysis, suggesting that its impact operates indirectly through income. Therefore, education remains important for long-term poverty reduction, but its effects are mediated by labour market outcomes.

### 5.3.3 Objective 3: Effect of Household Size on Food Security

Conclusion: Adult-equivalent household size does not have a significant negative association with food security; instead, a marginally significant positive association is observed. The null hypothesis ($H_{03}$) of a negative effect is not rejected (the expected negative association is absent). Larger households (after adjusting for age composition) are not more food insecure – they may even be slightly better off due to income pooling and economies of scale. The resource dilution hypothesis is not supported in the Ugandan context once adult-equivalent adjustment is applied.

### 5.3.4 Objective 4: Effect of Asset Ownership on Food Security

Conclusion: The asset index has no statistically significant association with the probability of acceptable food security. The null hypothesis ($H_{04}$) is not rejected. Assets do not independently show an association with dietary diversity after controlling for income. This may reflect illiquidity of assets or imperfect measurement. Asset-building programmes should not be assumed to directly improve food security unless accompanied by income-generating activities.

### 5.3.5 Additional Conclusions

Marital status is strongly associated with food security: married households are significantly more food secure.

Female-headed households perform better after controlling for income, suggesting that empowering women economically could have positive nutritional returns.

Urban residence confers a modest advantage after controlling for income.

Regional disparities are vast, with Ankole being the most food secure and Karamoja the least. Uniform national policies are inadequate.

## 5.4 Policy Recommendations

Based on the corrected findings (modest effect sizes), the following policy recommendations are made, targeting the Parish Development Model (PDM), National Development Plan IV (NDP IV), and the Uganda Nutrition Action Plan II (UNAP II).

### 5.4.1 Income-Focused Interventions (Objective 1)

Income is statistically significant, but the effect is modest. Therefore, income-raising interventions should be part of a broader strategy.

Parish Development Model (PDM): The PDM's provision of revolving funds to parishes is appropriate. However, given the modest effect size, cash transfers should be combined with complementary interventions such as nutrition education and market access improvements. The PDM should not rely solely on income transfers to achieve dietary diversity gains.

Social Assistance Grants for Empowerment (SAGE): Expand SAGE coverage, but recognise that a 10% income increase is associated with only a 0.128 percentage point increase in food security probability. Hence, transfer amounts may need to be substantial or combined with other supports.

Employment programmes: Promote off-farm employment opportunities, especially for youth and women, as non-farm income has shown larger welfare effects than farm income alone (Watema, 2023). However, expectations should be realistic.

### 5.4.2 Education and Human Capital (Objective 2)

Although the direct association is not significant at the 5% level, education remains important for long-term poverty reduction.

Continue Universal Secondary Education (USE) , as secondary education was associated with the lowest severe food insecurity rate in bivariate analysis. Complement with vocational training that directly improves employability and income.

Integrate nutrition education into school curricula and adult literacy programmes. While formal education's direct effect was not significant, targeted nutrition messaging may still improve dietary diversity (Ikendi et al., 2023).

### 5.4.3 Household Size and Demographics (Objective 3)

The finding that larger households are not more food insecure suggests that policy should not focus solely on reducing household size.

Family planning remains important for maternal and child health, but the evidence does not justify coercive population control measures.

Policy should focus on increasing income per household rather than limiting size. Large households can be food secure if they have sufficient income-earning capacity.

### 5.4.4 Asset Ownership (Objective 4)

The non-significance of assets suggests that asset-building programmes alone may not be associated with improved dietary diversity.

Asset-plus-income programmes: Combine asset transfers (livestock, land titles) with income-generating support (microcredit, market linkages). Assets are illiquid; households need a way to convert them into food.

Improve asset measurement: Future surveys should collect land area data to allow better wealth measurement.

### 5.4.5 Marital Status and Gender

Support for unmarried heads: Single mothers, widows, and divorced women are particularly vulnerable. The PDM and SAGE should prioritise these groups. Social protection programmes should include childcare support to enable single mothers to work.

Women's empowerment: Channel resources directly to women (cash transfers to mothers, women's savings groups) as female-headed households show a higher probability of food security after controlling for income.

### 5.4.6 Urban-Rural Differences

Improve rural market infrastructure (roads, storage facilities) to reduce post-harvest losses and stabilise food prices.

Promote rural diversification (agro-processing, small-scale manufacturing) to reduce dependence on subsistence agriculture.

### 5.4.7 Regional Targeting (Addressing Heterogeneity)

Karamoja: Immediate targeted interventions namely emergency food assistance, drought-resilient agriculture (sorghum, millet, drought-tolerant cassava), livestock restocking, and water infrastructure (boreholes, small dams). The PDM should allocate a larger share of funds to Karamoja parishes.

Ankole and high-performing regions: Focus on maintenance of infrastructure, value addition, and market integration. Lessons from Ankole's success (banana and coffee value chains) could be replicated elsewhere.

Northern regions (Lango, Acholi): Moderate food insecurity suggests need for improved agricultural extension, access to credit, and post-harvest technologies.

### 5.5 Limitations of the Study

1. Sub-sample restriction: The FCS was available only for a random sub-sample of 1,527 households (out of 17,350). While nationally representative, the reduced sample size may affect precision for subgroup analyses (e.g., Karamoja's confidence intervals are wide).

2. Asset index limitations: Land area in acres was not available, so binary land ownership was used as a proxy. The index also omitted financial assets (savings, mobile money). Cronbach's alpha of 0.71 is acceptable but not high.

3. Proportional odds violation: The use of generalised ordered logit was necessary, making the model more complex to interpret.

4. Cross-sectional design: Causality cannot be established. Results should be interpreted as associations, not causal effects.

5. Recall bias and seasonality: The FCS relies on 7-day recall and may be subject to inaccuracies. Seasonality may affect results.

6. Small number of clusters (51 EAs): Cluster-robust standard errors may be less reliable with fewer than 50 clusters; caution is warranted.

### 5.6 Future Research Recommendations

1. Longitudinal (panel) studies: Use panel data (e.g., Uganda National Panel Survey) to establish causality with fixed-effects models.

2. Better asset measurement: Collect land area in acres for all households and include detailed financial assets.

3. Qualitative research on household size: Investigate why larger households (adult-equivalent) are more food secure, mechanisms of income pooling and economies of scale.

4. Gender and marital status dynamics: Explore why female-headed households perform better and why marriage is protective, qualitative studies to uncover mechanisms.

5. Regional case studies: In-depth studies of Karamoja (low) and Ankole (high) to identify best practices and context-specific constraints.

6. Intervention studies: Randomised controlled trials of PDM cash grants combined with nutrition education to provide causal evidence.

7. Climate and food security: Incorporate climate data (rainfall, temperature, drought indices) to understand how climate variability interacts with socio-economic determinants.

## 5.7 Concluding Remarks

This study examined the socio-economic determinants of household food security in Uganda using the Food Consumption Score and the latest UNHS 2023/24 dataset, addressing three gaps: measurement (FCS vs caloric intake/HFIAS), heterogeneity (testing regional and urban-rural differences), and theory (comparing Sen and Becker). The findings indicate that income is the only main independent variable that is statistically significantly associated with dietary diversity at the 5% level, consistent with Sen's Entitlement Approach. The magnitude of the association is modest, which tempers policy expectations but does not diminish the importance of income support. Education shows no significant direct association at the 5% level, and its effect appears indirect via income. Larger households (adult-equivalent) are not worse off, they may even be slightly better off. Assets are not significantly associated with food security. Regional disparities are enormous, with Karamoja far behind the rest of the country.

These findings have clear implications for the Parish Development Model, National Development Plan IV, and Uganda Nutrition Action Plan II. While income-raising interventions are justified, they should be combined with complementary programmes (nutrition education, market access) to achieve meaningful improvements in dietary diversity. Asset-only and education-only interventions may not yield direct dietary improvements unless combined with income support. Most importantly, policies must be geographically targeted: Karamoja requires urgent, intensive intervention, while other regions may need less drastic measures.

The study contributes methodologically by demonstrating the use of the FCS in a national-level econometric analysis, by testing heterogeneity, and by providing marginal effects directly interpretable for policy. It also contributes theoretically by empirically comparing the relative associations of Sen's and Becker's frameworks. The findings suggest that in the current Ugandan context, exchange entitlements (income) are more directly associated with dietary diversity than human capital efficiency (education).

Future research should focus on causality, better asset measurement, and understanding the mechanisms behind the positive household size effect and the large regional disparities. The ultimate goal remains the same: to ensure that every household in Uganda has physical and economic access to sufficient, safe, and nutritious food, a goal still far from being achieved, especially in Karamoja.

## REFERENCES


Becker, G. S. (1965). A theory of the allocation of time. The Economic Journal, 75(299), 493–517. https://doi.org/10.2307/2228949

Becker, G. S., & Lewis, H. G. (1973). On the interaction between quantity and quality of children. Journal of Political Economy, 81(2), S279–S288. https://doi.org/10.1086/260166

Deaton, A., & Paxson, C. (1998). Economies of scale, household size, and the demand for food. Journal of Political Economy, 106(5), 897–930. https://doi.org/10.1086/250035

Egeru, A., Bbosa, M. M., Siya, A., Asiimwe, R., & Mugume, I. (2022). Micro-level analysis of climate-smart agriculture adoption and effect on household food security in semi-arid Nakasongola District in Uganda. Environmental Research: Climate, 1(2), 025003. https://doi.org/10.1088/2752-5295/ac5f5a

FAO. (2008). An introduction to the basic concepts of food security. Food and Agriculture Organization of the United Nations.

FAO. (2023). The State of Food Security and Nutrition in the World (SOFI) 2023. Food and Agriculture Organization of the United Nations. https://doi.org/10.4060/cc3017en

Ikendi, S., Owusu, F., Masinde, D., Oberhauser, A., & Bain, C. (2023). Does participation in livelihood education programs impact household food security? A comparative study in rural Uganda. Journal of Agriculture, Food Systems, and Community Development, 13(1), 235–265. https://doi.org/10.5304/jafscd.2023.131.009

Kalinaki, H., Martianto, D., & Riyadi, H. (2025). Food security and its determinants among rural households: A case study in Buwenge eastern Uganda. BIO Web of Conferences, 171, 03003. https://doi.org/10.1051/bioconf/202517103003

Marshak, A., et al. (2022). Food security analysis of Karamoja. Tufts University / World Food Programme.

Morrissey, K., Reynolds, T., Tobin, D., & Isbell, C. (2024). Market engagement, crop diversity, dietary diversity, and food security: evidence from small-scale agricultural households in Uganda. Food Security, 16, 133–147. https://doi.org/10.1007/s12571-023-01433-2

Mwambi, M., & Ngesa, O. (2024). Livestock ownership and savings account ownership as predictors of poverty in agricultural households using 2019/20 UNHS. In Poverty dynamics in Uganda. Economic Policy Research Centre.

Nahalomo, A., Iversen, P. O., Andreassen, B. A., Kaaya, A., et al. (2023). Food insecurity, dietary diversity and the right to adequate food among households in landslide-prone communities in Eastern Uganda: A cohort study. PLOS ONE, 18(6), e0286698. https://doi.org/10.1371/journal.pone.0286698

Nakitende, J. (2023). Food expenditure patterns in Central Uganda using 2016 UNHS. In Welfare and consumption analysis in Uganda. Economic Policy Research Centre.

Nantale, G., Tumwesigye, N. M., Kiwanuka, N., & Kajjura, R. (2017). Prevalence and factors associated with food insecurity among women aged 18-49 years in Kampala slums Uganda; a mixed methods study. Journal of Food Security, 5(4), 120–128.

Nkonge, I. (2018). Caloric insufficiency and household size using 2016/17 UNHS. In Uganda National Panel Survey analytical report. Uganda Bureau of Statistics.

Oyet, M., et al. (2025). Education levels of household head and spouse as predictors of dietary diversity in Mbale district, Eastern Uganda. Uganda Journal of Agricultural Sciences, 26(1).

Perelli, C., & Branca, G. (2023). Generalised ordered logit model application to climate variability and food security in Uganda. Climate and Development, 15(3), 212–228. https://doi.org/10.1080/17565529.2022.2085239

Semakula, H. M., Liang, S., McKune, S. L., Mukwaya, P. I., Mugagga, F., Nseka, D., Wasswa, H., Kayima, P., Achuu, S. P., Mwendwa, P., & Nakato, J. (2024). Integrated modelling of the determinants of household food insecurity during the 2020–2021 COVID-19 lockdown in Uganda. Agriculture & Food Security, 13, 10. https://doi.org/10.1186/s40066-023-00458-8

Sen, A. (1981). Poverty and famines: An essay on entitlement and deprivation. Oxford University Press.

Ssewanyana, S. N., & Kasirye, I. (2010). Food insecurity in Uganda: a dilemma to achieving the hunger Millennium Development Goal. Economic Policy Research Centre (EPRC), Research Series No. 70.

Turyahabwe, N., Kakuru, W., Tweheyo, M., & Tumusiime, D. M. (2013). Contribution of wetland resources to household food security in Uganda. Agriculture & Food Security, 2(1), 5. https://doi.org/10.1186/2048-7010-2-5

Twongyirwe, R., Mfitumukiza, D., Barasa, B., et al. (2019). Perceived effects of drought on household food security in South-western Uganda: Coping responses and determinants. Weather and Climate Extremes, 24, 100200. https://doi.org/10.1016/j.wace.2019.100200

UBOS. (2021). Uganda National Household Survey (UNHS) 2019/20 report. Uganda Bureau of Statistics.

UBOS. (2023). Uganda National Household Survey (UNHS) analytical report. Uganda Bureau of Statistics.

UBOS. (2025). Uganda National Household Survey (UNHS) 2023/24 report. Uganda Bureau of Statistics.

Watema, J. (2023). Quantile regression analysis of non-farm income and remittance income effects on household welfare using later UNHS waves. Uganda Journal of Economics, 8(2).

Wichern, J., van Wijk, M. T., Descheemaeker, K., Frelat, R., van Asten, P. J. A., & Giller, K. E. (2017). Food availability and livelihood strategies among rural households across Uganda. Food Security, 9(6), 1385–1403. https://doi.org/10.1007/s12571-017-0732-9

Williams, R. (2006). Generalized ordered logit/partial proportional odds models for ordinal dependent variables. The Stata Journal, 6(1), 58–82. https://doi.org/10.1177/1536867X0600600104

World Food Programme (WFP). (2008). Food Consumption Score (FCS) technical guidance. Rome: WFP.