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HOUSEHOLD INCOME INEQUALITY AND FOOD INSECURITY IN GHANA

JOSEPH EKOW BONNEY

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BY

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THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL AND FOOD ECONOMICS, FACULTY OF AGRICULTURE, FOOD AND CONSUMER SCIENCES, UNIVERSITY FOR DEVELOPMENT STUDIES, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE IN AGRICULTURAL ECONOMICS

MARCH, 2023

DECLARATION

Student

I hereby declare that this thesis is a result of my original work and that no part of it has been presented for another degree in this University or elsewhere:

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Signature:…….. Date:…….

Name: Joseph Ekow Bonney

Supervisors

We hereby declare that the preparation and presentation of this thesis was supervised following the guidelines on supervision of thesis laid down by the University for Development Studies.

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ABSTRACT

Despite the rise in Ghana's GDP per capita, food insecurity is still a challenge. Data from the World Income Inequality Database show that the consistent rise in Ghana's GDP per capita income is accompanied by a rising income inequality trend. The rising income inequality is attributed to rising incomes of only the wealthy classes, leaving more people in economic crises. While several determinants of household food insecurity have been examined, the role of household income inequality is missing in the Ghanaian context. This study used data from the seventh round of the Ghana Living Standards Survey to examine the effect of household income inequality on food insecurity. Since household income inequality can be decomposed into intra and inter-household components, this study considers the effects of intra- and inter-household income inequalities on food insecurity. 2,737 households were used for intra-household analyses since they have at least two income sources which satisfy inequality estimation. Also, 749 communities were used for inter-household analyses due to successful identification and matching of household characteristics. Both intra- and inter-household income inequalities were calculated using the Gini index. Food Insecurity Experience Scale, Dietary Diversity Score and Food Expenditure per capita were used as food insecurity indicators.S The Atkinson, Mean Log Deviation and Theil indices were used to assess the extent to which intra- and inter-household income inequality contribute to overall income inequality. Also, an Extended Ordered Probit with Endogenous Covariate model was employed to examine factors influencing intra- and inter-household income inequalities and the effects of both household income inequality components on food insecurity simultaneously. The results show that intra-household income inequality contributes about 14 to 22% to overall income inequality while inter-household income inequality contributes about 78 to 86%. While labour employment, university degree, skills, Social Security and National Insurance Trust contribution, and internal transfer reduce intra-household income inequality, contributing household employees, remittance, miscellaneous income as well as social exclusion increases it. Inter-household income inequality increases with more Livelihood Empowerment against Poverty receiving, socially excluded and discriminated households but reduces when more households participate in labour markets and when more household heads are employed. The results also show that both intra- and inter-household income inequalities increase food insecurity at the household and at community levels respectively. In addition to income inequality, household size and ownership of residence also increase food insecurity. However, income and assets per capita, remittance, university degree, employment of household heads, community population, urbanisation, availability of financial institutions, and public transport passage via community reduce food insecurity. Based on the findings, it is suggested that government and private development agencies should assist in providing favourable conditions that will increase tertiary school enrollment and labour employment opportunities. It is also suggested that community leaders and social activists should ensure that individuals have equal rights to participate in social activities and use public services without discrimination.

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DEDICATION

I dedicate this work to my late father, Mr. Benjamin Fiifi Bonney, and to my family.

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ACRONYMS AND ABBREVIATIONS

1D1F	One District One Factory
1D1W	One District One Warehouse
1PL	One Parameter Logistic
1V1D	One Village One Dam
AFJ	Aquaculture for Food and Jobs
BECE	Basic Education Certificate Examination
BMELV	Federal Ministry of Food, Agriculture and Consumer Protection
CAADP	Comprehensive Africa Agricultural Development Programme
CTT	Classical Test Theory
CV	Coefficient of Variation
DDS	Dietary Diversity Score
ELCSA	Latin American and Caribbean Household Food Security Scale
EOPEC	Extended Ordered Probit with Endogenous Covariate
EOProbit	Extended Ordered Probit
FANTA	Food and Nutrition Technical Assistance
FAO	Food and Agricultural Organisation
FE pc	Food Expenditure per capita
FIE	Food Insecurity Experience
FIES	Food Insecurity Experience Scale
FNS	Food and nutrition security
GDP	Gross Domestic Product
GE	Generalized Entropy
GFSI	Global Food Security Index
GLSS	Ghana Living Standard Survey
GoG	Government of Ghana
GSS	Ghana Statistical Service
HDDS	Household Dietary Diversity Score
HFIAP	Household Food Insecurity Access Prevalence
HFIAS	Household Food Insecurity Access Scale
HFSSM	Household Food Security Survey Module
HHS	Household Hunger Scale
ICT	Information and Communication Technology

IFJ	Investment for Food and Jobs
IMF	International Monetary Fund
IRF	Item Response Function
IRT	Item Response Theory
ITA	International Trade Administration
LEAP	Livelihood Empowerment Against Poverty
LMIC	Low- and middle-income countries
MCCO	Margaret Court Community Outreach
MLD	Mean Log Deviation
MLE	Maximum Likelihood Estimator
MoFA	Ministry of Food and Agriculture
MOFEP	Ministry of Finance and Economic Planning
MSLC	Middle School Leaving Certificate
OECD	Organisations for Economic and Co-operation Development
PFJ	Planting for Food and Jobs
PHC	Population and Housing Census
RFJ	Rearing for Food and Jobs
SSA	Sub-Sahara African
SDGs	Sustainable Development Goals
SNAP	Supplemental Nutrition Assistance Program
SOFI	State of Food Insecurity
SSNIT	Social Security and National Insurance Trust
TIV	Triangular Instrumental Variable
UNDP	United Nation Development Programme
UNICEF	United Nations International Children's Emergency Fund
VoH	Voice of the Hungry
WAAPP	West Africa Agricultural Productivity Programme
WFP	World Food Programme
WHO	World Health Organisation
WIID	World Income Inequality Database

CHAPTER ONE

INTRODUCTION

1.1 Background

The declaration on World Food Security during the 1996 World Food Summit in Rome aimed to halve the world's undernourished by halving poverty before 2015 (FAO, 1996). Unfortunately, statistics from the Food and Agricultural Organization of the United Nations (FAO) revealed that, in the early 2000s, the undernourished population in developing nations was growing (BMELV et al., 2006). This led to the fourth 'Policies against Hunger' workshop in Berlin, 2005. This workshop discussed and focused on implementing the 'Voluntary Guidelines on the Right to Food' (BMELV et al., 2006). To realize the right to food, the Voluntary Guidelines provided strategies for economic development, agriculture, food and nutrition as well as social safety nets and food emergencies for the disabled and vulnerable, respectively (BMELV et al., 2006).

The Voluntary Guidelines displayed a positive impact on food security until 2014, where the proportion of people suffering from undernourishment began to rise (FAO et al., 2019). The consequence was that, in 2019, the estimated world's undernourished population grew to almost 650.3 million, representing an increase of over 17 million from 2018 and nearly 35 million from 2015 (FAO et al., 2021). The outburst of COVID-19 pandemic shot this statistic further up to about 768 million at the end of 2020, thereby delaying actions proposed to meet the second (Zero Hunger) goal of the Sustainable Development Goals (SDGs) (FAO et al., 2021). The incidence of undernourishment is mostly high in underdeveloped countries, with the greatest proportions found in Asia (418 million) and Africa (282 million) followed by the Latin America and the Caribbean (60 million), and the rest found in Oceania (FAO et al.,

2021). The incidence of hunger and undernourishment are mostly attributed to poverty and the high costs of diets among poor societies (FAO et al., 2020; WHO, 2020).

People often use hunger and food insecurity interchangeably, but food insecurity goes beyond mere hunger (FAO et al., 2019). Loopstra (2018) explained that people can experience food insecurity without being hungry. While hunger affects poor societies, food insecurity affects both poor and rich societies. At the national level, food insecurity is described as an ideal sign of poverty (Tomita et al., 2019). Food availability and accessibility are the two basic measures of food insecurity at the national level (FAO et al., 2021). Availability describes the adequacy of food supplied while accessibility describes how people access food in relation to increasing food prices and poverty (FAO et al., 2021). However, national food insecurity is mostly measured by availability because national level food accessibility data is often unavailable (Hossain et al., 2021).

Measuring food insecurity using national-level indicators is likely to result in ineffective policy recommendations. This is because some economies may have larger proportions of the world's available food per capita and may be considered nationally food secure, yet, significant amounts of their households suffer food insecurity (Richards et al., 2016). This means household food insecurity prevails in all parts of the world. Household food insecurity does not consider only food availability as measured at the national level, but also, households' accessibility and utilization of these foods for longer periods (Drammeh et al., 2019; Holleman & Conti, 2020). Hence, there is a possibility of food insecurity among rich households. Food insecurity prevails in low-income households as a result of resource constraints and in high-income households due to unequal distribution of resources among household members (Aurino et al., 2020; Jessiman-Perreault & McIntyre, 2017; Men et al., 2020).

Undernutrition is the major consequence of food insecurity among low-income households (Kolovos et al., 2020). This is because, once a household is food insecure, the recommended dietary intake for various food items is not met, leading to nutritional deficiency (Loopstra, 2018). To cope with poverty, some households adopt one-way diets that have large quantities of starchy staples but with little or no protein and vitamin-related food items. Food insecurity (through undernutrition) has influenced poor physical and psychological health in many households (Domingo et al., 2021; Duffy et al., 2019). Studies show that the likelihood of being stunted, underweight or wasted is high in food-insecure households (Chakona & Shackleton, 2018; Chandrasekhar et al., 2017; Mahmudiono et al., 2018). Also, the prevalence of obesity is associated with food insecurity (Mahmudiono et al., 2018). Engidaye et al. (2019) showed that food insecurity increases the incidence of anaemia among pre-school aged children. Individuals who are severely food insecure are more likely to have depressive and suicidal thoughts (Jessiman-Perreault & McIntyre, 2017; Kolovos et al., 2020; Sweetland et al., 2019). Also, low life quality and poor academic performance among children is found to increase with food insecurity (Grineski et al., 2018).

Understanding and assessing the determinants of food insecurity is the only way effective strategies can be designed to reduce undernutrition-related problems. Over the years, researchers have recognized the connection between economic development and food insecurity at national and regional levels. For example, food insecurity is relatively low in developed nations than in less developed nations and reduces with Gross Domestic Product (GDP) per capita (Smith et al., 2017). Beside income differences, developed nations have more extensive welfare systems and charity sectors compared to less developed countries (Hossain et al., 2021). According to Guiné et al. (2021), food insecurity is significantly influenced by political instability and violence. Food

insecurity is also known to be dependent on some macro-economic variables (Holleman & Conti, 2020), such as a high rate of unemployment and lack of social spending (Hossain et al., 2021).

Even though some national-level variables may influence household food insecurity, socioeconomic and household characteristics play significant roles. For example, in America, young household heads are more likely to experience food insecurity (Cordero-Ahiman et al., 2020; Morales et al., 2021; Tomayko et al., 2017). In Canada, unmarried individuals are more likely to experience food insecurity compared to married individuals (Burris et al., 2021; Tarasuk et al., 2019). Social network is found to reduce food insecurity among European households (Dudek & Myszkowska-Ryciak, 2022; Grimaccia & Naccarato, 2022). In Asia, attaining higher levels of education is associated with low levels of food insecurity (Joshi et al., 2019; Mahmudiono et al., 2018). Kleve et al. (2021) found that food insecurity is high among Australian households staying in their own houses compared to households staying in rented apartments. In Ethiopia, female-headed households are more likely to experience food insecurity (Dasgupta & Robinson, 2022; Gebre & Rahut, 2021), while in South Africa, food insecurity increases with household size (Abrahams et al., 2018; Tomita et al., 2019). Tuholske et al. (2020) and Saaka et al. (2017) also found that having more assets plays an important role in reducing food insecurity in Ghanaian households.

Most of the reported cases of household food insecurity are the result of poverty. Research shows that poverty can be reduced by narrowing income inequality gap among individuals (Holleman & Conti, 2020). An economy experiences income inequality when its individuals do not equally share its income. Howard and Carter (2020) explained income inequality as the substantial disparities in the distribution of income between individuals, groups, populations or social classes. According to the

authors, income inequality is a major dimension of social stratification which is affected by other forms of inequality, such as political power and social status. Income inequality increases if income differences are reinforced and decreases if income differences are compensated during allocation (Molina et al., 2018). According to the World Bank (2022), income inequality causes vulnerability in poor societies. While income inequality exists in all parts of the world, it is very high in less developed countries especially those of Africa and Asia, leading more people in those regions to experience low levels of welfare (Holleman & Conti, 2020). However, in Africa, income inequality is associated with relatively low inter-generational social mobility (de Vreyer & Lambert, 2018). This means as income inequality increases, social and personal development becomes challenged in most societies. While income inequality can be examined among different groups or sub-groups, households are important micro sub-groups that determine individuals' command over basic life sustaining needs, such as food, shelter, and health care, among others. Therefore, household income inequality analyses are important so that specific policies can target households directly.

Globally, food insecurity is the major cause of suffering among poor populations (Drammeh et al., 2019). FAO et al. (2022) reported that about one-third (2.3 billion) of the world's population is currently moderately or severely food insecure. Out of this figure, one-third (795 million) live in Africa, which means that more than half of Africa's population is food insecure. The prevalence of food insecurity led to the implementation of various programmes under various policy frameworks to increase food availability and access through increasing productivity and total output as well as incomes (MoFA, 2018). Some of these programmes, in Ghana for instance, include the 'Ghana Shared Growth and Development Agendas' (GSGDA I & II) and the 'Medium-

Term Agricultural Sector Investment Plans' (METASIP I & II). The GSGDA, from 2010 to 2017, is the fifth series of the Medium-Term National Development Policy Framework (MTNDPF) to champion the 'Better Ghana Agenda' programme (NDPC, 2010, 2014). Also, the METASIP, from 2011 to 2015, was developed based on a participatory process to increase GDP growth from the agricultural sector by at least 6% annually (MoFA, 2010). These programmes were implemented simultaneously and expected to contribute to achieving the SDGs through agricultural transformation, wealth creation, improving service delivery in education and health, food and nutrition security as well as ensuring employment-led economic growth (MoFA, 2018; NDPC, 2014).

1.2 Problem Statement

Over the years, Ghana has recorded a significant increase in economic growth per capita (*Figure 1.1*) and has been acknowledged as food sufficient due to improved production of some staple crop (MoFA, 2018). According to Wu et al. (2019), even though some nations may experience a rise in their national income per capita, a significant number of individuals and households find it challenging to access sufficient and healthy foods that meet their nutritional requirements. A critical case of their findings is the case of Ghana, where increasing per capita GDP is accompanied by an increasing prevalence of moderate or severe food insecurity (*Figure 1.2*). Among the Sub-Sahara African (SSA) countries, Ghana ranked fourth on the 2021 Global Food Security Index (GFSI) after South Africa, Botswana and Mali (Economist Impact, 2021). This means Ghana is performing well in solving food insecurity than other SSA countries. However, the increasing prevalence of food insecurity is a threat and needs to be tackled.

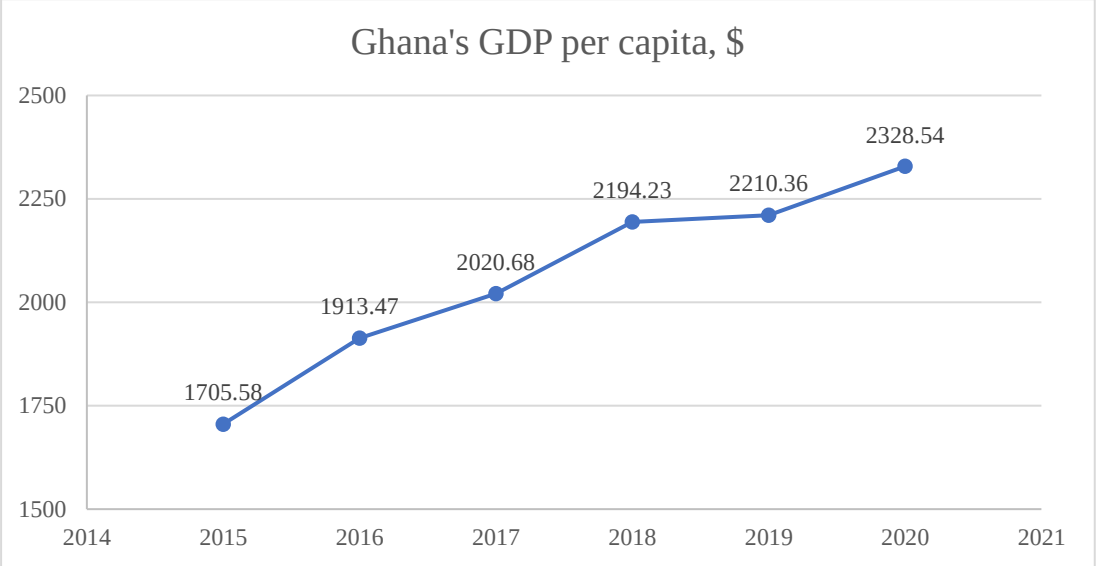

Figure 1.1: Trend of per capita GDP of Ghana

Source: World Development Indicator, World Bank (2022)

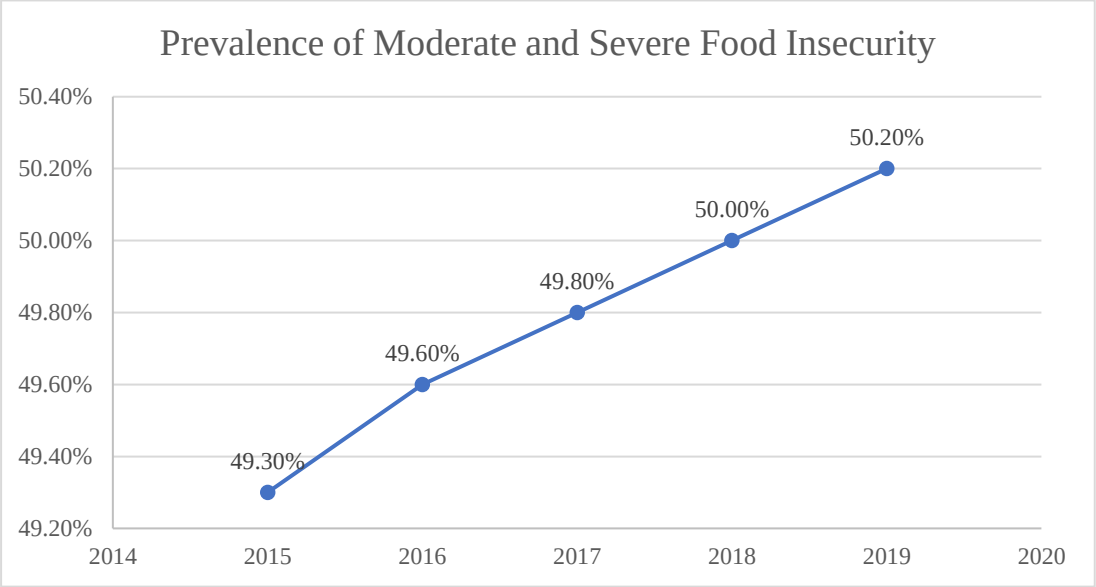

Figure 1.2: Trend of Ghana's prevalence of moderate and severe food insecurity

Source: Country Profile, FAO (2021)

Although several macro-economic variables influence food insecurity, Hossain et al. (2021) reported that the impact of income inequality is more significant. Holleman and Conti (2020) also observed a significant positive correlation between income inequality and food insecurity. FAO et al. (2021) reported that apart from poverty and the high costs of diets, persistent levels of income inequality increase the prevalence of food

insecurity, especially among socially excluded and marginalized groups. This appeals for attention on addressing income inequality. Unfortunately, as far as the empirical literature in Ghana is concerned, the connection between income inequality and food insecurity, especially at the household level, has received no attention. However, a report from UNDP (2017) shows that for periods of rising GDP per capita and the prevalence of food insecurity, income inequality also increased (*Figure 1.3*). MoFA (2018) further reported that although most prioritized social development issues are curbed, household food insecurity and income inequality are still challenging.

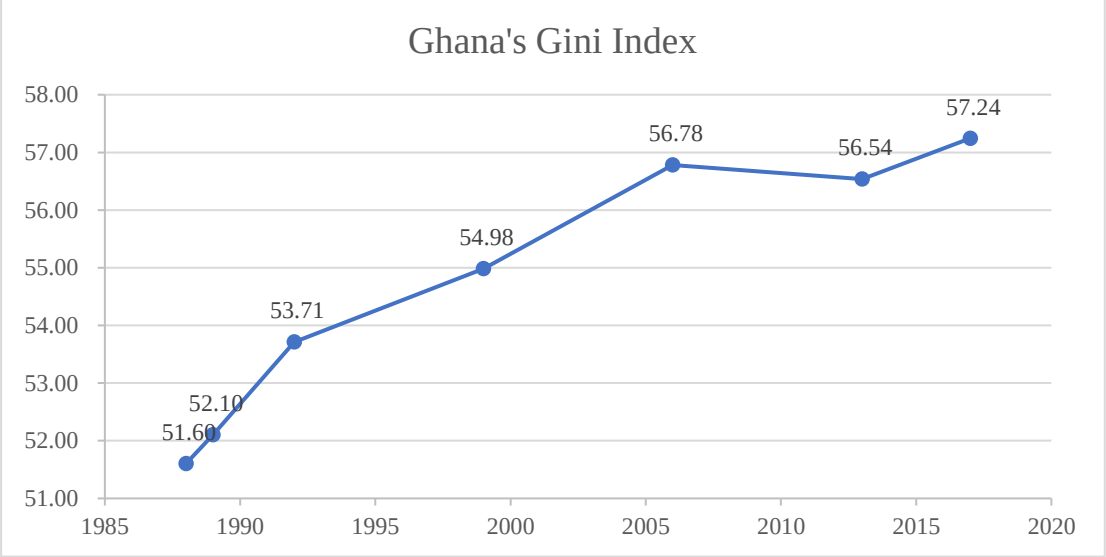

Figure 1.3: Trend of Ghana's inequality measured by the Gini index

Source: World Income Inequality Database, (UNU-WIDER, 2021)

With high-income inequality, only a small proportion of the population is assumed to possess massive portions of the society's total income. Logically, as income inequality increases, the rich become richer, the poor become poorer while those on or a little above the poverty line are likely to become poor. Thus, if income differences are not compensated for, the proportion of poor people will increase making more individuals and households find it challenging to meet their basic food needs, thereby increasing household food insecurity. Household food insecurity can be reduced from an income

inequality perspective only if there is enough evidence to prove that household income inequality indeed influences household food insecurity.

According to Costa and Pérez-Duarte (2019), if a population is categorized into sub-groups, overall inequality can be decomposed into inter- (between) and intra- (within) group components, since the population is a composition of individual households. Since many social interventions often target households, overall income inequality can be assessed by inter- and intra-household components. Hence, to analyze the effect of income inequality on household food insecurity, this study considers the effects of both inter- and intra-household income inequality.

1.3 Research Questions

The main research question is framed as follows:

"*What is the effect of household income inequality on food insecurity in Ghana*"?

From this main research question, the following specific research questions are asked:

i. To what extent do inter-household and intra-household income inequalities contribute to overall income inequality?
ii. What factors influence inter-household and intra-household income inequalities?
iii. What are the effects of inter-household and intra-household income inequalities on household food insecurity?

1.4 Research Objectives

Corresponding to the main research question, the main research objective is also framed as follows:

"*To help improve household food security by analysing the effect of household income inequality on food insecurity in Ghana*".

To achieve this broad research objective, the following specific objectives are derived:

i. To assess the extent to which inter-household and intra-household income inequalities contribute to overall income inequality.
ii. To examine factors influencing inter-household and intra-household income inequalities.
iii. To analyse the effects of inter- and intra-household income inequalities on household food insecurity.

1.5 Justification

Food insecurity is a composite phenomenon, therefore, eradicating it will require multi-sectoral policy approaches (Cordero-Ahiman et al., 2020). Oftentimes, food insecurity in most households is not due to the unavailability of food, but rather lack of economic access by household members (Crush et al., 2019). That is, even though food may be available in most societies, households may not be able to afford it due to low income or high prices. Thus, providing adequate income-generating opportunities is one vital approach to addressing economic inaccessibility. However, in high-income societies, some households may be challenged with food needs if incomes are not equally distributed (FAO et al., 2021). Therefore, understanding and providing actions that can reduce or eliminate income disparities between and within households can help address these challenges.

First of all, this study will identify the composition of household income inequality that needs more attention from development agencies seeking to address the national income inequality challenge. Secondly, this study will identify specific social and demographic groups as well as socioeconomic and institutional variables that need to be targeted by social programmes and policies to ensure social development through efficient and equitable income allocation. This will also provide households with the

necessary knowledge on why and how to reduce inequalities between income generating opportunities and human capital among members. The outcomes of the study will assist development agencies in the formulation of policies geared towards the reduction of food insecurity from an income inequality perspective. The findings of will assist the local government in the provision of comprehensive and strategic policy frameworks that will enhance quality of life and enhanced welfare by reducing food insecurity and improving nutrition among deprived people. Lastly, this study will contribute to the literature on food insecurity and income inequality at the household level.

1.6 Organization of the Thesis

This thesis is structured into five chapters. The current chapter is the Introduction, which outlines the background (facts and explanation of general concepts), problem that motivated the study, research questions and objectives as well as the significance of this study. The second chapter, Literature Review, reviews studies that have been conducted in relation to the key concepts (income inequality and food insecurity). Chapter three discusses the study area, research design, data source and type, theoretical and conceptual framework, measurements of key concepts and analytical methods used to achieve the various objectives. Chapter four presents and discusses the results (descriptive and objective-based) of the study, while chapter five summarizes the methodology and key findings, concludes the study, and proposes recommendations that will support government and other development agents.

CHAPTER TWO

LITERATURE REVIEW

2.0 Chapter outline

Section 2.1 of this chapter defines and explains the concepts and forms of inequality. The causes and effects of inequality are highlighted in sections 2.2 and 2.3 respectively. Section 2.4 explains the various measures of inequality while section 2.5 briefly explains the approaches for measuring inequality and their interpretations. The concept of inequality decomposition is explained in section 2.6. This chapter also provides an extensive empirical review of global and regional inequality (section 2.7). Sections 2.8 and 2.9, respectively, provide empirical reviews of the impact of and factors influencing regional- and national-level inequality. In section 2.10, the measurements of some household food (in)security indicators were explained. Lastly, empirical reviews of global food insecurity status, the effects of and factors influencing food insecurity are, respectively, provided in sections 2.11, 2.12 and 2.13.

2.1 Definition, Concepts and Forms of Inequality

Inequality is frequently defined as the uneven distribution of resources (Yang, 2017). According to Afonso et al. (2015a), inequality is the state of being unequal, specifically, in status, rights and opportunities. Although there are different forms of inequality, the two commonest forms are the inequality of outcome and inequality of opportunity (European Commission, 2017). While inequality of outcome considers the disparities in living conditions and economic wellbeing of people, inequality of opportunity focusses on disparities in circumstances beyond one's control (i.e., gender, family background, ethnicity, etc.), decisions, talents, efforts and lucks that facilitate the outcomes (Afonso et al., 2015a). Because inequality of opportunity is not directly measurable, inequality is mostly defined by researchers as a blend of outcome

(economic) variables (Martin et al., 2016). Measures of economic inequality are income, wealth, consumption, education attainment, health and overall economic wellbeing. Although economic inequality is presumed to be an outcome of all different forms of inequality, it is interdependent with inequality of opportunity (Martin et al., 2016; Narayan et al., 2013).

2.2 Causes of Inequality

While the causes of inequality vary across societies, the principally identified levels of inequality are due to higher income growth among the rich population compared to the income growth in poor population (European Commission, 2017). Inequality is mostly attributed to circumstances beyond individual's control (Narayan et al., 2013). One cause of inequalities is that some (especially, inequality of opportunity) are inherited from previous generations (Dabla-Norris et al., 2015). For example, poor academic performance has been observed to be associated with low parental skills and accomplishments (Dabla-Norris et al., 2015). Inequality is also caused by low employment opportunities in poor societies which are also accompanied by low minimum wages compared to those in rich societies (Carter & Reardon, 2014).

Technological changes and globalization are associated with inequality (European Commission, 2017). The introduction of new technologies is linked with higher productivity. This, therefore, increases the demand for skilled labor thereby eradicating some pre-existing jobs and rendering people with unskilled labor unemployed (Dabla-Norris et al., 2015). Since technologies are mostly developed in advanced nations, underdeveloped nations are always challenged in adopting them due to low levels of skilled personnel to operate those technologies (Narayan et al., 2013). Also, because poor nations adopt almost everything from advanced nations, they are deprived of the ability to develop and use their conceptions (Carter & Reardon, 2014).

Poor governance and weak civil society make it impossible to formulate and implement effective growth policies which lead to deprivation among some groups (Rohwerder, 2016). Also, in societies where human rights are not respected, most people are denied the rights to quality education and healthcare which simultaneously leads to rising inequality of outcomes (Seguino et al., 2013). According to (Narayan et al., 2013), where social and political structures are weak, inequality will replicate itself over time.

2.3 Effects of Inequality

Although inequality provides incentives for people to compete and invest in their lives, it has significant effects (Dabla-Norris et al., 2015). Rising inequality is associated with poor growth (European Commission, 2017). In cases where higher levels of inequality are accompanied by higher levels of poverty, most people have lower opportunities to invest in their capacities (skills, talents, etc.). This therefore makes them unable to reach their full potentials, which significantly reduces overall growth. Higher inequalities deprive many households from accumulating adequate human and physical capital (Dabla-Norris et al., 2015). It reduces educational attainments of poor children which also reduce their levels of knowledge acquisition (Cingano, 2014). Inequality causes political instability as it breeds financial crises, economic imbalances and conflicts (Yang, 2017). It also results in inefficient policy decisions which reduce overall growth (Stewart, 2013). According to Rohwerder (2016), social problems such as theft and violence are common in societies with high levels of inequality. The author further added that inequality reduces the durability of growth, investment and innovations and can also prevent poverty reduction. Higher levels of inequality result in low access to food and quality nutrition by most deprived groups (Stewart, 2013). Inequality causes deprivation and social exclusion (European Commission, 2017; Yang, 2017). According to Stewart (2013), increasing inequality increases poverty and all other

poverty related issues. Where talents, efforts, hard work and creative mindsets are controlled among poor populations, one inequality component leads to the other (Afonso et al., 2015a). Thus, all forms of inequality operate in a vicious cycle if no effective policies are implemented (Martin et al., 2016).

2.4 Measures of Inequality

Effectively understanding inequality requires that the measures are clearly stated. Specifying the measures of inequality assists in formulating specific policies to target specific groups of people, since different inequality measures have different policy implications (Rohwerder, 2016). The widely used measures of inequality are 'vertical' and 'horizontal' inequalities. Vertical inequality measures inequality between individuals or households of a given population or sub-population (Stewart, 2013). For example, measuring income inequality between individuals of a nation, region, province or district. On the other hand, horizontal inequality represents how resources are distributed among different groups of people, such as inequality between different societies or populations, sub-populations or socioeconomic groups (Wargent, 2014). Specific examples include inequality estimates between nations, regions, provinces, districts, communities, or between specific socioeconomic groups in a given community. When estimating vertical inequality, the welfare-based measures (income, wealth, expenditure, etc.) for all individuals or households are used. However, when estimating horizontal inequality, the averages (or per capita) of the welfare-based measures for the various groups are used (Rohwerder, 2016). For instance, when estimating income inequality between communities, per capita income of each community is used, but when estimating gender income inequality, per capita incomes of the various genders are used.

2.5 Approaches for Measuring Inequality and their Interpretations

According to the literature, several indicators are used to measure inequality. All inequality indicators are acknowledged to perform different functions and possess different information due to varying properties (Afonso et al., 2015b). Costa and Pérez-Duarte (2019) argue that selecting an inequality indicator is guided by the researcher's objective. Measuring inequality is classified into three broad categories, which are the 'graphical approach, the 'indices approach' and, the 'ratio and percentile shares' (Afonso et al., 2015b).

2.5.1 The graphical approach

The only graphical approach for measuring inequality is by the 'Lorenz curve', which tells the proportion of a society's income owned by a given proportion of the society's population (Afonso et al., 2015b).

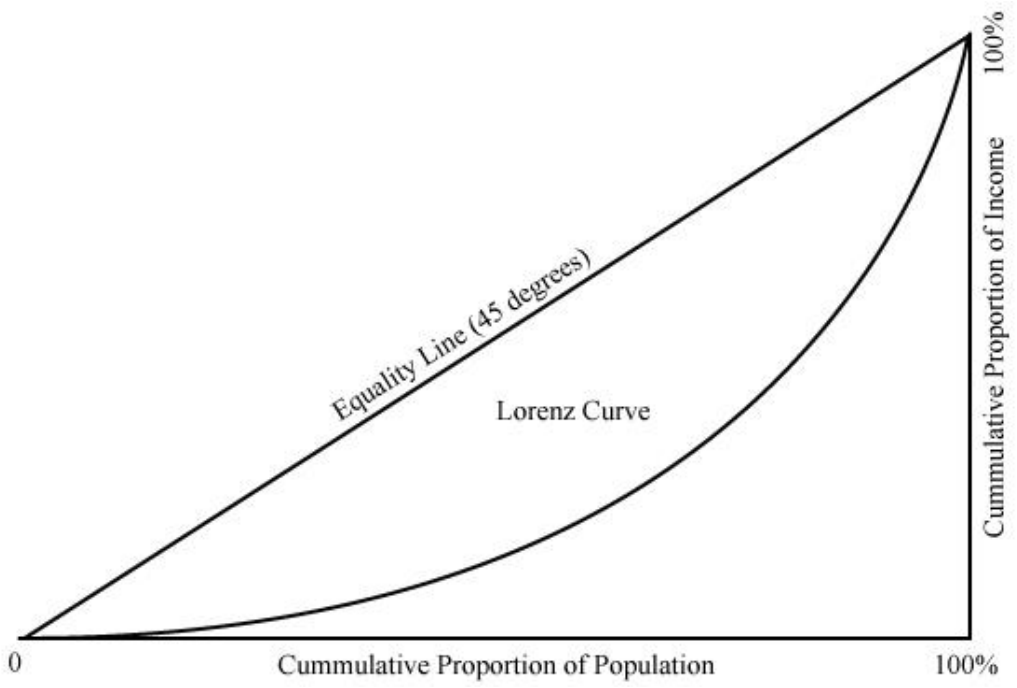

Figure 2.1: Sample Lorenz curve

Source: Author's construct

The Lorenz curve is plotted with the cumulative proportion of the population (from the poorest to the richest) on the horizontal axis and the cumulative proportion of income on the vertical axis. The presentation of inequality by the Lorenz curve is done in relation with the 45 degrees perfect equality line. The curve is interpreted such that, the further away the Lorenz curve is from the equality line, the higher the level of inequality and vice versa. Figure 2.1 depicts a sample Lorenz curve.

2.5.2 The index approach

The widespread inequality indices are the Gini index, Pietra index, the class of Atkinson indices and the family of Generalized Entropy indices. Both the Gini and Pietra indices are intuitively derived from the Lorenz curve. However, while the Gini index measures the normalized area between the perfect equality line and the Lorenz curve, the Pietra index (also known as Hoover index, Schutz index or the Rici index) corresponds to the maximum vertical distance between the perfect equality line and the Lorenz curve (Costa & Pérez-Duarte, 2019). Although the Gini index is frequently cited, the Pietra index has the simplest interpretation. Also, both indices range from 0 (in the case of perfect equality) to 1 (in the case of perfect inequality).

The Atkinson and the Generalized Entropy indices are families of inequality measures where the individual measures are obtained by the aversion parameter (ε) and sensitivity parameter (α), respectively. The Atkinson index is defined as the "normalised ratio of the equally distributed equivalent level of resource to the mean of the actual resource distribution" (Atkinson, 1970). The Atkinson index is the commonest welfare-based inequality measure and measures the proportion of a society's income which needs to be foregone to have an equal level of welfare between members (Afonso et al., 2015b). The family of Generalized Entropy index, on the other hand, measures the maximum entropic distance of resource distribution in an entropic

system (Costa & Pérez-Duarte, 2019). Like the Gini and Pietra indices, the Atkinson index ranges from 0 (in the case of perfect equality) to 1 (in the case of perfect inequality). However, the Generalized Entropy indices range from 0 to ∞ (based on the natural log of the average welfare-based indicator used). Both the Atkinson and the Generalized Entropy indices possess the properties which allow sub-group decomposition. While the class of Atkinson indices satisfy multiplicative decomposability, the family of Generalized Entropy indices satisfy the additive decomposability (Yang, 2017).

2.5.3 The percentile shares and ratios of percentiles

The percentile shares and ratios of percentiles are useful inequality measures but do not possess the properties of inequality indices. The percentile share is defined as the share of total resources owned by a given corresponding percentile of the population (Rohwerder, 2016). For example, the top 10% or the 90th percentile share is the resource share owned by the 90th percentile of the population. Similarly, the bottom 20% or 1st quintile share is the resource share owned by the 20th percentile of the population. The ratios of percentiles alternatively measure the ratio of resource shares for any two given corresponding population percentiles. For example, a P90/P10 tells the ratio by which the income share of the top 10th percentile is greater than the bottom 10th percentile.

2.6 Concept of Inequality Decomposition

Inequality analyses help in assessing and understanding how resources are distributed among groups of people over a given period. To effectively analyse and understand inequality, the concept of inequality decomposition was introduced (Shorrocks, 1982, 1983, 1984). Shorrocks (1984) argued that inequality can be decomposed by subgroups,

income sources, causal factors as well as other sociodemographic characteristics. The widespread inequality decomposition is the subgroup decomposition (Heshmati, 2004). Shorrocks (1984) argues that, when a population or sample is partitioned into subgroups, inequality can be assessed by the between and within groups components (respectively, inter- and intra-group inequality). For example, overall inequality can be assessed by inter- and intra-region at the national level. Similarly, at the regional level, inequality can be assessed by the inter- and intra-district components. Assessing the inter- and intra-group compositions of inequality helps in analysing the expected effects of redistributive policies on the welfare of deprived groups (Heshmati, 2004).

Although several indicators have been used to measure inequality, not all display the properties which allow their decomposability (for example, the percentile shares and ratios, as well as the Pietra index). Although the Gini index has many advantageous properties and is considered the default choice of inequality measure by many, it does not allow proper decomposition by subgroups unless there is no overlapping in individual incomes by subgroups (Costa & Pérez-Duarte, 2019). This is because the Gini index lacks consistency by subgroup since the decomposition is always accompanied by a residual term (Shorrocks & Wan, 2005). Due to this, researchers desire to use other inequality indicators (i.e., Atkinson family and the class of Generalized Entropy indices) to analyse subgroup decomposition and to assess the contributions to inequality from inter- and intra-groups compositions.

2.7 Empirical Review of Global and Regional Inequality

Global and regional inequalities are the distribution of resources among all people in the world and in a given continent respectively (Gradín, 2021). Over the decades, global inequality has become an interesting topic for public debate (Mijs, 2021). Therefore, researchers have developed an interest in assessing how resources are distributed

among the world's population over time and how it is influenced by country-specific policies and global megatrends (Solt, 2020). However, the lack of adequate data makes measuring global inequality complex (Gradín, 2021). Therefore, global inequality is mostly measured by between- and within-country inequality components (Rao et al., 2019). While between-country inequality is the inequality estimate among countries using national level welfare indicators (e.g., per capita GDP), within-country inequality is the inequality estimate among individuals of a specific country using individual welfare indicators.

A Gini trend of between-country inequality shows that there has been a gradual reduction in global inequality, that is, from 68% in 1950 to 61% in 2019 (Gradín, 2021). In Europe, between-country inequality in 2015 was found to be 33.50% using the Gini index (Vacas-Soriano & Fernández-Macías, 2018). Kim et al. (2020) found that the Gini estimate for between-country inequality in Europe is 30.925%. This indicates a reduction in between-country inequality over time. For within-country inequality, Russia has the highest Gini estimate (41.60%) while Ukraine has the lowest (24.60%) among European countries (Kim et al., 2020). Between-country inequality in Asian countries was found to be around 55.0% while the average within-country inequality is around 35% (Rao & Min, 2018).

Even though income inequality has shown a decreasing trend among Latin American and the Caribbean (LAC) countries, about 56% of income is currently owned by the top 10% of the population (Chancel et al., 2022). The Gini estimate between LAC countries is around 47% (Ferreira et al., 2022). Guatemala has the highest (58.2%) Gini estimate among the LAC countries followed by Honduras (57.4%) whereas Uruguay (37.8%) and Venezuela (40.6%) have the lowest (Amarante et al., 2019). About 46% of income in North America is owned by the top 10% with a Gini estimate of about 40% (Chancel

et al., 2022; Ferreira et al., 2022). The rising income inequality in North America is due to the consistent rise in inequality in the United State of America (USA) (Census Bureau, 2021). The USA has the highest inequality estimate (48.9%) among the North American countries and increases averagely by 0.9% per annum (Census Bureau, 2021).

Unlike other countries, income inequality in Australia is neither rising nor declining significantly (Coates & Chivers, 2019). However, about 44% of Australia's total income is owned by the top 20% and records a Gini estimate of about 35% (Davidson et al., 2020a, 2020b). Sulemana and Kpienbaareh (2018) reported that the inequality trend for most African countries exhibits a U-shape trend. In 2014, the between-country inequality in African countries was estimated to be 58.6% (Asongu & Odhiambo, 2019; Ibrahim et al., 2021). Ofori et al. (2022) found between-country inequality in 2020 for African countries to be 48.2%. This indicates a reduction in inequality among African countries.

2.8 Empirical Review of the Impact of Regional and National Inequality

Among 84 mixed countries, Elgar et al. (2020) found that within-country inequality reduces social trust and civic engagement but increases group affiliation. In Europe, Mijs (2021) found that between-country inequality is positively associated with meritocratic belief. In Northern Europe, within-country inequality increases homicide and incarceration rates (Kim et al., 2020). Omar and Inaba (2020) found that within-country inequality reduces financial inclusion among developing countries. Demir et al. (2019) reported that the high carbon dioxide gas emission in Turkey is influenced by high levels of income inequality. In Africa, within-country inequality increases the corruption index and decreases natural resource rent and national income per capita (Sulemana & Kpienbaareh, 2018). Asongu and Odhiambo (2019) reported that

inequality within African countries reduces mobile phone and internet penetration. Also, inequality within African countries increases violent crime (Adeleye & Jamal, 2020) and reduces financial depth, financial efficiency and financial stability (Tchamyou, 2021).

2.9 Empirical Review of Factors Influencing Regional and National Inequality

Sulemana et al. (2019) found that inequality increases with urbanisation but reduces when there is trade openness. GDP per capita is found to increase inequality (Kunawotor et al., 2020; Sulemana et al., 2019). Literature shows that while school enrolment reduces inequality (Kunawotor et al., 2020; Tchamyou et al., 2019), education expenditure increases it (Rao et al., 2019), creating a contradiction between education enrolment and expenditure. Rao et al. (2019) also found that inequality reduces with the share of labour income and health expenditure but increases with total factor productivity. Tchamyou (2021) found that money supply and liquid liability reduce inequality. The financial depth and financial inclusion, as well as remittances were found to reduce inequality (Omar & Inaba, 2020; Tchamyou et al., 2019). Age dependency, natural disasters, foreign direct investment and long-life learning were found to increase inequality (Dorn et al., 2022; Tchamyou, 2021) but social safety net had a negative influence on inequality (Owoo et al., 2020). Ofori et al. (2022) found that ICT diffusion, economic development and tourism as well as political stability reduces inequality while globalization and human capital increase it. Kunawotor et al. (2020) also reported inequality in the previous period and government expenditure increase inequality while capital formation and natural resource rent play important roles in reducing inequality.

2.10 Indicators for Measuring Household Food (In)Security

During the 1996 World Food Summit, food security was defined as *"a situation where all people, at all time, have physical, social and economic access to safe, sufficient and nutritious foods that meets their dietary needs and food preference for a healthy life"* (Ballard et al., 2014). This means measurement of food security involves several dimensions. The four main dimensions or pillars of food security include; availability, accessibility, utilization and stability. It would be logical and desirable to have a food security indicator that factors all these pillars into the operationalisation of food security, however no such metric exists.

To avoid the challenges associated with adopting only one indicator, a variety of food security indicators have been developed. Some of these indicators are national level indicators and are inappropriate for individual and household studies (e.g., Dietary Exposure Assessment, Domestic Food Price Index, Food Availability Index, Fresh Food Retail Volume, Shannan Entropy Diversity Metric, Population Share with Adequate Nutrients, Prevalence of Undernourishment, Volatility of Food Prices etc.). Among several household food insecurity indicators, only a few are consistently used in the food insecurity literature. This is because most of the household indicators have several draw backs or are not easily measured. For instance, the 'Household Average Dietary Energy Consumption', 'Household Dietary Energy Share from Macronutrients' and 'Household Dietary Energy Share from Non-staples'. Using these indicators require measuring the weight of food consumed by households, so it can easily be converted into dietary energy (kcal) using a Food Composition Table. However, most households do not measure the weights of food they consume, making these indicators somehow impractical.

Even though all food insecurity indicators have some drawbacks, some are consistently used in the literature. Among the consistently used food insecurity indicators, four are experience-based. These are the Household Food Insecurity Access Scale (HFIAS), the Household Hunger Scale (HHS), the Latin American and the Caribbean Food Security Scale (ELCSA) and the Food Insecurity Experience Scale (FIES).

The HFIAS was developed by the USAID, in partnership with FAO, and Tufts and Cornell Universities, during the Food and Nutrition Technical Assistance II (FANTA II) project between 2001 and 2006 (Ballard et al., 2011). The HFIAS was created from a short questionnaire which consists of nine food consumption experience questions and their frequency of occurrence. Respondents are asked whether they have ever experienced a given situation. Based on their responses (yes or no), they are either or not asked how frequently (rarely, sometimes or often) they experience such a situation.[1] The potential score for a question is 0-3 points, which result in 0-27 points for all nine questions. Complete details for categorization of the HFIAS (food secure, mildly food insecure, moderately food insecure and severely food insecure) are provided in Coates et al. (2007). The weakness of the HFIAS is that some questions do not meet the psychometric criteria for cultural invariance (Deitchler et al., 2010). The questions in the HFIAS serve as reference questions for all other experienced-based indicators.

Due to the weakness of the HFIAS, the HHS was developed during the FANTA III project (Ballard et al., 2011). The HHS uses three hunger experience questions (verified to be culturally invariant) from the HFIAS. However, the occurrence frequency points are assigned differently from that of the HFIAS.[2] This makes the potential score for each question 0-2 points and a total HHS score of 0-6 points for all three questions. The

[1] The frequency of experience (rarely, sometimes and often) is assigned 1, 2 and 3 point(s) respectively.
[2] Rarely and sometimes are assigned 1 point, while often is assigned 2 points.

HHS is categorized as little to no hunger (0-1 point), moderate hunger (2-3 points) and severe hunger (4-6 points).

The ELCSA was developed from the HFIAS and the US Household Food Security Survey Module (US HFSSM) in 2010 to measure food insecurity in the Latin American and Caribbean regions (Ballard et al., 2011). The ELCSA uses fifteen food consumption experience questions (with yes or no responses), of which seven questions are designed for households with children. Each question is assigned 1 point (for affirmative response), which results in 0-8 points for households without children and 0-15 points for households with children.

The last experience-based indicator is the FIES, which was developed by the FAO during the Voice of the Hungry (VoH) project in 2013. The FIES uses 8 questions, which are obtained from the HFIAS and the adult-referenced questions of the ELCSA (Ballard et al., 2013). The method for constructing the FIES is grounded in the Item Response Theory and is detailly discussed in Chapter Three of this thesis.

The Food Consumption Score (FCS) and the Household Dietary Diversity Score (HDDS) are indicators that measure the diversity in food consumption. Dietary diversification is important as it increases the likelihood of consuming adequate micronutrients (such as vitamins, calcium, iron and among others) which help in improving health and anthropometric statuses (Kennedy et al., 2011). The FCS was developed in 1996 by the World Food Programme (WFP). The FCS uses 8 food groups and asks respondents to indicate the frequency at which they consume those food groups in the previous seven days. These 8 food groups are assigned different weights based on their relative nutritional values. The FCS is obtained by summing the products of consumption frequency (in days) and the weights assigned to the various food groups (see Swindale and Bilinsky (2006) for detailed explanation and measurement).

Like the FCS, the HDDS also measures the diversity in foods consumed. The HDDS was released in 2006 as part of the FANTA II project. The HDDS uses 16 food groups which are aggregated to obtain 12 standardized food groups in total due to the similarities in some food groups (Swindale & Bilinsky, 2006). The 12 food groups used in estimating HDDS are Cereals, Roots and tubers, Vegetables, Fruits, Eggs, Meat, poultry and offal, Milk and milk products, Pulse, legumes and nuts, Oil and fats, Fish and seafoods, Sugar and honey and Miscellaneous foods. All food groups are treated equally and assigned a point each if consumed by a household in a given period, usually 24 hours (Swindale & Bilinsky, 2006). The HDDS is obtained by simply counting the food groups consumed and is expected to range from 0 to 12 points for every household. Even though the methods for estimating the FCS and HDDS are quite dissimilar, their scores are highly correlated (Kennedy et al., 2011; Swindale & Bilinsky, 2006).

Another food insecurity indicator is the Household Food Expenditure Share (HFES), which is used as a proxy for income. As the name suggests, it measures the proportion of food expenditure in household total expenditure. The HFES follows the Engel's law with the assumption that poor and vulnerable households spend a greater proportion of their incomes on food.

2.11 Empirical Review of Food Insecurity Status Globally

Literature shows that food insecurity is low in high-income countries (Holleman & Conti, 2020; Hossain et al., 2021; Loopstra, 2018). This is true as Jessiman-Perreault and McIntyre (2017) employed the FIES and found that only about 12% of Canadian adults are food insecure. Using the same indicator, Men et al. (2020) and Tarasuk et al. (2019) also found that about 11% of Canadian households are marginally to severely food insecure. In America, Morales et al. (2021) found that about 17% of white households are food insecure.

However, food insecurity remains a challenge in underdeveloped societies. In Latin America and the Caribbean for instance, Cordero-Ahiman et al. (2020) employed the ELCSA and found that about 72% of rural households in the Paute River Basin of the Azuay Province of Ecuador were mildly to severely food insecure. Analysis with the ELCSA also shows that about 73% of Mexican households are mildly to severely food insecure (Kolovos et al., 2020). Tomayko et al. (2017) used two validated items from the HFSSM and found that about 61% of Indian households in America are food insecure. In Dominican Republic, an estimate from the FIES shows that about 68% of households are severely food insecure (Wallace et al., 2020).

In Indonesia, the HFIAS reveals that about 58% of households with stunted children or obese mothers are mildly to severely food insecure (Mahmudiono et al., 2018). Joshi et al. (2019) employed the HFIAS and found that about 45% of urban Indian households in slum settings are mildly to severely food insecure. With the same indicator, 44.2% of Pakistan households are severely food insecure (Shahzad et al., 2021).

In the East Africa, Gebre and Rahut (2021) employed the HFIAS and found that 52%, 50% and 40% of households are food insecure in Tanzania, Kenya and Ethiopia respectively. With the HDDS, about 77.2% of Ethiopian households have acceptable to moderate dietary diversity, while the HFIAS shows that about 72.9% are food insecure (Engidaye et al., 2019)

In South Africa, Tomita et al. (2019) used the HFIAS and observed that about 21% of individuals with multi-drug resistance tuberculosis are food insecure. Abrahams et al. (2018) estimated from the HFSSM that about 42% of pregnant women in South Africa are food insecure. Crush et al. (2019) used the HFIAS and found that in Windhoek, Namibia, about 94% of households are mildly to severely food insecure.

In West Africa, Sweetland et al. (2019) employed the FIES and found that about 35%, 31% and 30% of individuals in Nigeria, Uganda and Ghana, respectively, are moderately or severely food insecure. Longitudinal evidence from the HHS showed that about 16% of Ghanaian children are transitory and persistently food insecure (Aurino et al., 2020). Tuholske et al. (2020) employed that HFIAS and found that about 58% of households in Accra, Ghana are moderately or severely food insecure. Lambon-Quayefio and Owoo (2021) also found that the average Food Expenditure Share in Ghanaian households is 62.5%, indicating a medium level of vulnerability.

2.12 Empirical Review of the Effects of Food Insecurity

Studies have reported that food insecurity affects mental health. Kolovos et al. (2020) found that food insecurity is more likely to cause depressive symptoms among the Mexican population. A study conducted among Canadian adults shows that food insecurity increases mental health disorders (Jessiman-Perreault & McIntyre, 2017). Abrahams et al. (2018) found that food insecurity influences major depressive episodes, anxiety disorder and suicidal behaviors among pregnant South African women. Food insecurity increases mental distress in Nigeria (Sweetland et al., 2019).

Food insecurity also affects nutritional health. Severe food insecurity causes child nutritional deficiency in India (Chandrasekhar et al., 2017). Food insecurity contributes to child stunting and obese mothers in Indonesia (Mahmudiono et al., 2018). According to Engidaye et al. (2019), food insecurity is likely to influence anaemia among preschool aged children in Ethiopia. In South Africa, Chakona and Shackleton (2018) also found that food insecurity is associated with stunting and being underweight among children.

The food insecurity implications of academic performance is reported in the literature. Seidu et al. (2022) reported that the level of truancy is high among food insecure adolescents in Seychelles. In Ghana, Aurino et al. (2020) found that food insecurity reduces literacy, numeracy and short-term memory. Masa and Chowa (2021) also found that food insecurity reduces academic achievement and self-efficacy as well as attendance and commitment to schooling among school-going adolescents in Ghana.

2.13 Empirical Review of Factors Influencing Food Insecurity

Climatic conditions affect food production and food availability at the national level which is likely to increase food insecurity at the household and individual levels. Using an ordered probit regression model, Gebre and Rahut (2021) found that Kenyan, Ethiopian and Tanzanian farmers who are vulnerable to dry spell are more likely to be food insecure. Hossain et al. (2021) used a national panel data and employed the Prais-Winsten regression model. They found that state welfare spending per capita reduces food insecurity among OECD countries. Burris et al. (2021) employed a logistic regression model and found that old adults who benefitted from Supplemental Nutrition Assistance Program (SNAP) in the United States have higher levels of food insecurity while those receiving cash support have lower levels of food insecurity. Similarly, in Sub-Sahara Africa, Dasgupta and Robinson (2022) found that households that receive food safety nets are more food insecure while those that receive cash safety nets are food secured. In Perth, Western Australia, Hardcastle and Caraher (2021) employed a chi-square analysis and found that food bank participants of the Margaret Court Community Outreach (MCCO) are more food secured than non-participants. Chakona and Shackleton (2019) also found that households that receive social grants are more likely to be food insecure. Results from an endogenous treatment regression model showed that, in Ghanaian households where children are exploited through many forms

of works, food insecurity is high (Lambon-Quayefio & Owoo, 2021). Mabe et al. (2021) used an endogenous switching regression with ordinal outcomes and found that awareness of SDG2 reduces food insecurity among Ghanaian households.

Regarding socioeconomic factors, income poverty is one key determinant of food insecurity (FAO et al., 2021). Empirical literature shows that individual, household and national income reduces food insecurity (Abrahams et al., 2018; Holleman & Conti, 2020; Hossain et al., 2021; Morales et al., 2021; Tarasuk et al., 2019). Assets depict the wealth of a household. The wealthier a household is, the lower the levels of food insecurity (Chakona & Shackleton, 2018; Saaka et al., 2017; Tuholske et al., 2020).

Employment increases income which translates to low levels of food insecurity (Holleman & Conti, 2020; Morales et al., 2021; Saaka et al., 2017). Achieving higher levels of education is also found to reduce food insecurity (Dasgupta & Robinson, 2022; Gebre & Rahut, 2021; Joshi et al., 2019; Santos et al., 2022; Tomayko et al., 2017).

In large size households, more members struggle to meet their basic food needs rendering them food insecure. This is evident as literature reports a positive association between household size and food insecurity (Abrahams et al., 2018; Chakona & Shackleton, 2018; Cordero-Ahiman et al., 2020; Gebre & Rahut, 2021; Holleman & Conti, 2020; Joshi et al., 2019; Lambon-Quayefio & Owoo, 2021; Morales et al., 2021; Saaka et al., 2017; Tomayko et al., 2017; Tuholske et al., 2020).

Generally, older household heads have more resources than younger household heads. However, beyond a certain age, the household heads become vulnerable to economic shocks due to their inability to work. Therefore, the effect of age on food insecurity is not straightforward. While some literature finds that age reduces food insecurity (Cordero-Ahiman et al., 2020; Mabe et al., 2021; Morales et al., 2021; Tomayko et al.,

2017), others find the reverse relation (Gebre & Rahut, 2021; Holleman & Conti, 2020). Averagely, male household heads have more resources and therefore are likely to be more food secure than female household heads (Dasgupta & Robinson, 2022; Shahzad et al., 2021; Tomita et al., 2019).

Remittances or social supports are supposed to increase household income which will translate to having a high food security status. However, the effect of food insecurity is not consistent, especially with different food insecurity indicators. Shahzad et al. (2021) found that social aids or supports reduce food insecurity, while Cordero-Ahiman et al. (2020) also found that human development bonus reduces food insecurity. These studies argue for the importance of social support and remittances in reducing food insecurity. Other studies found that households that receive social assistance and grants are more likely to be food insecure (Tarasuk et al., 2019; Tomita et al., 2019). The reason could be that the assistance and grants are to help them cope with poverty and not to eradicate it. But other studies contradict these findings. For example, Morales et al. (2021) found that households that receive free groceries have high HDDS but more likely to experience food insecurity. Tuholske et al. (2020) also found that remittances increase household food consumption score but increases the likelihoods of experiencing food insecurity.

CHAPTER THREE

METHODOLOGY

3.0 Chapter Outline

This chapter is structured into eight sections. Section 3.1 discusses topical issues of the study area, section 3.2 states the research designs used for the study while section 3.3 discusses the data type and source used for the study as well as the sampling units. Sections 3.4 and 3.5, respectively, discuss the theoretical and conceptual frameworks upon which this study is built. Section 3.6 discusses the operationalization of the key variables (income inequality and food insecurity at the household- and community-levels) in this study. The analytical and empirical techniques used in acheiving the objectives are explained in section 3.7 while the descriptions and measurements of all independent variables used in the econometric modeling are provided in section 3.8.

3.1 Study Area

3.1.1 Geography and climate

Ghana sits in the south-central region of West Africa and shares boundaries with Cote d'Ivoire to the west, Togo to the east, Burkina Faso to the north and the Gulf of Guinea to the south. The country coversa total land area of about 239,000 km^2, and lies between latitudes 4.50°N and 11.50°N and longitude 3.50°W and 1.30°E (World Bank, 2021). About 11% (26,625 km^2) of its land is covered by natural and seasonally flooded lakes (UNDP, 2019). The country is categorized into six agro-ecological zones which fall under two broad ecological zones (World Bank, 2021). The Tropical Forest, Coastal Savannah, Moist Semi-Deciduous and Transition zones fall under the Southern zone while the Guinea Savannah and Sudan Savannah zones fall under the Northern Savannah Ecological zone. The ecological zones are categorized based on varying climatic conditions they experience. The Northern zone experiences a unimodal rainfall

pattern with an average annual rainfall of 960.9 mm, whereas the Southern zone experiences a bimodal rainfall pattern with an average annual rainfall of 1208.1 mm (Röhrig & Lange, 2020). Ghana also experiences an average temperature of 27.75^{o}C (28.2^{o}C and 27.3^{o}C for the Northern and Southern zones, respectively). At extremely hot seasons, the Northern zone experiences a maximum temperature greater than 35^{o}C. The mean annual temperature is projected to rise by approximately by 1.8^{o}C in 2030 if greenhouse gas emissions are not controlled (Röhrig & Lange, 2020).

3.1.2 Population, labour force and employment

The recent population and housing census (PHC) reveals that there are over 30.8 million people in Ghana with a population density of 129 people per km^2 (GSS, 2021a). The urban population constitutes about 57%. In Ghana, the female population (50.70%) is slightly higher than the male population (49.30%), while the Greater Accra Region is the most populated (17.70%). Before the end of 2021, Ghana's labour force population was nearly 14 million, with about 4.65% being unemployed (World Bank, 2022).

3.1.3 Education and health

The proportion of literates (people who can read and write any language) at age 6 years and above are about 69.80%. However, about 96% of this population group can read and write the English Language while 52.80% can read and write other languages (GSS, 2021b). In addition, the gross enrolment rate for those aged 3 years and above is about 79% with Greater Accra leading (91.0%). Ghana's life expectancy currently stands at 64.35 years after a consecutive increase by an average of about 0.26 (0.4%) years annually since 2017 (World Bank, 2022). The increasing life expectancy is explained by a decline in mortality rate due to the consecutive declines in the incidence of malaria,

child and maternal anemia, tuberculosis and other killer diseases over the same period (World Bank, 2022).

3.1.4 Agriculture and food security

Agriculture is one of the important economic sectors in Ghana as it is the major source of food and raw materials for other sectors. In 2020, agriculture employed about 29% of Ghana's total active labour force and contributed about 19.25% to its GDP. The income obtained from agriculture stood at GH₵12,698 million in 2020, indicating a 7.39% growth ahead of 2019 (World Bank, 2022). Although Ghana exports significant amounts of agricultural raw materials and vegetables to other nations, its import value of food and other agricultural related commodities is massive. For example, ITA (2022) reports that Ghana's food and agricultural import reached US$1.9 billion in 2021 and will continue rising as its population increases and food processing sector remains underdeveloped. Food programmes implemented to cut down food imports and increase national food sufficiency confirmed that there is an increase in production for some staple food (MoFA, 2018). Yet, some Ghanaians find it challenging to meet their food needs. This is evident as about 50.2% of Ghanaians are moderately to severely food insecure leading to an increased prevalence of diet-related diseases (FAO, 2021).

3.1.5 Economy, poverty and inflation

Recent statistics show that Ghana's economic growth rate declined to 0.41% in 2020 from 6.50% and resulted in a GDP of US$ 68.5 billion (GH₵ 391.9 billion) due to the COVID-19 pandemic lockdown (MOFEP, 2022; World Bank, 2022). This had massive impacts on households and it increased the poverty rate by about 2.0%. Following the pandemic, Ghana suffered debt discomfort as its overall fiscal deficit and public debt to GDP elevated to 15.2% and 81.1% respectively. After some important alliances,

overall fiscal deficit to GDP reduced to 11.3% in the first half of 2021. Due to a consistent increase in exchange rate as well as food and non-food price escalation, inflation stood at 16.3% in the first quarter of 2022 and continued to about 32% in July (GSS, 2022).

3.2 Research Design

The study also employed two quantitative research designs (i.e., descriptive and causal-comparative research design). Quantitative research design is a formal and systematic empirical investigation of observable phenomena by statistical, mathematical or computational techniques (Marczyk et al., 2010). Kumar (2018) stated that quantitative research designs are precise, well organized, have been tested for their validity and reliability and can be clearly defined. According to Leedy and Ormrod (2019), a quantitative research design involves the subjection of quantified data to statistical treatment in order to support or contradict other knowledge claims. The utmost advantage of the quantitative research design is that its methods produce consistent and measurable data that can be generalized to a large population (Marshall, 1996).

Descriptive research design helps to describe a phenomenon and its characteristics. Descriptive research is more concerned with ‘what’, ‘how much’ or ‘how many’ rather than ‘how’ or ‘why’ something happened (Nassaji, 2015). In descriptive research, the data is often analyzed using frequencies, percentages, averages, differences or other statistical analyses which does not determine correlation or causation between variables (Apuke, 2017). In this study, descriptive research design was employed to provide summary statistics or describe the quantitative characteristics of the variables of interest in the study.

On the other hand, a causal-comparative research design tries to identify and determine the causal effect of independent variables on a dependent variable or reasons for pre-existing differences among groups of individuals (Apuke, 2017). In a causal-comparative research design, the outcome variable is directly observable and the main concern of the researcher is to find out the determinants (independent variables) that give rise to changes in the outcome variable (Salkind, 2010). In addition, the independent variables in this research are not subjected to treatments or manipulations. This study used a causal-comparative research design to help estimate the effects of socio-economic and other determinants on income inequality and food insecurity.

3.3 Data Type, Source and Sampling

This study used secondary data, obtained from the Ghana Living Standard Survey Round 7 (GLSS7) of the Ghana Statistical Service (GSS). GLSS is a multi-functional, nation-wide household survey that offers a wealth of data in assessing the living conditions of Ghanaian households (GSS, 2019). The survey took place over a period of 12 months (from October, 2016 to October, 2017) by sampling 1,000 enumeration areas and a total sample size of 14,009 households from the previous 10 administrative regions using probability proportion to size (PPS) sampling. This dataset contains information from three different questionnaires (household, community and price questionnaires). The household questionnaire is made of 4 different modules (Modules A, B, C and D) with about 13 sections ranging from demographic characteristics of household members, income and expenditure patterns of households, households' food security status to governance, peace and security. The community questionnaire comprises of information on available infrastructures in various communities while the price questionnaire sought information on market prices of food and non-food items.

Income is the core variable for this study. Also, inequality cannot be estimated for only one income source. Hence, a sub-sample of 2,737 households was created for intra-household inequality analysis, since they have at least two income sources (two or more household members earn income) that satisfy the preconditions for inequality estimation. Also, 749 communities in Ghana were used for inter-household inequality analysis due to successful identification and matching of household characteristics and community information.

3.4 Theoretical Framework

3.4.1 Theory of intra- and inter-household inequality

The theoretical framework used by Haddad and Kanbur (1989) in addressing the consequences of neglecting intra-household inequality was adopted. The object for this inequality analysis is income. An individual's income might comprise of income from businesses, enterprises, equities, investments, wages, salaries and non-labour income (remittances, miscellaneous incomes etc.).

To proceed, let y_i denote individual income, where, $i = 1, 2, \dots n$ represents the individuals in the sample with positive incomes and n is the total number of individuals. If the total income in the sample is given as $\sum y_i$, then the average income ($\bar{y}$) in the sample equals $\sum y_i / n$. Now, let $j = 1, 2, \dots m$ denote households with m as the total number of households in the sample. If a household's total income (y_j) is the sum of all individual incomes in household j (i.e., $\sum y_{ij}$) and the number of individuals in the household is denoted by n_j, then the average household income ($\bar{y}_j$) equals $\sum y_{ij} / n_j$.

To accurately measure overall income inequality denoted as I, it is important to consider inter- (between, I_B) household and intra- (within, I_W) household income inequalities as the components of overall income inequality. Overall income inequality

is a function of all individual incomes, y_i. Kanbur (2016) argued that if each individual in a household is given the average income of that household for estimation, the overall income inequality, I will be equal to the inter-household income inequality, I_B. This is because individuals within households will be assumed to have equal incomes and there will be no income inequalities within the households. Therefore, the intra-household component of inequality will be zero (i.e., $I_W = 0$). This indicates that overall income inequality will be underestimated if the intra-household component is suppressed (i.e., by giving each individual their average household income).

To further prove the nature of the under-estimation with mathematical representation, Haddad and Kanbur (1989) introduced the density functions of individual incomes (y) and average household income ($\bar{y}_j$) when assigned to each individual in households. For simplicity, the average household income ($\bar{y}_j$) assigned to each household individual will be denoted as x. The density of y is specified conditioned on x as $a(y|x)$, which captures the inequality within a household with average income x (Haddad & Kanbur, 1989). If the marginal density of x in the population is denoted as $p(x)$, then the density of y in the population, $f(y)$ can be specified as:

$$f(y) = \int a(y|x)p(x)dx \qquad (1)$$

Also, given a convex function $h(.)$, it is expected that:

$$E[h(y)] = \int \left[\int h(y)a(y|x)dy\right]p(x)dx \;\geq\; E[h(x)] = \int h(x)p(x)dx \qquad (2)$$

where, $E[h(y)]$ and $E[h(x)]$ are the expected convex functions for the distribution of y and x, respectively. Expression (2) indicates that the convex function under the distribution of y is greater than that of x. Hence, the area bounded by the 45° equality line and the Lorenz curve will be greater for the distribution of y than that of x. This

means that total income inequality will be underestimated if income inequality within households is suppressed. Therefore, it is important to address the various compositions of income inequality.

Furthermore, to assess the decomposition of total income inequality, Haddad and Kanbur (1989) considered the coefficient of variation because if the mean of y and x are equal, the variance can be used as the measure of inequality. From (1) and (2), the overall income inequality can be specified as;

$$V(y) = \int V(y|x)p(x)dx + V(x) \quad (3)$$

where, $V(x)$ is the inter-household component and $\int V(y|x)p(x)dx$ is the intra-household component.

3.4.2 Item Response Theory

The Item Response Theory (IRT) is a family of mathematical models that attempt to interpret the relationship between latent traits (unobserved characteristics) and their observed manifestations (Reise et al., 2011). The IRT offers a set of theoretical base and statistical techniques that analyze a given set of survey items by creating a trait scale from those items and comparing the performance among various populations and survey contexts (Nord, 2014). IRT is the dominant measurement theory primarily designed to test for aptitude and achievement, but has however become the widespread psychometric method, receiving extensive applications in the measurement of attitude, behavior as well as health outcomes (Glockner-Rist & Hoijtink, 2003; Reise et al., 2011). IRT focuses on how different survey test items function in assessing certain latent traits of people (Thorpe & Favia, 2012). According to Reeve et al. (2007), IRT describes the relationship between a person's response to a survey question/item and his/her latent trait that the scale measures. IRT helps in studying the relation between

individual differences on a latent trait variable which inspire item responses and the probability of responding in a particular response category (Reise et al., 2011). This makes it easy to estimate parameters for each item using his/her underlying level of latent trait variable that is being measured (Yang, 2014). The optimal purpose of this theory is to create a multi-item scale for evaluating latent variables that are not directly measured (Embretson & Reise, 2004).

In testing for the latent trait of subjects, IRT mostly makes use of multiple binary response items (coded 1/0 for example, correct/incorrect, positive/negative, yes/no, true/false, affirmed/denied, etc.), but also use ordinal response items in different contexts. The basic hypothesis of the IRT is that a continuous measure of the latent trait should be obtained from the binary response items used in the test, so that the probability of responding correctly or affirming to an item with a particular level of difficulty depends on the latent trait of the subject (Ballard et al., 2013). Although the IRT is commonly used in educational and psychological testing fields, it was proposed as an appropriate analytical technique for processing and analysing information that will lead to computing food insecurity experience along a continuum scale (Ballard et al., 2013). The IRT was, hence, adopted by Ballard et al. (2013) to assess the prevalence of food insecurity in FAO's Voices of the Hungry (VoH) project.

If X_h represents the observed food insecurity items, β_h represents the difficulty level of affirming to these food insecurity items and θ_i represents the latent food insecurity trait level of subjects (households), then the probability that a household i will affirm to an observed food insecurity item h can be specified as:

$$\Pr\left(X_{h,i} = 1|\theta_i, \beta_h\right) = F(\theta_i, \beta_h) \quad (4)$$

where, $F(\cdot)$ is the Item Response Function (IRF). The IRF provides statistical basis for estimating both the items' difficulty parameter (β) and the subjects' trait score (θ) and uses a maximum likelihood estimation (MLE) to estimate the likelihood of responding correctly or affirming to different test items (Jumailiyah, 2017)

3.5 Conceptual Framework

The underlying causes of food insecurity, according to The State of Food Insecurity (SOFI) reports, are poverty and higher food prices (FAO et al., 2019, 2020). Increasing prices decrease the purchasing power of people thereby making some to have less access to sufficient foods that meet their basic food needs. People living in poor societies or households, on the other hand, always struggle to meet their food needs. Recent SOFI reports documented that income inequality can significantly influence food insecurity (FAO et al., 2021). Therefore, the three underlying causes of food insecurity are poverty, higher prices and income inequality. However, more attention is given to income inequality, since it is an important concept in this study.

It is noticed that living standards are high in urban areas than in rural areas and where there are more infrastructure and people, living standards increase due to increasing opportunities. Also, due to the increasing opportunities in high living standards areas, they receive more infrastructures (such as schools, quality roads, processing industries, etc.) and people are forced to migrate to such areas, thereby increasing population. These therefore infer a two-way link between living standard and household settlement. In urban and areas with more infrastructure, people are exposed to social opportunities. This is likely to increase immigration rate and population simultaneously. These alongside with living standards are likely to influence food insecurity. The demographic characteristics of the household head could influence household decision making in resource mobilisation so as to meet the needs (including food) of the household.

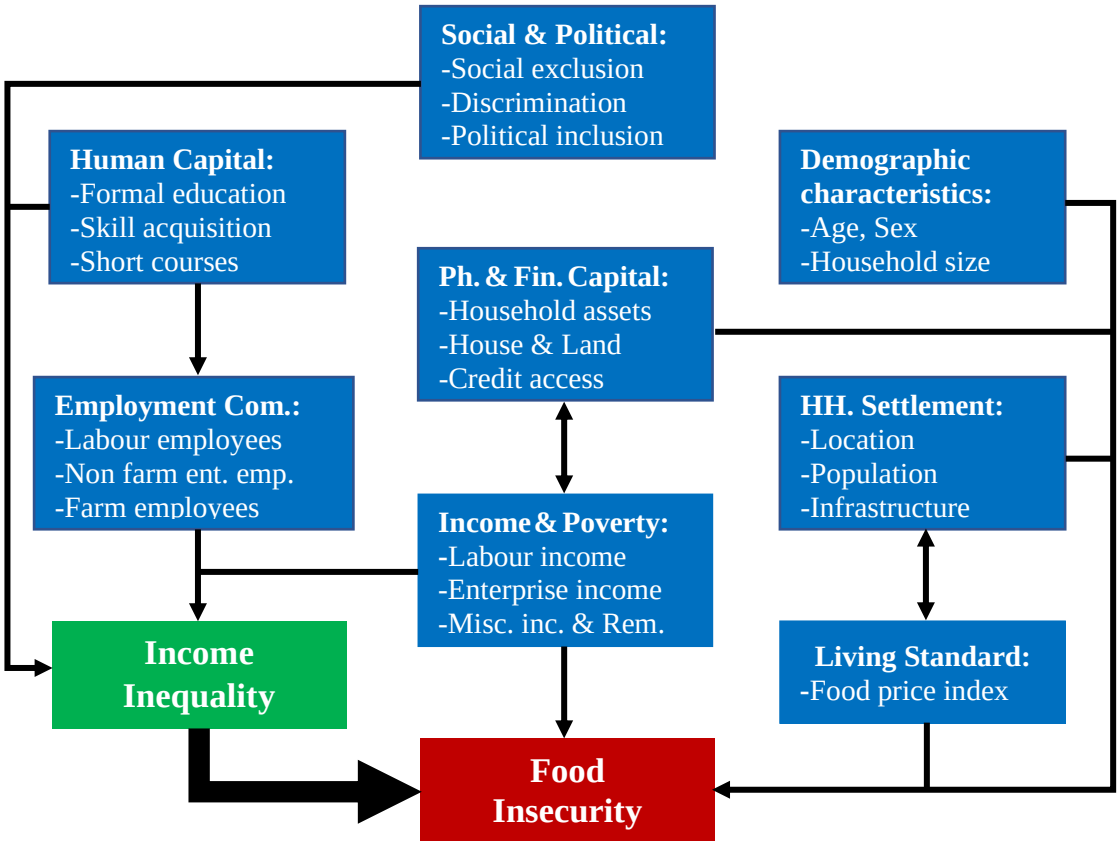

Figure 3.1: Framework linking income inequality, food insecurity and other factors

Source: Author's conceptualization

Physical capital consists of physical or liquid assets (e.g., land, house, furniture, etc.) that can be used for production activities. Physical capital, together with financial capital (credit access), can be used for financial investments in order to yield income and also increase the food security status of households. Alternatively, households with more income have higher capacities to afford productive inputs (e.g., land, houses, farm machineries, etc.) for investment, which will yield more income and reduce food insecurity at the same time. Thus, there is a reverse link between household income and physical and financial capital. Various income streams such as remittances, miscellaneous income and labour income increase total household incomes and may be used as determinants of income inequality within households since they target individual household members.

Human capital (e.g., education, skill acquisition, etc.) improves experience that influences the employment status of individual members, which will correspondingly influence the income and inequality levels of members in various households. When people are discriminated or socially excluded, they are denied the rights to valuable opportunities due to social stratification. On the contrary, political participation leads to social recognition and exposure to opportunities. These however influence income differences among individuals and households.

3.6 Operationalisation of Key Variables

3.6.1 Income inequality

3.6.1.1 Intra-household income inequality

The concept of intra-household inequality was introduced by Sen (1973). He argues that inequality estimate between two individuals randomly selected from a household can be used to represent inequality within (intra) the household. Hence, some studies estimate inequality among spouses as the representation of intra-household inequality. For example, Chiappori and Meghir (2015) and Molina et al. (2018) estimated intra-household inequality between spouses using their expenditure. Malghan and Swaminathan (2020) also analyzed intra-household inequality between spouses using their gross incomes. Other studies vary their choice of individuals in their analyses. For example, Echeverría et al. (2019) analysed intra-household welfare inequality between adults and children using their average consumption expenditure while Lechene et al. (2019) used husband, wife and child for households with a couple and only a child.

In this study, income is a central component of the analysis. Hence, annual income (GH₵) from household members were used. Since inequality cannot be estimated for a single member household, the target households are those with at least two members with positive income (i.e., labour income, farm income, non-farm self-employed

income, income from equity capitals/investments, remittances, miscellaneous incomes, etc.). Labour income in this study represents incomes obtained by supplying labour to another person or organisation (wage, salary, commission, etc.). Farm income represents incomes obtained from working on personally owned or a household farm while non-farm enterprise income represents incomes obtained for operating personally owned enterprise or working in household enterprises other than agriculture.

Let $j = 1, 2, \ldots m$ denote households with m as the total number of households in the sample. Denote the household members with positive incomes with $i = 1, 2, \ldots n_j$, so that n_j represents the total number of members with positive income in household j. If y_{ij} is the income of individual i in household j, then the average income of household $j \left(\sum y_{ij} \Big/ n_j\right)$ can be represented by $\bar{y}_j$. Therefore, intra-household income inequality for each household j using the Gini index is specified as:

$$G_j = \frac{\sum_{i=1}^{n_j} \sum_{r=1}^{n_j} |y_{ij} - y_{rj}|}{2n_j^2 \bar{y}_j} \tag{5}$$

where, $|y_{ij} - y_{rj}|$ is the absolute income difference between all possible combination of two members from household j. Due to the difficulty of achieving possible combination for households with large members, Shorrocks (1983) developed other Gini estimates which yield the same results as (5). These are given as:

$$G_j = \frac{\sum_{i=1}^{n_j} (2i - n_j - 1) y_{ij}}{n_j^2 \bar{y}_j} \tag{6}$$

where, i represents individuals' position in household j when their incomes are arranged in ascending order of magnitude.

3.6.1.2 Inter-household income inequality

To operationalize inter-household income inequality, the households are structured into sub-groups (i.e., communities). Let $c = 1,2, \dots k$ denote community with k being the total number of communities in the sample. Let $j = 1,2, \dots m_c$ also denote households with m_c being the total number of households in community c. Let $y_j \; and \; \bar{y}_j$ represent the total and mean income of any household j respectively. Let μ_c represent the average per capita household income of any community c. The Gini estimate for the inter-household income inequality mimics that of the intra-household or overall inequality estimate but there are slight differences in the notations. Therefore, the inter-household Gini estimate mimicking (6) can be mathematically presented as:

$$G_c = \frac{\sum_{j=1}^{m_c}(2j - m_c - 1)\bar{y}_{jc}}{m_c^2 \mu_c} \tag{8}$$

where, j represents households' position in a community c when their mean incomes are arranged in ascending order of magnitude.

3.6.2 Household food insecurity

3.6.2.1 Food Insecurity Experience Scale (FIES)

The FIES was developed by the FAO in 2014 via the Voices of the Hungry (VoH) project to measure the severity of food insecurity experienced by individuals or households. The FIES considers only the access dimension of food security. It comprises of eight self-assessed questions obtained from two extensively used experience-based food insecurity indicators; the Household Food Insecurity Access Scale (HFIAS) and the Latin American and Caribbean Food Security Scale (ELCSA) (Ballard et al., 2013). The household-referenced version of the FIES questions used for this study are listed in the table below.

Table 3.1: Household version of FIES questions

	During the last 12 months;
Q1	Were you or any household member at a time worried you would run out of food because of a lack of money or other resources?
Q2	Were you or any household member at a time unable to eat healthy and nutritious food because of a lack of money or other resources?
Q3	Did you or any household member at a time eat only a few kinds of foods because of a lack of money or other resources?
Q4	Did you or any household member at a time skip a meal because there was not enough money or other resources to get food?
Q5	Did you or any household member at a time eat less than you thought you should because of a lack of money or other resources?
Q6	Did your household ran out of food because of a lack of money or other resources?
Q7	Were you or any household member at a time hungry but did not eat because there was not enough money or other resources for food?
Q8	Did you or any household member at a time go without eating for at least a whole day because of a lack of money or other resources?

Note: Responses to these questions are strictly YES or NO

It is not advisable to analyse these questions independently since they jointly measure the severity of food insecurity. An interesting aspect of these questions is that their arrangement is believed to be associated with an increasing difficulty. That is, any household that positively responds to Q8 should also respond to the preceding seven questions. Similarly, any household that negatively responds to a mid-range question, say Q5, should negatively respond to the subsequent questions. Therefore, the severity of food insecurity can be analysed and assumed on an ordinal scale by summing the positive responses. However, due to translation difficulties, lack of understanding of questions or differences in managing food insecurity among different cultures and livelihood systems, there might be differences in ordering of items along the severity scale for different regions (Ballard et al., 2013). Hence, this could lead to lack of consistency and reliability of severity scale if the FIES is analysed by summing positive

responses. To eliminate these challenges, the FIES is grounded in IRT (specifically, the Rasch model) so that the severity of the items can be established on a continuous scale.

The Rasch model is the common name for the One Parameter Logistic model (1PL) and is assumed to be the simplest formulation of the IRT. The Rasch model is based on the notion that, a subject's response to a binary response item is dependent on only one characteristic or parameter of the item in question and grounded in a standard logistic framework (Cai & Thissen, 2014). The parameter of the items the Rasch model takes into consideration is the difficulty parameter. With the Rasch model, the probability that a household i will affirm or positively respond to any item X_h is a function of the difficulty parameter of the item, β_h and the latent food insecurity experience level of the household θ_i. The Rasch model is specified in equation (9) below:

$$\Pr\left(X_{h,i} = 1|\theta_i, \beta_h\right) = \frac{e^{(\theta_i - \beta_h)}}{1 + e^{(\theta_i - \beta_h)}} \quad (9)$$

To evaluate the validity and reliability of estimates produced from the Rasch model, certain assumptions must be met. The first is the 'Uni-dimensionality' assumption, which ensures that all the items included in the analysis should measure only one latent trait (food insecurity in this study). The second is the 'Conditional Independence' assumption. This assumption indicates that the probability of affirming to an item by a household should be independent on the affirmation of another item by the same household or a household's probability of affirming an item should not depend on another household. This assumption allows the formation of the likelihood function through which the model parameters are estimated (Ballard et al., 2013). Ballard et al. (2013) argues that, in the context of FIES, this assumption may fail due to challenges rising from the design and implementation of the test. They suggest that only careful linguistic and cultural adaptation of questions and proper administration by well-trained

enumerators can avoid such challenges. Another assumption is 'Discriminatory Power', which states that all items should possess equal power which indicates the slope/steepness of the items. The final one is the 'Invariance' assumption, which ensures that item and subject parameters do not change across population. In other words, estimates from the Rasch model should remain constant at all times even when the participation group changes (Jumailiyah, 2017). This assumption is also referred to as the 'Reliability' assumption (Hamzah et al., 2019).

If the stated assumptions are not met, the Classical Test Theory (CTT) which analyses food insecurity severity by the raw score on an ordinal scale may be used (Ballard et al., 2013). Once these assumptions are met, the likelihood function can be maximized with respect to parameters measuring the food insecurity severity. The Rasch model uses MLE to estimate the item parameters and the underlying latent trait (food insecurity severity) through a calculation procedure with several scoring algorithms (Jumailiyah, 2017). This MLE approach seeks to provide maximum trait values of food insecurity for each household. The calculation procedure used in estimating the likelihood of being food insecure by each household is specified as:

$$\log L_i(\theta) = \sum_{i=1}^{N} \{x_{ih} \log_e P_h(\theta_i) + (1 - x_{ih}) \log_e [1 - P_h(\theta_i)]\} \qquad (10)$$

where, $L_i(\theta)$ is the likelihood of being food insecure, x_{ih} is the proportion of affirmed items and $P_h(\theta_i)$ is the probability that a household i with food insecurity severity θ will affirm to item X_h. The maximum likelihood of being food insecure by each household is achieved by estimating the first derivative of the log likelihood function with respect to the latent trait, θ, which is specified in equation (11) as follows:

$$\frac{\partial \log L_i(\theta)}{\partial \theta} = \sum_{i=1}^{n} \frac{x_{ih} - P_h(\theta_i)}{P_h(\theta_i)[1 - P_h(\theta_i)]} \times \frac{\partial \log(\theta)}{\partial \theta} = 0 \qquad (11)$$

The MLE for food insecurity severity scores are calculated using 'Fisher Information' scoring method. The food insecurity scores of households are grouped into four food categories for further analyses following the categorization of Ballard et al. (2013). These categories are "Food Secure", "Mildly Food Insecure", "Moderately Food Insecure" and "Severely Food Insecure".

3.6.2.2 Household Dietary Diversity Score (HDDS)

This study adopts the HDDS as a food security indicator using a different timeframe. Kennedy et al. (2011) specified that the 24-hour recall time frame was chosen by FAO because it reduces recall error since people can easily recall within shorter time frames than longer ones; however, other time frames such as a week or a month have been used by other studies (Chakona & Shackleton, 2019; Tomayko et al., 2017). Also, recalling the dietary diversity pattern over a number of periods might help in measuring the sustainability and stability in dietary diversity by the household. In the GLSS 7 dataset, consumptions were recalled for 4 days per period for 6 periods. Therefore, to calculate the HDDS in this study, the average HDDS was calculated for the 6 periods. This was done by the mathematical expression below:

$$HDDS = \frac{\sum_{p=1}^{6}(HDDS_P)}{Number\ of\ periods\ (6)}, \qquad p\ denotes\ period \tag{12}$$

According to Swindale and Bilinsky (2006), there is no universal categorization of the dietary diversity scores, however, tertile or quartile categorization is ideal. This study used the quartile categorization for further analyses. The categories from the quartile points are namely "Very Low Dietary Diversity", "Low Dietary Diversity", "Moderate Dietary Diversity", and "High Dietary Diversity" for points 0-3, 4-6, 7-9 and 10-12 respectively (by approximating the scores to the nearest whole number).

3.6.2.3 Household Food Expenditure per capita (FE pc)

The household food expenditure per capita was used as one of the food insecurity indicators. It is perceived that rich households spend more to have sufficient and nutritious foods, while, poor households struggle to meet their food needs, thereby making them have low food expenditure per capita compared to rich households. Unlike the two indicators, there is no ideal categorization for per capita household food expenditure. However, the per capita household food expenditure in this study was grouped into 'quartile' classes for consistency.

3.7 Analytical Framework

3.7.1 Contribution of inter- and intra-household income inequality to the overall

This study considers decomposing the population into households so that specific policies can target households directly. Households are micro groups in which household characteristics or characteristics of household heads and some members have significant effect on the welfare of household individuals. Therefore, this study uses the class of Generalized Entropy and the Atkinson indices to analyse inequality by assessing inter- and intra-household income inequality.

Class of Generalized Entropy

This study uses the Theil index and the Mean Log Deviation which are special cases of the Generalized Entropy (GE) index. Given a population size of n people with positive individual incomes $y_i = y_1, y_2, \dots, y_n$ and the population's average income $\bar{y}$, the GE index is mathematically specified as:

$$GE(\alpha) = \frac{1}{\alpha(\alpha-1)}\frac{1}{n}\sum_{i=1}^{n}\left[\left(\frac{y_i}{\bar{y}}\right)^{\alpha} - 1\right] \qquad (13)$$

where, α denotes the class of sensitive parameter of the GE to income variations in various parts of the income distribution (Cowell, 2003). The GE indicator becomes

more sensitive to the upper tail of the distribution as α approaches $+\infty$ and becomes more sensitive to the lower tail as α approaches $-\infty$. The sensitivity parameter assumes both positive and negative values except 0 and 1 $(\alpha \neq \{0,1\})$. This is because the denominator $[\alpha(\alpha-1)]$ becomes 0, making the GE indicator undefined. The indices of special cases of $\alpha = \{0,1\}$ were attained using '*de l'Hôpital rule'*. The sensitivity parameters $\alpha = 0$ and $\alpha = 1$ are respectively the Mean Log Deviation and the Theil index. The case of $\alpha = 2$ represents half of the squared coefficient of variation (CV) though not a special case (Costa & Pérez-Duarte, 2019).

Theil index

The Theil index was introduced by Henri Theil as a consequence of Shannon's Information Theory (Theil & Uribe, 1967). It is calculated as the sum of the natural log of the ratio of individual's income to the population's average weighted by the individual's income share in the population. The overall Theil index is stated as (14).

$$TH = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_i}{\bar{y}}\right)\ln\left(\frac{y_i}{\bar{y}}\right) \tag{14}$$

As stated earlier, the population is structured into households so that inequality contribution from within and between households can be assessed. If $j = 1,2,\ldots,m$ denotes households, n_j denotes the number of members with positive incomes in household j, y_{ij} denotes individual income in household j and $\bar{y}_j$ denotes the average income in household j; then the Theil index for each household can be calculated as:

$$TH_j = \frac{1}{n_j}\sum_{i=1}^{n_j}\left(\frac{y_{ij}}{\bar{y}_j}\right)\ln\left(\frac{y_{ij}}{\bar{y}_j}\right) \tag{15}$$

However, the intra-household component of the overall Theil index will be obtained by summing the products of each household's Theil and its income share in the population. This is expressed as:

$$TH^W = \sum_{j=1}^{m} \frac{\sum y_{ij}}{\sum y_i} \left[\frac{1}{n_j} \sum_{i=1}^{n_j} \left(\frac{y_{ij}}{\bar{y}_j} \right) \ln \left(\frac{y_{ij}}{\bar{y}_j} \right) \right] \quad (16)$$

Also, the inter-household component of the overall Theil index is obtained by summing the products of the natural logs of the ratio of each household's average income to the population's average and its income share in the population. This is expression as:

$$TH^B = \sum_{j=1}^{m} \frac{\sum y_{ij}}{\sum y_i} \left[\ln \left(\frac{\bar{y}_j}{\bar{y}} \right) \right] \quad (17)$$

Mean Log Deviation (MLD)

Similar to the Theil index, MLD is calculated as the negated sum of the products of the natural log of the ratio of individual's income to the population's average and the individual's share to population. Mathematically expressed as (18).

$$MLD = -\frac{1}{n} \sum_{i=1}^{n} \ln \left(\frac{y_i}{\bar{y}} \right) \quad (18)$$

Following (18), the MLD for/within each household j is calculated as:

$$MLD_j = -\frac{1}{n_j} \sum_{i=1}^{n_j} \ln \left(\frac{y_{ij}}{\bar{y}_j} \right) \quad (19)$$

The intra-household component of the overall MLD is obtained by summing the products each household's MLD and its individual share in the population $\left(\frac{n_j}{n} \right)$. This is calculated as:

$$MLD^W = \sum_{j=1}^{m} \frac{n_j}{n} \left[-\frac{1}{n_j} \sum_{i=1}^{n_j} \ln \left(\frac{y_{ij}}{\bar{y}_j} \right) \right] \quad (20)$$

Also, the inter-household component of the overall MLD is obtained by summing the products of the natural logs of the ratio of each household's average income to the population's average and its individual share in the population. This is expressed as:

$$MLD^B = \sum_{j=1}^{m} \frac{n_j}{n}\left[\ln\left(\frac{\bar{y}_j}{\bar{y}_j}\right)\right] \quad (21)$$

The overall inequality for both indices is expressed as the sum of the within and between components. That is; $TH = TH^W + TH^B$ and $MLD = MLD^W + MLD^B$.

Atkinson Indices

This is the most popular welfare-based inequality measure. Using the same notations from the Generalized Entropy index, the Atkinson index can be expressed as:

$$Atk(\varepsilon) = 1 - \frac{1}{\bar{y}}\left[\frac{1}{n}\sum_{i=1}^{n} y_i^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} \quad (22)$$

where, ε is the aversion parameter which indicates the utility society will gain for accepting smaller income in exchange for more equal distribution. The aversion parameter takes on values greater than 0 (but, $\varepsilon \neq 1$). This is because the denominator $(1-\varepsilon)$ becomes 0, making the expression undefined. This makes the aversion parameter $\varepsilon = 1$ a special case in the family of Atkinson indices. Hence, this study focuses on this special case in addition to the two cases in the Generalized Entropy. The Atkinson index with $\varepsilon = 1$ can be expressed as:

$$Atk\ (1) = 1 - \frac{1}{\bar{y}}\left[\prod_{i=1}^{n} y_i\right]^{\frac{1}{n}} \quad (23)$$

Given that the population is structured into households, the Atkinson index for or within each household can be calculated as:

$$Atk_j\ (1) = 1 - \frac{1}{\bar{y}_j}\left[\prod_{i=1}^{n_j} y_{ij}\right]^{\frac{1}{n_j}} \quad (24)$$

The intra-household component of the overall Atkinson index can be specified as:

$$Atk^{W}\ (1) = 1 - \prod_{j=1}^{m}\left[\frac{1}{\bar{y}_j}\left[\prod_{i=1}^{n_j} y_{ij}\right]^{\frac{1}{n_j}}\right]^{\frac{n_j}{n}} \tag{25}$$

The inter-household component of the overall Atkinson index is also specified as:

$$Atk^{B}\ (1) = 1 - \frac{1}{\bar{y}}\left[\prod_{j=1}^{m}\bar{y}_j\right]^{\frac{n_j}{n}} \tag{26}$$

Unlike the Generalized Entropy indices, the overall inequality for the Atkinson indices cannot be expressed as the direct additive terms of within and between components. However, it is expressed as the summation of the two components minus their products. That is; $Atk = Atk^{W} + Atk^{B} - (Atk^{W} \times Atk^{B})$.

3.7.2 Analysing the effects of household income inequality on food insecurity

Analysing the effects of inter- and intra-household income inequality on household food insecurity is based on a concept where households are categorized into various food insecurity classes measured on an ordinal scale. This gives room for the application of an 'Ordered Probit Regression Model' or 'Ordered Logistic Regression Model'. The categorization of households into food insecurity classes is such that, different households may exhibit different food insecurity severities, nevertheless, they may fall in the same class. This therefore provides the bases to assume that the actual food insecurity severity scores of households are latent (unobserved). For this empirical analysis, the latent food insecurity severities of households (y_i^*) are assumed to be linearly dependent on their income inequalities (G_i) and other exogenous covariates (x_i) as specified in equation (27) below:

$$y_i^* = x_i\beta + \boldsymbol{G_i\beta} + \varepsilon_i \tag{27}$$

where, β represents a vector of parameter estimates and ε_i represents unexplained or error term. Also, given the cut-off points (c_j) on which the classes are created, the coding schemes for the observed food insecurity classes can also be written as:

$$y_i = \begin{cases} 0 \;\; if \;\; y_i^* \leq c_1 \\ 1 \;\; if \;\; c_1 < y_i^* \leq c_2 \\ 2 \;\; if \;\; c_2 < y_i^* \leq c_3 \\ 3 \;\; if \;\; c_3 < y_i^* \end{cases} \tag{28}$$

If the underlying error term (ε_i) follows a standard normal distribution, an Ordered Probit Regression Model would be preferred to analyse the effects of income inequality on household food insecurity. Because the ε_i is assumed to be normally distributed, it is expected to have a mean of zero and unit variance. However, ε_i is not controlled to be autonomous to G_i. This means there is a great chance that some factors (for example, government interventions) may influence both income inequality and food insecurity simultaneously but may not be captured in the econometric estimation. This might result in a correlation between income inequality (G_i) and the error term (ε_i), distorting the normality of ε_i and would lead to a potential endogeneity causing a biasedness in the parameter estimate for G_i. Therefore, the error term (ε_i) will possess two distinct components that are independent on each other. This will be specified as:

$$\varepsilon_i = u_i + v_i \tag{29}$$

where, u_i is the unobserved heterogeneity component that leads to the endogeneity and v_i is a distinctive component of the error term with variance σ_v^2 (Wooldridge, 2010).

To deal with this source of endogeneity, a triangular instrumental variable (TIV) approach is used (Imbens & Newey, 2009). Fortunately, the extended ordered probit model (eoprobit in Stata) has an inbuilt TIV approach and the algorithms are mounted on STATA version 15 and advanced versions (StataCorp, 2017). The eoprobit model

accommodates endogenous covariates (continuous, binary, ordered), treatment and sample selection or the combination of two or all. This study employs the eoprobit with continuous endogenous covariate (EOPEC). This is because, the measurement for household income inequality is fractional (0,1) but can be treated as continuous.

The EOPEC model estimates two separate models simultaneously by combining first stage linear regression model (addressing factors influencing income inequality) and a second stage ordered probit model (addressing the effect of income inequality on household food insecurity). The specifications of the EOPEC model are as follows:

$$y_{im}^{*} = x_{im}\beta + \boldsymbol{G_{im}\beta} + \varepsilon_{im} \quad (30)$$

$$\boldsymbol{G_{im}} = x_{im}^{*}\alpha + z_{im}\alpha + e_{im} \quad (31)$$

where, x is a vector of exogenous covariates such that $x^{*} \in x$, z is a vector of instruments influencing household income inequality (G_i) but not food insecurity (y_i^{*}), α and β are vectors of parameter estimates, ε_i and e_i are error terms with $m = 1, 2$ (inter- and intra-household analyses). The instruments used to identify the model include '*social exclusion', 'discrimination against public service use'* and '*the number of salary employees (at the household level)'* or '*proportion of households with salary employee(s) (at the community level)'*. Social exclusion and discrimination cause social stratification and deny people the right to significant opportunities which further affect the distribution of income in a given society. In the Ghanaian setting, salary employment averagely offers high returns per annum compared to other forms of employment (GSS, 2019). Therefore, engaging more people in the labour market will have an effect on income inequality.

The TIV approach in the EOPEC model calculates and uses the linear prediction of the first stage model (income inequality) as an independent variable in the second stage

model (food insecurity). The calculation and use of the linear prediction ensure that all unobserved components (i.e., potential causes of endogeneity) of income inequality are eliminated from the food insecurity model. The TIV approach makes the error terms (ε_i, e_i) become multivariate normal with zero means and variances specified as:

$$\begin{bmatrix}\varepsilon_i \\ e_i\end{bmatrix} \sim \mathcal{N}\left[\begin{pmatrix}0\\0\end{pmatrix}, \begin{bmatrix}1 & \sigma' \\ \sigma & \sum_e\end{bmatrix}\right]$$

where, σ is the covariance of ε_i and e_i $[cov\,(\varepsilon_i, e_i)]$ and $\sum_e$ is the variance of e_i $[var\,(e_i)]$. The variance of ε_i $[var\,(\varepsilon_i)]$ is now a unit variance indicating that ε_i in the outcome equation is normalized.

Given the multivariate normality, equations (30) and (31), the conditional density of food insecurity (y_i^*) at any class can be written as the conditional mean and variance of ε_i. These are respectively written as:

$$E(\varepsilon_i|G_i, x_i, z_i) = \sigma' \sum_e^{-1}(G_i - x_i^*\alpha - z_i\alpha)' \quad (32)$$

$$Var(\varepsilon_i|G_i, x_i, z_i) = \sigma' \sum_e^{-1}\sigma \quad (33)$$

Also, the conditional density of G_i on the instruments and other exogenous covariates can be written as (34):

$$f(G_i|x_i^*, z_i) = \phi(G_i - x_i^*\alpha - z_i\alpha, \sum_e) \quad (34)$$

The EOPEC model uses the Maximum Likelihood Estimator (MLE) to estimate model parameters by selecting the set of parameter values that maximizes the likelihood function. Given the cut-off points for the food insecurity classes ($c_{j-1}\ and\ c_j$ representing the lower and upper limits respectively), conditional variance of ε_i and the conditional density of G_i, the likelihood function can be specified as:

$$L = \prod\prod \Phi\left[c_{j-1}, c_j, \sigma'\sum_e^{-1}\sigma\right] \phi[G_i - x_i^*\alpha - z_i\alpha, \sum_e] \quad (35)$$

Taking logs of the likelihood function gives the log likelihood function specified as:

$$\ln L = \sum_{i=1}^{N} \omega_i \left\{ \ln \Phi^* \left[c_{j-1}, c_j, \sigma' \sum_e^{-1} \sigma \right] + \ln \phi [G_i - x_i^* \alpha - z_i \alpha, \sum_e] \right\} \quad (36)$$

The probability of a household being located in any food insecurity class is obtained from the likelihood function specified as:

$$Pr(y_i = j | G_i, x_i) = \Phi^* \left(c_{j-1}, c_j, \sigma' \sum_e^{-1} \sigma \right) \quad (37)$$

where, Φ^* is the cumulative density function for the standard normal distribution.

3.8 Descriptions and Measurements of Variables Used in Econometric Modeling

3.8.1 Independent variables used for intra-household analyses

Since this study involves intra-household income inequality analysis, it is important to examine effect intra-household decision making. Where household members' welfare, preferences, contributions or bargaining powers are not clearly defined, intra-household decision making frameworks, such as the unitary and collective models, are usually ineffective (Acosta et al., 2020; Kafle et al., 2019; Shibata et al., 2020). Hence, to assess the effect of intra-household decision making on other outcomes, it is important include vital socioeconomic information of household heads since they are the main decision makers in most households (Djurfeldt et al., 2018; Sariyev et al., 2021).

There are no data on household decision making in the GLSS dataset. Also, since household heads are the main decision makers in most Ghanaian households (Novignon et al., 2019), some socioeconomic characteristics of household heads were included to examine how they influence intra-household income inequality. *Table 3.2* reports the definitions and measurements of all variables used for intra-household analysis.

Table 3.2: Description and measurements of variables for intra-household analyses

Variables	Description and Measurements
Household Income pc	Annual household income per capita, GHc – Logged
Household Head's Income	Annual income of household head, GHc – Logged
Remittance	Annual remittance received by household, GHc – Logged
Average labour Income	Annual average household labour income, GHc – Logged
Miscellaneous Income	Annual miscellaneous income received by household, GHc – Logged
Assets Value pc	Value of household assets per capita, GHc – Logged
Household Head's Age	Age of household head, years
Household Size	Number of household members
Members with Degree	Number of household members with university degree
Labour Employees	Number of household labour employees
Non-Farm Contributing Employees	Number of members contributing to household non-farm enterprise
Members with Skills	Number of household members with skill/course training
Internal Transfer Receivers	Number of members who receive income from household heads or high-income earners within the household
SSNIT Contributors	Number of members who contribute to the SSNIT scheme
LEAP Beneficiaries	Number of members who receive LEAP payments
Emp. Household Head	1 if the household head is employed, 0 otherwise
House Ownership	1 if the household owns their residence, 0 otherwise
Land Ownership	1 if the household owns plot(s) of land, 0 otherwise
Access to Credit	1 if the household have credit access, 0 otherwise
Sex (male)	1 if the household head is a male, 0 otherwise
Location (urban)	1 if the household is sited in an urban area, 0 otherwise
Farm Household	1 if the household is engaged in farming, 0 otherwise
Social Exclusion	1 if any household member is excluded from participating in social activities, 0 otherwise
Household Political Involvement	1 if any household member is involved in politics, 0 otherwise
Food Price Index	Average food price for some basket of selected foods in each community, GHc

3.8.1 Independent variables used for inter-household analysis

Table 3.3 summarizes the definitions and measurements of independent variables used for the inter-household analyses and their measurements.

Table 3.3: Description and measurements of variables for inter-household analyses

Variables	Description and Measurements
Food Price Index	Average food price for some basket of selected foods in each community, GHc
Average Household Size	Average household size in each community
Community Population	Estimated community population, Logged
Availability of Financial Institution(s)	1 if community has at a financial institution, 0 otherwise
Availability of Daily Community Market	1 if community has at a daily market, 0 otherwise
Public Transport Passage via Community	1 if public transport passes through the community, 0 otherwise
Location (urban)	1 if community is an urban community, 0 otherwise
Social Exclusion	Proportion of households in each community that are socially excluded from participating in some activities
Opinion on Development Issues	Proportion of households in each community that members are invited to discuss development issues
Household Political Involvement	Proportion of households in each community that are involved in politics
Discrimination against Public Service use	Proportion of households in each community that are discriminated from using some public services
Households with Degree Holder(s)	Proportion of households in each community with degree holder(s)
Employed Household Heads	Proportion of households in each community with employed household head
Labour Employment	Proportion of households in each community with labour employee(s)
LEAP Benefiting Households	Proportion of households in each community that receive LEAP payment

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 Chapter Outline

This chapter discusses the results of the empirical analyses. The contents of this chapter include summary statistics of variables used for the intra- and inter-household analyses (4.1 and 4.2) as well as other key variables (4.3). Section 4.4 discusses the results on the contribution of inter- and intra-household income inequalities to overall income inequality. The results of factors influencing intra-household income inequality and its effect on food insecurity are presented and discussed in sections 4.5 and 4.6 respectively. Sections 4.7 and 4.8 respectively discuss the results of factors influencing inter-household income inequality and its effect on food insecurity.

4.1 Summary Statistics of Variables Used for Intra-Household Analyses

4.1.1 Socioeconomic characteristics of household heads

4.1.1.1 Sex distribution of household heads

About 81% of households included in the intra-household analysis are male-headed. The inclusion of a few female household heads in the sample is because female headed households are those of widows, separated, divorced or women who are never married (Yoosefi et al., 2020). Further scrutiny of the data reveals that only about 12% of female headed households have at least two employed members, implying that less female headed households have the chance of being included for the intra household analysis.

Table 4.1: Sex distribution of household heads

Categories	***Frequency***	***Percentage***
Female	530	19.36
Male	2,207	80.64
Total	**2,737**	**100.00**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.1.2 Age distribution of household heads

The result shows that 24.59% of the household heads are within the age range 35 - 44 years, while the average age of the sample is approximately 48 years. A very small (1.28%) proportion of the household heads were younger than 25 years. The household heads below 25 years are small in the sample because such young people are considered adults but often stay alone or with their friends in rented apartments. This could reduce their chances of being included for the intra-household analysis. The maximum and minimum ages of the sample are respectively 99 and 17 years.

Table 4.2: Age distribution of household heads

Categories	***Frequency***	***Percentage***	***Mean***	***St. Dev.***	***Min.***	***Max.***
Below 25 years	35	1.28	22.37	1.69	17	24
25-34 years	490	17.90	30.50	2.66	25	34
35-44 years	673	24.59	39.32	2.85	35	44
45-54 years	656	23.97	49.28	2.92	45	54
55-64 years	504	18.41	58.85	2.74	55	64
65 years and above	379	13.85	72.79	6.94	65	99
Total	**2,737**	**100.00**	**48.14**	**14.22**	**17**	**99**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.1.3 Education of household heads

Education is an essential human capital factor which represents an individual's level of knowledge, experience, values, morals and personal development. The result reveals that 44.39% of household heads have no formal educational qualification. This is followed by those with basic education certificates (BECE) or middle school leaving certificates (MSLC) while only about 8% have at least a bachelor's degree.

Table 4.3: Distribution of household heads' educational qualifications

Categories	***Frequency***	***Percentage***
None	1,215	44.39
BECE/MSLC	816	29.82
SSCE/WASSCE/ 'O' or 'A' Level	253	9.24
Certificate/ Diploma/HND	234	8.55
Bachelor's Degree or better	219	8.00
Total	**2,737**	**100.00**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.1.4 Marital status of household heads

Marriage is an important institution of most societies that legally recognises the union between two partners, dominantly a male and a female, in a relationship. From the result, 72.71% of the household heads in the sample were married, 10.56% were in consensual union and 9.17% were widowed at the time the data were collected. A relatively small proportion of household heads in the sample, however, were separated, divorced or never married as reported in *Table 4.4* below.

Table 4.4: Distribution of household heads' marital statuses

Categories	***Frequency***	***Percentage***
Married	1,990	72.71
Consensual Union	289	10.56
Separated	57	2.08
Divorced	86	3.14
Widowed	251	9.17
Never married	64	2.34
Total	**2,737**	**100.00**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.1.5 Employment statuses of household heads

Employment shows the income stream of individuals. Employment status here describes the sectors household heads are engaged in for income or livelihoods. The result shows that 50.31% of the household heads were self-employed in farm (25.14%)

and non-farm (25.17%) enterprises. Also, 37.27% were labour employees (public and private employees). *Table 4.5* further reports that 4.82% of household heads were unemployed, 1.57% were retired while 6.03% were inactive at the time of data collection.

Table 4.5: Distribution of household heads' employment statuses

Categories	***Frequency***	***Percentage***
Public employees	343	12.53
Private employees	677	24.74
Self-employed (Non-Farm)	689	25.17
Self-employed (Farm)	688	25.14
Unemployed	132	4.82
Retired	43	1.57
Inactive	165	6.03
Total	**2,737**	**100.00**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.1.6 Annual incomes of household heads

Income in the GLSS data describes the total monies received by household heads in the past 12 months. The sources of income include salaries, wages and bonuses from main and secondary jobs, profits from farm and non-farm enterprises, remittances and other miscellaneous incomes such as the Livelihood Empowerment Against Poverty (LEAP) programme, Social Security and National Insurance Trust (SSNIT), state pension, retirement benefits, among others. The results show that the annual incomes of household heads range from GH₵ 16.00 to 921,000.00 with an average of approximately GH₵ 9,509.00. The results further reveal that 32.37% of household heads receive between GH₵ 1,001.00 - 5,000.00 annually. This is followed by those who receive about GH₵ 1,000.00 and below (20.13%).

Table 4.6: Distribution of household heads' annual incomes

Categories (GH₵)	*Freq.*	*Perc.*	*Mean*	*St. Dev.*	*Min.*	*Max.*
1000 and below	741	27.07	391.30	274.20	16.00	1,000
1,001 - 5,000	809	29.56	2,701	1,135.6	1,010	5,000
5,001 - 10,000	434	15.86	7,150	1,453	5,040	10,000
10,001 - 20,000	492	17.98	14,112	2,824.4	10,020	20,000
Above 20,000	261	9.54	43,426	64,629	20,249	921,000
Total	**2,737**	**100.00**	**9,509**	**24,376**	**16.00**	**921,000**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.2 Distribution of household composition

4.1.2.1 Household composition by size

A household is a housing unit with a person or a group of related or unrelated people by blood who share the same housekeeping and cooking arrangements (Yoosefi et al., 2020). Household size is therefore the number of people in the household. The sample excludes single-member households because, inequality cannot be estimated for a single person. However, most of the households (58.31%) have about 2 to 5 members whereas less than 1% have more than 20 members (*Table 4.7*). The result also shows that the average household has 6 members with the maximum being 27 members.

Table 4.7: Distribution of household composition by size

	Freq.	*Perc.*	*Mean*	*St. Dev.*	*Min.*	*Max.*
2-5	1,596	58.31	3.79	1.03	2	5
6-10	983	35.92	7.23	1.24	6	10
11-20	150	5.48	13.09	2.12	11	20
Above 20	8	0.29	24.25	2.19	21	27
Total	**2,737**	**100.00**	**5.60**	**2.89**	**2**	**27**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.2.2 Household composition by sex

The proportion of households without a male is 2.52% while 90.28% have 1 to 5 male members. Also, 1.10% of households have no female member while 90.53% have 1 up

to 5 female members. The distribution of female members in the households exhibits similar pattern as the distribution of male members (*Table 4.8*).

Table 4.8: Distribution of household composition by sex

	Males		***Females***	
	Frequency	***Percentage***	***Frequency***	***Percentage***
0	69	2.52	30	1.10
1-5	2,471	90.28	2,478	90.53
6-10	188	6.87	211	7.71
Above 10	9	0.33	18	0.66
Total	**2,737**	**100.00**	**2,737**	**100.00**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.2.3 Household composition by formal education

Education increases human capital and improves people's ability to perform certain tasks as well as increases their exposure to better employment opportunities. The data reveals that 5.63% of the households have no member with a formal education, 0.69% have more than 10 members while 81.46% of the households have about 1 to 5 members with formal education.

Table 4.9: Distribution of household composition by formal education

Formal Education	***Frequency***	***Percentage***
0	28	1.02
1-5	2,040	74.54
6-10	619	22.61
Above 10	50	1.83
Total	**2,737**	**100.00**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.2.4 Household composition by short training courses and skills

Surprisingly, about 87% of the households have no member that has got a technical, vocational or ICT skills training. Also, 93.86% of households have no member who has ever attended a short training course.

Table 4.10: Distribution of household composition by short courses and skills

	Short Training Courses		***Tech./Vocational/ICT Skills***	
	Frequency	***Percentage***	***Frequency***	***Percentage***
0	2,569	93.86	2,425	88.60
1	134	4.90	260	9.50
2	32	1.17	45	1.64
3	2	0.07	7	0.26
Total	**2,737**	**100.00**	**2,737**	**100.00**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.2.5 Household composition by employment

Employment defines economic statuses of households. The data shows that about 38% of households have no labour employee, while further 37.96% of households have no member employed in household non-farm enterprises. The latter sample could basically represent the proportion of households that do not own or run non-farm enterprises. Also, 65.25% have no member employed in household farm businesses.

Table 4.11: Distribution of household composition by employment

	Labour Employment		***Non-Farm Enterprise***		***Farm Enterprise***	
	Freq.	***Perc.***	***Freq.***	***Perc.***	***Freq.***	***Perc.***
0	977	35.70	1,039	37.96	1,786	65.25
1-5	1,756	64.15	1,690	61.75	887	32.41
Above 5	4	0.15	8	0.29	64	2.34
Total	**2,737**	**100.00**	**2,737**	**100.00**	**2,737**	**100.00**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.3 Distribution of households' residential tenancy

Tenancy describes the arrangement by which households occupy their dwellings. The result reveals that about 54% of households live in their own houses, 24.19% live in rented houses or apartments, 21.04% live in rent-free houses/apartments while 0.48% are squatting. Squatting refers to a situation where a household settles in a residence

without any legal claim and may gain adverse possession to the residence through involuntary transfer (Chen, 2021).

Table 4.12: Distribution of households' residential tenancy

	Frequency	***Percentage***
Owning	1,486	54.29
Renting	662	24.19
Rent-free	576	21.04
Squatting	13	0.48
Total	**2,737**	**100.00**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.4 Distribution of households' physical capital

Household physical capital in this study describes all tangible assets owned by a household used in operating its activities. This includes household properties (such as furniture, electronics, etc.), fixed inputs and inventories from household farm and non-farm enterprises (unsold produce, unharvested crops, livestock, etc.) as well as shares. The importance of physical capital to a household is that, part or all of it can be liquidated into cash when the household faces financial challenges. Asset value shows the expected income the household receives when all its tangible assets are liquidated. The result shows that all tangible assets in most of the households (34.01%) are worth between GH₵ 1,001.00 and GH₵ 5,000.00. This is followed by those whose assets are worth below GH₵ 1,000.00 (24.44%). Also, the assets of about 19.55% of households are worth over GH₵ 20,000.00. The distribution of asset value ranges from GH₵ 2.00 to GH₵ 50,000,000.00 and an average value of approximately GH₵ 50,787.00.

Land is an important asset in every economic activity since it is used in the production of crops, rearing of livestock, siting of office spaces, among others. The result indicates that about 50.13% of households own plot(s) of land. The data also reveals that about 58% of households own at least a house or a building. One might expect the distribution

to be the same as that of the residential tenancy. However, this includes households residing in their own houses, those with houses in other locations but residing in rented houses/apartments due to job transfers as well as those with office spaces, stores and uncompleted buildings.

Table 4.13: Distribution of households' physical capital

	Freq.	***Perc. %***	***Mean***	***Min.***	***Max.***
Asset Value (GH₵)					
1000 and below	669	24.44	476.91	2.00	1,000
1,001 - 5,000	931	34.01	2,511.99	1,005	5,000
5,001 - 10,000	339	12.39	7,038.51	5,010	9,976
10,001 - 20,000	263	9.61	14,273.22	10,045	19,985
Above 20,000	535	19.55	243,438.6	20,036	50,000,000
Total	**2,737**	**100.00**	**50,787.30**	**2.00**	**50,000,000**
Land Ownership					
Yes	1,372	50.13			
No	1,365	49.87			
House/Building Ownership					
Yes	1,593	58.20			
No	1,144	41.80			
Total	**2,737**	**100.00**			

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.5 Distribution of household's total annual income by income sources

The result reveals that most households are engaged in non-farm household enterprises (68.72%) followed by labour employment (64.30%). However, on average, labour employment provides more income to households (GH₵14,477.40) compared to non-farm household enterprise (GH₵11,308.31). Although the average income from labour employment is higher than non-farm household enterprises, the latter provides more income to resource endowed households. On average, crop cultivation provides about

GH₵2,490 to farm households annually while livestock rearing provides about GH₵ 998.00. Also, households that engage in other agricultural activities (i.e., shea nuts and wild fruits picking, hunting, collection of snails and crabs, mushroom farming, etc.) make approximately GH₵324.00 while those that engage in share cropping earn about GH₵886.36 on average per annum.

Agricultural lands have significant values. Although most households do not sell their lands, those that do earn an average of GH₵5,936.00 per annum whereas leasing of lands provides an about GH₵382.12 to households. To support the farm activities, some farm households sell or rent their equipment and other farm machinery which fetches them about GH₵1,658.00 averagely. For households with working member(s) outside the household, they receive an average remittance of GH₵1,592.91 annually. This is consistent with the actual GLSS7 main report of an average annual household remittance of GH₵1,511.00 (GSS, 2019). Households also receive approximately GH₵586.00 as miscellaneous income (SSNIT, retirement benefits, LEAP, state pensions, inheritance, bride prices, gifts, etc.) while some households make up to about GH₵5,460.00 per annum from water sales. All these income sources accumulate to an average household total annual income of approximately GH₵18,853.00, with the range between GH₵64.00 and GH₵1,020,540.00.

Table 4.14: Distribution of household total annual income by income sources

GH₵	***Obs.***	***Mean***	***Std. Dev.***	***Min.***	***Max.***
Labour Income	1,760	14,477.40	18,318.0	104	228,000
Crop Income	792	2,490.28	5,103.76	5	58,600
Livestock Income	568	998.47	2,858.27	10	42,400
Other Agric. Income	358	324.42	1,799.09	5	32,268
Income from Share Cropping	50	886.36	1,520.82	20	8,550
Miscellaneous Income	313	586.06	2,237.18	11	27,649
Remittance	336	1,592.91	3,474.66	20	40,800
Non-Farm Ent. Income	1,881	11,308.31	37,584.6	80	1,001,000
Sales of Water	29	1,944.62	1,699.48	78	5,460
Sales and Rent of Agric. Equipment/Machinery	53	1,658.00	6,482.64	10	45,000
Income from Land Sold	5	5,936.00	2,584.66	4,000	10,000
Income from Land Lease	17	382.12	522.36	100	2,000
Total Household Income	**2,737**	**18,853.36**	**35,068.75**	**64**	**1,020,540**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.6 Distribution of households' annual food and alcohol expenditure

The result reveals that households spend averagely GH₵4,986.44 on food items per annum. Even though they may purchase some food items, few of the households consume from their own harvested crops and animals which are averagely valued at GH₵1,889.59 per annum. Furthermore, households spend averagely GH₵445.90 and GH₵1,022.58 respectively on non-alcoholic beverages and already prepared meals, that is food away from home (street, hotel and restaurant foods). Also, the average total household food expenditure (food, alcohol, tobacco and narcotics) is GH₵6,743.85.

Table 4.15: Distribution of households' annual food and alcohol expenditure

GH₵	*Obs.*	*Mean*	*Std. Dev.*	*Min.*	*Max.*
Own-produced food items	775	1,888.59	4,463.63	16.425	86,096.20
Purchased food items	2,732	4,986.44	4,084.31	87.60	50,888.30
Non-alcoholic beverages	2,133	445.90	536.94	2.92	5,803.50
Food away from home	2,111	1,022.58	1,385.53	7.30	22,659.20
Food Expenditure	**2,737**	**6,652.55**	**5,255.64**	**102.20**	**86,967.82**
Alcohol/Tobacco/Narcotics	717	348.56	534.07	7.30	6,847.40
Food & Alc./Toba./Narc.	**2,737**	**6,743.85**	**5,279.85**	**102.20**	**86,967.820**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.1.7 Distribution of households' freedom and government participation

Social exclusion denies people their right to freedom and restricts their access to opportunities. The results show that about 6% of households are socially excluded from participating in social activities and services. Also, about 7% of households are discriminated against in the use of public services. The results further reveal that about 6% of households are involved in politics (*Table 4.16*).

Table 4.16: Distribution of households' freedom and involvement in governance

	Yes		*No*	
	Freq.	*Perc.*	*Freq.*	*Perc.*
Social Exclusion	164	6.06	2,544	93.94
Discrimination against Public Service	196	7.19	2,531	92.81
Opinion on Development Issues	316	11.61	2,406	88.39
Political Involvement	163	5.99	2,559	94.01

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.2 Summary Statistics of Variables Used for Inter-Household Analyses

4.2.1 Distribution of average household size and population in communities

On average, there are about 4 members per household. Meanwhile, in some communities, there are about 13 members per household. The result also shows that the

estimated average number of people in each community is about 11,672 whereas the highest populated community has 350,000 people (*Table 4.17*).

Table 4.17: Distribution of average household size and population in communities

	Mean	***Std. Dev.***	***Min***	***Max***
Average Household Size	4.21	1.47	1.8	13.13
Estimated Community Population	11671.57	33279.31	100	350000

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.2.2 Distribution of socio-economic characteristics in communities

In 67.56% of the sampled communities, no household has a member with a university degree. For those that have, an average of about 2 out of 15 households have member(s) with university degree. The community with the maximum number of households with university degree holder(s) is 7 out of 15. Also, in 0.27% of the communities are no employed household heads and in 7.08% of the communities are no labour employees (*Table 4.18*).

Table 4.18: Distribution of socio-economic characteristics in communities

	No Record		***HHs. Recorded***	
	Freq.	***Perc.***	***Mean***	***Max.***
Households with Degree Holder(s)	506	67.56	1.95	7
Households with Employed Head	2	0.27	11.31	15
Households with Labour Employee(s)	53	7.08	4.86	14
Households with Non-Farm Enterprise	32	4.27	6.05	14
Farm Households	103	13.75	9.54	15

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.2.3 Households income transfer and remittances in communities

The LEAP programme offers cash transfer to severely deprived households to alleviate short-term poverty (UNICEF, 2020). The result shows that in about 89% of the communities no household receives LEAP, but in some communities, 10 out of 15

households receive the LEAP fund. Also, in 74.63% of the communities, no household receives any remittances.

Table 4.19: Distribution of income transfer in communities

	No Record		***HHs. Recorded***	
	Freq.	***Perc.***	***Mean***	***Max.***
LEAP Receiving Households	665	88.79	2.93	10
Remittance Receiving Households	559	74.63	2.30	12

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.2.4 Freedom and government participation in communities

The result indicates that 69.56% of communities have no recorded case of social exclusion. However, for communities that recorded social exclusion (30.44%), an average of about 3 out of 15 households were excluded from participating in social activities and services. Surprisingly, all 15 households in some communities are socially excluded. Also, in about 60% of the communities, no single household is discriminated against in the use of public services. The result further reveals that no household is involved in politics in about 57% of the communities. Likewise, in about 43% of the communities, no single household member was invited to share their opinions on development issues.

Table 4.20: Distribution of freedom and government participation in communities

	No Record		***HHs. Recorded***	
	Freq.	***Perc.***	***Mean***	***Max.***
Social Exclusion	521	69.56	3.10	15
Discrimination against Public Service	450	60.08	2.38	12
Opinion on Development Issues	323	43.12	2.79	14
Political Involvement	427	57.01	2.08	14

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.2.5 Availability of public services

The result shows that among the communities sampled for inter-household analyses, 37.65% have financial institutions, 29.77% have daily community markets, 88.39% have access to electricity while 83.04% have direct access to public transport services.

Table 4.21: Distribution of public service availability

	Available		***Not Available***	
	Freq.	***Perc.***	***Freq.***	***Perc.***
Financial Institution	282	37.65	467	62.35
Daily Community Market	223	29.77	526	70.23
Electricity	662	88.39	87	11.62
Public Transport Services	622	83.04	127	16.96

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.3 Summary Statistics of Income Inequalities and Food Insecurity Statuses

4.3.1 Intra- and inter-household income inequalities

The average intra-household income inequality is 0.2723. This indicates a low income inequality within households and implies that, on average, individuals whose incomes are above their household's per capita income will have to transfer about 27.23% of their incomes to those whose incomes are below the household's per capita income to have an equal distribution of income within the households. Also, the average inter-household income inequality is 0.5371, indicating a high income inequality between households. This means that, on average, households whose incomes are above the community's average income will have to transfer about 53.71% of their incomes to households below the average income to have an equally-distributed income between households in the communities.

Table 4.21: Distribution of households' freedom and involvement in governance

Inequality Components	*Obs.*	*Mean*	*St. Dev.*	*Min*	*Max*
Intra-Household Income Ineq.	2,737	0.2723	0.1613	0	0.7918
Inter-Household Income Ineq.	749	0.5371	0.1228	0.1471	0.8574

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.3.2 Food insecurity status by various indicators

4.3.2.1 Food insecurity status by FIES

The responses to the FIES questions presented in the methodology are binary. The detailed distribution of affirmations to the various questions at both the household and community levels is presented in Appendix A. The response pattern to these questions led to the adoption of the Rasch model to generate a food insecurity severity scale. Following the groups generated by the Rasch model, households and communities are grouped into various food insecurity classes. *Figure 4.1* shows the prevalence of food insecurity at both the household and community level.

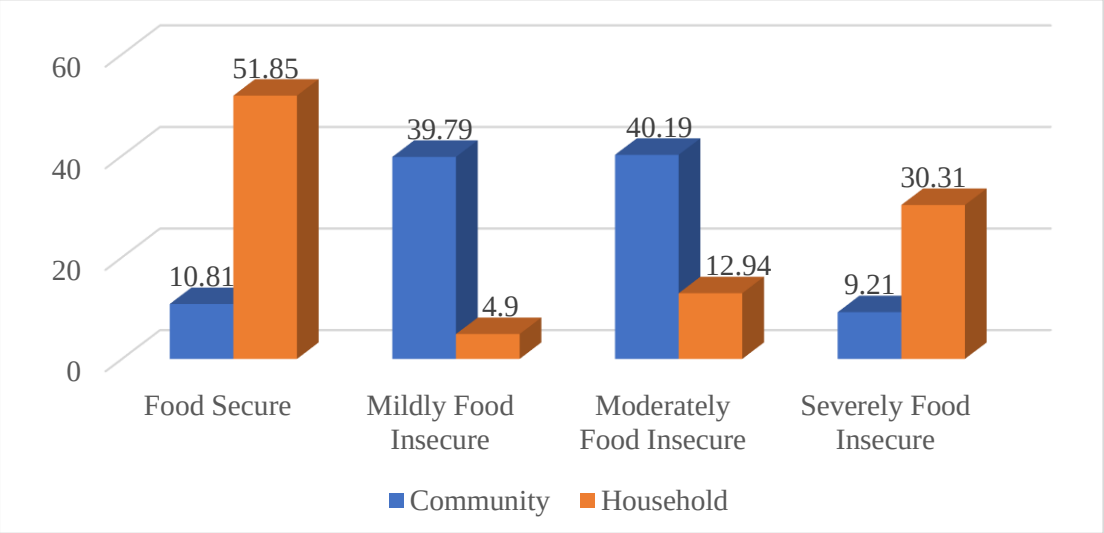

Figure 4.1: Distribution of food insecurity by FIES

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.3.2.2 Food insecurity status by HDDS

Dietary diversity describes the consumption of varying diets. The results show that the most households in the sample consumed cereals (99.56%) as well as vegetables (99.20%). Compared to the other food groups, a smaller number of households (50.56%) consume milk and milk products. Detailed distribution of various food groups consumed by the households is presented in Appendix B. The results further show that most households have moderate dietary diversity while only few have very low dietary diversity (*Figure 4.2*). Nevertheless, most communities have low dietary diversity. The average DDSs at the household level is 6.30 food items while that at the community level is 5.50. This means, the average household in the sample has a moderate dietary diversity while the average community has a low dietary diversity.

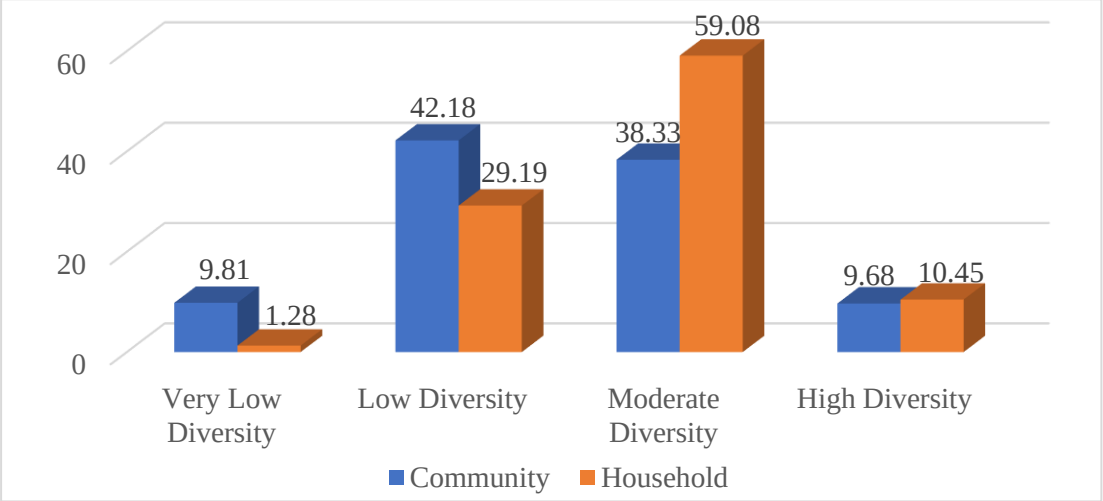

Figure 4.2: Distribution of food insecurity by HDDS

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.3.2.3 Food insecurity status by FE pc

The results reveal an average household annual food expenditure per capita (FE pc) of GH₵1,423.70 and ranges from GH₵25.55 to GH₵11,489.52. Also, at the community level, the average annual FE pc is GH₵1,745.44. This means, in the average

community, household members spend about GH₵1,745.44 on food. The food expenditure per capita for households and at the community level was classified into inter-quartile classes. *Figure 4.3* reports the distribution of food expenditure per capita by various classes.

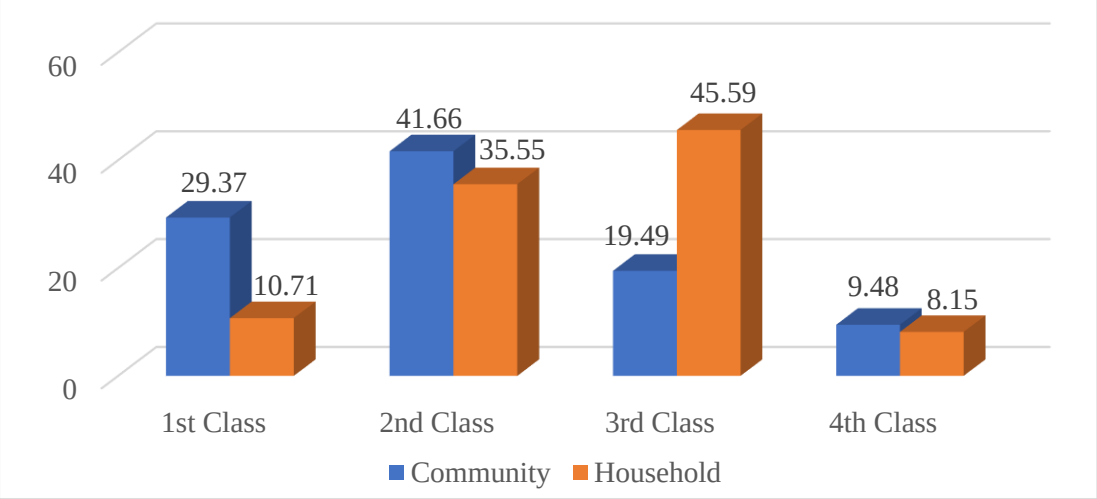

Figure 4.3: Distribution of per capita food expenditure by various classes

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.4 Contributions of Inter- and Intra-Household Inequality to Overall Inequality

This section reports the results of income inequality for the Mean Log Deviation, Theil index, Coefficient of Variation (CV), Gini index and the Atkinson index with aversion parameter 1. *Table 4.22* presents inequality estimates for overall (all positive individual incomes in the sample) and per capita household income (when individuals are assigned their per capita household income). The overall Gini index estimate of 0.6537 denotes a high level of inequality in the study sample. The value implies that in order to have an equal distribution of income, individuals in the sample above the sample's average income would have to transfer about 65% of their incomes to those below the average income. The overall Atkinson index of 0.6502 also shows that individuals in the sample can achieve a maximum level of welfare with about 65% of the sample's total income.

The Generalized Entropy indices (MLD, Theil and CV) measure the entropic distance by which individual incomes in the sample are away from equality. However, their estimates are not interpretable (Afonso et al., 2015b).

Most researchers estimate inequality using per capita household income to represent overall inequality. Estimating inequality with household per capita income underestimates overall inequality (Haddad & Kanbur, 1989). This is evident in *Table 4.22* as estimates using per capita income are lower than those of the actual individual incomes. The household per capita income inequality estimates are larger than the 2017 inequality estimates in the World Inequality Database by UNU-WIDER (2021). The difference might be attributed to their use of expenditure instead of income. According to de Vreyer and Lambert (2018), aside wealth or assets which are accumulated over time, income inequality estimates are larger than the inequality estimates for other welfare measures (e.g., expenditure, consumption). This is because people borrow to spend or consume in order to meet their basic needs or to have a decent lifestyle while some borrow to impress.

Table 4.22: Overall income inequality estimates for different indices

	MLD GE (0)	**Theil GE (1)**	**CV GE (2)**	**Atkinson ($\varepsilon = 1$)**	**Gini**
Overall	1.05050	0.86898	2.25466	0.65024	0.65373
Per capita	0.87256	0.74467	1.89723	0.58212	0.61232

Note: Annual average income = GH₵6,555.00, Sample size (n) = 13,194

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

Estimating inequality using household per capita measures represents inter-household inequality (Haddad & Kanbur, 1989). Since overall inequality can be decomposed into inter- and intra-household when the population is partitioned into households, one may be tempted to interpret the difference between overall and inter-household inequality

as intra-household inequality. This may be true, depending on whether the index is decomposable or not (Shorrocks, 1980). According to the literature, only the Atkinson, MLD and Theil indices are easily decomposable. While the GE indices are decomposed by additive terms, the Atkinson index is decomposed by a multiplicative term.

Table 4.23 reports the contributions of inter- and intra-household inequalities to the overall inequality for the three indices. The results reveal that intra-household inequality contributes between 14 to 22% while inter-household inequality contributes between 78 to 86% to overall income inequality in the sample. de Vreyer and Lambert (2018) used the Theil index and found that intra-household consumption inequality contributes about 14% to the overall consumption inequality in Senegal. This finding is similar to theirs despite different welfare measures. Klasen and Lahoti (2021) also found that intra-household inequality accounts for about 29% of the overall inequality in India. Their estimate is quite high compared to that of this study, due to a few reasons. Firstly, they did a multidimensional inequality analysis based on living standards, education and health. Also, based on the 2020 World Development Indicators, India has a lower GDP per capita compared to Ghana (US$ 1,900.71 versus US$ 2,328.53) as well as a high unemployment rate, population and average household size (Papadopoulos, 2020; World Bank, 2022). The contribution of intra-household income inequality found in this study implies that, we are likely to make an error of about 14% to 22% if we estimate national poverty using only household level welfare-based indicators. The contribution of intra-household inequality found in this study shows that ignoring it during poverty and inequality estimation may provide misleading conclusions and wrongly guide welfare policies.

Table 4.23: Contributions of inter- and intra-household inequalities to overall

	MLD GE (0)	**Theil GE (1)**	**Atkinson ($\varepsilon = 1$)**
Overall Income Inequality	1.05050	0.86898	0.65024
Inter-household Income Inequality	0.87256	0.74467	0.58212
(% contribution)	**(83.03)**	**(85.69)**	**(78.12)**
Intra-household Income Inequality	0.17794	0.12431	0.16301
(% contribution)	**(16.97)**	**(14.31)**	**(21.88)**

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.5 Intra-Household Analyses

As specified in the methodology, the EOPEC model was employed to analyze the effect of intra-household inequality on food insecurity due to suspected endogeneity. The results show that there is a significant correlation between the error terms for the first (intra-household income inequality) and second (household-level food insecurity) stage models of FIES and FE pc. This indicates that intra-household income inequality was indeed endogenous in the food insecurity model. Therefore, the use of the extended ordered probit model is more appropriate than using the simple ordered probit model.

In terms of model goodness of fit, the results reveal that all the independent variables included in the model jointly explain the variations in food insecurity. The associated Wald chi^2 values of 760.27, 1310.05 and 442.84 for FIES, FE pc and HDDS, respectively are statistically significant at 1% level. Again, all the threshold parameters (cut off points, denoted as cut1, cut2 and cut3) are significant at the 1% level (*Table 4.24*). This indicates that the model clearly distinguishes between all categories of food insecurity.

Table 4.24: Model diagnostics for intra-household analyses

	FIES	FE pc	HDDS
	Coefficient (Std. Err.)	**Coefficient (Std. Err.)**	**Coefficient (Std. Err.)**
cut1	-3.6741*** (0.4974)	3.1842*** (0.4481)	1.3414*** (0.4679)
cut2	-3.5265*** (0.4956)	4.7000*** (0.4683)	2.7678*** (0.4601)
cut3	-3.1158*** (0.4908)	6.5157*** (0.4936)	4.2874*** (0.4635)
Correlation (Errors)	**-0.2912*** (0.0882)**	**0.3233*** (0.0725)**	**-0.0525 (0.0911)**
Obs.	2708	2708	2708
Wald Chi2(14)	760.27	1310.05	442.84
Prob>Chi	0.0000	0.0000	0.0000

*Note: ***, ** and * represent 1%, 5% and 10% significant levels respectively*

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS)

4.5.1 Factors influencing intra-household income inequality

This section presents and discusses the results for the first stage of the intra-household analyses when the EOPEC model is estimated with all the food insecurity indicators. Although there are slight differences in the coefficients, the directions of influence are the same.

4.5.1.1 Household composition and intra-household income inequality

The number of labour employees is found to have a negative effect on intra-household income inequality (significant at 1% level when all indicators are used). This means that if the number of household labour employees increases, income inequality within the household will reduce. Labour incomes are mostly determined by minimum wages and averagely the highest source of income for most Ghanaians per annum (GSS, 2019). Hence, having more salary employees means large proportion of household incomes will not be clustered in the hands of few members. This would also translate into a low level of income inequality within the household.

Contrary to the results on labour employees, an increase in the number of household non-farm income contributing employees increases income inequality within the household. This result is statistically significant at 1% for all inequality indicators. Generally, contributing household employees are unpaid family workers or may receive infrequent payments (UNSD, 2017). Where payments are received, their levels of earning are incomparable to the proprietors (UNESCO, 2022). According to the World Bank (2022), some family contributing employees may receive their incomes indirectly in the form of household spendings. They also argue that these set of employees lack social protection, safety nets and adequate saving, thereby exposing them to economic shocks compared to the proprietors. Thus, greater proportion of the incomes generated go to the proprietors, resulting in a huge income gap among the members.

Holding all other factors constant, if the number of household members with university degree increases, income inequality within the household will decline (significant at 1% for using all indicators). Higher education qualification such as a university degree indicates an increase in one's human capital and exposure to better job opportunities. Having more household members with university degree means that the members are more exposed to higher skills with greater opportunities to obtain better paying jobs, which can reduce income inequality within the household.

If the number of members with skills or short course training increases, income inequality reduces, holding all other factors constant (significant at 10% for only FIES). Like education, having skills or short course trainings increases human capital. This helps to increase productivity for certain employment positions or increasing one's idea in starting and operating their personal enterprises, hence the inverse relation observed in this study.

The number of household members receiving internal income transfers is found to have a negative effect on intra-household income inequality (significant at 5% using FIES but 1% using HDDS and FE pc). Internal transfer is an income redistributive measure from high-income earners to unemployed or low-income earners within the household. Internal transfers increases overall welfare within households and serves as a form of compensation for income differences (Molina et al., 2018). As more unemployed or low-income earners receive transfers from high-income earners, the household gets the chance to bridge its income gap between members.

SSNIT contribution, at 1% significance level, reduces income inequality within households for all indicators. This means that if the number of SSNIT contributors within the household increases, income inequality will reduce holding all other factors constant. The SSNIT scheme primarily gathers contributions from working members and periodically replaces part of the lost income (when members are unable to work) due to old age or permanent disability. Also, in the case of death of a member, dependents receive fixed amounts as payment. Assuming all households comprise only aged or disabled members receiving no other form of income, then if only few household members were SSNIT contributors, income inequality in the households would be high because only few would receive payments. However, as more members become contributors and receive payments from their contributions, income inequality would reduce.

The results also indicate that LEAP significantly reduces income inequality within households (significant at 10% using all indicators). This means, if the number of LEAP beneficiaries in a household increases, income inequality within that household will reduce. LEAP payments are made by governments to individuals in vulnerable households. In vulnerable households, only few members receive incomes (might not

be so great). This means such households will not only experience high income inequality, but also lower welfare due to low per capita household incomes. Therefore, if the number of LEAP beneficiaries in such households increase, their welfare will rise and the income gap between household members will fall, *ceteris paribus*.

4.5.1.2 Household head characteristics and intra-household income inequality

At 1% significant level for all inequality indicators, an increase in the income of the household head increases intra-household inequality, holding all other factors constant. In most households, the heads are the highest income earners. Due to this, a proportionate increase in their incomes moves it further away from the incomes of other household members, causing an increase in income gap within the household.

If the household head is employed, income inequality within the household reduces (significant at 10% when using all indicators). In other words, income inequality within the household is high if the household head is unemployed. This is because unemployed household heads may receive either retirement benefits, social security contributions, insurance, remittances or gifts which are no match to salaries, wages or earnings from self-employment (GSS, 2019). This increases the income gap between the unemployed household head and employed household members. However, if the household head is employed, he or she will earn salary or wage similar to employed household members, thereby reducing income gap.

The results also show that age of the household head increases income inequality within the household, and this is significant at 1% for all inequality indicators. Aging is oftentimes associated with more experience or higher employment positions which also attract higher remuneration. Higher remuneration also means that such household heads earn high incomes, and where other household members' incomes are held constant,

intra-household inequality will increase as household heads become older. Also, in cases where household heads are aged, most of the working-class children or family members may leave and form their own households. Thus, in most cases, only the employed household heads and the younger, unemployed members will be left in the household. Hence, income inequality will be high.

4.5.1.3 Income sources and intra-household income inequality

The results reveal that receiving remittances (at 1% level of significance for all indicators) increases income inequality within the household. This means that, holding all other factors constant, if the amount of remittances received by the household increases, income inequality within the household also increases. These results look surprising but not implausible. Obviously, if remittances received increases, household welfare will somehow rise as remittances increase household income. However, due to the decision-making processes in most Ghanaian households where all powers are mostly vested in the household head, remittances are often received or given to household heads. Since household heads are mostly the highest income earners, remittances add up to their income and widens the inequality gap.

The results indicate a positive association between miscellaneous income and income inequality within the household (significant at 1% level for all indicators). The components of miscellaneous income include retirement benefits, state pensions, inheritances, bride prices, gifts, among others. Most of these income components target household heads. As stated earlier, household heads possess larger shares of household income. Therefore, increasing miscellaneous income increases their share in household income thereby widening the inequality gap between members.

Table 4.25: Factors influencing intra-household income inequality

Variable	FIES	FE pc	HDDS
	Coefficient (Std. Err.)	Coefficient (Std. Err.)	Coefficient (Std. Err.)
Labour Employees (count)	-0.0348*** (0.0054)	-0.0375*** (0.0051)	-0.0392*** (0.0052)
Non-Farm Contributing Employees (count)	0.0190*** (0.0039)	0.0172*** (0.0039)	0.0189*** (0.0040)
Miscellaneous Income (ln)	0.0138*** (0.0026)	0.0134*** (0.0025)	0.0135*** (0.0026)
Remittance (ln)	0.0073*** (0.0013)	0.0077*** (0.0013)	0.0077*** (0.0014)
Farm Household	0.0612*** (0.0065)	0.0596*** (0.0064)	0.0563*** (0.0066)
Household Head's Income (ln)	0.0094*** (0.0016)	0.0101*** (0.0016)	0.0096*** (0.0017)
Members with University Degree	-0.0248*** (0.0066)	-0.0251*** (0.0066)	-0.0257*** (0.0066)
Members with Skill Training	-0.0157* (0.0094)	-0.0134 (0.0092)	-0.0128 (0.0097)
Average Labour Income (ln)	0.0110*** (0.0011)	0.0111*** (0.0011)	0.0117*** (0.0011)
Internal Transfer Receivers	-0.0102** (0.0042)	-0.0118*** (0.0041)	-0.0119*** (0.0044)
SSNIT Contributors	-0.0925*** (0.0191)	-0.0991*** (0.0187)	-0.0918*** (0.0197)
LEAP Beneficiaries	-0.0225* (0.0120)	-0.0223* (0.0119)	-0.0235* (0.0124)
Age of Household Head	0.0008*** (0.0002)	0.0009*** (0.0002)	0.0009*** (0.0002)
Employed Household Head	-0.0185* (0.0104)	-0.0199* (0.0103)	-0.0186* (0.0104)
Social Exclusion	0.0275** (0.0122)	0.0105 (0.0120)	0.0201 (0.0125)
Household Political Involvement	-0.0155 (0.0126)	-0.0166 (0.0124)	-0.0151 (0.0130)
Constant	0.0839*** (0.0214)	0.0839*** (0.0213)	0.0844*** (0.0215)

*Note: ***, ** and * represent 1%, 5% and 10% significant levels respectively*

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS

Household average labour income, at 1% level, significantly increases income inequality within the household, holding all other factors constant. In most households, greater proportion of employees are labour employees (GSS, 2019). This means the greater shares of their household income are derived from labour income. Therefore, a proportionate increase in average labour income means the incomes of labour employees will further drift away from the incomes of non-labour employees. This however increases the income inequality between labour employees and non-labour employees within the household.

At 1% significant level for all indicators, income inequality is high within farm households compared to non-farm households. In most farm households, more members are engaged on the farm. Similar to the case of contributing household employees, household members who are engaged on farms are paid indirectly through household spendings or may receive little renumerations which are lower than their marginal productivity of labour (World Bank, 2022). Also, because those responsible for the farm activities dedicate more in the form of capital investments (UNESCO, 2022), they receive major shares of farm incomes which increases income gap within the household.

4.5.1.4 Social factors and intra-household income inequality

Social exclusion significantly influences intra-household income inequality (at 5% level when the model is estimated with FIES). That is, intra-household income inequality is high within households where members are excluded from participation in social activities. When people face social exclusion, they may be denied the right to basic healthcare, education, employment opportunities, among others (Kawamoto, 2017). According to Bak (2018), social exclusion and income poverty are not mutually exclusive. This is because, the socially excluded lack several opportunities which may

make them perform ineffectively, thereby affecting their incomes. Therefore, in households with socially excluded members, great portions of income are more likely to be controlled by the unexcluded, resulting in a wide income gap.

4.5.2 Determinants of household-level food insecurity in Ghana

This section also presents and discusses the second stage results of the inter-household analyses for all three food insecurity indicators.

4.5.2.1 Effect of intra-household income inequality on food insecurity

This section focuses specifically on intra-household income inequality because it is the main variable of interest in the model. The results reveal that intra-household income inequality has no significant effect on household dietary diversity. A possible explanation for the non-significant result is that the recall period for the consumption of the food items used in the GLSS7 dataset was almost a month. This period is a wide enough gap for any household to consume a more diversified diet, especially poor or rural households who sorce their foods from varying sources (Chakona & Shackleton, 2019; Tomayko et al., 2017). This means that the sample may not differ much in terms of their dietary diversity, hence the non-significant effect.

However, the results further reveal that intra-household income inequality increases the probability of experiencing household food insecurity (FIES) but reduces household food expenditure per capita (FE pc) at 1% level of significance. This means the higher the income inequality within a household, the greater the level of food insecurity. For households with higher income inequality, some members may be deprived, especially those with little or no incomes. This means they have to depend on those few income earners for their survival. Intra-household income inequality exists both in poor and rich households, but, its welfare implications on poor households are massive (Klasen

& Lahoti, 2021). Poor households are already vulnerable because the household earners' incomes are not enough to meet members' basic needs. Therefore, increasing income inequality within poor households make members more vulnerable, which worsen the severity of food insecurity they experience. This is because they will reduce their food expenditure per capita and may consume poor, unhealthy and less preferred diets to cope with poverty (Chakona & Shackleton, 2018; Loopstra, 2018). Although resources in rich households may be enough to meet members' needs, the presence of income inequality may increase the sense of subsidiarity because more members will depend on a few income earners (Pollard & Booth, 2019). Dependency is somehow embarrassing (especially to diffident people) since it makes one feel incompetent, inadequate or useless (Douglas et al., 2018; Garthwaite, 2016; Purdam et al., 2016). Due to this, some dependents may find it difficult to request for assistance to meet their food needs, exposing them to food insecurity. Also, in rich households, economic (e.g., price fluctuations) and non-economic (e.g., ill health of income earners) shocks are likely to affect their finances. This will make them alter their consumption patterns for certain foods when shocks extend for longer periods (Ansah et al., 2021). Similarly, in the absence of income earners (e.g., due to unexpected business trips), the dependents are likely to experience food insecurity, especially in households where no or little internal transfer is made.

4.5.2.2 Other factors influencing household level food insecurity

Per capital household income is more likely to reduce FIE and more likely to increase FE per capita as well as HDDS (significant at 1% for all indicators). These results mean that households with higher income per capita are less likely to experience food insecurity, which is expected. Higher per capita household income is an indication that the household possesses better financial resources to meet their needs. Previous studies

(Saaka et al., 2017; Tarasuk et al., 2019) also found a negative relationship between household income and food insecurity. A study conducted by Abrahams et al. (2018) reveals that there is a vicious cycle of relationship between income and food insecurity. That is, those with no income do not have adequate command over food whereas those with inadequate food do not have enough energy to work for income, *ceteris paribus*.

Where food price indices are high, households are less likely to experience food insecurity while their FE pc and dietary diversity are more likely to be high (significant at 10% level for FIES but 1% for FE pc and HDDS). This means that in areas with high food price indices, food insecurity is low. Food price indices represent living standards in various societies. Since food price indices are average food prices in a given locality, once would expect food insecurity to be high in societies with high food price index. This is because as the average prices of food increase, more people will be forced to reduce their consumption holding all other factors constant. The findings in this study could however be explained in the sense that high food price indices are indicative of better living standards, especially in high-income societies that already experience very low levels of food insecurity.

For household head characteristics, the results show that age of the household head significantly influences food insecurity (at 1% for FIES only). That is, if the age of a household head increases, the household is less likely to experience food insecurity, *ceteris paribus*. This result is consistent with other studies that report a negative effect of household head's age on food insecurity (Cordero-Ahiman et al., 2020; Joshi et al., 2019; Morales et al., 2021; Tomita et al., 2019). Mabe et al. (2021) argued that older household heads possess extra resources which can assist in providing the basic food needs of their families more comfortably than younger household heads. Also, due to

their experience in mobilising household resources, they are more likely to provide the food needs of their families easily in times of shocks compared to younger heads.

Table 4.26: Effect of intra-household income inequality on food insecurity

	FIES	FE pc	HDDS
	Coefficient (Std. Err.)	**Coefficient (Std. Err.)**	**Coefficient (Std. Err.)**
Intra- Household Income Inequality (Gini)	**2.3329*** (0.5408)**	**-2.4275*** (0.4516)**	**0.3675 (0.5742)**
Household Income per capita (ln)	-0.2550*** (0.0254)	0.2649*** (0.0232)	0.1421*** (0.0252)
Household Size	0.0201** (0.0092)	-0.1200*** (0.0093)	0.0485*** (0.0091)
Asset Value per capita (ln)	-0.1488*** (0.0146)	0.1356*** (0.0131)	0.0945*** (0.0138)
House Ownership	0.1658*** (0.0550)	-0.1363*** (0.0499)	-0.3129*** (0.0552)
Members with University Degree	-0.4539*** (0.0915)	-0.0190 (0.0525)	-0.0512 (0.0597)
Land Ownership	0.1545** (0.0625)	0.0539 (0.0557)	0.1465** (0.0633)
Access to Credit	0.1055* (0.0622)	0.0687 (0.0564)	0.0672 (0.0634)
Remittance (ln)	0.0199** (0.0083)	0.0171** (0.0073)	0.0256*** (0.0082)
Age of Household Head	-0.0063*** (0.0019)	0.0012 (0.0017)	-0.0028 (0.0018)
Sex of Household Head (Male)	-0.1890*** (0.0605)	-0.0588 (0.0562)	-0.1076* (0.0624)
Location (Urban)	-0.2358*** (0.0553)	0.4294*** (0.0527)	0.4213*** (0.0537)
Employed Household Head	-0.1290* (0.0784)	0.0672 (0.0721)	0.1283* (0.0744)
Food Prices Index	-0.7489* (0.4154)	2.6942*** (0.3900)	2.0812*** (0.4232)

*Note: ***, ** and * represent 1%, 5% and 10% significant levels respectively*

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS)

Sex of the household head is found to significantly influence household food insecurity (at 1% level for FIES and 10% for HDDS). Male household heads are less likely to experience food insecurity but more likely to have low dietary diversity compared to

their counterpart female household heads, *ceteris paribus*. In other words, female heads are more likely to experience food insecurity but more likely to exhibit high dietary diversity. Females generally possess less resources compared to males (Joshi et al., 2019; Tomita et al., 2019), which is likely to expose them to experience food insecurity compared to males. Also, in most cases, female household heads are divorcees or widows who were once married as house wives (Yoosefi et al., 2020). They therefore become vulnerable when their spouses are not with them, making it difficult to meet their household needs. However, because women crave more for different food attributes, they are more likely to show higher dietary diversity compared to men.

Even though the FIES and the HDDS are both food security indicators, their influences in relation to sex in this study are contradicting, which obviously indicates the aspect of food security each indicator measures. While the FIES subjectively measures the economic access to nutritious and sufficient diets (Ballard et al., 2013), the HDDS measures the physical access to or the consumption of varying diets, as a proxy for nutrient adequacy, irrespective of the sufficiency (Swindale & Bilinsky, 2006). Therefore, while a household that consumes insufficient but more varying diets will be classified food secure by the HDDS, it will be classified food insecure by the FIES, due to diet insufficiency. Also, the recall period for the FIES is usually extensive compared to the HDDS, which means the former plays an important role in measuring the stability dimension. Therefore, a deprived household that fortunately consumes more varying diets within the 24 or 48 hours recall period of a researcher, will be classified food secure by the HDDS. Meanwhile, another household that usually consumes quality and sufficient diets, 3-times-a-day, but skips a single meal in a month (due to lack of resource) will be considered food insecure by the FIES.

Where household heads are employed, the households are less likely to experience food insecurity and more likely to display high dietary diversity (significant at 10% for FIES and HDDS). Employment increases the probability of generating income, hence, when the household head is employed, the ability to meet household food needs is also likely to increase. The direction of influence meets *a priori* expectation since other studies found similar results (Abrahams et al., 2018; Saaka et al., 2017).

For household composition, the results show that increasing household size reduces FE pc and increases the likelihood of experiencing food insecurity (significant 5% for FIES and 1% for FE pc). All else held constant, household size reduces household resource per capita because members are more likely to compete for the few available resources, which will reduce the ability to meet their household needs, including food. On the contrary, increasing household size is found to increase household dietary diversity at 1% level of significance. This is not surprising because when the household size is large, members are more likely to gather food from different sources which will result in having diverse foods.

Having more members with university degree significantly influences food insecurity (at 1% level for FIES only). That is, when the number of household members with university degree increases, the household is less likely to experience food insecurity holding all other factors constant. It is obvious that higher education negatively correlates with poverty through better employment opportunities (Tuholske et al., 2020). Therefore, increasing the number of people with university degree indicates more human resource which translates into higher economic access to meet household needs. This finding is in line with Joshi et al. (2019), Mahmudiono et al. (2018) and Tomayko et al. (2017) who also reported that having at least a college degree reduces food insecurity. In South Africa, Abrahams et al. (2018) and Tomita et al. (2019) found

that individuals who have completed grade 12 are less likely to experience food insecurity.

Regarding physical capital, the results show that household assets significantly influence food insecurity at 1% level of significance for all food insecurity indicators. This means if the value of a household's assets increases, FIE is likely to reduce while FE pc and HDD are likely to increase. The value of household assets is a good proxy of household wealth. The wealthier a household, the greater its chances of providing for the household's needs. This result is consistent with Abrahams et al. (2018) and Tuholske et al. (2020) who found that asset index reduces food insecurity in South Africa and Ghana, respectively.

When households own their houses, it indicates that no proportion of their incomes will be allocated to rent. Hence, their budgeted funds allocated for meeting other household needs will be high. Tarasuk et al. (2019) argued that households living in their own houses are protected from temporal income shocks and inflationary pressure to which renters fall victim. While other studies (Jessiman-Perreault & McIntyre, 2017; Morales et al., 2021) show that owning a house reduces the chances of being food insecure, this study found the reverse. At 1% significant level for all indicators, households are more likely to have low FE pc and dietary diversity and also more likely to experience food insecurity if they own their residence. This finding seems counterintuitive; however, further scrutiny of the data revealed that the average number of members in households that own their residence is almost twice the average number of members in households that do not own their residence (5.1 against 3.2; differences is significant at 1%). Meanwhile, larger household size is positively associated with food insecurity. The study also reveals that about 75% of households that own their residence are from rural

location. Households in rural location are exposed to less employment and income generating opportunities which affect their command for food.

The results show that land ownership significantly influences food insecurity (at 5% for both FIES and HDDS). Holding all other factors constant, households owning land are more likely to experience food insecurity and also more likely to have a high dietary diversity. The direction of influence for dietary diversity is consistent with Chakona and Shackleton (2018), who found that South African households with land access have low levels of food insecurity. Having land access means one has the chance to engage in farm production activities and increase their household food supply. However, the direction of influence for FIE could be due to the fact that most households with lands are typical rural farm households who depend mainly on farming for their food needs. Due to seasonality and perishability of agricultural produce, most of these households find it challenging to meet their food needs during off seasons and in times of shocks.

In terms of financial capital, households with access to credit are more likely to experience food insecurity, holding all other factors constant (at 10% significant level). Having access to credit means people will have the capacity to expand their production activities and increase their incomes which will translate to being food secure. However, the result in this study showed otherwise. More often, credit facilities are given to poor or rural farmers to enhance their production activities and to alleviate poverty (Cordero-Ahiman et al., 2020). Further analysis of the data reveals that over two-thirds of households with credit access are rural farmers. According to FAO et al. (2014), financial credits offered by some financial institutions come with high interest rates. This makes rural farmers use significant portions of their incomes to settle credit interests. Also, in the midst of unfavorable climatic conditions, farmers encounter managerial, technical, marketing and health challenges which reduce their overall

returns from farm production (Asafo-Adjei & Buabeng, 2016; Talib & Ashraf, 1970). For example, a rural farmer who successfully cultivates his/her farm might be challenged with no ready market, no storage facility or poor road network connecting potential markets. These factors are likely to result in high post-harvest losses. Aside these cultivation and post-harvest challenges, farmers are also faced with low market prices due to high perishability of agricultural produces. These challenges reduce the expected revenues making some farmers run into massive losses after settling all interests on credit, which similarly affect their food consumption patterns thereby making them food insecure.

In terms of income transfers, the results reveal that remittance significantly influences food insecurity (at 5% level for FIES and FE pc but 1% for HDDS). This means if the remittances received by households increase, they are more likely to increase FE pc and HDD but also more likely to increase FIE. Remittances are non-labour incomes that augment household income. All other things equal, and given higher income, household demand for food is expected to increase (Cordero-Ahiman et al., 2020). The direction of influence for the FIE result does not follow this assumption, but in line with Tarasuk et al. (2019) who also found that remittances are associated with food insecurity. This can be explained by the fact that remittances are mostly received by economically disadvantaged households (aged, widows, divorcees, etc.) that already struggle to meet their basic needs (Tomita et al., 2019). A focus group discussion conducted by Chakona and Shackleton (2019) reveals that remittances and grants received by most households are not used on food only, but also to settle other household bills (especially utility bills). Due to this, they tend to reduce the quantities and qualities of food they consume which exposes them to experiencing food insecurity. Another explanation to these results is that, majority of remittance-receiving households are poor or very poor.

Remittances are thus expected to assist them buy more diverse food which will result in having high food expenditure per capita and dietary diversity. However, because remittances only help to cope with poverty but do not eradicate poverty, households are likely to experience food insecurity due to economic shocks and especially in cases where the remittances are not consistently received.

In terms of location factors, the results show that at 1% significant level for all indicators, urban households are more likely to have higher FE pc as well as HDDS and also less likely to experience food insecurity compared to rural households. Urban areas have more employment and income generating opportunities compared to rural areas. This makes urban households to be more resource endowed which will increase their demand for food and lower their levels of food insecurity experienced.

4.6 Inter-Household Analyses

As stated in the methodology section, an endogeneity test was conducted using appropriate instruments. The results show that the error terms of the first (inter-household income inequality) and second (community-level food insecurity) stage models are significantly correlated for all food insecurity indicators. These signal that inter-household income inequality is indeed endogenous to food insecurity, and therefore the use of the EOPEC model is more appropriate than the use of a simple ordered probit model. Also, the Wald chi-square values are significant at 1% level for all models (*Table 4.27*), implying that the independent variables included in the models jointly explain the variation in the community-level food insecurity. As in the case of intra-household analyses, the results for the inter-household analyses also generated significant cutoff points for all indicators, which means the model clearly distinguishes between all categories of the food insecurity indicators.

Table 4.27: Model diagnostic for inter-household analyses

	FIES	FE pc	HDDS
	Coefficient (Std. Err.)	**Coefficient (Std. Err.)**	**Coefficient (Std. Err.)**
cut1	4.6759***	-4.4398***	-4.0773***
	(0.1538)	(0.4263)	(0.4061)
cut2	4.7644***	-4.2193***	-3.6144***
	(0.1536)	(0.5590)	(0.5414)
cut3	4.8620***	-4.0754***	-3.1956***
	(0.1619)	(0.6505)	(0.6759)
Correlation (Errors)	**-0.9981*** (0.0013)**	**0.9883*** (0.0162)**	**0.9544*** (0.0333)**
Obs.	745	745	745
Wald Chi2 (10)	1487.57	1471.25	1151.10
Prob>Chi2	0.0000	0.0000	0.000

*Note: ***, ** and * represent 1%, 5% and 10% significant levels respectively*

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

4.7.1 Factors influencing inter-household income inequality

This section presents and discusses the results for the first stage regressions of the inter-household analyses using the EOPEC model for all the food insecurity indicators.

Among the factors, the results show that social exclusion increases inter-household income inequality (significant at 5% level when the model is estimated using FIES and HDDS). The result means that income inequalities between households will increase if the proportion of households that are excluded from participating in social activities increases. When households are excluded in a society, they are denied the rights to participate in social activities and services (such as health care, education, employment opportunities, etc.). According to the literature, social exclusion correlates with poverty in the sense that, the socially excluded lack valuable opportunities which may help in the personal, social, psychological and financial growth (Bak, 2018). Thus, when more households are socially excluded, only a few households have the full rights to participate in all social activities. These few households will have relatively higher

employment and income generating opportunities compared to the socially excluded. Therefore, a major portion of the society's resources will be captured by few households, causing a huge resource gap between the households.

Table 4.28: Factors influencing inter-household income inequality

Variable	FIES	FE pc	HDDS
	Coefficient (Std. Err.)	Coefficient (Std. Err.)	Coefficient (Std. Err.)
Social Exclusion (Prop.)	0.0068** (0.0032)	0.0034 (0.0054)	0.0289** (0.0142)
Opinion on Development Issue (Prop.)	-0.0028 (0.0025)	0.0062 (0.0077)	0.0135 (0.0119)
Household Political Involvement (Prop.)	0.0028 (0.0034)	-0.0083 (0.0095)	0.0303 (0.0195)
Discriminated against Public Service use (Prop.)	0.0061* (0.0035)	0.0050 (0.0079)	0.0383** (0.0168)
Labour Employed (Prop.)	-0.0018** (0.0009)	-0.0081 (0.0059)	-0.0115** (0.0051)
LEAP Benefiting Households (Prop.)	0.0022* (0.0011)	0.0081 (0.0063)	0.0118** (0.0057)
Availability of Financial Institution(s)	0.0243** (0.0116)	0.0248** (0.0116)	0.0250** (0.0115)
Location in Urban Area	-0.0714*** (0.0114)	-0.0664*** (0.0123)	-0.0644*** (0.0119)
Employed Household Heads (Prop.)	-0.0092** (0.0039)	-0.0165** (0.0081)	-0.0124** (0.0056)
Constant	0.5829*** (0.0119)	0.6073*** (0.0251)	0.6027*** (0.0179)

*Note: ***, ** and * represent 1%, 5% and 10% significant levels respectively*

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

In communities where more households are discriminated against in the use of public services, income inequality between households is high (significant at 10% and 5% levels using FIES and HDDS, respectively). When people become victims of discrimination, they may suffer mental health disorders which may lead to drug abuse and/or alcoholism (O'Donnell et al., 2018). This has the potential to reduce their overall productivity as well as incomes due to poor health. Therefore, a significant portion of

income within the community would be controlled by few households, thus generating a wide income gap between households.

At 5% level of significance (FIES and HDDS models), increasing the proportion of households with labour employees decreases income inequality between households, holding all other factors constant. Labour income is the highest contributor, by income source, to overall income in most Ghanaian households (GSS, 2019). This means that as more households in a community have labour employment, there will be minimal differences in per capita household income which will result in low inter-household income inequality in such a community.

Increasing the proportion of LEAP receiving households increases inter-household income inequality, holding all other factors constant (significant at 10% and 5% levels in FIES and HDDS models, respectively). LEAP receiving households have significantly low per capita income. In communities where high proportions of households are LEAP beneficiaries, only few households possess high incomes. This means large portions of income are contributed by few households (non-beneficiaries). This therefore increases income gap between households.

The results also show that at 5% significance level, all food insecurity indicators show that increasing the proportion of employed household heads reduces income inequality between households by about 0.92% to 1.65% (significant at 1% level), holding all other factors constant. In most Ghanaian households, the heads are the highest contributors to household incomes (GSS, 2021c). Also, the main sources of their incomes are through employment activities. Therefore, in communities where more household heads are employed, income differences between households will be low, thereby reducing inter-household income inequality.

Where financial institutions are available, it is presumed that individuals will not have to travel long distances for financial transactions. Hence, more individuals (especially those that are financially challenged) can readily obtain credit facilities to start or improve their businesses which may also reduce income gap. The results however showed the reverse. That is, inter-household income inequality is rather between 2.43% to 2.50% high in communities with financial institutions (significant at 5% level for all models). The literature reveals that most individuals are discouraged by the high lending rates and short repayment periods of credits and loans from most financial institutions (Bondinuba, 2012; Mensah et al., 2015; Munishi et al., 2022). Ussif (2020) found that most financial institutions fail to offer loan services to some individuals and small-scale enterprises due to lack of collateral security. These bureaucratic procedures and impediments mean that only a few individuals and enterprises (i.e., those with relatively high levels of income and assets) are likely to obtain loan facilities to expand their businesses. This therefore increases income gap between households.

The results also reveal that, at 1% significance level for all food insecurity indicators, income inequality between urban households is between 6.44% to 7.16% lower compared to income inequality between rural households. There are more employment and income generating opportunities in urban towns compared to rural areas. Therefore, more households have higher chances of making decent incomes which will result in minor income differences between urban households.

4.6.2 Determinants of community-level food insecurity in Ghana

This section also presents and discusses the second stage results of the inter-household analyses for all three food insecurity indicators.

4.6.2.1 Effect of inter-household income inequality on food insecurity

Inter-household income inequality significantly increases food insecurity by increasing FIES and reducing both FE per capita and HDDS. This means that in communities with high inter-household income inequality, more households are likely to experience food insecurity by having low per capita expenditure on food and low dietary diversity. A high inter-household income inequality in a given community indicates that significant a proportion of that society's income is contributed by only few households. In other words, a high inter-household income inequality means more households have relatively low income per capita. Although high income inequality does not necessarily mean poverty, both are positively and highly correlated, especially in less developed countries (Rohwerder, 2016). High income inequality in such countries is associated with low social welfare (Stewart, 2013). Thus, in communities with high income inequality, more members are unable to afford decent lifestyles. Therefore, they may struggle to meet their basic needs, making them consume insufficient and low-quality diets, especially in societies with low or no charity or welfare systems.

4.6.2.2 Other factors influencing community-level food insecurity

The results show that dietary diversity is likely to be high in communities with high food price index (significant at 10% level for HDDS). Food price indices represent living standards and are high in high-income societies. Households in high-income societies have more resources to afford diverse diets compared to those in low-income societies irrespective of the prices.

Research shows that communities with more members have a university or college degree is reported to be associated with having more decent and well-paid jobs which then translate into having sufficient and quality diets (Joshi et al., 2019; Mahmudiono et al., 2018; Tomayko et al., 2017). The results of this study confirm this general

finding. In communities where more households have at least a degree holder, food insecurity is likely to be low, holding all other factors constant (significant at 5% level for FIES).

Table 4.29: Effect of inter-household income inequality on food insecurity

	FIES	FE pc	HDDS
	Coefficient (Std. Err.)	**Coefficient (Std. Err.)**	**Coefficient (Std. Err.)**
Inter-Household Income Inequality (Gini)	8.4298*** (0.2189)	-8.4421*** (0.2262)	-8.1048*** (0.3427)
Food Price Index	-0.0082 (0.0453)	0.6000 (0.4328)	0.6054* (0.3129)
Households with Degree Holder(s) (Prop.)	-0.0228** (0.0102)	0.0283 (0.0233)	0.0198 (0.0278)
Average Household Size	0.0545* (0.0303)	-0.1677* (0.0868)	0.0375** (0.0167)
Estimated Community Population (ln)	-0.0043 (0.0027)	0.0160 (0.0121)	0.0260* (0.0142)
Availability of Financial Institution(s)	-0.2086** (0.0981)	0.2305** (0.1001)	0.2271** (0.1005)
Availability of Daily Community Market	0.0030 (0.0068)	0.0103 (0.0185)	0.0040 (0.0333)
Availability of Electricity	-0.0096 (0.0097)	.01202 (0.0261)	0.0147 (0.0448)
Public Transport Passage via Community	-0.0192* (0.0107)	0.0595 (0.0467)	0.0329 (0.0410)
Location (Urban)	-0.5878*** (0.0979)	0.5188*** (0.1206)	0.5002*** (0.1121)

*Note: ***, ** and * represent 1%, 5% and 10% significant levels respectively*

Source: Author's calculation from Ghana Living Standard Survey-Round 7 (GLSS 7)

If the average household size of a community increases, FIES and dietary diversity are likely to increase while FE per capita is likely to reduce (significant at 10% level for FIES and FE per capita but 5% for HDDS). In communities with large household sizes, members compete over a few resources. This makes members to be somewhat challenged in meeting their basic needs. This is therefore likely to reduce their food consumption per capita, making them experience food insecurity. However, due to their

large numbers, members are more likely to assemble and consume foods from different sources which will make them have a high dietary diversity.

The Malthusian theory states that as population increases, the demand for food will outweigh the supply of food, leading to food shortage, and individuals may be forced to consume from fewer dietary sources. However, the results in this study show otherwise. At 10% significance level, dietary diversity is likely to increase as the population of a community increases. This result could be linked to the fact that more people migrate to high opportunity communities in order to have more decent lifestyles (McAuliffe et al., 2020). This rather increases population in communities with more opportunities (with low food insecurity), making food security to be high in those populated communities.

While FIES is likely to be low, FE per capita and HDDS are likely to be high in communities with financial institutions (5% significant level for all indicators). Financial institutions offer financial capitals in the form of credits to business proprietors, farmers and individuals in order to increase their productivities and improve economic livelihoods (Carvalho & Carvalho, 2015). In communities where financial institutions are available, individuals do not need to travel long distances for financial transactions. This makes it easier to access credits for investment compared to those in communities without financial institutions.

Food insecurity experienced is likely to be low in communities where public transports passes (significant at 10% level for only FIES). In these communities, members have higher advantages of travelling to other communities to work and earn livelihoods which will translate into being food secure compared to those in communities without public transport passage.

The results also show that FIE is likely to be low while FE per capita and HDDS are likely to be high in urban communities (significant at 1% level for all indicators). Urban communities have more employment and income generating opportunities than rural communities. Therefore, urban households are more likely to display low food insecurity and high dietary diversity compared to rural households. Also, most households in rural areas cultivated more of the food items in their consumption bundle. However, due to high food prices in urban areas, rural farmers are motivated to transport most of their produce to urban markets for more revenues (Crossley et al., 2009). Furthermore, due to perishability, most agricultural products from rural areas are sold to urban processors, who might process and sell them in urban markets. These, in addition to imports, make foods to be available to urban households than rural households.

CHAPTER FIVE

SUMMARY OF KEY FINDINGS, CONCLUSION AND RECOMMEDATIONS

5.0 Chapter Outline

Section 5.1 of this chapter summarizes the key findings of the study, section 5.2 concludes the key findings while section 5.3 proposes recommendation for government and other development agencies.

5.1 Summary of Key Findings

Although Ghana's GDP per capita has consistently increased over the years, household food insecurity still persists. A key hypothesis made in this study is that the consistent rise in per capita income is due to the increasing incomes of the wealthy class (increasing income inequality) making more households to be food insecure. To test this hypothesis, this study examined how household (inter- and intra-household) income inequality influences food insecurity, using the GLSS Round 7 dataset, which collected information on 14,009 households from 1,000 enumeration areas in Ghana. A sub-sample of 2,737 households was created for intra-household inequality analysis, since they have at least two income sources that satisfy inequality estimation. Further, 749 communities in Ghana were used for inter-household income inequality analysis due to successful identification and matching of the communities with household characteristics. Both inter- and intra-household income inequalities were calculated using the Gini index. The food insecurity indicators used were the Food Insecurity Experience Scale (FIES), Dietary Diversity Score (DDS) and Food Expenditure per capita (FE pc). The special cases of the Generalized Entropy (Mean Log Deviation and Theil) and the Atkinson indices were used to assess the extent to which inter- and intra-household income inequalities contribute to overall income inequality. The Extended

Ordered Probit with Endogenous Covariate (EOPEC) model was then used to analyse factors influencing household income inequality and their effects on food insecurity.

The key findings from these analyses are summarized below:

- The average annual income for the sample was found to be GH₵6,555.00, with an overall income inequality from the MLD, Theil, Atkinson and Gini indices being 1.05, 0.87, 0.65 and 0.65 respectively.
- Intra-household income inequality was found to contribute between 14-22% to overall income inequality while inter-household income inequality contributes between 78-86%.
- Averagely, households spend about GHc1,423.70 per capita on food annually, which provides an average dietary diversity score of 6.30 food items.
- About 70% and 56% of the households in the sample have at least a moderate dietary diversity and experience little or no food insecurity respectively.
- With regards to decision making within the households, the study found that intra-household income inequality increases by about 0.94% to 1% if the household heads' incomes increase by 1% and reduces by 1.85% when the household heads is employed.
- The study found that, when the number of labour employees, university degree holders, members with vocational or technical or ICT skills, internal transfer receivers, SSNIT contributors and LEAP beneficiaries within the household increase by one person each, intra-household income inequality reduce by about 3.5%, 2.5%, 1.6%, 1%, 9.3% and 2.3% respectively.
- Intra-household income inequality increases by 1.9%, 0.7%, 1.4% and 1.1% respectively if non-farm enterprise contributing household employees, remittances,

miscellaneous and labour incomes increase by 1%. Also, intra-household income inequality is 6.1% and 2.8% high in farm and socially excluded households respectively.

- Inter-household income inequality is about 7% low in urban communities and reduces by 0.9% when more household heads are employed as well as when more households have labour employees.
- Inter-household income inequality is about 2.5% high in communities with financial institution(s) and increases by 2.9%, 3.8% and 1.1% respectively if the proportion of socially excluded, discriminated and LEAP receiving households increase by 1%.
- Intra-household income inequality is more likely to increase food insecurity experience by 2.3 points and less likely to increase food expenditure per capita by 2.4 points at the household level but has no significant effect on dietary diversity.
- If per capita household income, assets, members with university degree, age of household head and food price index increase, food expenditure per capita and household dietary diversity are more likely to increase whereas food insecurity experience is more likely to reduce.
- When the households head is employed, dietary diversity is more likely to be 0.1 point high while food insecurity experience is likely to be low by 0.1 point.
- Access to credit, house and land ownership as well as remittance are more likely to increase food insecurity experienced by about 0.17 points. However, remittances and land ownership are more likely to increase food expenditure per capita and dietary diversity by 0.15 point for both indicators.

- Household size is more likely to reduce food expenditure per capita by 0.12 point but more likely to increase food insecurity experience and household dietary diversity within the households by 0.02 and 0.05 points respectively.
- Inter-household income inequality is likely to increase food insecurity experienced by 8.4 points and also likely to reduce food expenditure per capita and dietary diversity by 8.4 and 8.1 points respectively.
- Food price index and estimated community population are more likely to increase dietary diversity by 0.61 and 0.06 points respectively, but has no effect on food insecurity experienced and food expenditure per capita at the community level.
- In communities with public transport passage and those where more households have members with university degree, food insecurity experienced is likely to be 0.02 point less.
- Availability of financial institution(s) reduce the likelihood of experiencing food insecurity by 0.21 point and increases the likelihood of having a high food expenditure per capita and dietary diversity by 0.23 point at the community level.

5.2 Conclusion

- Both inter- and intra-household income inequality contributes significantly to overall income inequality.
- Having more labour employees, university degree holders, skilled members, SSNIT contributors, LEAP and internal transfer receivers and an employed household head reduce intra-household income inequality.
- Non-farm contributing household employees, remittance, miscellaneous and labour incomes, ages and incomes of household heads, social exclusion and being in a farm household increase intra-household income inequality.

- Number of LEAP benefiting, socially excluded and discriminated households as well as the availability of financial institution(s) increase inter-household income inequality while the number of households with labour employee(s) and employed household heads reduce inter-household income inequality.
- Both inter- and intra-household income inequality increase food insecurity.
- Other factors that increase household food insecurity are household size, access to credit and ownership to residence.
- On the other hand, factors that reduce household food insecurity include per capita household income, assets, university degree, remittances, ages and employment of household heads, community population, urbanisation, price index, availability of financial institutions and public transport passage via communities.

5.3 Recommendation

Based on the conclusions, the following recommendations are made:

- Inequality- and poverty-based research should incorporate intra-household analyses in order not to understate inequality or poverty estimates when using per capita household indicators only.
- Government and private development-oriented agencies should assist in providing favourable opportunities and conditions, such as scholarships and subsidized/soft student loans, to increase tertiary education enrolment since having more individuals with university degrees reduces income inequality and food insecurity.
- Individuals, especially youth, are encouraged to acquire more skills by taking advantage of free or low cost technical, vocational and ICT skills in order to increase their skill intensities and exposure to better employment opportunities.
- State and private agencies should assist in creating more labour job opportunities since food insecurity and inequality reduce if more people have labour jobs.

- Employees are encouraged to contribute proportions of their incomes to SSNIT so that when they are unable to work due to old age or permanent disability, their lost incomes can be replaced partly by their contributions.
- Household heads and high-income earners should transfer portions of their incomes to unemployed and low-income earners of the households in order to reduce income inequality within households and improve overall household welfare.
- Leaders and social activists should ensure that individuals and households have the freedom to participate in social activities and use public services without discrimination.
- The Central Bank and government should provide favourable conditions that can make financial institutions to be extended to villages for low-cost access and to increase financial services.
- Roads should be constructed and extended through various communities in order to increase public transport passage.

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APPENDICES

Appendix A: Response pattern for FIES questions

Table A1: Response pattern for FIES questions

	Yes			No	
	Obs.	***Freq.***	***Perc. %***	***Freq.***	***Perc. %***
FIES-Q1	2,733	1,331	48.70	1,402	51.30
FIES-Q2	2,731	1,246	45.62	1,485	54.38
FIES-Q3	2,735	1,352	49.43	1,383	50.57
FIES-Q4	2,735	1,161	42.45	1,574	57.55
FIES-Q5	2,735	1,207	44.13	1,528	55.87
FIES-Q6	2,735	939	34.33	1,796	65.67
FIES-Q7	2,735	767	28.04	1,968	71.96
FIES-Q8	2,731	209	7.65	2,522	92.35

Appendix B: Proportion of households consuming the various foods

Table B1: Proportion of households consuming the various foods

	Visit 1	**Visit 2**	**Visit 3**	**Visit 4**	**Visit 5**	**Visit 6**
Cereals	92.99	92.22	92.58	91.45	90.50	91.04
Roots and Tubers	57.29	55.02	55.06	54.73	54.14	54.36
Vegetables	90.90	90.50	90.65	90.46	90.35	91.04
Fruits	28.97	27.44	28.79	27.07	27.14	26.30
Meat, Poultry and Offal	44.17	40.45	40.99	41.06	42.16	40.33
Eggs	23.53	20.35	21.56	19.58	20.16	20.16
Fish and Sea Foods	84.44	81.29	82.57	83.22	82.75	81.69
Pulse, Legumes and Nuts	38.55	36.54	38.03	35.29	36.93	34.74
Milk and Milk Products	23.38	25.25	22.87	23.41	22.76	21.99
Oils and Fats	53.70	48.96	48.34	46.21	47.13	45.70
Sugar and Honey	32.99	29.85	29.34	29.01	27.95	27.65
Miscellaneous	84.03	82.50	82.65	80.23	81.25	80.30