Comparative study of Household Food security, Under Five Children Nutritional Status and Dietary Diversity between Selected Coffee and Wheat Growers of Ethiopia

Mequanent Muche

A Dissertation submitted to the Center of Rural Development, College of Development Studies,

Presented in fulfillment of Requirement for Degree of Doctor of Philosophy in Development Studies (Rural Development)

Addis Ababa University

Addis Ababa, Ethiopia

June 2024

Addis Ababa University

School of Graduate Studies

College of Development Studies

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Major Advisor: Professor Degefa Tolossa.(PhD)

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ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

This is to certify that a thesis prepared by Mequanent Muche entitled: Comparative Study of Household Food security, Under Five Children Nutritional Status and Dietary Diversity Between Selected Coffee and Wheat Growers of Ethiopia, submitted in fulfillment for the requirement for the Degree of Doctor of Philosophy in Development Studies (Rural Development) complies with the regulations of the University and meets the accepted standards concerning originality and quality.

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Thus, the dissertation has been submitted for examination with my approval as university supervisor.

Supervisor Name: Prof. Degefa Tolossa (PhD)

Signature: _____

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ABSTRACT

Ethiopia, among the world's least developed nations, faces widespread food insecurity in its rural areas. Coffee and wheat are crucial crops, serving as cash and staple foods, respectively, yet their impact on household food security, the nutritional status of under-five children, and dietary diversity remain inadequately studied. This research focused on the Dodota district wheat farmers and the Gomma district coffee growers, examining the current status and the determinants of these factors. A total of 370 rural households were surveyed to assess food security, with 226 households further analyzed to understand the nutritional status and dietary diversity of under-five children in these agricultural contexts. The study employed a mixed research design and pragmatist philosophy, utilizing household surveys, focus groups, and key informant interviews. Household Food Insecurity Access Scale (HFIAS) measured food insecurity, while nutritional status and dietary diversity were assessed through anthropometric measures and a dietary diversity score based on eight food groups, respectively. Findings revealed prevalence rates of stunting (19%), wasting (21.2%), and underweight (17.2%) among under-five children across all households. Factors such as birth order, child sex, exclusive breastfeeding, meal frequency, maternal education, and awareness of child nutrition significantly influenced these outcomes in both wheat and coffee-growing households. Maternal employment status, dietary diversity, and nutritional awareness were significant predictors of child BMI and wasting in wheat-growing households. Regarding dietary patterns, a substantial majority (79.6%) of children consumed grains, nuts, and tubers, followed by milk and milk products (60.6%), foods cooked in oil (60.2%), and eggs (46.9%). Determinants of household food security and child dietary diversity were identified using an ordered logit econometric model, highlighting that 43.2% of households were food secure, with the majority of food-insecure households (60.5%) found among coffee growers. Factors such as educational level, land degradation, market access, agricultural advisory services, credit access, household occupation, annual farm income, and asset values significantly influenced food security status and child dietary diversity among wheat and coffee growers. These findings underscore the need for integrated development policies addressing demographic, socioeconomic, and institutional aspects specific to wheat and coffee producers to ensure household food security and improve child nutrition outcomes along with improved dietary diversity.

Key words: Coffee growers, Wheat growers, comparative study, determinants, food security, HFIAS, Child nutrition, Dietary diversity, Jimma, Arsi, Gomma, Dodota, under-five children

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Acronyms and Abbreviations

FAO/UN	Food and Agricultural Organization of the United States
FDRE	Federal Democratic Republic Of Ethiopia
FGD	Focus Group Discussion
FNS	Food and Nutrition Security
IFPRI	International Food Policy Research Institute
KAP	Knowledge Attitude and Practice
KI	Key Inofrmants
NGOs	Non-Governmental Organizations
PSNP	Productive safety Net Program
SPSS	Statistical Package for Social Sciences
UNICEF	The United Nation Children's Fund
USAID	United States Agency for International Development
WB	World Bank
WFP	World Food Program
WVE	World Vision Ethiopia

This dissertation has three standalone research papers and the status of each paper is listed below:

1. Paper one: Comparative Analysis of Household Food Insecurity between Selected Coffee and Wheat Growers of Ethiopia is published in Taylor and Fransis. Cogent food and Agriculture https://www.tandfonline.com/doi/full/10.1080/23311932.2022.2149134

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CHAPTER ONE: INTRODUCTION

1.1 Background

Globally, approximately 735 million people (9.2% of the world population) suffer from hunger. The prevalence of moderate or severe food insecurity has escalated from 11.3% in 2015 to 21.7% in 2022. In 2022, Asia, Latin America, North America, and Europe reported moderate or severe food insecurity rates of 24.2%, 37.5%, and 8%, respectively. According to 2023 FAOSTAT data, global rates of moderate or severe food insecurity reached 26%, with significantly higher rates in Africa (64.5%) and low-income countries (71%) (FAO et al., 2023). Globally, the prevalence rates for undernourishment, wasting, and stunting were 9.2%, 6.8%, and 22.3%, respectively. In low-income food-deficit countries, 24.9% and 30.5% of children under five were undernourished and stunted, respectively (FAO et al., 2023).

Africa had the highest proportion of people affected by hunger (20%) compared to other low-income regions like Asia (8.5%), Latin America and the Caribbean (6.5%), and Oceania (7%) (FAO et al., 2023). In 2022, approximately 2.4 billion people (29.7% of the global population) experienced moderate or severe malnutrition. Rural areas showed a high prevalence of food insecurity at 33.3%, with 64.5% of rural Africans affected by moderate or severe food insecurity. The prevalence of global moderate or severe food insecurity increased from 45% in 2015 to 60.9% in 2022. In Ethiopia, the prevalence rates among children under five in 2022 were 21.9% for undernourishment, 6.8% for wasting, and 34.4% for stunting.

Malnutrition remains a significant public health issue, particularly in developing countries, contributing to the majority of nutrition-related morbidity and mortality among children under five, with a substantial concentration of cases in sub-Saharan Africa (Frazzoli and Mantovani, 2020). It is estimated that in Africa, 6.7% (45.4 million) of children are stunted and 5.7% (38.9 million) are wasted (Wana et al., 2023). Global cases of stunting decreased from 61.4 million in 2000 to 54.4 million in 2020 (Onis et al., 2021).

Household food insecurity, child malnutrition, and inadequate dietary diversity pose significant challenges, particularly in countries like Ethiopia, where identifying demographic, socioeconomic, and institutional factors is crucial for addressing these issues (Shumeta, 2017; Nigatu et al., 2018). Left untreated, food insecurity can lead to malnutrition, heightening susceptibility to life-threatening diseases (FAO et al., 2021).

Ethiopia faces typical causes of chronic food insecurity such as adverse climatic changes, high population pressure, natural resource degradation, and technological and institutional challenges (Anderson et al., 2015; FAO, 2015; Epfrem, 2020). Chronic malnutrition, wasting, and associated physical and mental health issues significantly contribute to child morbidity in developing nations, including Ethiopia, as noted by WHO (2016) and Black et al. (2013). Meeting minimum dietary diversity standards remains a considerable hurdle in developing countries, including Ethiopia (Bedada Damtie et al., 2020). The crucial role of nutrition in children's intellectual and physical development has been underscored (Frempong & Annim, 2017).

Food insecurity, stunting, wasting, underweight, and inadequate dietary diversity are widespread issues among children under five in low-income countries such as Ethiopia. Approximately 39% of Ethiopian children suffer from stunting, 22% from underweight, and 11% from wasting (Binyam et al., 2022). A UNICEF strategy report (UNICEF, 2022) highlights that one in three children globally fails to grow adequately due to malnutrition, micronutrient deficiencies, and insufficient diets necessary for healthy growth (Ahmed et al., 2012). WHO and the World Bank (2021) report that 45% of child deaths are linked to under nutrition. The prevalence of stunting in Ethiopia ranged from 35.3% to 57.5% between 2000 and 2020, with an average estimate of 45.5% during this period (WHO and WB, 2021).

1.2 Statement of the Problem

The economic and social impacts of food insecurity, malnutrition, and inadequate dietary diversity among children under five in rural Ethiopia are multifaceted. These issues contribute to reduced productivity, hindered cognitive development, social instability, and diminished prospects for both children and adults, ultimately resulting in significant loss of life. Chronic malnutrition alone costs

Ethiopia 55.5 billion Birr annually, equivalent to 16.6% of its GDP (Alliance, 2022). According to FAO (2022), poverty and food insecurity are pervasive in Ethiopia, with over 20 million people facing food insecurity, requiring 13 to 15 million to receive food aid. The prevalence of chronic food insecurity in 2020 was 21.2%, while combined moderate and severe food insecurity affected 55.1% of the population. Additionally, Boero et al. (2021) and FAO et al. (2023) highlight household food insecurity, malnutrition among children under five, and poor dietary diversity as predominant issues in low-income countries, including Ethiopia. These factors contribute significantly to nutrition-related health conditions and mortality among children under five, particularly in developing regions like sub-Saharan Africa (Frazzoli and Mantovani, 2020). Wells et al. (2021) emphasize that malnutrition, characterized by underweight, stunting, and wasting, is prevalent in low-income countries such as Ethiopia.

Ethiopia faces typical causes of chronic food insecurity, including adverse climatic changes, high human population density, and various demographic, socioeconomic, and institutional challenges (Anderson et al., 2015; FAO, 2015; Efrem, 2020). Consequently, the prevalence of malnutrition, encompassing stunting and wasting, was reported at 6.7% (45.4 million) and 5.7% (38.9 million), respectively (Wana et al., 2023). The prevalence of underweight, stunting, and wasting among children is estimated at 22%, 39%, and 11%, respectively (Binyam et al., 2022). According to a UNICEF strategy report, malnutrition affects one in three, one in two, and two in three children due to deficiencies in essential nutrients and inadequate diets necessary for healthy growth (Ahmed et al., 2012; UNICEF, 2022).

Children suffering from malnutrition are more susceptible to illnesses, hindering their potential to become productive members of society (Rytter et al., 2014; Beyene et al., 2015). Furthermore, children experiencing food insecurity and conditions like stunting, wasting, or underweight face increased risks of dropping out of school and performing poorly academically, which detrimentally affects family and national development (Beyene et al., 2015). Untreated food insecurity, combined with child malnutrition and poor diets, leaves children vulnerable to life-threatening diseases (FAO et al., 2021), with severe cases resulting in premature death that could have been prevented with cost-effective measures.

Understanding the factors underlying household food insecurity, malnutrition among children, and poor dietary diversity at both household and individual levels is crucial for improving the well-being of rural households. Numerous studies have attempted to assess and identify determinants of household food security, child nutrition, and dietary diversity in various contexts. However, most have focused on specific agricultural households such as wheat or coffee growers without comparing these groups or examining their interrelationships across different agricultural systems. Studies such as Degefa (2002), Mequanent et al. (2014), Adugna (2012), Fekadu and Mequanent (2010) have assessed household food security and identified demographic, socioeconomic, and institutional factors in diverse settings. Similarly, research like Bedada et al. (2020), Dinku et al. (2020), Eshete et al. (2018), Kuche et al. (2020), Seboka et al. (2021a), Sema et al. (2021), and Woldegebriel et al. (2020) has explored dietary diversity among children under five. However, these studies often focus solely on household food security, child nutritional status, or dietary diversity, failing to consider their associations and the complex, interrelated causes of food insecurity, nutritional status among children under five, and dietary diversity within different agricultural systems such as cereal and cash crop production.

Therefore, this study aims to conduct a comparative analysis of household food security, nutritional status among children under five, and dietary diversity among coffee and wheat grower rural households in Jimma and Arsi zones, specifically focusing on Gomma and Dodota districts.

1.2 Objectives of the study

The primary objective of this study was to evaluate the current status and factors influencing household food security, nutritional status, and dietary diversity among under-five children in coffee-growing households in Goma district, Jimma zone, and wheat-growing households in Dodota district, Arsi Zone, Ethiopia.

The specific objectives addressed were as follows:

1. To analyze the prevalence and determinants of household Food Security: This component aimed to conduct a comparative analysis of household food security status and its determinants between coffee-growing households in Goma district and wheat-growing households in Dodota district (Object I).
2. To Assess Children's Nutritional Status and Its Determinants: The study sought to assess and compare the nutritional status and its determinants among children aged 6-59 months in coffee-growing households in Goma district and wheat-growing households in Dodota district (Objective II).
3. To Identify Factors Influencing Children's Dietary Diversity Factors: This part aimed to evaluate and compare the dietary diversity status and factors influencing dietary diversity among under-five children in coffee-growing households in Goma district and wheat-growing households in Dodota district (Objective III).

1.4 Research Questions

The study addressed the following research questions based on the outlined objectives and contextual factors:

1. What are the current status and determinants of household food security for wheat and coffee-growing farmers in Dodota and Goma districts, respectively? (Objective I)
2. What are the prevalence and determinants of the nutritional status of children under the age of five in wheat and coffee-growing farmers in Dodota and Goma districts, respectively? (Objective II)
3. What are the status and determinants of dietary diversity among children under five years old in wheat and coffee-growing farmers in Dodota and Goma districts, respectively?(Objective III)

By addressing these research questions, the study aimed to provide insights into the differences and similarities in household food security, nutritional status, and dietary diversity between coffee and wheat-growing rural households in Ethiopia.

1.5. Significance of the study

This study aimed to provide new insights into assessing household food security, the nutritional status of under-five children (with a specific focus on stunting, wasting, and underweight), and the dietary diversity of under-five children within selected coffee and wheat-growing communities in Ethiopia.

The research seeks to advance development theory and practice by improving the understanding of how household and individual food and nutrition security are measured and identifying key factors contributing to food security at the household level and nutritional status at the individual level. Additionally, the study aims to enrich existing knowledge in development studies, offering valuable information on effective strategies for implementing appropriate measures to improve food security and nutritional status among households and individuals. These outcomes are expected to provide valuable insights to development practitioners and policymakers, enabling the implementation of timely and targeted interventions to reduce vulnerability to food and nutrition insecurity. Moreover, the study aims to identify critical factors influencing food and nutrition security at both household and individual levels, with findings documented and disseminated to district, zonal, and NGO stakeholders as foundational material for further research and development strategies.

Community members and experts from governmental and non-governmental organizations actively participated in the study, collaboratively exploring challenges related to household food security and the nutritional status of under-five children, particularly focusing on adverse nutritional outcomes such as stunting, wasting, and underweight in the respective study sites. These participants played an integral role in identifying existing challenges and proposing potential solutions, which could inform the formulation of community-level development policies. Consequently, the study is expected to make significant contributions through its findings, lessons learned from community discussions, and recommendations for enhancing household food security and child nutrition at the household and individual levels within the study sites. It aims to influence programs, approaches, and interventions designed to alleviate food insecurity, malnutrition, and poverty at household and individual levels, thereby improving access to food

and related resources to foster intended development in rural areas. By applying diverse methodologies to identify development challenges such as food insecurity and malnutrition in rural settings, the study is poised to support local governments in gaining deeper insights into household food insecurity and the malnutrition of under-five children, specifically regarding issues like stunting, wasting, and underweight.

Overall, the study anticipates yielding significant findings that can contribute to enhancing household well-being, improving food security, achieving better nutritional status among children, and promoting dietary diversity within the study areas.

1.6 Methodological Approach

1.6.1. Philosophical Underpinning

Research begins with what the researcher assumes to be investigated, drawing primarily from their knowledge and experiences. This study, as part of social reality, applied pragmatism philosophy as its philosophical underpinning. Saunders et al. (2009) explained that a strong linkage exists between the theoretical standpoint adopted by the investigator and the methods and methodology applied. This approach helps capture issues related to what establishes social reality—in this case, the prevalence of household food insecurity, under-five children nutrition, and poor diet and dietary diversity—from an ontological point of view, what it means to know the social reality from the epistemological basis, and how to study the methodological basis of social reality (Corbetta, 2003; Gray, 2014). According to Grix (2002), there is a logical link between ontology, epistemology, methodology, and research methods. Additionally, the author differentiates between the methodology of methods and hypotheses regarding the modes of constructing knowledge.

In this particular study, the method is a procedure for assessing household food security and its associated factors, the prevalence of underweight, stunting, and wasting, and their correlates, as well as the prevalence of poor diet and dietary diversity among under-five children and its determinants. Depending on whether reality exists externally or within the mindset of the individual, scientists classify ontological positions as objectivism and constructivism (Saunders et

al., 2009). Objectivism (realism) asserts that social phenomena and associated meanings exist independently of social actors. The epistemological view of this ontological position supports the application of natural science methods to explore social realities.

On the other hand, according to constructivist philosophy, social phenomena and their associated meanings are sourced from continual construction and constant revision by social actors themselves (Stephen, 1998). The epistemological orientation of constructivism (interpretive approach) posits that natural science methods cannot explore all social realities; instead, they require social scientists to uncover the subjective (contextual) meanings of social acts (Grix, 2002; Saunders et al., 2009).

Following these philosophies, pragmatism, defined and defended by Charles Sanders Peirce in the 19th century (Maxcy, 2003), argues that knowing the world (reality) is inseparable from agency within it. Morgan (2007) further explained a paradigm as the system of beliefs and practices that influence how researchers select both the questions they study and the methods they use to study them. Assessing the prevalence of household food insecurity, under-five children's nutritional status, and dietary diversity as central social phenomena demands the application of both objectivism and constructivism. Identifying the status and determinants of household food insecurity, under-five children's nutritional status, and dietary diversity can be explored with the application of both perspectives in different contexts.

The central concern of pragmatism is dealing with actions, situations, and consequences rather than specific applications and solutions to problems. This philosophy focuses less on the methods applied to research and more on the problems, ultimately leading the researcher to apply a pluralistic approach to better understand the problem (Creswell, 2013). Pragmatists view reality in two ways: the positivist view that reality exists independently of our minds and the constructivist view that truth is not everlasting and unchanging. Pragmatism does not support the idea that one reality is better than another (Cherryholmes, 1992). According to this approach, the ontology, epistemology, and methodology of research should be sourced from the nature of the research itself (Saunders, Lewis, and Thornhill, 2009). Pragmatism accepts both positivist and interpretivist views of reality depending on the nature of the research, making it possible to apply mixed research

methods. Pragmatism applies various methods, assumptions, and worldviews, using qualitative and quantitative data collection methods and subsequent analysis based on the nature of the research (Creswell, 2014).

This study utilizes qualitative and quantitative data to address problems and provide relevant policy recommendations. Pragmatism rejects traditional philosophical dualism, views knowledge as constructed based on real-world experiences, considers truth as tentative and subject to change over time, understands human experiences through prevailing language and communication, and endorses theories that inform practices. According to Johnson and Onwuegbuzie and Johnson (2006) and Biesta (2010), the central focus of pragmatism is on the results of the research rather than solely on the problem. This study requires the application of both worldviews in different contexts. For instance, assessing household food security status along with nutritional status and dietary diversity necessitates the application of both positivist and constructivist approaches to categorize households as food secure, mildly food insecure, moderately food insecure, and severely food insecure. The study applied pragmatism philosophical assumptions, primarily using mixed research methods.

Moreover, pragmatism places primary importance on the research questions (Tashakkori and Teddlie, 2003). The central assumptions of pragmatism are based on theories that are often both contextual and generalizable by analyzing "transferability" to different situations.

Mixed research methods allow for understanding complex phenomena, which other approaches might not address alone (Creswell and Plano Clark, 2011; Morse and Niehaus, 2009), enabling researchers to work on both quantitative and qualitative hypotheses. Thus, recognizing the aforementioned justifications, this study applied mixed methods, encompassing both qualitative and quantitative approaches, to analyze household food security and under-five children in the coffee-growing communities of Gomma district, Jimma zone, and wheat-growing communities of Dodota district, Arsi zone, Ethiopia.

1.6.2. Research Methods

The research utilized quantitative and qualitative primary data collected through a cross-sectional survey (Kothari, 2004) conducted from 2019 to 2022. The study employed a household survey, focus group discussions (FGDs), key informant interviews, anthropometric measurements, and personal observations as data collection methods. Additionally, interview schedules and checklists were employed as tools for data collection.

1.6.3. Data Collection Methods

Data on household food security prevalence, nutritional status, dietary diversity among children under five, and their influencing factors—such as demographic, socioeconomic, and institutional aspects—were gathered via semi-structured interviews. Qualitative perspectives on these variables were derived from Focus Group Discussions (FGDs), Key Informant Interviews (KIIs), and personal observations.

1.6.4. Method of Data Analysis

Demographic, socioeconomic, institutional, and food access-related data collected from various sources were cleaned and inputted into SPSS (2022). Descriptive statistics (means and percentages), inferential statistics (chi-square and t-test), and an econometric model (ordered logit regression model) were utilized to identify significant variables influencing household food security and the dietary diversity of children under five years old

1.6.4.1 Measuring Household Food Security Status

Household food security was assessed using the HFIAS method, which categorizes households into four levels of food insecurity (access) based on scores derived from specific questionnaire items. According to Coates et al. (2007), households are classified as follows: food secure if scoring '0' or '1' on the first frequency of occurrence question and '0' on Q2 to Q9; mildly food

insecure if the first item scores '2' or '3', or the second item scores '1', '2', or '3', or the third item scores '1', or the fourth item scores '1', with Q5 to Q9 scoring '0'; moderately food insecure if the third item scores '2' or '3', or the fourth item scores '2' or '3', or the fifth item scores '1' or '2', or the sixth item scores '1' or '2', with items seven to nine scoring '0'; severely food insecure if the fifth item scores '3', or the sixth item scores '3', or the seventh item scores '1', '2', or '3', or the eighth item scores '1', '2', or '3', or the ninth item scores '1', '2', or '3' (Coates et al., 2007). The prevalence of overall household food insecurity was calculated as the proportion of food-insecure households among those interviewed and those within respective production systems.

1.6.4.2. Determinants of household food security

Researchers in the field of economics and development agreed that regression methods such as linear, logistic, and ordinal regression are vital to analyze the relationship between multiple explanatory variables with two dependent variable(s). The aforementioned methods would allow the researcher to estimate the magnitude of the explanatory variable on the dependent variable. To obtain valid results while attempting to estimate the outcome variable using explanatory variables, one should be curious and appropriately choose which model should be the best fit for the current context (Chen and Hughes, 2004).

Ordinal regression model is a type of logistic regression model that is used to analyze ordinal dependent variables. According to McCullagh and Nelder (1989), if the outcome variable is in the ordinal scale, the ordinal regression model is a preferred modeling tool that does not assume normality or constant variance. Still, it requires the assumption of parallel lines across all levels of the outcome variable. It is rooted in the general framework of generalized linear models meant for the analysis of ordinal dependent variables. The ordinal regression model describes the relationship between an ordered response variable and a set of explanatory variables which may be continuous or discrete. Similarly, the ordinal logistic regression procedure empowers one to select the predictive model for ordered dependent variables.

In the current study ordinal regression method of analysis was used to meet the objectives set since the response variable has four ordered categories (food secure, mildly food insecure, moderately

food insecure and severely food insecure) and the value of each category has meaningful sequential order. The study also used logit link function which is generally suitable for analyzing the ordered categorical data when all categories are evenly distributed (SPSS, 2022).

When the logit link is applied, the general form of ordinal regression model is formulated as:

$$f(\gamma j(x)) = \log\left(\frac{f(\gamma\, j(x)}{1 - f(\gamma\, j(x)}\right) = \log\left(\frac{pr(y \le jX}{pr(y > jx}\right) = \alpha j + \beta x,\ j = 1,2 \ldots k-1$$

$$\gamma j(x) = \frac{e^{\alpha j + \beta x}}{1 + e^{\alpha\, j + \beta x}}$$

In this particular formula, j indicates the cut-off points for all categories (k) of the dependent variable, the function $f(\gamma j(x)$ is the link function that links the systematic components (i.e $\alpha j + \beta x$) of the linear model, the alpha j represents a separate intercept or threshold for each cumulative probability and b represents the regression coefficient (McCullagh and Nelder, 1989).

1.6.4.3 Determinants of child dietary diversity

Regression methods such as linear, logistic, and ordinal regression are vital to estimating the magnitude and effect of explanatory variables on dependent variables (Chen and Hughes, 2004). The ordinal regression model is a type of logistic regression model that is used to analyze ordinal dependent variables when the outcome variable is an ordinal scale, it is a preferred modeling tool that does not assume normality or constant variance (McCullagh and Nelder, 1989, The model requires the assumption of parallel lines across all levels of the outcome variable and it is rooted in the general framework of generalized linear models meant for the analysis of ordinal dependent variable.

Several econometric models could be applied to analyze ordinal dependent variables like child dietary diversity among under the age of five children in coffee and wheat growers can be labeled as low, medium, and high. However, after assessing several alternative models that can fit to ordinal response dependent variables in the same category, ordinal regression model had been chosen to estimate the dependent variable of current research. The dependent variable, child

dietary diversity has three ordered categories (low dietary diversity, medium dietary diversity, and high dietary diversity). The values attached to each category have meaningful sequential categories and it applied logit link function which is generally suitable for analyzing ordered categorical data when all categories are evenly distributed (SPSS, 2022).

When the logit link is applied, the general form of an ordinal regression model is formulated as:

$$f(\gamma j(x)) = \log\left(\frac{f(\gamma\, j(x)}{1 - f(\gamma\, j(x)}\right) = \log\left(\frac{pr(y \le jX}{pr(y > jx}\right) = \alpha j + \beta x,\ j = 1,2 \ldots k-1$$

$$\gamma j(x) = \frac{e^{\alpha j + \beta x}}{1 + e^{\alpha\, j + \beta x}}$$

According to McCullagh and Nelder, (1989), referring to this particular formula, j indicates the cut-off points for all categories (k) of the dependent variable, child dietary diversity in this case, the function f (yi(x)) is the link function that links the systematic components (i.e aj+bx) of the linear model, the alpha j a represents a separate intercept or threshold for each cumulative probability and b represents the regression coefficient.

Secondary data were obtained from pertinent non-governmental sources such as GIZ, CRS (Catholic Relief Service), Self Help Ethiopia, USAID; and Government organizations like Zonal and district-level health and agriculture offices. Data obtained from the above sources were analyzed and triangulated with other data obtained from primary sources. Besides, electronic and printed documents from various sources were contacted for further analysis of subtle ideas.

Secondary data were taken from various NGOs like GIZ, FAO, GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit), CRS (Catholic Relief Service), Self Help Ethiopia. Likewise, Governmental organizations mainly have health and agricultural offices at different administrative levels and , PSNP coordination offices, d Besides to this, food security policy documents, electronic and printed materials from various pertinent sources, research conducted by individuals, institutions, and organizations were contacted for further exploration of subtle ideas.

1.7. Basic concepts of food security and Nutrition Security

Formal definition of Food security was first given during the world first in 1996 which defined food security as a situation "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996). This definition incorporates the four essential components of a measure of food security at the individual and household levels as outlined by Campbell (1991): (1) availability of having sufficient quantity of food, (2) quality of the available food concerning the food types and the diversity of the diet, (3) physiological acceptability relating to feelings of food deprivation, restricted food choice, and anxiety about the quantity and quality of food on-hand in the households stores, and (4) social acceptability of consumption patterns, determined by social norms in respect of meal frequency and composition and way of food acquisition such as being able to purchase foods instead of having to beg, scrounge, or steal food (Barrett 2010; de Haedey et al. 2011; Haddad et al. 1994; Headey et al. 2012; Maxwell, 1996a; Webb et al. 2006).

Food and nutrition security is concept is used to combine the aspects of food security and of nutrition security, as well as to point to the idea that they are related. The use of the term "food and nutrition security" has become common practice in a number of international agencies such as IFPRI, UNICEF and FAO. In particular, IFPRI has used this term since the mid-1990s (CFS, 2012). Accordingly, food and nutrition security is defined as "a condition when all people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food which meets their dietary needs and food preferences for an active and healthy life". Weingarten (2010) further developed the definition as a condition under which adequate food (quantity, quality, safety, socio-cultural acceptability) is available and accessible for and satisfactorily utilized by all individuals at all times to live a healthy and happy life. Some scholars have seen the complexity of this definition its weakness, arguing that the lack of specificity has clouded interpretation of causal factors of food security and thus make finding consensus on appropriate approaches to tackle food insecurity difficult (Dilley and Boudreau 2001; Maxwell 1996b).

Malnutrition on the other hand, is a state of society's nutritional problems (poor nutrition) that can result from insufficient or excessive or unbalanced diet or from inability to absorb foods. However, it is frequently used to mean under nutrition from either inadequate calories or inadequate specific dietary components for whatever reason (Nikolas, 2011). The current study uses the term malnutrition as under nutrition that encompasses being low weight for one's age (underweight), low height for one's age (stunting) and low weight for height (wasting) which are measured with the aid of anthropometric measurements in children. These measures of malnutrition are often interrelated and children whose measurements fall below two standards deviations from the reference mean are generally considered malnourished. Each measure captures different aspects of malnutrition such as stunting, underweight and wasting and which is explained here under.

1.8. Food and Nutrition security indicators

Anthropometric indicators (AI): The previous indicators focus on the macro level, anthropometric indicators such as stunting (low height-for-age), underweight (low weight-for-age), and wasting (low weight-for-height) measure nutritional outcomes at the individual level. The nutritional outcome is influenced by aspects beyond the availability of and accessibility to food, such as the interactions between food losses, intra-household food distribution, individual health and activity levels, and also environmental quality. Unlike generic indices, anthropometric indicators measure directly the point of policy interest as they reflect undernutrition and how it might affect health and well-being (de Haen et al. 2011). Svedberg (2011) also pointed out the advantage of anthropometric indicators that they directly reflect the imbalances between energy intakes and expenditures. According to Deaton and Dreze (2009), Poor anthropometric outcomes are also associated with higher morbidity and mortality. Anthropometric indicators measure nutritional outcomes, but not cover specific nutrients that might be deficient. Nevertheless, at this junction, it is argued that stunting might reflect long-term consequences of under consumption of essential micronutrients such as vitamins and minerals (Walker et al. 2007, Svedberg 2011).

As anthropometric data, if derived from household surveys, has the advantage to be disaggregated by groups and regions, thus enabling group and spatial analysis. Another advantage of

anthropometric norms, particularly for children under five, is that they are universal as the genetic potential growth for children is assumed uniform (Svedberg 2011). However, anthropometric measures are not free of limitations rather the measure is subject to measurement error including technical error of measurement and the difficulty to obtain exact age of children is sometimes difficult in study contexts.

The Dietary Diversity Scores (DDS): Dietary diversity represents the number of different foods or food groups consumed over a given reference period (Hoddinott and Yohannes 2002). There exist many diet diversity scores in the literature, with different purpose such as measuring individual diet quality versus household food access, with different number and definition of food groups, unit of analysis (individual or household), reference periods, etc. Hoddinott and Yohannes (2002) embraced that diet diversity scores are meaningful indicators for four reasons. First, dietary diversity scores correlate with measures of food consumption and are a good measure of household food access and caloric availability. Second, a varied diet is a worthy outcome in itself. Third, more diet variety is associated with a number of improved outcomes, according to various researches conducted in the field of nutrition particularly in birth weight (Rao et al. 2001), child anthropometric status (Hatloy et al. 2000), improved hemoglobin concentration (Bhargava et al. 2001), reduced risk of mortality from cardiovascular disease (Kant et al. 1995) and incidence of hypertension (Miller et al. 1992). Fourth, diet diversity scores can be collected through household surveys and can be used to examine nutritional adequacy at individual and intra household levels.

1.9 Empirical studies on Household food security

Over 50 million children under five in the world are affected by wasting. Roughly half live in Southern Asia and one-quarter in sub-Saharan Africa. Addressing the burden of wasting will require a multipronged approach, including prevention, early identification, and treatment. Africa has seen an upward trend in the number of stunted children. Besides, over 10 percent of children aged 5–19 have a BMI-for-age below -2 standard deviations from the median of the WHO reference population. As is the case with wasting among preschool-age children, there are dramatic differences in the prevalence of thinness among children aged 5–19 years by region of the world.

Food insecurity contributes to overweight and obesity, as well as under nutrition, and high rates of these forms of malnutrition coexist in many countries. The higher cost of nutritious foods, the stress of living with food insecurity, and physiological adaptations to food restriction help explain why food-insecure families may have a higher risk of overweight and obesity.

Global food availability and access developed rapidly enough to keep abreast of population growth. As a result, many countries improved their food security and made impressive achievements in reducing hunger and malnutrition by 2015. An impact evaluation found that households headed by women in Ethiopia had the largest gains in productivity and farm investments and faced fewer climate-related food shortages.

The number of undernourished people in sub-Saharan Africa rose from 181 million in 2010 to almost 222 million in 2016, an increase of 22.6 percent in six years, and –based on current projections – may have increased further to more than 236 million in 2017. In similar instances, the number of undernourished people is estimated to have reached 821 million – around one person out of every nine in the world in 2017. Undernourishment and severe food insecurity appear to be increasing in almost all sub regions of Africa (FAO, 2018).

These new estimates unfortunately confirm that the prevalence of undernourishment in Africa and Oceania has been increasing for a number of years. Africa remains the continent with the highest PoU, affecting almost 21 percent of the population (more than 256 million people. In Africa, the situation is more pressing in the region of sub-Saharan Africa where an estimated 23.2 percent of the population – or between one out of four and one out of five people in the region – may have suffered from chronic food deprivation in 2017. An increase in the prevalence of undernourishment has been observed in all sub regions of sub-Saharan Africa except for Eastern Africa (FAO).

Prevalence of thinness, stunting, and overweight/obesity were 11.6%, 15.6%, and 7.1%, respectively. The odd of stunting among adolescents in households in the lowest wealth tertile was nearly 6-fold higher compared to the highest tertile. Conversely, the odds of overweight/obesity were higher among adolescents in the households in the middle wealth tertile (AOR ¼ 2.72 [1.08-6.86]) compared to the highest tertile.

Assessment of food security and nutritional status had been addressed by various individuals, groups and multilateral organizations. The major concerns of these studies were to assessing status of households food security and/land individuals food security and nutritional status in different contexts. Similarly huge amount of research on literature focuses on assessing the nutritional status of under five children. Moreover, most of the studies are dominated by quantitative studies accompanied by econometric models of various types (Degefa, 2002; Mequanent and Esubaeew, 2015; Mequanent et al., 2014; Adugna, 2012; Beyene and Muche, 2010) or assessment of nutritional status of different population groups in the society such as Melkie (2007), Abdulselam (2017), Solomon and Amare, (2013), Amaha et al., (2015). Qualitative aspect of food security and nutritional status of rural households is many of them was addressed except very few works like Degefa (1996, 2002). Moreover, comparative studies in the areas of food and nutrition security in Ethiopia is not common phenomenon, though we have a number of separate studies in this regard (Degefa, 2002; Beyene and Muche, 2010). Linkage between production system(purpose) and food and nutrition security; linkage between food security and nutritional status referring cash crop producers and non-cash is almost untouched areas of food and nutrition studies in Ethiopia. Study conducted by Beghin and Teshome (2016) food insecurity status of coffee growers in south west ethioia is 43%. Similarly, regions that primarily produce cash crops such as coffee are among the ones that experience the worst under nutrition in developing countries, resulting in poor productivity levels, low school performance of children, and a poor health situation in farming families (Chiputwa et al, 2016). Cost of Hunger in Africa9 estimates that the cost of malnutrition in Africa extends to the levels between 1.9% and 16.5% of the countries' gross domestic product (GDP). The situation of Gomma district and Dodota district (study sites) is not different from the country level picture.

1.10 Determinants of child nutrition and dietary diversity

Malnutrition is driven by a range of biological and socioeconomic factors that interact from the national level down to the individual level. According to UNICEF (1990), these factors vary across regions, communities, and over time, making it crucial to identify the specific causes of malnutrition in each locality to effectively address nutritional issues.

UNICEF's 1990 global conceptual framework identifies malnutrition and mortality in children and women as the result of a complex sequence of interconnected events. These events are categorized into three main groups: immediate, underlying, and basic determinants of malnutrition. Immediate causes include inadequate dietary intake and disease, which are considered the most direct factors. Underlying causes that contribute to inadequate dietary intake and disease are context-specific and include insufficient food availability and access, inadequate care for children and mothers, and insufficient health services and environmental conditions, such as a lack of clean water and sanitation.

Basic or structural causes encompass broader economic, technological, political, cultural, and institutional factors, including control over physical resources and the level of human development. Understanding these determinants is essential for addressing malnutrition in developing countries like Ethiopia. This paper specifically examines the socioeconomic, demographic, health, and environmental factors contributing to child malnutrition in Ethiopia.

1.11 Analytical framework of food and nutrition security

The FNS framework developed by UNICEF identifies three levels of determinants for under nutrition: the basic, underlying, and immediate causes. At the individual level, immediate causes of nutritional status include dietary intake and health status. Beyond these immediate factors, three additional influences come into play: household food insecurity (in terms of availability and access), inadequate care, lack of (quality) health services, and an unhealthy environment (Evita et al., 2013). These factors stem from broader underlying causes, often classified as income poverty in the framework. Household food security is a critical prerequisite for adequate dietary intake at the individual level, supporting proper food utilization essential for physiological development.

The framework highlights the importance of caregiving practices such as child feeding, health-seeking behaviors, support for mothers during pregnancy and lactation, and mothers' autonomy in household decision-making, especially in health and nutrition matters (Quisumbing et al., 1995; Smith & Haddad, 2000). However, women's capacity and autonomy in households are often

constrained by cultural and institutional factors. Additionally, the impact of unhealthy environments as underlying causes of under nutrition is significant, as discussed by Campbell (1991), who debates whether food insecurity should be viewed as a nutritional outcome or a predictive variable.

The basic causes of under nutrition are rooted in the broader social, economic, and political context. Macroeconomic stability, economic growth and its distribution, public expenditure, governance, and the quality of institutions are crucial factors affecting food and nutrition security (Ecker & Breisinger, 2012). Financial resources from international markets or development agencies can act as a buffer during times of crisis. Public investments in infrastructure and agricultural research are vital for enhancing food and nutrition security. The interplay between social, political, and economic contexts ensures that public expenditures are used effectively and efficiently, serving as fundamental drivers of under nutrition.

Despite its broad acceptance, the UNICEF framework does not address specific thresholds for food and nutrition security. For instance, it does not acknowledge the critical window for preventing under nutrition, which spans from pre-pregnancy through the first 1,000 days of life (World Bank, 2006). Moreover, the framework focuses mainly on the underlying causes of under nutrition and lacks an analysis of food quality and its impact on malnutrition, including obesity. Many developing countries are experiencing a dual burden of malnutrition, where both under nutrition (such as stunting) and over nutrition (such as overweight and obesity) coexist within the same population or household (Hawkes et al., 2005; FAO, 2006). Over nutrition is emerging as a significant issue, with increasing rates of obesity and diet-related chronic diseases in developing countries (Shetty, 2012). Contributing factors to over nutrition include globalization, changes in information and cultures, shifts in lifestyles and physical activity patterns, demographic changes, and rapid urbanization (Hawkes et al., 2005; Popkin et al., 2012).

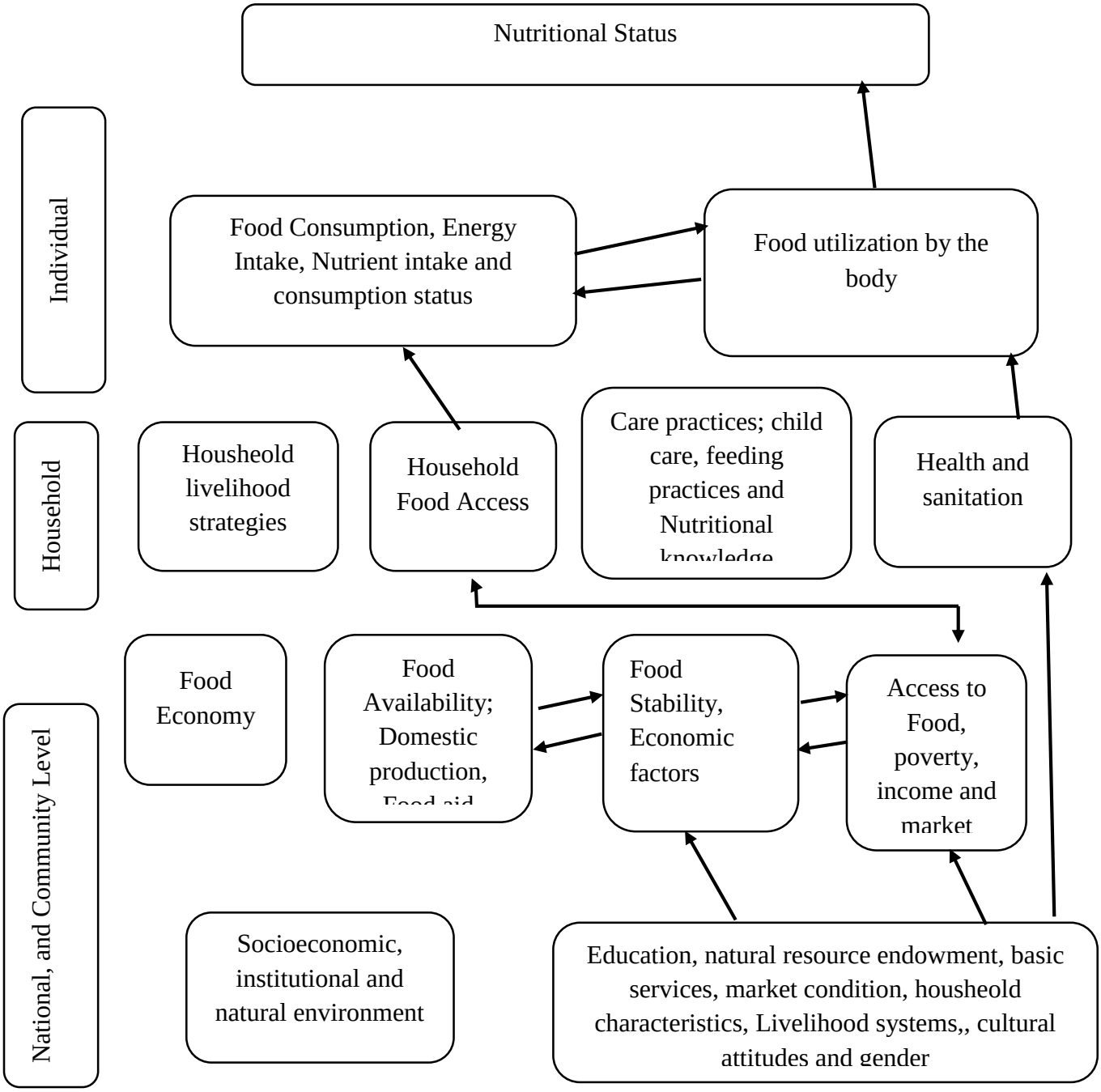

Figure 1 Analytical framework of food and nutrition security (Adopted from FAO, 2008)

1.12 Dissertation Structure

The dissertation is organized into five chapters:

Chapter One provides the general background of the study. It introduces the research problem, offering an overview of household food security, the nutritional status of children under five, and dietary diversity. This chapter also discusses the factors influencing household food security, the nutritional status of young children, and their dietary diversity. Additionally, it reviews both theoretical and empirical findings from previous research on these topics.

Chapter Two presents an analysis of household food security between coffee growers in Goma District, Jimma Zone, and wheat-growing rural households in Dodota District, Arsi Zone. It identifies the major factors contributing to household food security, summarizes key findings, and provides discussions, concluding remarks, and recommendations based on the results.

Chapter Three focuses on assessing the nutritional status of children under five in wheat and coffee-growing households in Dodota District, Arsi Zone, and Goma District, Jimma Zone. This chapter evaluates the prevalence of underweight, stunting, and wasting among these children and identifies major determinants. It includes key research findings, discussions, conclusions, and recommendations.

Chapter Four offers a comparative analysis of dietary diversity among children under five in wheat and coffee-growing rural households in Arsi Zone, Dodota District, and Jimma Zone. It presents key research findings, discusses these results, and provides recommendations based on the analysis.

Chapter Five concludes the dissertation. It summarizes the overall findings and elaborates on recommendations for communities, policymakers, and development organizations. The chapter aims to propose effective actions to improve household food security, enhance child nutrition and dietary diversity, and address related developmental concerns to improve the nutritional status of children under five and reduce food insecurity and malnutrition.

CHAPTER TWO: COMPARATIVE STUDY OF HOUSEHOLD FOOD SECURITY BETWEEN SELECTED COFFEE AND WHEAT GROWERS OF ETHIOPIA[1]

ABSTRACT

Ethiopia is one of the least developed countries where food insecurity is dominant in rural households. Coffee and wheat are the most important cash and staple crops, respectively in Ethiopia and yet their association with household food security is not sufficiently addressed. This study was conducted on coffee growers of Gomma district and wheat farmers of Dodota district to assess status and determinants of household food insecurity. A total of 370 households were interviewed in the two districts. Semi-structured questionnaire, focus group discussions and key informants' interview were used to engage with the farmers. Household Food Insecurity Access Scale (HFIAS) was used to measure household food insecurity. Determinants of household food security status (FSS) were elicited using ordered logit econometric model. The result indicated 43.2% and 56.8 % of sample households were food secure and insecure, respectively. The majority (60.5%) of food insecure households were found in coffee growers. Educational level, land degradation, access to market, agricultural advisory services and credit positively influenced FSS of both wheat and coffee growers, yet purpose of production had significant effect only on FSS of wheat growers while remittance had strong association with coffee growers' FSS. Household occupation, annual farm income and total household asset values also had positive effect on FSS of sample respondents. Hence, mixed development policies and strategies that aimed to address demographic, socioeconomic and institutional aspects of wheat and coffee producers should be designed to assure food security at household level.

Key words: comparative study, determinants, food security, HFIAS

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2. 1. Introduction

Ethiopia is one of the most under-developed nations and labeled as low-income country next to Benin, Burkina Faso and Burundi. Poverty and food insecurity are dominant features of the country, over 20 million people are food insecure of which 13 to 15 million need food assistance (FAO et al., 2022). Per capita income in Ethiopia for 2021 was $944, which is substantially lower than the regional average (WB, 2021). According to Boero et al. (2021), the proportion of inhabitants affected by chronic food insecurity in 2020 was 21.2% while the combined prevalence of moderate and severe food insecurity was 55.1 %.

In Ethiopia, large number of populations is dependent on farm production. Crop agriculture in the country is complex, involving substantial variation in crops grown across different regions and ecologies. Principal crops include coffee, cereals, pulses (e.g. beans), oilseeds, potatoes, sugarcane, and vegetables. Ethiopian agriculture is highly vulnerable to severe droughts, erratic rainfall, and crop and livestock diseases. All typical causes of chronic food insecurity such as adverse climatic changes combined with high human population pressure, natural resources degradation and technological and institutional aspects are prevalent in the country (Anderson et al., 2015; FAO, 2015; Efrem, 2020 and FAO, 2015).

The issue of food security study has paramount importance in countries like Ethiopia mainly because identifying demographic, socioeconomic and institutional factors are pre-requisite to address food insecurity problems (Shumeta, 2017) and untreated food insecurity will lead to malnutrition which leaves children and adults more susceptible to contracting life-threatening diseases (FAO et al, 2021). In addition to this, food insecurity prevents children from growing into productive members of the society and be adults who are fully able to participate in the economic and social development of their countries. In extreme cases, it leads to premature death which could be prevented with relatively simple and inexpensive measures.

Coffee is one of the most valuable cash crops in the country. It is Ethiopia's largest export crop and the backbone of the Ethiopian economy, providing 25.1% of the foreign exchange earnings in 2020 (ITA, 2022). In Ethiopia, 856,591.99 hectare of land is allocated for coffee production. It’s

annual production is 584,789.6 metric tons (CSA, 2021). The main coffee producing areas in Ethiopia are West and South- west, Southern, Eastern, and Central regions (Melkamu, 2015). From top 25 coffee producing districts in Ethiopia, Oromia regional state dominates with 18 coffee producing districts and the remaining top coffee producing districts are located in South Nations, Nationalities and Peoples Regional State (SNNP) (James et al., 2015). Jimma Zone of Oromia Regional State is one of the coffee growing zones in the South-Western part of Ethiopia. Given all year-round rainfall, dense forest cover and favorable environment, Jimma zone has high potential for coffee production. The total land area of the zone is 1.1 million hectares of which, 69% of land is allocated for coffee production and covers 43% and 21% of the coffee export share of Oromia Regional State and the country, respectively. Almost all districts in the zone produce coffee with various proportions. Gomma district is one of the 21 districts in Jimma zone where coffee production potential is very high (Jimma Zone Administration Office, 2018). However, the coffee harvest time is once in a year and the income obtained from it is utilized all year round. In this district coffee income is assumed to be utilized for the purchase of food and nonfood items. However, the contribution of coffee production for household food security in the district is not yet known.

Wheat on the other hand, is an important staple food crop in Ethiopia. Ethiopia is the largest wheat producer in sub-Saharan Africa (Adugnaw and Dagninet, 2020). In Ethiopia, wheat is cultivated on over 1.8 million hectares and accounts for 14.629% of the cropland. It contributes about 16.91% of the grain production in the country (CSA, 2021). The crop is widely grown by subsistent farmers under rain-fed conditions and nearly 30% of cereal farm households are dependent on wheat farming (CSA, 2021). The major wheat producing areas include Arsi, Bale, East Gojjam, East Shewa, South Wello and West Arsi zones which produce more than half of Ethiopian wheat (CSA, 2021). Arsi zone is typically known for its potential and production of wheat located in South-Eastern part of Ethiopia. The total land area of Arsi zones is 1.98 million hectares. It contributes nearly 20% of national wheat production (CSA, 2021). Dodota is one of the wheat producer districts in Arsi zone, known for its high potential and conducive wheat production environment.

Coffee grower farmers as specialization agricultural production system are expected to have in better off financial capacity due to income obtained from sale of coffee. On the other hand, wheat

grower farmers, unlike coffee growers are expected to have better probability of producing variety of food groups and have better access to diversified food groups grown around their homestead meant mainly for household consumption and that in turn put them in better position of food security status as they have better possibility to access to various food groups. The question pose here is that whether coffee growers attain better food security status which may emanate from their comparative income advantage as compared to wheat growers who are expected to be engaged in production of homestead gardening meant mainly for household consumption or not. In this regard, little or no such studies had been conducted in the current context.

Many studies in the subject focused on identifying individual factors of food security without relating the other component and failed to consider the very nature of food security in different agricultural production systems. The various, complex and interrelated causes of food insecurity in different agricultural systems have not been studied in detail. Therefore, the current research focused on comparative study of food security status of coffee and wheat grower rural households of Jimma and Arsi zones, respectively in general and Gomma and Dodota districts in particular. The two crops, coffee and wheat are crucial income sources and have vital contribution to attain household food security among coffee and wheat growers, respectively. Thus, conducting comparative study at the two study sites was aimed to identify food security/insecurity determinants among these rural households and analyzes the linkage between production systems. This comparative study will enable researchers and stakeholders to understand the similarity and difference of household food security factors among wheat and coffee grower households so as to make inferences and policy recommendations on how to address the key food security issues at both communities.

2.2 Material And Methods

2.2.1 Description of the study areas

The research was conducted in wheat and coffee growing rural households of Dodota wordea of Arsi Zone coffee growing rural households of Gomma district of Jimma zone and (Figure 1). Gomma district is one of the eight top major coffee growing districts of the zone, where coffee served as major income and livelihood source for majority of its population (JZARDO, 2018). The

district is located between 7° 49' 59.99" N and Latitude 36°39' 59.99"E Longitude with in attitude ranges from 1380 to 1680 meters. According to CSA (2012), total population of Gomma district was 350,882 of which 177,994 were women. There are 36 Kebeles (the smallest administrative unit of Ethiopia) in the district of which 31 are dominantly rural administrations.

Dodota is one of the major wheat growing districts of Arsi Zone of Oromia Regional state, Ethiopia. It is located between latitude 8° 15′ 0″ N and 39° 20′ 0″ E longitude with altitude ranges of 1400m to 2500 m.as.l. The total population of Dodota district is 86,761 of which 50% are women. The district's majority (92.48%) is dominated by rural households where 68% produces wheat as their major crop (CSA, 2012). The study districts has a total area of 65, 000 ha of land in which 701 ha is irrigated. The farmers in Dodota district's seasonal calendar is: May to July for sowing; July to November –mid season or growing and November to December for harvesting. They spend nearly 250 days from sowing to harvesting. On the other hand, seasonal calendar at Goma district coffee growers is: November to February is harvest for harvest (coffee picking) and from February to October is allocated for several activities related to land preparation, planting and transplanting of new seedlings, plant protection and other land management practices.

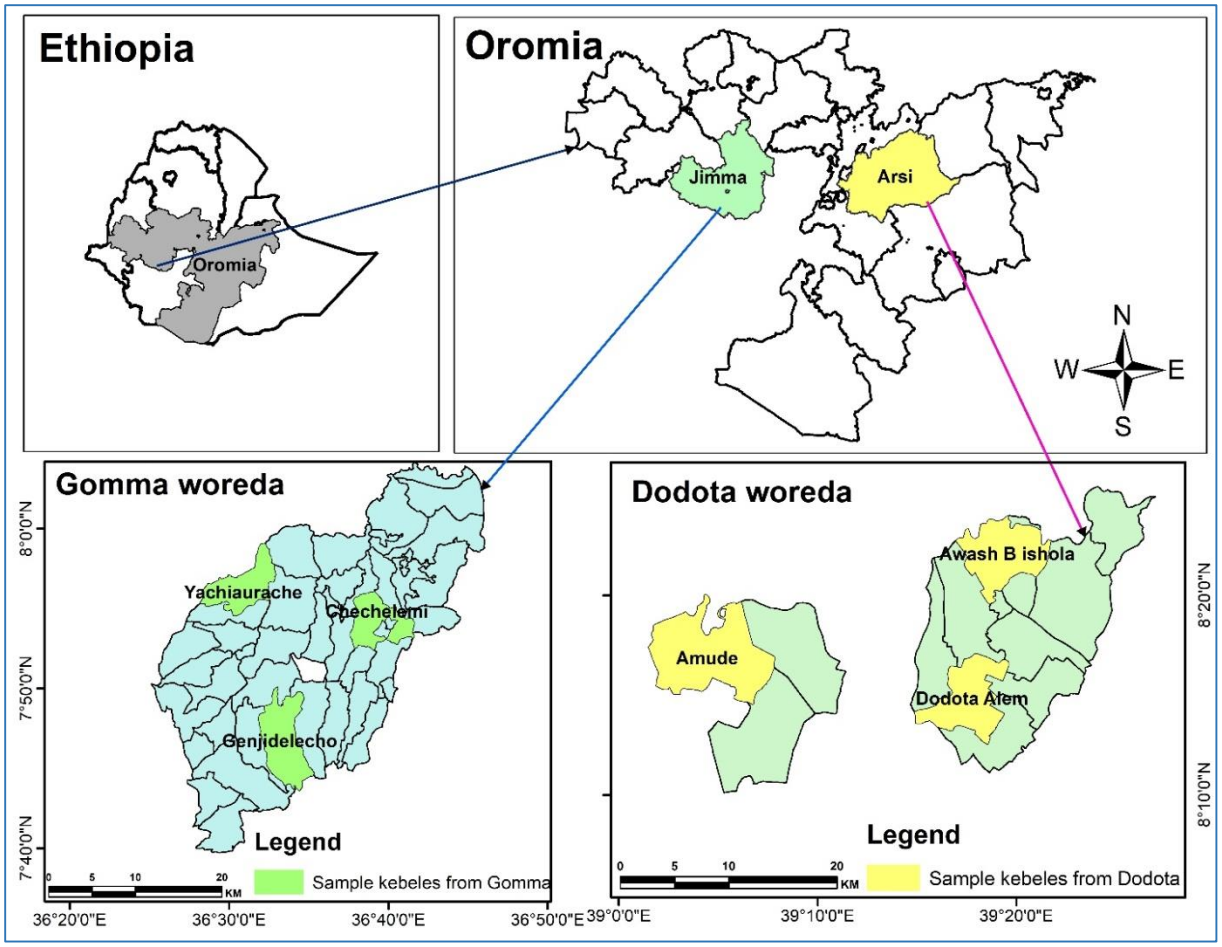

Figure 1 Map of the study districts

2.2.2 Study design

The current study employed mixed research design which is a procedure for collecting, analyzing and application of both qualitative and quantitative methods in a single study, linking major themes of the study across the survey (semi-structured interview) and Focus Group Discussion (FGD), key informant discussions (KIs) along with personal observation. The design allows comparison of data obtained from qualitative and quantitative sources to clearly understand the research problem (Creswell et al., 2011). It also helps to understand complex phenomena, which otherwise other approaches cannot address alone (Creswell et al., 2011; Morse and Niehaus, 2009).

2.2.3 Sampling procedure

2.2.3.1.Sampling procedure of quantitative data

Multistage stratified sampling procedure was applied to randomly select households from the two research sites. In the first stage, Jimma and Arsi zones were selected purposively based on their coffee and wheat production potentials, respectively in the country. In the second stage, stratified random sampling method was applied to select Gomma district from Jimma zone and Dodota district from Arsi zone. In the third stage, six kebele administrations (three from respective districts) were identified randomly (lottery method). Accordingly, Genjidelecho, Yachiyaurache and Chochelemi were taken from Gomma district coffee growers and Awash Bishola, Dodota-Alem and Amude were obtained from Dodota district wheat growers. In the fourth stage, the farm households were identified using systematic random sampling method.

2.2.3.2 Sampling procedure for Qualitative data (Focus group discussants and Key informants)

Assisted with Development agents, eight community members who were living in the village for long period of time, willing to participate in the study, aware of household food security and community development issues were selected to form one focus group in each sample Kebele. Therefore, non-probability (purposive) sampling method was used to select a total of six FGDs (three from Coffee growers -Goma district and three from wheat growers Dodota district).

Likewise with consultation of kebele administrator and community development agents, total of 12 community key informants(two from each Kebele administration) were selected from six kebele administrations purposively based on their value and acceptance in the community, depth of knowledge on village livelihood, food security and various development aspects of respective study sites using non-probability (purposive) sampling method.

2.2.4 Sample size determination

Simplified sample size determination formula suggested by Yamane (1967) was used to come up with representative samples.

$n_1 = \frac{N_1}{1+N_1(e^2)}$ And $n_2 = \frac{N_2}{1+N_2(e^2)}$

Where, n is sample size, N_1 and N_2 are population size and *e* is level of precision. N_1 (2928) and N_2 (2566) were population sizes of rural households in Gomma and Dodota districts, respectively while n_1 and n_2 were sample sizes of the districts in the same order and e is level of precision, which is 0.07.

Based on the above calculation, the sample sizes were n_1= 188 for Gomma district and n_2= 188 for Dodota district. However, the final sample size obtained from Dodota district was 182 as 6 questionnaires were rejected during data cleaning process. Hence, the total sample size used in the current study was 370. The samples were 86 from Genjidelecho, 53 from Yachiyaurache and 49 households from Chochelemi kebeles of Gomma district coffee growers, and 82 samples from Awash Bishola, 47 from Dodota-Alem and 53 wheat growers from AmudeKebele of Dodota district.

2.2.5 Data Types

The study used quantitative and qualitative data from primary and secondary sources. Primary data were collected from sample respondents, FGD discussants and Key informants from respective districts. Data from secondary sources including but not limited to electronic and printed media such as internet journals, periodic reports, and proceedings, unpublished and published sources were assessed and used for triangulation purpose.

2.2.6 Data collection methods and procedures

Household survey data were collected from sample respondents using semi structured interview schedule and Household Food Insecurity Access Scale (HFIAS) questionnaire. Household surveys were carried out with an intention of collecting both quantitative and qualitative data of demographic, socioeconomic, institutional, and other psychosocial variables related to household food security status and its determinants. HFIAS is mainly intended to measure access dimension of food insecurity (Becquey et al., 2010) and is composed of nine questions or items (Q1-Q9), which were asked with a recall period of four weeks. The questions (Q1-Q9) in their shortened versions are listed in Table 1. For each HFIAS item, there was a follow-up of the frequency of occurrence question to determine whether the condition happened rarely (once or twice), sometimes (three to ten times) or often (more than ten times) in the past four weeks. These responses are coded as often '3', sometimes '2', rarely '1', or not at all '0'

The respondent included in the household survey was a person in charge of food/meal preparation and/or household head in respective sample households (Becquey et al., 2010). Enumerators who live in the area, fluent speakers of local language (Oromifa), well acquainted with local and cultural contexts, and working within the selected districts were recruited for the data collection. They were trained on the contents of the interview schedule and data collection techniques. Pre-test on non-sample respondents was also made under supervision of the researcher. Finally, the formal data collection was conducted on sample respondents after necessary modification and adjustments were accommodated as per the result obtained from the pre-test.

Focus Group Discussion and Key informants' interview along with personal observations were also applied to collect qualitative data from carefully and purposively selected FGD discussants and key informants using checklist as data collection instrument. The participants in FDG and KI interview were encouraged to use their local language that they were most familiar with and development agents most familiar with the local language facilitated the group discussions. These methods addressed the feelings, perceptions and understanding of local people over pertinent food and nonfood related issues at household level. Majority of the data generated from these methods were used for data triangulation and as standalone analysis against the objectives of the study. Data

generated from FGD and KIs were recorded, transcribed and described as per the objectives of this study with their prior informed consent. Data were collected from the study areas between April 2019 and September 2020.

2.2.7 Method of data analysis

Demographic, socioeconomic, institutional, and food access-related data collected from several sources were cleaned and entered into SPSS (2022. Descriptive statistics (means and percentages); inferential statistics (chi-square and t-test), and econometric model (ordered logit regression model) were employed to identify important variables that determine household food security.

2.2.8 Measuring Household Food Security Status

According to Coates et al. (2007), HFIAS classifies households into four levels of household food insecurity (access) based on the score obtained from the given question items. These include food secure, mildly food insecure, moderately food insecure and severely food insecure. Accordingly, households were grouped into four categories (levels). A household is food secure if it scored '0' or '1' in the first FI frequency of occurrence question and '0' in Q2 to Q9; mildly food insecure if the first FI frequency of occurrence item has '2' or '3' or the second item has '1,' '2,' or '3' or the third item has '1' or the fourth item has '1' and items Q5 to Q9 score '0'; moderately food insecure if item three = '2' or '3' or item four = '2' or '3' or item five = '1' or '2' or item six = '1' or '2' and item seven to nine = '0'; and severely food insecure if item five = '3' or item six = '3' or item seven = '1,' '2,' or '3' or item eight = '1,' '2,' or '3' or item nine = '1,' '2,' or '3' (Coates, et al., 2007). The overall household food insecurity prevalence was computed as the proportion of food-insecure households out of the total interviewed households and households interviewed in respective production systems.

2.2.9 Determinants of Household Food Security

Researchers in the field of economics and development agreed that regression methods such as linear, logistic, and ordinal regression are vital to analyze the relationship between multiple explanatory variables. The aforementioned methods would allow researcher to estimate the magnitude of explanatory variable on the dependent variable. To obtain valid results while

attempting to estimate the outcome variable using explanatory variables, one should be curious and appropriately choose which model should be the best fit of the current context (Chen and Hughes, 2004).

Ordinal regression model is a type of logistic regression model that is used to analyze ordinal dependent variables According to McCullagh and Nelder (1989), if for instance the outcome variable is in ordinal scale, the ordinal regression model is a preferred modeling tool which does not assume normality or constant variance, but requires the assumption of parallel lines across all levels of the outcome variable. It is rooted in the general framework of generalized linear models meant for analysis of ordinal dependent variable. Ordinal regression model describes the relationship between an ordered response variable and a set of explanatory variables which may be continuous or discrete. Similarly, the ordinal logistic regression procedure empowers one to select the predictive model for ordered dependent variables.

In the current study ordinal regression method of analysis was used to meet the objectives set since the response variable has four ordered categories (food secure, mildly food insecure, moderately food insecure and severely food insecure) and the value of each category has meaningful sequential order. The study also used logit link function which is generally suitable for analyzing the ordered categorical data when all categories are evenly distributed (SPSS, 2022).

When the logit link is applied, the general form of ordinal regression model is formulated as:

$$f(\gamma j(x)) = \log\left(\frac{f(\gamma\, j(x)}{1 - f(\gamma\, j(x)}\right) = \log\left(\frac{pr(y \le jX}{pr(y > jx}\right) = \alpha j + \beta x,\ j = 1,2 \ldots k-1$$

$$\gamma j(x) = \frac{e^{\alpha j + \beta x}}{1 + e^{\alpha\, \mathrm{j} + \beta x}}$$

In this particular formula, j indicates the cut-off points for all categories (k) of the dependent variable, the function $f(\gamma j(x)$ is the link function that links the systematic components (i.e $\alpha j + \beta x$) of the linear model, the alpha j represents a separate intercept or threshold for each cumulative probability and b represents the regression coefficient (McCullagh and Nelder, 1989).

Secondary data were taken from various multilateral organizations like FAO and different NGOS like GIZ, CRS (Catholic Relief Service), Self Help Ethiopia and Government organizations like Zonal and district level productive safety net program (PSNP) office, district agriculture offices, district health offices, health centers and health posts. Data obtained from the above sources were analyzed and triangulated with other data obtained from primary sources. Besides, food security policy documents, electronic and printed documents from various multilateral organizations such as FAO, UN, IFPRI and so forth, NGOs working on food security and related issues, researches conducted by individuals, institutions and organizations were contacted for further exploration of subtle ideas.

2.3 Results And Discussion

2.3.1 Distribution of respondents by their response to food insecurity access indicator

The distribution of respondents with respect to HFIAS questions was found to be dominated by higher percentage of coffee growers for majority of the questions. Out of the given nine food access indicator questions, coffee growers had shown higher percentage for six questions i.e eating limited variety of foods (86.2%), eating food not really wanted to eat (60.6%), eating small portion of food (71.8%), incidence of not having any kind of food in the household (72.9%), sleeping hungry without food (55.9%), and spending whole day and night without food (52.7%). The responses of sample respondents for the HFIAS questions asked with a recall period of four weeks implied are summarized in Table 1.

The percentage of wheat growers for the above-mentioned questions were 85.2%, 58.8%, 63.7%, 64.8%, 63.7%, 37.4 and 26.9%, respectively. On the other hand, wheat grower households worried more about food (91.2%) as compared to coffee growing households, which was 78.7%. Likewise, 91% wheat grower households were unable to eat preferred food items because of various reasons including food unavailability and lack of financial capacity to buy food. This implies that, majority of wheat growers (65%) eat fewer meals in a day due to unavailability of sufficient food in the household and was slightly higher than coffee growers (61.2%). The FGD and Key informants' discussion also asserted that the source of worries for most of the households were lack of financial

capacity, unemployment and poverty. In general, from this finding it can be observed that wheat-growing households were in a better position to access food than coffee growers. Coffee growers faced serious food shortages at the household level.

Freq=frequency

Table 1 Affirmative responses of sample respondents to items on the Household Food Insecurity Access in rural Arsi and Jimma zones, Ethiopia (N = 370)

Food Access indicators	**Household Occupation**					
	Total HHs		**Wheat Growers**		**Coffee growers**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**
Worry for food	314	84.9	167	91.2	148	78.7
Unable to eat preferred foods	306	82.7	166	91.2	140	74.5
Eat a limited variety of foods	317	85.7	155	85.2	162	86.2
Eat foods that you did not want	221	59.7	107	58.8	114	60.6
Eat a smaller meal	251	67.8	116	637	135	71.8
Eat fewer meals in a day	233	63	118	64.8	115	61.2
No food to eat of any kind	253	68.4	116	63.7	137	72.9
Go to sleep at night hungry	173	46.8	68	37.4	105	55.9
Go day and night without eating	148	40	49	26.9	99	52.7

2.3.2 Household food security

HFIAS is a valid measure of food insecurity at household level in developing countries (Knuepell et al., 2009; Maes et al., 2009). Based on this food security measurement tool, the 370 households included in the present study were classified in to four levels of household food security status. Among all respondents, 160 (43.2%) households were identified as food secure while 109 (29.2%), 86(23.2%) and 15 (4.1%) sample respondents were mildly, moderately and severely food insecure, respectively (Table 2). This indicated that 210 (56.8%) of total respondents in the study area were food insecure at various levels (Mild, Moderate or severe), of which 127 (60.5%) were found in coffee growing farmers.

The study also clearly showed that household food security status of wheat growing and coffee growing rural households was different. As it can be depicted from Table 2, percentage of food secure households was high in wheat grower households (54.4%) than coffee growers (32.4%). In the contrary, coffee growers were dominated by mild (35.6%) and moderately (29.8%) food insecure households than wheat growers where, 23.1% and 16.5% of them were mildly and

moderately food insecure, respectively. The percentage of severely food insecure households was higher (73.3%) in wheat growers as compared to coffee growers (26.7%). The finding from FGD and key informants' interview conducted in Dodota district and secondary data obtained from relevant offices confirmed these resource poor and severely food insecure households in wheat grower farmers are targeted in PSNP.

Several studies conducted in Oromia regional states showed that the percentage of food insecure households vary from place to place. For instance, a study conducted by Mequanent et al. (2014) showed that the percentage of food insecure rural households in Mana district of Jimma zone was 42.9%. Higher share of food insecure households of 83.5% was reported by Tiyou et al. (2012) in Jimma town pensioners. On the other hand, Debeli et al. (2021) reported 22.78% food insecure households in Gumay district of Jimma zone. A review of food security status in Ethiopia indicated that the incidence of food insecurity in the country in 2019 was 64% (Abebaw and Betru, 2019). In general, the determinant factors of food security and coping strategies used were different at different levels of application, so that percentages of food insecure households greatly vary on the locations in which the studies were conducted (Mohameed et al., 2021; Mohammed and Mohammed, 2021; Pakravan-Charvadeh et al., 2021; Mengistu et al., 2022).

Table 2 Food security status of households in Arsi and Jimma zones, Ethiopia

	Total HH (N=370)	Production system			
		Wheat Grower (n=182)		Coffee Grower (n=188)	
Household Food security status	Freq (%)	Freq (% from the total FSC)	% from wheat HHs	Freq (% from the total FSC)	% from Coffee HHs
Food secure	160 (43.2)	99 (61.9)	54.4	61(38.1)	32.4
Mildly food insecure	109 (29.5)	42(38.5)	23.1	67(61.5)	35.6
Moderately food insecure	86 (23.2)	30 (34.9)	16.5	56(65.1)	29.8
Severely food insecure	15 (4.1)	11 (73.3)	6	4(26.7)	2.1

Freq= Frequency; FSC= food security category

2.3.3 Distribution of respondents against major socioeconomic explanatory variables

The minimum and maximum age attained by the respondents in the study areas were 19 and 85 years, respectively. The means of the ages of the sample respondents in the wheat and coffee growers were late thirties across the different food security status groups except for mildly food insecure and severely food insecure coffee grower households in which cases the means were 40 and 33 years, respectively (Table 3). Several researchers such as Eshetu and Young-Bohk (2017), Fikire and Zegeye (2022), and Mengistu et al., (2022) found that age of household and food security had positive association. On the other hand studies conducted by Mohammed et al. (2021), and Mohammed and Mohammed (2021) revealed negative association between age of household head and household food security.

Family size was measured in adult equivalent (AE). The result has shown that the minimum and maximum family sizes were 1.3 and 10.7, respectively. The mean family size for food secure, mildly food insecure, moderately food insecure and severely food insecure household of wheat growers were found to be 4.2, 4.35, 4.1 and 4.4, respectively whereas in coffee growers the mean family sizes were 4.76, 4.53, 4.71 and 3.75 in the same order. Highest family size was recorded among moderately food insecure households of wheat (10.3) and coffee (10.7) than other food secure/insecure status groups (Table 3). The food secure/insecure households in the respective study sites had no significant difference in terms of the mean family size. Many studies found that an increase in the family size decreases the chances of food security in the household (Abebaw and Betru, 2019; Kleve et al., 2021; Mohammed and Mohammed, 2021). According to empirical findings of N De et al. (2013), Kumar Sahu et al. (2021) and Owoo (2021) large family size with subsistence agricultural production in developing countries exerts more pressure on consumption than the labor it contributes to production. Hence, large family size is more likely related to being food insecure in a household.

Total land and cultivated land were considered as key variables that may determine household food security status. Thus, these variables were analyzed to see their distribution among various

food security/insecurity groups of coffee and wheat growers of the study sites. From the analysis, there had been evidence that some of the farmers didn't have any type of land including land for cultivation. Conversely, the maximum size of total land in the study populations was 10 hectares which was recorded in food secure households of coffee growers. The mean hectare of total land decreases across food secure, mildly food insecure, moderately food insecure and severely insecure rural households of both wheat and coffee growers (Table 3). On the other hand, the minimum and maximum cultivated land allocated for households were zero hectare and six hectares, respectively.

Land is a critical production factor that determines the type of crops grown and the size of crop harvests. The mean cultivated land areas for food secure, mildly food insecure, moderately food insecure and severely food insecure households of wheat growers were 1.67, 1.55, 1.34, and 1.24 hectares, respectively. Likewise, food secure coffee grower households obtained highest share of both cultivated and total land. This implies that farmers who had larger farm land for their crop production were found to have increased food access and utilization, thus land ownership and size of land is critical factor influencing household food security. Under subsistence agriculture, land is expected to play a significant role in influencing farm households' food security. Similar studies conducted in Arsi (Eshetu and Young-Bohk, 2017) and Benshangul Gumuz Zones (Mohammed and Mohammed, 2021) confirmed that land size has positive and significant effect on household food security status.

The descriptive statistics showed that most of the sampled respondents either had farm income, non-farm income, off-farm income or income from multiple activities (Table 3). However, it is evident from this finding that there were households who didn't obtain income from any of the above-mentioned sources. These households either got their income from remittances (gifts), PSNP engagements or any other sources. The maximum incomes obtained by farmers from farm, non-farm and off-farm activities were 205,000, 144, 000 and 60,000 birr, respectively in the study areas. The mean annual farm income of food secure, mildly food insecure, moderately food insecure and severely food insecure wheat grower households were 24,914, 22,602, 22,136 and 17,129 birr, respectively. Mean annual income earnings of coffee grower household's from farm activities were 15,811, 10,773, 7,852 and 6,325 birr in that order across the food security status

groups. Though coffee is a cash crop in Ethiopia, the income coffee producers earned from their farm activities was smaller than wheat growers. The data obtained from Jimma zone office of Agriculture and rural development indicated that coffee in Ethiopia is marketed via two main channels: domestic consumption and for exports. Most of smallholder farmers in the study area sell their coffee to local collectors in the nearby markets; this puts the producers at a disadvantage since they sell their coffee at price set by the private merchants which are usually very low compared to the prevailing market price (JZARDO, 2018). The other likely explanation could be the farm land holding size in coffee producing district was smaller than that of wheat farmers and the production size could be limited. Likewise, the possible reason for food secure households at both production areas to have better farm income as compared to insecure households was that farmers in food secure status groups had relatively larger farm size and are more likely to get higher income from the sale of their produce than those households who had little land hence, increased production and diversified household income which in turn would enhance households' food security.

On the other hand, the highest mean annual incomes of 13,817 birr and 5,567 birr were obtained by food secure and moderately food insecure wheat grower households in the same order. These farmers were engaged in non-farm and off-farm activities, respectively. Conversely, the highest income of 5,550 birr sourced from non-farm activities was obtained by severely food insecure coffee farmers. Similarly, mildly food insecure coffee farmers had the highest annual off farm income (1388 birr) as compared to other food secure/insecure groups. Yet, the total amount (sum) of income wheat growers obtained from the above-mentioned sources was high (38,556 birr) in food secure households and low (29,747 birr) in severely food insecure households. The same trend was observed in coffee growing households with the highest total annual income of 21,580 birr obtained by food secure households and the lowest total annual income of 12,125 birr obtained by severely food insecure households (Table 3).

Based on this study, households with low income were likely to be food insecure as compared to households who had average and higher household income. This finding is supported by Eshetu and Young-Bohk (2017), Mengistu etal. (2022), Abdalla (2021) and Mohammed and Mohammed (2021). Likewise, N De et al. (2013) and Mengistu et al. (2021) reported that income earned from

various income generating activities is crucial coping strategy for farm households to manage unexpected income losses for survival and the improvement of food security.

The result of key informants' interview and FGD discussants also agreed on the above findings. Shortfalls of agricultural productions resulting from temporary failures due to unexpected drought or long-term factors such as shortages of farm land, inadequate farm income trigger households to participate in off/non-farm activities. Households engaged in casual and seasonal labor, retail, and so forth to generate alterative income apart from farm income to manage unexpected income losses for survival and ultimately reduce the probability of being food insecure.

Apart from farm, non-farm and off-farm income sources, gift or remittance was found to be one of prominent income sources among respondents of wheat and coffee grower farm households. The mean remittance of all respondents was ranging from none (zero) to 40,000 birr. The mean values of remittance of food secure, mildly food insecure, moderately food insecure and severely food insecure wheat growing households were 1027, 633, 789, and 527 birr, respectively while the mean values were 9245, 6553, 9055 and 4375 birr in coffee grower households in the same order. It is evident from this study that remittances could contribute to the improvement in the food security of receiving households. Findings of many researchers in the country also revealed households with access to remittance have higher ability to secure adequate quality of food, and lower experience of insufficient quantity of food intake than those without remittance (Abadi et al 2018 ; Adams and Cuecuecha, 2010; Zarate-Hoyos, 2004).

Number of livestock kept by households was explained in tropical livestock unit (TLU) among the various categories of food security status. Livestock ownership and magnitude in TLU ranges from non-existence of livestock in both farming households to 20 TLU in wheat growers. In coffee growers the mean TLUs ranged between 1 and 2. Relatively higher mean TLUs (ranging from 2-4) were recorded among the different food security status groups of wheat farmers than coffee growers (Table 3). This may have contributed for the better food security status of the wheat grower households than coffee growers. Livestock in the study areas contributes to food security both directly and indirectly. Key informants referred livestock as sources of supplementary food, cash income, input for crop production and soil fertility management, saving, employment and

means of transport in the study areas. In addition, livestock are considered as a means of security and coping strategy during crop failure and other calamities. Likewise, results of previous researches also revealed households with a greater number of livestock have a better chance to be food secure and thus, have less risk of food insecurity (Mohammed et al., 2021; Mohammed and Mohammed, 2021; Mengistu et al., 2022).

The study further evaluated the extent to which the household income covers the minimum level of expense needed for food items, thus assessed the extent to which the sample households are food secure or insecure. Accordingly, the minimum and maximum annual expenditure on food items by all sample respondents were 1040 and 61200 birr, respectively (Table 3). On average food secure, mild, moderate and severely food insecure wheat grower households spent 4537, 4536, 4123 and 4055 birr, respectively on food items per annum. Similarly, mean expenditures on food items by coffee growers were 19960, 11448, 10108 and 9885 in the same order, which was much higher than wheat farmers' expenditure on food items. This could be attributed to the fact that wheat farmers use their own produce mainly for the household consumption and spend small amount of money per annum for the purchase of food items from local markets. Farmers in FGD also illustrated that farmers in Dodota district produce diversified crops such as barley, fababean, field pea, linseed, maize etc.… in addition to wheat mainly for household consumption.

Coffee farmers, on the other hand, usually consume a very small portion of their harvest and they rely on coffee income to purchase food items from local markets which ultimately trigger coffee growers spend much of their income for the purchase of food items than wheat growers. However, household expenditure on food items has shown decreasing trend along food security/insecurity groups i.e from food secure to severely food insecure coffee growing households. Similar studies conducted in several contexts had shown that households whose food expenditure was higher tend to be food insecure. The finding from FGD discussants and Key informants interview confirmed that most coffee growing households spend their money mainly on purchase of food items, medication, school material purchase, farm inputs, social obligations and payback debts which makes them unstable and keeps them in vicious circle of poverty and food insecurity.

The minimum and maximum annual cost of production per hectare by all sample respondents were 0 and 16850 birr, respectively. On average food secure, mild, moderate and severely food insecure wheat grower households spent 3794, 3313, 3430 and 2875 birr per hectare for wheat production in that order. Similarly, mean expenses for coffee production were 1727, 2132, 1479 and 700 birr per hectare across the food security status groups and were much lower than wheat growers' production costs. This could be explained by the high cost of items for wheat production in the study area including rental value of combiner-harvester, improved seed, fertilizer, chemical and opportunity cost of labor. Nevertheless, the cost of coffee production was minimal as most sampled farmers in Goma district grew forest and home garden coffee, and had minimal expense for farm management. Jenaa et al. (2012) also reported that the use of chemical fertilizers or pesticides in coffee production in Jimma Zone was not widespread.

Table 3 Distribution of sample respondents against socioeconomic characteristics of continuous variables

Food security status of wheat growers								
Variable	**Food secure**		**Mildly food insecure**		**Moderately food insecure**		**Severe food insecure**	
	Min (Max)	**Mean (SD)**	**Min (Max)**	**Mean (SD)**	**Min (Max)**	**Mean (SD)**	**Min (Max)**	**Mean (SD)**
Age of HH head(Years)	26(60)	38(8)	25(60	39(7)	19(60)	37(8)	30(56)	39(9)
Adult equivalents	1.3(7.55)	4.2(1.7)	1.35(7.4)	4.35(1.61)	1.35(10.3)	4.1(1.63)	2.35(7.5)	4.4(1.76)
Total land(Ha)	0.25(6)	1.81(1.22)	0.5(3)	1.55(0.98)	0(6)	1.34(1.15)	0(3)	1.26(0.8)
Cultivated land(Ha)	0.25(4)	1.67(1.07)	0.5(3)	1.55(0.98)	0(6)	1.34(1.15)	0(3)	1.24(0.8)
Farm income	1000(205000)	24914(33316)	0(84200)	22602(19417)	0(76400)	22136(25349)	0(93950)	17129(17722)
Non-Farm income	0(46000)	13817(15536)	0(25000)	7140(7550)	0(144000)	8031(17214)	0(25000)	4227(8208)
Off- farm income(Annual	0(18000)	2137(5304)	0(20000)	3419(6623)	0(60000)	5567(9548)	0(25000)	3382(8020)
Amount of gift/remittance	0(10000)	1027(2154)	0(5000)	633(1160)	0(12300)	789(1637)	0(3200)	527(1036)
Tropical livestock unit	0(13)	3(3)	0(15)	4(4)	0(20)	3(3)	0(5)	2(2)
Expenditure on food items	1346(12600)	4537(2552)	1900(7600)	4536(2117)	1050(13600)	4123(2610)	1040(13000)	4055(2768)
Cost of Production	1000(8200)	3430 (2199)	727(7200)	3313(1974)	500(8350)	3430(2139)	1080 (662)	2875 (2052)
Asset value in Birr	1750(220610)	23551(10263)	1085(121350)	16754(21521)	1035(54000)	10263(4196)	2520 (445)	16129 (1452)
Food security status of coffee growers								
Age of HH head(Years)	23(85)	39(11)	23(73)	40(10)	24(61)	39(10)	28(40)	33(5)
Adult equivalents	2.35(8.25)	4.76(1.50)	2.35(7.70)	4.53(1.53)	2.15(10.70)	4.71(1.86)	2.35(5.20)	3.75(1.62)
Total land(Ha)	0.13(10.00)	1.17(1.30)	0.13(7.50)	1.06(1.40)	0.13(4.75)	0.84(.77)	0.13(1.00)	0.47(.39)
Cultivated land(Ha)	0.13(5.00)	1.09(84)	0.13(2.25)	0.82(.69)	0.13(3.75)	0.75(.59)	0.13(1.00)	0.44(.39)
Farm income	0(120000)	15811(19022)	0(50000)	10773(11052)	0(45000)	7852(9766)	3000(8000)	6325(2314)
Non-Farm income	0(30000)	4821(7515)	0(20000)	4007(5619)	0(72000)	3916(10011)	3000(8000)	5550(2424)
Off- farm income	0(18000)	948(2908)	0(18000)	1388(3695)	0(7000)	372(1306)	0(1000)	250(500)
Amount of gift/remittance	500(40000)	9245(8709)	1000(36000)	6553(5926)	500(40000)	9055(7854)	1500(9999)	4375(3902)
Tropical livestock unit	0(8)	2(2)	0(11)	2(2)	0(6)	2(2)	0(3)	1(1)
Expenditure on food items	2367(61200)	19960(75112)	1400(37440)	11448(8752)	1185(29856)	10108(5790)	6440(16800)	9885(4745)
Cost of production	0(5100)	1727(1275)	0(16850)	2132(2568)	0(5000)	1479(1216)	0(1400)	700(808)
Asset value in Birr	1341(41580)	9680(7120)	1170(29000)	8199(6407)	1040(23940)	6854(5803)	1550(2975)	2171(728)

Note: *All income categories (Farm, non-farm and off farm including remittances) are presented in annual basis*

2.3.4 Distribution of respondents against major socioeconomic continuous explanatory variables

The educational level of the household head is a key factor associated with household food security status. Results of the present study showed that increased household education attainment was associated with an increased probability of being food secure at both locations (Table 4 and 5). Majority of food secure households of wheat (53.5%) and coffee (78.7%) growers attained primary and secondary schools, respectively whereas majority of moderately (50%) and severely food insecure (63.6) households in wheat farming areas had no formal education. Conversely, majority of moderately insecure households (55.4%) and severely food insecure households (75%) of coffee growers attended basic education. This is consistent with other studies that showed food security to be positively associated with the level of education (Abebaw and Betru, 2019; Akukwe, 2020; Mengistu et al., 2021; Mohammed et al., 2021; Mengistu et al., 2022; Mohammed and Mohammed, 2021). This could be explained by the fact that educated household heads have increased awareness on the possible advantages of modern agricultural production and could easily embrace technological inputs. They also have increased efficiency and better decision-making ability, hence increased production and diversify household income which in turn would enhance households' food security.

Level of soil degradation had shown statistically significant difference along the food security status groups both in wheat (x^2=240.61 and p<0.000) and coffee growers (x^2=143.22; p<0.000). Majority of respondents in food secure groups reported that their land was characterized by no soil degradation or mild level of degradation. Likewise, moderately and severely food insecure households suffer from poorly fertile land due to severe land degradation. This suggested that land degradation reduces agricultural productivity and poses a serious threat on food security status of households. Decline in soil fertility due to long-term cultivation with little or no fertilizer application is the major form of land degradation in most parts of Ethiopia and the major reason for low production and productivity which intrn affects the food security status of households. This is supported by literature showing soil fertility problem has positive association with household food insecurity (Holden and Shiferaw, 2004; Tsegaye and Bekele, 2010).

Households in the study areas produce their crops for consumption, market or both purposes. Close to half (52.5%) of food secure households produce coffee meant only for market supply while

19.7% of them produce coffee both for market only and household consumption. Likewise, 28.4% and 38.8% of mildly food insecure and 26.8% and 33.9% of moderately food insecure households produce coffee with the purpose of market and both for market and consumption, respectively. Majority of respondents in severely food insecure households produce coffee for their own consumption. This implies that the variable had significant effect ($p<5\%$) on food security status of coffee producers though its association with food security level was weak (Table 5). Conversely, purpose of production had no effect on food security status of wheat framers as majority of wheat grower households in the four status groups produce wheat both for selling and consumption. This implied that purpose of production can have different effect on a household food security. For example, market-oriented production may have negative affect on household food consumption due to reduced food availability as a result of a sell of big portion of produce (Von Braun and Kennedy, 1994). On the other hand, production for market supply may increase income and allow households to purchase additional and alternative food items. Likewise, production for consumption may reduce food insecurity as there will be sufficient food in the household. These findings are supported by Kuma et al. (2019) and Rubhara et al. (2020).

Remittance had significant ($P<1\%$) association with food security status of wheat growers. Wheat growing households who were not receiving remittances tend to be severely food insecure (Table 4). However, the association was insignificant in coffee grower households. Studies conducted in different parts of the country indicated that in some areas remittance had significant association with food security status whereas, in some study locations the association is weak. As per Mengistu eta al. (2022) rreceiving remittances is a household coping strategy that might reduce poverty, alleviate hunger, promote better diets and increase productive investments. On the other hand, researchers such as Cock et al. (2013), Akukwe (2020) and Mengistu et al. (2021) observed negative association between receiving remittances and the food security status.

Taking into account the overall effect of food security programs on household food security status, there was significant difference between the status groups of both wheat and coffee households (Tale 4 and 5). The result indicated that all wheat growers (100%) and most coffee producers (86.9%) in food secure groups were not supported by any food security program. However, great majorities of respondents in the three food insecure status groups at both locations had been supported by PSNP programs and their livelihood situations are a little bit better after they became beneficiary of the program though they still remain food insecure. As per the research conducted

by Welteji et al. (2017), contribution of such programs for the food security and livelihood of a household depends on factors such as age and education level of the household head, culture of savings and accumulation of assets and engagement of beneficiary households in diversified asset building livelihood strategies. Likewise, the research conducted by Bahru et al. (2020) on impact of PSNP on food security and child nutrition did not find any evidence of association between PSNP and household food security.

The FGD discussants and key informants' interview in Dodota district revealed that rural households who don't have any type of land or have small size of infertile land; no livestock at all or have small number of small ruminants; lack financial capacity to buy agricultural inputs and household consumables; don't have collateral to take credit; and willing to participate in the program were involved in PSNP. The program arranged 15kg of wheat per individual per month and 250 birr to cover non-real food demand of the household. Assuming selected beneficiaries can fulfill their household food demand for six months counting from harvest time, the program usually covers the food demand gap for the remaining six months. Besides, a maximum of five family members will be considered in the PSNP.

Here the real beneficiaries and FGD discussants complained that the aforesaid ration is not sufficient to cover the food demand of targeted households. They added that the allocated benefit was calculated 15 and 20 years back where the price of commodities and household food demand was far cheaper than the current food prices. Hence, food security and livelihood of PSNP beneficiaries remained the same even deteriorated. Biased selection, small amount of cereal and money allocated to cover household food demand, and selection biases were also mentioned by FGD discussants as major shortfalls of the program. Due to the listed internal factors and other external issues associated with it, the result of the program is not as such satisfactory and doesn't seem achieving its goal.

Market access had significant association with food security status of both wheat and coffee growers. Majority of households in food secure status group had better market access than the food insecure households at both study sites. However, the frequency data in Table 4 and 5 revealed that wheat producers had better market access than coffee growers. According to Mengistu et al. (2021), Mengistu et al. (2022) and Mohammed et al. (2021) to ensure food access, an adequate amount of food must be within the physical reach of vulnerable households, whether through their

own production or through market. Jacoby and Minten (2009) also reported that market access increases farmer's income through decreased transaction costs, which can, in turn, empower them to purchase variety of foods from local markets and reduce household food insecurity. Likewise, Abay and Hirvonen (2017) agreed that access to markets can increase smallholders' income and improve their food consumption, and consequently reduce poverty and food insecurity.

Development Agents contact has significant positive influence on food security status of wheat and coffee households at P<1% and P<5%, respectively. Majority of respondents in food secure status groups had contact with development workers while the contact with DAs was minimal in moderately and severely food insecure households. This indicated that an increased contact to development agents increases the probability of households to be food secure as a result of dissemination of agricultural extension and improved technologies to the farm households by DAs thus ultimately increases production and productivity. This finding is in agreement with Tewodros and Fikadu (2014) who reported access to extension measured in contact with development agents show significant difference between food secure and insecure households.

The impact of access to microfinance on food security status of households in the study areas are displayed on Table 4 and 5. The results indicated that microcredit utilization had an important influence on food security level of rural wheat (P<0.000) and coffee (P<0.1) grower households. From food secure households of wheat and coffee, 100% and 52.5%, respectively of respondents were credit users from microfinance institutions whereas almost equal proportions of respondents at both locations were credit non-users. This reveals that credit user households were more food secure than non-users in the study area. Mounting evidence suggested that access to credit helps farmers to purchase inputs and agricultural equipment that would potentially contribute to increased agricultural productivity (Urago and Bozoglu, 2022). Nour and Abdalla (2021), Mohammed et al. (2021) and Ngema et al. (2018) also reported microcredit utilization as one of the viable solutions to improve the food insecurity problem in the country.

According FGD discussants and key informants, most rural households prefer to take credit from government supported microfinance institutions such as Oromia credit and saving institution. However, high interest rate, lack of collateral, delay in credit provision, group lending and repayment structure and other constraints discourage most users. Thus, farmers look for other sources such as private lenders and organizations rendering the service. According to discussants

in Dodota district, wheat production in the area involved participation of various organizations and institutions such as brewery industries, flour factories and other import and export companies working in relation to wheat production and marketing. These partners were involved in various forms of support where one is provision of farmers with farm inputs on credit basis. These loans are expected to be paid back soon after harvest in kind (wheat). However, the market price of wheat soon after harvest becomes low due to high supply of the produce channeled to the local and federal markets. These and other factors put the farm households not to be benefited from wheat production, which could have fetched higher price if it could have been sold sometime from harvest season. FGD discussants and key informants stressed that, immediate sell of wheat after harvest led most wheat growers to become highly vulnerable to food insecurity, remain poor and trapped in the same vicious circle of taking credit during sowing season and pay back in kind with low market price every harvest season. On the other hand, the only institution providing financial services to producers in Dodota district was government-supported microfinance and the service provided for the coffee farmers was very limited; not available to all producers who need credit.

Table 4 Distribution of wheat grower respondents by categorical socioeconomic variables and household food security status

Food security status among wheat grower households (n=182)														
		Food secure (n=99)			Mildly food insecure (n=42)			Moderately Food insecure (n=30)			Severe Food insecure (n=11)			
Variable	Response categories	Freq.	% from SG (99)	% from total HHS	Freq.	% from SG (42)	% from total HHS	Freq.	% from SG (30)	% from total HHS	Freq.	% from SG (11)	% from total HHS	Chi square	p-Value
Educational level of the Household head	No formal educ	12	12.1	6.59	0	0	0.00	15	50	8.24	7	63.6	3.85	99.56	0.000
	Basic educ	22	22.2	12.09	36	85.7	19.78	11	36.7	6.04	4	36.4	2.20		
	Primary educ	53	53.5	29.12	5	11.9	2.75	3	10	1.65	0	0	0.00		
	Secondary educ	12	12.1	6.59	1	2.4	0.55	1	3.3	0.55	0	0	0.00		
Level of farm land degradation	Mild	26	26.3	14.29	0	0	0.00	1	3.3	0.55	0	0	0.00	240.60	0.000
	Moderate	5	5.1	2.75	38	90.5	20.88	2	6.7	1.10	0	0	0.00		
	Severe	0	0	0.00	1	2.4	0.55	10	33.3	5.49	11	100	6.04		
	None	68	68.7	37.36	3	7.1	1.65	17	56.7	9.34	0	0	0.00		
Purpose of production	Consumption	29	29.3	15.93	5	11.9	2.75	10	33.3	5.49	4	36.4	2.20	7.21	0.302
	Market	1	1	0.55	0	0	0.00	0	0	0.00	0	0	0.00		
	Both	69	69.7	37.91	37	88.1	20.33	20	66.7	10.99	7	63.6	3.85		
Gift/remittance	Yes	99	100	54.40	11	26.2	6.04	0	0	0.00	2	18.2	1.10	140.78	0.000
	No	0	0	0.00	31	73.8	17.03	30	100	16.48	9	81.8	4.95		
Involvement in any food security program	Yes	0	0	0.00	41	97.6	22.53	30	100	16.48	9	81.8	4.95	171.39	0.000
	No	99	100	54.40	1	2.4	0.55	0	0	0.00	2	18.2	1.10		
Access to nearest market	Yes	99	100	54.40	38	90.5	20.88	20	66.7	10.99	10	90.9	5.49	33.969	0.000
	No	0	0	0.00	4	9.5	2.20	10	33.3	5.49	1	9.1	0.55		
Access to DA	Yes	99	100	54.40	26	61.9	14.29	9	30	4.95	8	72.7	4.40	74.775	0.000
	No	0	0	0.00	16	38.1	8.79	21	70	11.54	3	27.3	1.65		
Access to MFIs	Yes	99	100	54.40	34	81	18.68	8	26.7	4.40	6	54.5	3.30	84.997	0.000
	No	0	0	0.00	8	19	4.40	22	73.3	12.09	5	45.5	2.75		

SG: Status group; DA: Development Agent; MFIs: Micro Finance Institutions

Table 5 Distribution of coffee grower households by categorical socioeconomic variables and household food security status

Variable	Response categories	Food security status among coffee grower households (n=188)												Chi-square	P-value
		Food secure(61)			Mildly food insecure(67)			Moderately Food insecure(56)			Severe Food insecure(4)				
		Freq.	% from SG (61)	% from total HHS	Freq.	% from SG (67)	% from total HHS	Freq.	% from SG (56)	% from total HHS	Freq.	% from SG (4)	% from total HHS		
Educational level of the HHH	No formal educ.	0	0	0.00	1	1.5	0.53	25	44.6	13.30	1	25	0.53	201.72	0.000
	Basic educ	1	1.6	0.53	49	73.1	58.30	31	55.4	16.49	3	75	1.60		
	Primary educ.	12	19.7	6.38	16	23.9	57.10	0	0	0.00	0	0	0.00		
	Secondary educ	48	78.7	25.53	1	1.5	2.00	0	0	0.00	0	0	0.00		
Level of farm land in degradation	Mild	56	91.8	29.79	13	19.4	15.30	16	28.6	8.51	0	0	0.00	143.22	0.000
	Moderate	5	8.2	2.66	51	76.1	70.80	16	28.6	8.51	0	0	0.00		
	Severe	0	0	0.00	3	4.5	9.70	24	42.9	12.77	4	100	2.13		
Purpose of production	Consumption	17	27.9	9.04	22	32.8	34.90	22	39.3	11.70	2	50	1.06	12.73	0.048
	Market	32	52.5	17.02	19	28.4	28.40	15	26.8	7.98	1	25	0.53		
	Both	12	19.7	6.38	26	38.8	44.80	19	33.9	10.11	1	25	0.53		
Gift/remittance	Yes	31	50.8	16.49	44	65.7	39.30	34	60.7	18.09	3	75	1.60	3.40	0.334
	No	30	49.2	15.96	23	34.3	30.30	22	39.3	11.70	1	25	0.53		
Involvement in any food security program	Yes	8	13.1	4.26	40	59.7	37.00	56	100	29.79	4	100	2.13	93.63	0.000
	No	53	86.9	28.19	27	40.3	33.80	0	0	0.00	0	0	0.00		
Access to nearest market	Yes	23	37.7	12.23	40	59.7	40.80	34	60.7	18.09	1	25	0.53	9.46	0.024
	No	38	62.3	20.21	27	40.3	30.00	22	39.3	11.70	3	75	1.60		
Access to DA	Yes	47	77	25	44	65.7	35.50	41	73.2	21.81	2	50	1.06	2.53	0.046
	No	14	23	7.4	23	34.3	35.90	15	26.8	7.98	2	50	1.06		
Access to MFIs	Yes	32	52.5	17.02	41	61.2	42.70	21	37.5	11.17	2	50	1.06	6.92	0.074
	No	29	47.5	15.43	26	38.8	28.30	35	62.5	18.62	2	50	1.06		

SG: Status group; DA: Development Agent; MFIs: Micro Finance Institutions

2.3.5 Econometric Analysis

The nature of dependent variable in this particular study was levels of food security/insecurity status in coffee and wheat grower rural households and is ordinal level which requires ordinal analysis. Therefore, ordinal logistic regression model was applied to identify determinant factors of food in/security in the study areas. The model was fitted to a total of 16 variables of which six: household occupation, amount of farm income, total household asset value, purpose of production (market oriented), market access and access to microfinance institutions had effect on household food security status with various levels of significance (Table 6).

The result indicated that as compared to coffee production, wheat production had significant role in attainment of household food security. The model result revealed that there is statistical and positive association with household food security and wheat production at $p<1\%$. The descriptive analysis also confirmed that majority of food insecure households were found in coffee growers than wheat growers. The FGD and Key informants stated wheat growers produce different types of food crops besides to wheat which is essential to serve the household food demand. Besides, presence of Wonji sugar factory, research organizations, seed enterprises and other private firms in the vicinity are non-farm and off-farm income opportunities along with their regular farm activities. Wheat farmers use income from various sources as coping mechanisms during critical food shortage. Thus, they are better off in attaining household food security as compared to their counter parts (coffee growers). On the other hand, coffee growers, in addition to their dependency on coffee production, which is full of market and production risks, they face shortage of financial capacity to cover the household food and non-food demand. The FGD discussants also pointed out that presence of middle men in the coffee market, coffee berry disease (CBD), sky rocketing cost of inputs and lack of institutional support worsen the problem of household food insecurity among coffee farmers in the study area.

In most households of coffee and wheat farm households their food store lasts from 6 to 8 months depending on their wealth status and other factors. Thus, farm income obtained from farm activities (sell of crop and livestock) will be insurance for the remaining four to six months prior to next harvest; serve the household to fulfill immediate household food and non-food demands during bad times. The model estimation indicated that annual farm income obtained by households had

prominent role in enhancing household food security in coffee and wheat farmers. Both coffee and wheat farmers fulfil their household food and nonfood demands from sale of marketable commodities including coffee and wheat in respective study sites. Several studies conducted in different parts of the country confirmed the positive and significant association of annual farm income with household food security attainment (Mengistu et al., 2021; Mitiku et al., 2012).

The operational definition of total household asset in the context of this research is the sum value in birr of all assets owned by the household including but not limited to land and any valuable structure on the land, agri-tools, any valuable asset in the household and workplace, Jewelry, money at hand or saving and so forth which are reported by the household during the period of data collection. The model estimation has shown that total household asset value had significant and positive association with household food security in coffee and wheat growing farmers at $p<5\%$. Guo (2011), Thamaga-Chitja et al.(2004) and Lutomia et al. (2019) found similar results.

According to FGD and Key informants, households who have large size of fertile farm land, different types of valuable production tools, personal properties, money at hand or in saving and properties deposited in different forms have all year-round food availability and access, thus they are food secure. These households use these assets as insurance and/or coping mechanisms during bad times such as drought. In the contrary, households who don't have such valuable assets are vulnerable to food insecurity and other shocks any type of shock. Thus, according to them accumulation of household asset and household food security are highly related.

Rural households in the study areas produce respective crops with diverse purposes vis-à-vis for household consumption, commercial purpose or both for consumption and supply to the market. Decision to be engaged in one or more of the above options depends on various factors including demographic, socioeconomic and institutional factors. Fulfilling household food and non-food demand through supply of their produce to the market, production meant mainly for household consumption and compromising between production for consumption and market can be some.

The model result indicated that market-oriented production had positive and significant effect on household food security at $p<5\%$ (Table 6). From the qualitative data we found that, households

who own large and fertile farm land, and have access to market and credit service mostly produce for market apart from household consumption. Market oriented production enable households to fulfill their food and nonfood demands and hence attain their food security. The descriptive statistics on Tables 4 and 5 had also revealed purpose of production had significant effect on food security status of coffee growers but not on wheat grower households. Kuma et al. (2019) and Usman and Callo-Concha (2021) confirmed that more commercialized households have better chance to obtain higher income and increased productivity due to increased input use and purchasing power of additional and/or alternative food items for the household.

Market is crucial institution both for coffee and wheat grower smallholders and it has paramount contribution for household food security. Coffee and wheat are major sources of livelihood and food security in Dodota and Gomma districts, respectively. Coffee growers take coffee to the market so as to buy food and non-food items, agricultural inputs, medical and school expenses and other household demands. This indicated that market is backbone for coffee grower rural households. Likewise, wheat is important cereal crop used as staple food and marketable commodity.

FGD discussants and Key informants confirmed that, wheat is major sources of food among wheat growers where it is used in different forms. After fulfilling household food demand, farmers take the crop to the market so as to buy alternative food items, agricultural inputs and other household demands. Income obtained from sell of both commodities is also utilized to pay credit which had been taken for the purchase of agricultural inputs and services in the household. They emphasized that lack of market information, storage facility and lack of financial capacity to repay the credit force farmers to sell their produce immediately after harvest at cheapest price which ultimately affect the household food security of households.

The model estimation had shown that access to market had significant and positive association with household food security at $p< 1\%$ (Table 6). The finding was in line with Ahmed et al. (2017), Mengistu et al. (2021), and Mohamed Nour and Abdalla (2021). Likewise, microfinance institutions have prominent contribution in reducing poverty and improving household food security (Kinde and Addisu, 2016). Findings from Zeller and Sharma (1998) in Ghana also asserts that combination of credit service with education resulted in improvement in household food security attainment. The

present study revealed that there was significant and positive relationship between access to credit services/microfinance institutions and attainment of household food security at (P<1%) (Table 6). Similar study by Nour and Abdalla (2021) also confirmed that farmers who are engaged in production of cash crops like coffee and partly wheat need microfinance institutions and/or banks to facilitate their farm business and hence to attain household food security. The role of financial institutions had paramount importance in various ways such as saving, provision of short term and long-term business loans, technical support, training and so forth to start a new farm or nonfarm business. Thus, access to microfinance had strong and significant effect on household food security.

Table 6 Ordinal logit estimates of determinants of household food security

HH Food Security Status	**Coefficient**	**SE**	**z**	**P-Value**
HHH occupation	0.4687***	0.1811	2.59	*0.001*
Age of HHH	0.0351	0.0783	0.45	0.653
Family size	-0.0103	0.3545	-0.29	0.771
Size of cultivated land	-0.0243	0.7936	-0.31	0.759
Annual farm income	0.0788**	0.0472	1.67	*0.095*
Annual nonfarm/Off farm income	0.0232	0.0771	0.3	0.763
Total expenditure on food	0.0172	0.0127	1.35	0.177
Cost of production (Annual)	-0.0428	0.0373	-1.15	0.251
Total HH asset value	0.0151***	0.0658	2.3	*0.022*
Education level of HHH	-0.0671	0.0173	-0.39	0.699
Production purpose (Market oriented production)	0.4473***	0.19222	-2.33	*0.02*
Amount of Gift/remittance received per annum	-0.0923	0.13768	-0.67	0.502
Access to nearest market	0.5185***	0.15984	-3.24	*0.001*
Access to DA	-0.1440	0.12663	-1.14	0.255
Access to Microfinance	0.5287***	0.16191	3.27	*0.001*
/cut1	1.052196	0.74276		0.4035897
/cut2	1.914118	0.74738		0.4492605
/cut3	3.10671	0.75404		1.628807
Log likelihood	-412.23835			
LR chi2 (19)	47.69			
Prob > chi2	0.0003			
Pseudo R2	0.5547			

2.4 Conclusion And Policy Recommendation

The current research was focused on comparative study of severity of household food security and its determinants between selected coffee and wheat farmers of Goma and Dodota districts, respectively. These farmers have peculiar characteristics in terms of their demographic, socioeconomic and institutional features as well as level of food security/insecurity and factors determining household food security.

Majority of wheat farmers produce wheat with prior purpose of consumption and market, indicating the crop has multiple roles among the small holders. On the other hand, food secure coffee farmers undergo market-oriented production, whereas food insecure households produce coffee for household consumption and to take the remaining to the market so as to buy household food and non-food items. The model result has shown that raising amount of annual farm income had prominent role to attain household food security. This implies that coffee and wheat as major crops are important to influence household food security with different proportions among rural households. Thus, policy and strategies designed to address the needs of smallholders to enhance their production and facilitation of market would enhance household food security status.

On the other hand, food insecure wheat farmers support their livelihood and food security using different strategies like engaging in off-farm and non-farm activities. Likewise, accumulation of household asset benefits rural coffee and wheat growers as coping strategy, source of livelihood and income diversification. Thus, policy and strategies which involves strengthening small holders in the area of income diversification, employment opportunity, asset formation and accumulation and resource management would have paramount importance to realize household food security.

The presence of institutions would facilitate marketing of farmers produces and buying agricultural inputs like fertilizer, improved seed, chemicals etc. that would in turn have contribution to attain household food security. Policy actions designed to address crop variety improvement, marketing of crop produce and availability of agricultural inputs, in one hand and accessibility of microfinance institutions on the other hand should be devised to maintain positive effect of these variables towards attainment of household food security. Generally, attaining food security in the study areas demands

implementation of diverse policies and strategies across all variables that had shown significant association with household food security.

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Disclosure statement

The authors declare that they have no competing interests

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Ethics approval and informed consent

Before the start of the actual research activities, the researchers have obtained support letters from Addis Ababa University, Center of Rural Development. The letters were submitted to Arsi and Jimma zones Agricultural Offices and concerned governmental and non-governmental organizations working in the area of food and nutrition security of respected study sites. Informed consents were obtained from the study units: household heads, members of focus group discussions and key informants before start of data.

CHAPTER THREE: COMPARATIVE STUDY OF THE NUTRITIONAL STATUS OF UNDER-FIVE CHILDREN IN COFFEE-GROWING AND WHEAT-GROWING RURAL HOUSEHOLDS IN ETHIOPIA[2]

Abstract

The current study attempted to compare the nutritional status of under-five children between wheat growers and coffee growers in rural households in the Arsi and Jimma zones of Ethiopia. Thus, a total of 226 children under five were taken from 378 rural households in the two study areas. It employed a mixed-research design. The prevalence of stunting, wasting, and underweight of under-five children among all households was 19%, 21.2%, and 17.2%, respectively. Several factors contributed to the nutritional status of children under five years. Birth order significantly affected child stunting both in wheat and coffee grower HHS. Sex influenced the BMI of both HHs. Exclusive breastfeeding was strongly associated with stunting of under-five children of both HHs. The frequency of meals had a strong influence on the stunting of children both in wheat and coffee grower HHs. Child dietary diversity significantly affected the stunting of under-five children both in wheat growers and coffee growers. Maternal education significantly influenced the BMI and Stunting of children in wheat and growing HHs. Maternal awareness of child nutrition was significantly associated with BMI for children in wheat and coffee growers, respectively. Child dietary diversity and maternal nutritional awareness significantly influence (BMI and wasting) and wasting of children, respectively in wheat-growing HHs. Maternal employment status was strongly associated with BMI and stunting. Substantial efforts should be made to address child- and maternal-focused factors to ensure malnourished children both in coffee- and wheat-growing rural households in the study areas and Ethiopia.

Keywords: Child nutrition, Ethiopia, Gomma District, Dodota district, Southwest Ethiopia, Arsi Zone, Coffee growers, Wheat growers

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3.1 Introduction

Malnutrition is the failure of a body to obtain appropriate nutrients during critical growth stages, which can be further explained as an imbalance between the supply and energy demand of the body to ensure its appropriate growth and function of the body (Wells et al., 2021). Studies have indicated that malnutrition, especially under nutrition, has long-lasting effects on individuals and generations. Children with malnutrition are found to have fewer defenses against disease, get sick faster and easily, and are less able to recover quickly and completely from diseases, prevents children from growing into productive members of society and being adults who are fully able to participate in the economic and social development of their countries (Rytter et al., 2014). Moreover, children who are unable to get diversified food and, as a result, are found in a state of stunting, wasting, or underweight are expected to have a higher risk of school dropout and poor academic performance, which may ultimately lead to failure in the overall development of families and nations at large (Beyene et al., 2015).

Malnutrition remains a major public health problem, particularly in developing countries, where it accounts for the majority of nutrition-related conditions such as morbidity and mortality among children under five years of age, with two-thirds of all cases originating from sub-Saharan Africa (Frazzoli and Mantovani, 2020). It was estimated that 6.7 percent (45.4 million) of children were stunted and 5.7 percent (38.9 million) of children were wasted in Africa. On the other hand, the number of children affected by stunting is generally declining between 2000 and 2020, which is 61.4 million and 54.4 million, respectively (Wana et al., 2023).

Stunting, wasting, and underweight are common phenomena in low-income countries such as Ethiopia. In Ethiopia, the number of children affected by stunting, underweight, and wasting is estimated to be 39%, 22,% and 11%, respectively (Binyam et al., 2022). According to the UNICEF strategy report (UNICEF, 2022), one in three children, one in two children, and two in three children are not growing well because of malnutrition, deficiencies in essential micronutrients, and not fed the minimum diet they need to grow healthy, respectively (Ahmed et al, 2012). Close to half(45%) of deaths of children were linked to under nutrition. Minimum (35.3) and maximum (57.5) point estimates of stunting in Ethiopia were observed in 2020 and 2000, respectively. The average point

estimate of stunting between 2000 and 2020 is 45.5 (WHO and WB, 2021). However, previous studies have shown that the prevalence of stunting and wasting is not uniformly distributed across various regions of Ethiopia.

Ethiopia is one of the countries striving to reach its global malnutrition goal by 2025 (Trübswasser et al., 2022). However, actions and interventions do not seem fast and congruent to achieve this goal (Amare et al., 2019; Heinrichs et al., 2021). At this junction, assessing the prevalence and determinants of poor nutritional outcomes in children, such as stunting and wasting, is paramount in guiding actions related to addressing malnutrition in the country. Besides, our understanding of the subject has been hampered for years by problems related to demographic, socioeconomic, institutional, and policy issues. Moreover, a large number of studies on the subject have focused on identifying individual factors without relating to other components, and have failed to consider the nature of food and nutrition security in different agricultural production systems. Thus, malnutrition in children as an outcome of lack of secure nutrition has serious consequences, such as underdevelopment and poverty; however, the nature of causation and/or the relationship between food security status and achievement of nutritional status has not yet been studied between cash and non-cash crop producers.

To this end, most food and nutrition security studies have focused on vulnerable areas, where adverse climate, drought, and natural resource degradation are observed. Thus, this study attempted to address issues such as the prevalence and determinants of malnutrition in coffee-growing areas of southwest Ethiopia and wheat-growing areas of central Ethiopia. Coffee grower farmers, as specialization agricultural production systems, are expected to have better financial capacity from income obtained from the sale of coffee. On the other hand, wheat grower farmers, unlike coffee growers, are expected to have a higher probability of producing a variety of food groups and have better access to various diversified food groups grown around their homestead meant mainly for household consumption and, in turn, put them in a better position of nutritional status as they have better access to micronutrients from various food groups. The question posed here is which production system *Vis-a-Vis* coffee growers or wheat growers would have a better probability of attaining a better child nutritional status? In this regard, no such studies have been conducted at the national level in general, or in the study areas in particular. Moreover, the findings will help

policymakers and development planners/decision makers to formulate separate interventions appropriate to attain a broader goal of achieving nutritional security between 6-59-month children of coffee-growing and wheat-growing households in Ethiopia.

3.2 Research Methodology

3.2.1 Description of the study areas

The study was conducted in coffee-growing rural households in the Gomma and Dodota districts of Jimma and Arsi zones, Ethiopia (Fig. 1).

Gomma District is one of the eight top major coffee-growing districts of the zone, where coffee serves as a major income and livelihood source for the majority of its population. The district is located between 7° 49' 59.99″ N and 36°39' 59.99″ E, with an altitude ranging from 1380 to 1680 m. The total population of Gomma District was 350,882, of which 177,994 were women. There are 36 kebeles (the smallest administrative unit of Ethiopia) in the district, of which 86% of them are predominantly rural administrations (CSA, 2012).

Dodota is one of the major wheat-growing districts in the Arsi Zone of the Oromia Regional State, Ethiopia. It is located between Latitude: 8° 15′ 0″ N and longitude: 39° 20′ 0″ E with altitude ranges of 1400m–2500 m a.s.l. The total population of the district is 86,761(92.48% rural). Wheat is produced by 68% of rural households as a major crop (CSA 2012). The district has a total area of 65, 000 ha of land and 701 ha of irrigation. Wheat, tomato, potato, sugarcane, teff, maize, horse bean, sorghum pea, and rape are the major crops grown in the area. In addition, the district is endowed with livestock such as cattle, goats, sheep, horses, mules, and poultry.

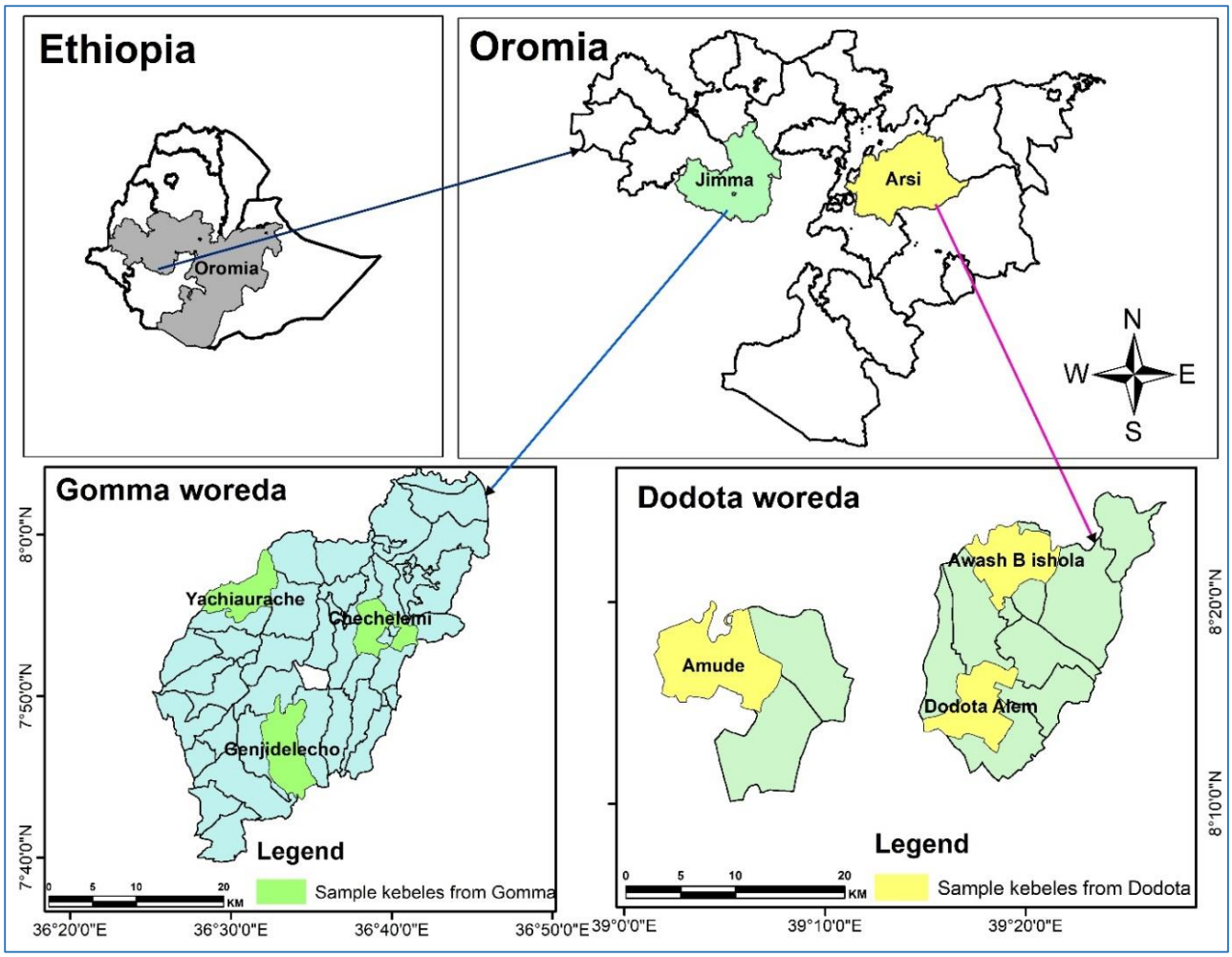

Figure 2 Map of the study sites

3.2.2 Study design

To assess nutritional status and identify determinant factors among children under the age of five, a cross-sectional mixed research design was applied. Such research designs allow for the comparison of data obtained from qualitative and quantitative sources to clearly understand the research problem (Creswell et al., 2011; Morse and Niehaus, 2009). Data were collected through interviews with the primary caregivers of the children using a pretested structured questionnaire, interviews with key informants (KIs), direct observation, and focus group discussions (FGD) with mothers and health extension workers at the respective study sites. The questionnaire was designed to assess the

nutritional status of children (underweight, stunting, and wasting) and its association with the demographic and socioeconomic characteristics of the household and the dietary diversity of the child. Moreover, this research adopted pragmatic philosophy as a methodological underpinning to conduct a comparative study of child nutritional status (6-59 months) between wheat growers and coffee growers' rural households.

3.2.3 Sampling procedure

A multistage stratified sampling technique was employed to approach study participants at the two research sites. In the first stage, the Jimma and Arsi zones were purposively selected based on their wheat and coffee production potentials and prominent contributions of commodities for the income and livelihood of rural households. In the second stage, a stratified random sampling method was applied to select the Gomma district from the Jimma zone and the Dodota district from the Arsi zone.

In the third stage, among the 54 kebeles (39 from Gomma and 15 from Dodota districts), six kebele administrations (three from respective districts) were obtained randomly using the lottery method. Accordingly, Genjidelecho, Yachiyaurache, and Chochelemi were obtained from Gomma district coffee growers, while Awash Bishola, Dodota-Alem, and Amude were obtained from Dodota district wheat growers. In the fourth stage, individual mothers and/or caregivers of children under five years of age children (6-59 months) living in the kebeles above were identified for household surveys using stratified random sampling followed by a systematic random sampling method. Due to technical issues, cost implications, and the assumption of equal treatment rendered to all under-five children in a particular household, this study considers only the youngest under-five children to represent a household. Zone-level health extension workers were involved and assisted in the process of identifying peasant associations and respondents.

3.2.4 Sample size determination for sample households

A simplified sample size determination formula was used to obtain representative samples (Yamane 1967).

$n_1 = \frac{N_1}{1+N_1(e^2)}$ And $n_2 = \frac{N_2}{1+N_2(e^2)}$

Where n is the sample size, N_1 and N_2 are the population sizes, and *e* is the precision level. N_1 (2928) and N_2 (2566) are the population sizes of rural households in the Gomma and Dodota districts, respectively, n_1 and n_2 are the sample sizes of the districts in the same order, and e is the level of precision, which is 0.07.

Based on the above calculation, the sample sizes are n_1= 188 for the Gomma district and n_2= 188 for the Dodota district. However, a total of 226 rural households, 104 from Gomma district and 122 from Dodota district, who only had 6-59-month-old children, were selected for nutritional status analysis. The 104 children were from coffee-growing kebeles of Gomma district, namely Galcho Dalocha (48), Yachiyaurache (29), and Chochelemi (27) kebeles of the Gomma district. Similarly, the 122 sampled children were 57 from Awash Bishola, 31 from Dodota Alem, and 34 from Amude in Dodota district.

3.2.5 Data collection methods and procedures

The data collection instruments employed in the study were semi-structured interview schedules, checklists, and anthropometry, while FGD, KI, and direct observations were the data collection methods.

Semi-structured interviews were used to capture information including demographic, socioeconomic, institutional, child-feeding, and health-related issues. Before data collection, necessary steps and procedures were obtained from the caretakers of the sampled children. Enumerators who live in the area speak the local language and are acquainted with local and cultural contexts were recruited for data collection. They were given a brief introduction to the objectives of the study and were trained on the contents of the interview schedule and data collection procedures.

Pre-tests on non-sample respondents were conducted under the supervision of the researcher. Finally, a formal survey was conducted on 226 households (under-five children) after necessary modifications, and adjustments were accommodated as per the results obtained from the pre-test.

Measuring the individual anthropometry of children under the age of five was given special emphasis in the instrument. The weight of a child was measured with minimal clothing and no shoes and recorded to the nearest accuracy of 100 g using a Salter scale with a capacity of measuring up to 25 kg, digital weighing scale, harness and spring balance, baby weighing scale, and local vessel depending on the age of the child. The measuring scale was properly calibrated before starting the measurements, and the weight was recorded as soon as the pointer on the scale stabilized. In line with this, appropriate safety cautions, such as the safe removal of the child from the weighing scale, were properly conducted.

The height and length of the child were measured using an infant meter and a vertical baby measuring board. For children below 24 months of age, length was measured using an infant meter, a standardized measuring board with a fixed footrest, and a moveable headpiece placed on a flat surface. The length was measured while the child was lying recumbent on a measuring board, with the head in an upright position and the body firmly stretched. When the position was correct, the headpiece was pushed down until it reached the head, and the length was recorded. The height of children aged > 24 months was measured while standing straight on a standing board placed on a hard flat surface against a wall with a line of sight perpendicular to the horizontal surface. The child was closely observed to ensure that the heels remained on the plate and the head was in an upright position during the measurement. The headpiece was then brought down on the child's head, and the reading was taken. The heights of the sampled children were measured without shoes and recorded to the nearest 0.1 cm. Height and weight measurements were obtained during the interview visits or at other scheduled visits. Anthropometric data were collected in collaboration with the health extension workers in the respective sample kebeles. Necessary steps and procedures were obtained before taking data from the sample children and their households.

The date of birth for each child was recorded by asking the mother/caregiver, and when possible, the child's birth date was crosschecked with vaccination cards. Age was recorded to the nearest

completed month. The mother's memory of eliciting the child's age was assisted by referring to local events when the child was born.

Six focus group discussions, three from each district, were held to supplement the information collected using household surveys, and some data were applied for standalone analysis. Each group was composed of eight discussants purposively selected from mothers or caregivers within households with under five children, experts from government offices, and NGOs. Participants were typically selected based on clear criteria, such as willingness to participate in the study, knowledge of the study sites, and child nutrition. The cultural aspects of food and causes of child malnutrition are major issues addressed by FGD.

Data that demanded in-depth insight, feelings, and perceptions of respondents on various aspects of child malnutrition were collected using in-depth interviews with key informants. Thus, a total of 16 community members were engaged in key informant interviews, that is, eight key participants per district. Willingness to participate in the study, awareness about the study sites, having explicit information about child health and nutrition, active involvement in community affairs, and being a parent (current or past) of under five years age of the child were some of the criteria to select the key informants. Accordingly, participants in KI involved three health extension workers, three community members, one NGO expert, and one government-based expert in each study district. Checklists were developed and used to guide discussions with focus groups and key informants. The participants were encouraged to use the local language that they were most familiar with. Health extension agents who were most familiar with the local language together with the researcher facilitated group discussions. The causes and consequences of child malnutrition and the role of family, government, NGOs, and various stakeholders in curbing child malnutrition were major issues addressed by the FGD and Key informants' interviews.

Data were collected from the study area between April 2019 and September 2022. The collected data were then made ready for conversion to compare with the standard to level the respective child's nutritional status as nourished malnourished and other nutritional outcomes, such as underweight, stunting, and wasting standards.

3.2.6 Measuring the nutritional status of children (6-59 months)

Anthropometric indicators are generally considered nutritional status indicators (WHO, 1995; Gibson, 2005; Johanna, 2010). The z-scores of weight-for-height (wasting), height-for-age (stunting), and weight-for-age (underweight) about the internationally defined (standard) cutoff points were used as anthropometric indices in this study (WHO, 2011). The Z-score is a measure of an individual's value concerning the distribution of the reference population. The formula used to calculate Z-scores is as follows:

$$\text{Z-value} = \frac{\text{Individual value (height or weight)} - \text{(median value of the reference population)}}{\text{The standard deviation of the reference population}}$$

The WHO (1995) Z-score cut-off point of <−2 SD was used to classify the nutritional status of sampled children, where -3SD = severe undernutrition, between -3SD and -2SD = moderate undernutrition, between -2SD and +2SD = normal nutritional status, and above +2SD = over-nutrition. The prevalence of malnutrition (wasting, stunting, and underweight) was expressed according to the degree of severity, both in terms of magnitude and percentage. Consequently, a child was regarded as malnourished if one of the anthropometric indices was abnormal (< -2 z-scores below the average reference). Children were considered wasted if their weight-for-height z-scores (WHZ) were below -2 standard deviations (SD). Wasting indicates thinness and is usually the result of recent nutritional deficiency. It is affected by seasonal shifts associated with the availability of food and the prevalence of the disease. Stunting, represented by a height-for-age z-score (HAZ) of < -2, results from extended periods of inadequate food intake, poor dietary quality, increased morbidity, or a combination of these factors. A weight-for-age z-score (WAZ) below -2 represents underweight and is the result of a combination of short- and long-term food shortages and growth disturbances (Haywood and Pienaar, 2021). Weight-for-age z-score (WAZ) is a measure of both acute and chronic malnutrition.

3.2.7 Method of data analysis

Data obtained from various means were classified as demographic, sociodemographic, and child anthropometry. The data were cleaned and entered into SPSS (version 25) and exported to STATA (Version 16.0), ENA for SMART, WHO Anthro 3.2.2, and Epi lnfo 6.04d computing software for further analysis and interpretation of the key results. Descriptive statistics such as mean, minimum, maximum, frequency, percentage, and inferential statistics, such as the chi-square test, were applied to identify important variables that determine children's nutritional status.

3.3 Results And Discussion

3.3.1 Prevalence of malnutrition

The overall prevalence of stunting, wasting, and underweight were 19%, 16.43%, and 20.8%, respectively (Fig. 4). The prevalence of stunting in the study area implied that one in five under-five children (19%) was suffering from chronic malnutrition. Stunting was more prevalent among the coffee growers (21.2%) as compared to wheat growers (17.2%). This may be because food grains in wheat producers are available more or less uniformly throughout the year as compared to coffee-growing areas. Due to the small size of land allocated for grains and other staple foods by coffee growers, there is a tendency to purchase only locally produced and available seasonal grains, vegetables, and fruits from other rural or town markets. Hence, stunting, which results from extended periods of inadequate food intake, poor dietary quality, and a combination of other factors, is more prevalent in coffee-growing rural households than in wheat growers.

In contrast, wasting may result from inadequate food intake or a recent episode of illness-causing weight loss. A relatively high prevalence of wasting was observed in coffee-growing areas, where one in five children (19.2%) was wasted. Wasting of under-five children was slightly lower in wheat growers, which is nearly 14%).

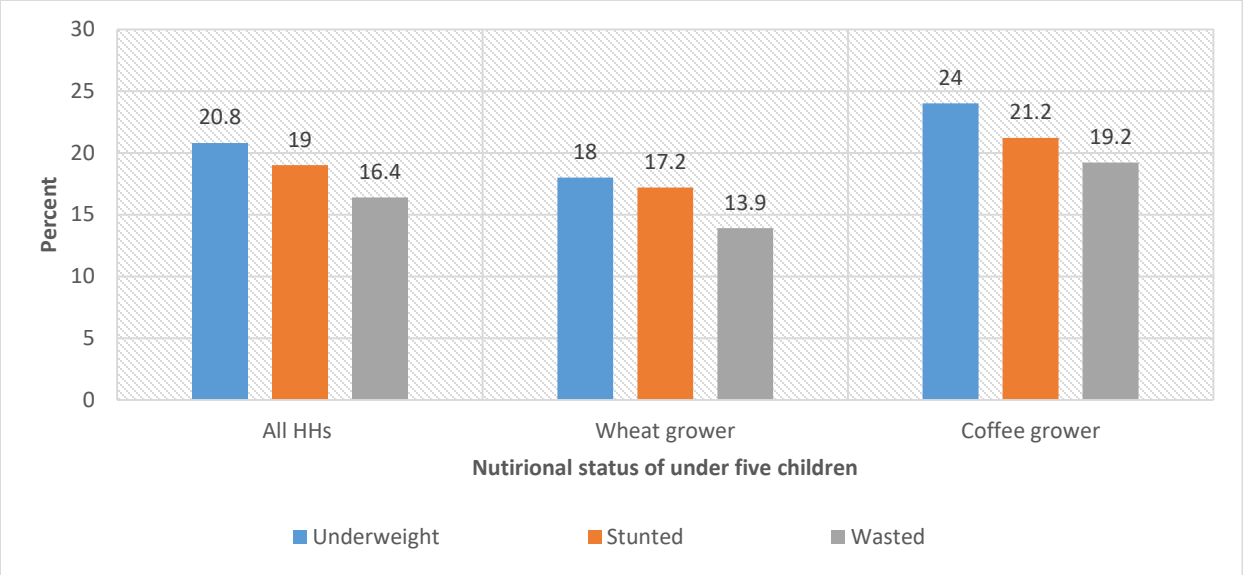

Figure 3Nutritional Status of Under-Five Children in Coffee and Wheat Grower Households

The proportions of underweight children among wheat growers and coffee growers were 18% and 24%, respectively. In general, the study has shown that the prevalence of wasting, stunting, and BMI in children under five were slightly to moderately higher in coffee-growing rural households than in children of wheat-grower households.

Similar statistics emerge from several studies; for instance, Ethiopia has shown the hat proportions of stunting, wasting, and underweight under-five five children were 39.3%, 28.6%, and 16.3%, respectively (Lemessa et al., 2023). The 2019 Ethiopian Mini-demographic and Health Survey (EMDHS) also revealed a prevalence of 37%, 7%, and 21% for stunting, wasting, and underweight, respectively. Tsegaye et al. (2019) reported a high prevalence of stunting (40%) in under-five-age children in West Shoa, Oromia region of Ethiopia. Similarly, Damite et al. (2023) reported that 9.4% of Ethiopian children aged 0–5 years were wasted in 2019, which is much lower as compared to the findings of the present study. In this study, the prevalence of stunting in Arsi (17.2%) and Jimma (21.2%) was lower than the national average 37%). Other studies, such as those by Berra and Yang (2017), Haile and Amboma (2018), and Tafesse et al. (2020), also revealed a low prevalence of both underweight and stunting in the Oromia region.

3.3.2 Association of anthropometric characteristics with demographic, socioeconomic, and institutional variables

Variables that were assumed to influence the nutritional status of under-five children were mainly expressed in terms of underweight, stunting, and wasting, and were categorized as child-related and maternal-related characteristics. As shown in Tables 7 and 8, various variables significantly affected underweight, stunting, wasting, or a combination of two or more nutritional outcomes in different ways.

As shown in Table 7, coffee grower HHs comprised a higher proportion of underweight, stunted, and wasted children than wheat grower HHs. Similarly, the percentage of male under-five children was higher in coffee grower HHs. Children from wheat grower rural households were better off in exclusive breastfeeding than children under five in coffee grower HHs. Children from coffee grower HHs were better at meal frequency (more than three times in 24 h) than those from wheat grower HHs. However, children from wheat grower HHs performed better in meal frequency (two and three times) than those from coffee grower HHs.

Table 7 Characteristics of under-five children in Coffee and Wheat grower HHs

Variable	**Response Categories**	**Wheat grower**		**Coffee grower**	
		F	**%**	**F**	**%**
Underweight	Underweight	22	18	25	24
	Healthy weight	100	82	79	76
Stunting	Stunted	21	17.2	22	21.2
	Healthy	101	82.8	82	78.8
Wasting	Wasted	17	13.9	20	19.2
	Healthy	105	86.1	84	80.8
Birth order	1st child	19	15.6	30	28.8
	2nd to 3rd	42	34.4	27	26
	4th to 5th	61	50	47	45.2
Sex of the child	Male	71	58.2	70	67.3
	Female	51	41.8	34	32.7
EBF	Yes	89	73	53	51
	No	33	27	51	49
Is you under five children still breast fed	Yes	54	44.3	35	33.7
	No	68	55.7	69	66.3

Frequency of meal meals day	Once	6	4.9	7	6.7
	Twice	22	18	18	17.3
	Three times	50	41	23	22.1
	> three times	44	36.1	56	53.8
Child dietary diversity status	Low	61	50	49	47.1
	Medium	42	34.4	32	30.8
	High	19	15.6	23	22.1
Has your youngest under five children been sick in the past two weeks?	Yes	15	12.3	23	22.1
	No	107	87.7	81	77.9

3.3.3 Relationship between Anthropometric and child Characteristics

3.3.3.1 The birth order of the child

Birth order refers to the order of under-five children in the family, such as first-born, second-born, and so forth. The percentages firstborns (28.8%) and six or more children (10.6%) were higher in coffee growers than their counterparts. Conversely, second to third (34.4%) and fourth to fifth (45.1%) orders at birth were higher among children of wheat growers (Table 8). The chi-square and associated p-value (0.0241) signifies that among the three outcomes of malnutrition, the variable has shown a statistically significant association at p<5% with underweight and stunting of under-five children of wheat growing rural households (Table 8 and Fig.5).

On the other hand, the birth order of the child in coffee grower household's children was highly influenced by stunting of under five children at p<5% rather than underweight and wasting. First-born children of birth orders four to six were less likely to be malnourished than those of birth order 4^{th} and above at both study sites. This might be because when the birth order of a child in the household increases, the care given to the children decreases as the mother becomes old and unable to provide appropriate care for those latecomers. Moreover, when the family number increases, it causes strain on family resources (Anwar et al., 2017) and those with higher birth order positions are likewise found to have worse outcomes than those with lower birth order positions (Kantarevic and Mechoulan, 2005). This variable has been reported to be an important determinant of the nutritional status of children of 6-59 months in Ethiopia by many researchers (Anwar et al., 2017; Zufan et al., 2019; Amare et al., 2019; Woldemariam and Genebo, 2022). However, this finding was

contrary to findings from other studies in Ethiopia, such as Fantay et al. (2016), who reported a non-significant association between birth order and the nutritional status of a child.

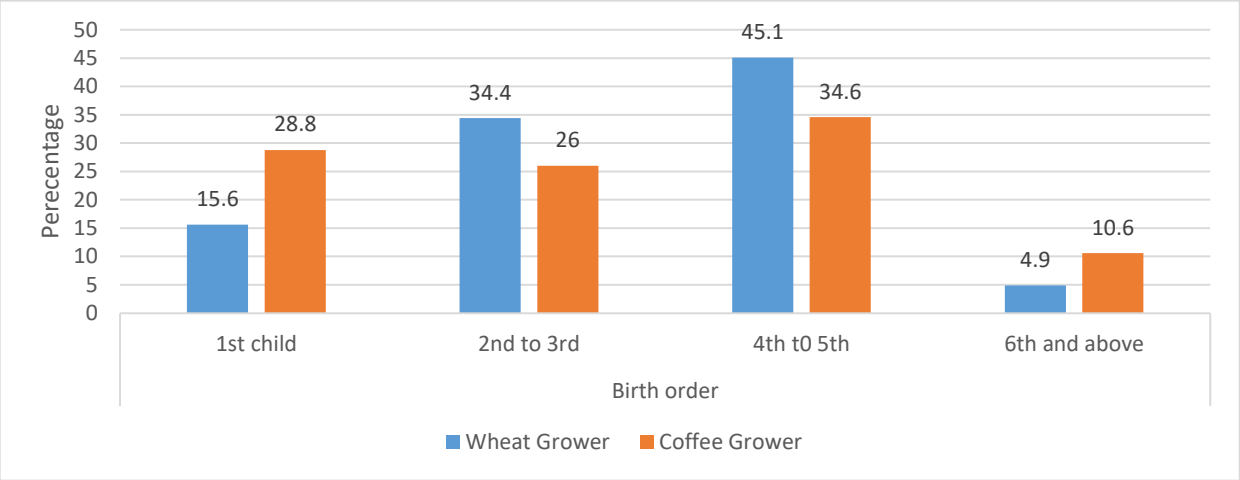

Figure 4 Distribution of sample children by their birth order

3.3.3.2 Sex of the child

Sex of a child was one of the hypothesized explanatory variables assumed to influence the nutritional status of under-five children. In this study, a higher number of boys, 58.2% and 67.3%, respectively were included from wheat- and coffee-producing households (Fig. 6). It has been observed from the findings that the sex of the under-five children had a strong and significant association with nutritional status of children of wheat growing households at $p<5\%$ for all outcomes, i.e., underweight, stunting, and wasting. On the contrary, the variable had a weak association with wasting and a strong link with underweight and stunting children in coffee grower households at $p<5\%$ and 10%, respectively. The relationships between anthropometric characteristics and the sex of the children are presented in Table 8.

This implied that boys were more likely to be affected by all forms of malnutrition than girls were. This is in agreement with a few other studies conducted in various parts of the country (Demisse and Worku, 2013; Zewdie and Abebaw, 2013; Asfaw et al. 2015) where boys showed a higher prevalence of undernutrition than girls did.

Studies conducted by Negash et al. (2015), Bealu et al. (2017), and Samuel et al. (2022) also indicated that malnutrition was more prevalent among males and was found to be a strong risk factor for child mortality. In addition, a meta-analysis of demographic and health surveys of sub-Saharan countries confirmed that the rates of malnutrition among boys were consistently higher than those among females, with statistically significant differences in 12 out of 16 studies (Wamani et al., 2007). However, some studies in the Tigray (Woldeamanuel and Tesfaye, 2019) and Somali (Damitie and Alebel, 2021) regions of Ethiopia indicated a higher prevalence of underweight in girls than in boys.

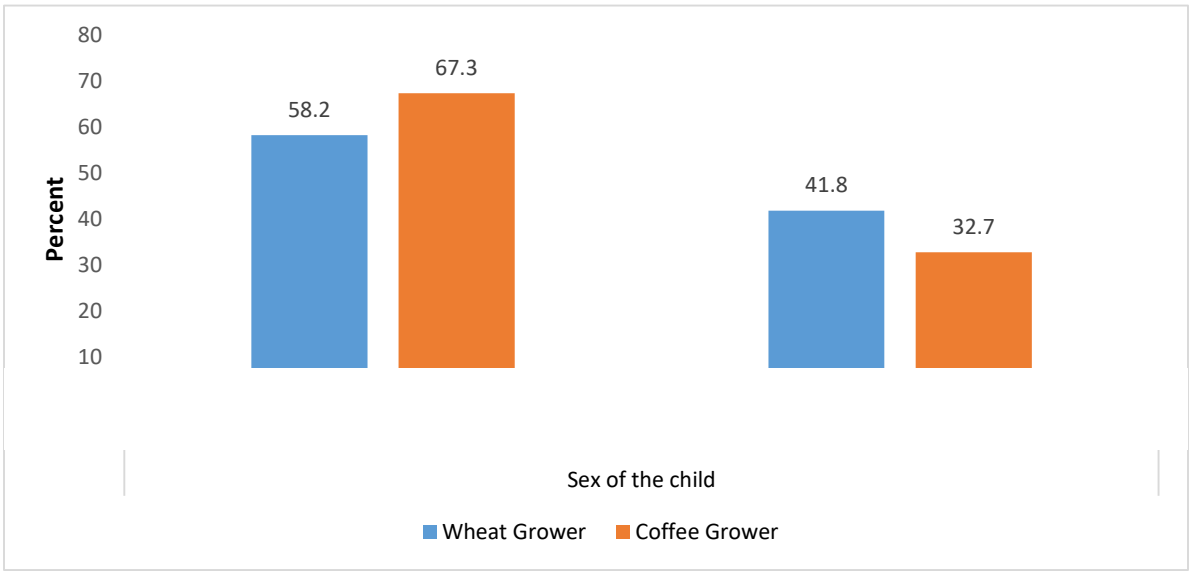

Figure 5 Nutritional Status of Under five children against sex of the child

The high prevalence of malnutrition in male children compared to females may be related to child behavior, where under-five female children might stay closer to home and thus have better access to food than their counterparts (Thurstan et al., 2020; Zelalem et al., 2023). In contrast, some studies have shown that boys under the age of five were given more complimentary food than girls (Samuel et al., 2022). According to Zelalem et al. (2023), boys, unlike girls, demand more energy through breastfeeding and additional food items to build their physical and mental processes and energy wasted due to their energy-demanding behaviors, such as exploration and energy-demanding behaviors in and outside of their home. Thus, it could be difficult for resource-poor rural households

to fulfill their boys' demands to maintain their nutritional status. On the other hand, the weaning of boys was mentioned as one of the major causes of malnutrition in children under five years of age (Thurstan et al., 2020; Mmbando et al., 2022). Other researchers argue that this may be due to hormonal or other unknown factors and call for further research to understand and tackle malnutrition in boys (Teshome et al., 2010; Roba et al., 2021).

Table 8 Relationship between children-related characteristics and nutritional outcome

child Wheat	Response category	BMI					Stunting					Wasting				
		Underweight		Healthy		Chi-square	Stunted		Healthy		Chi-square	Wasted		Healthy		Chi-square
		F	P	F	P		F	P	F	P		F	P	F	P	
Birth order (Wheat)	1st child	5	22.7	54	54.0	7.198** (0.0241)	5	23.8	51	50.5	12.641** (0.0450)	4	23.5	47	44.8	6.351 (0.196)
	2nd to 3rd	7	31.8	32	32.0		6	28.6	36	35.6		5	29.4	14	13.3	
	4th t0 5th	10	45.5	14	14.0		10	47.6	14	13.9		8	47.1	44	41.9	
Birth order (Coffee)	1st child	5	20.0	25	31.6	1.835 (0.607)	4	18.2	17	20.7	16.207** (0.0102)	6	30.0	24	28.6	1.850 (0.604)
	2nd to 3rd	6	24.0	22	27.8		8	36.4	26	31.7		4	20.0	23	27.4	
	4th t0 5th	14	56.0	32	40.5		10	45.5	39	47.6		10	50.0	37	44.0	
Sex of the child (Wheat)	Male	12	54.5	41	41.0	8.147** (0.047)	18	85.7	53	52.5	7.895*** (0.005)	4	23.5	73	69.5	9.007** (0.0316)
	Female	10	45.5	59	59.0		3	14.3	48	47.5		13	76.5	32	30.5	
Sex of the child (Coffee)	Male	18	72.0	27	34.2	13.329* (0.0566)	17	77.3	29	35.4	11.259** (0.0262)	14	70.0	56	66.7	0.082 (0.775)
	Female	7	28.0	52	65.8		5	22.7	53	64.6		6	30.0	28	33.3	
Child undergo EBF (Wheat-73%)	Yes	4	18.2	71	71.0	9.070** (0.0301)	7	33.3	75	74.3	7.508** (0.0476)	15	88.2	74	70.5	2.338 (0.126)
	No	18	81.8	29	29.0		14	66.7	26	25.7		2	11.8	31	29.5	
Child undergo EBF (Coffee-51%)	Yes	10	40.0	41	51.9	1.076 (0.300)	7	31.8	46	56.1	4.092** (0.043)	13	65.0	40	47.6	1.953 (0.162)
	No	15	60.0	38	48.1		15	68.2	36	43.9		7	35.0	44	52.4	
	No	13	52.0	56	70.9		13	59.1	56	68.3		10	50.0	59	70.2	
Frequency of meal per day (Wheat)	1-2 times	13	59.1	26	26.0	7.611* (0.072)	10	47.6	26	25.7	12.863** (0.0413)	2	11.8	26	24.8	6.118** (0.0374)
	3 times	7	31.8	31	31.0		9	42.9	35	34.7		6	35.3	35	33.3	
	>3 times	2	9.1	43	43.0		2	9.5	40	39.6		9	52.9	44	meals	
Frequency of meal per day(Coffee)	1-2 times	17	68.0	13	16.5	5.140 (0.162)	10	45.5	14	17.1	6.108** (0.0106)	2	10.0	23	27.4	3.681 (0.298)
	3 times	6	24.0	27	34.2		9	40.9	22	26.8		4	20.0	19	22.6	
	>3 times	2	8.0	39	49.4		3	13.6	46	56.1		14	70.0	42	50.0	
	Low	10	45.5	15	15.0	12.064**	14	66.7	18	17.8		7	41.2	16	15.2	

child Wheat	Response category	BMI					Stunting					Wasting				
		Underweight		Healthy		Chi-square	Stunted		Healthy		Chi-square	Wasted		Healthy		Chi-square
		F	P	F	P		F	P	F	P		F	P	F	P	
Child HDDS(Wheat)	Medium	8	36.4	32	32.0	(0.0356)	6	28.6	36	35.6	13.566** (0.0168)	7	41.2	35	33.3	9.624* (0.0732)
	High	4	18.2	53	53.0		1	4.8	47	46.5		3	17.6	54	51.4	
Child HDDS(Coffee)	Low	12	48.0	15	19.0	2.700 (0.259)	12	54.5	17	20.7	5.099** (0.0350)	11	55.0	38	45.2	0.645 (0.724)
	Medium	8	32.0	27	34.2		6	27.3	28	34.1		5	25.0	27	32.1	
	High	5	20.0	37	46.8		4	18.2	37	45.1		4	20.0	19	22.6	

3.3.3.3 Exclusive Breastfeeding (EBF)

Breast-feeding is of paramount importance for the current and future health and nutritional status of a child (Kramer and Kakuma, 2002). The impact of exclusive breastfeeding can manifest either in short-term and/or long-term outcomes of malnutrition. The long-term impacts of malnutrition are not easily manifested, but it might have severe and life-threatening impacts on the later stages of the child's overall physical, social, and cognitive development. In the current study, 51% and 73% of under five children in coffee and wheat growers respectively, were breastfed exclusively for the first six months (Table 8). The chi-square value and p-value associated with this variable had shown that underweight and stunting of children in wheat grower households were highly affected by EBF at $p<5\%$. The proportion of stunting among the exclusively breastfed children was 33.3% and 31.8% in wheat and coffee growers, respectively, which was significantly lower than among on-exclusively breastfed children. Likewise, 18% and 40% exclusively breastfed children were underweight in the study areas in the same order. This implies that exclusively breastfed children in the first six months of life were less likely to be underweight and stunted compared to children who were not exclusively breastfed. This finding is in line with the findings of other studies in Ethiopia, such as Fikadu et al. (2014), Kahssay et al. (2020), Mohammed et al. (2020), and Biniyam et al. (2022), who reported a significant association between the length of exclusive breastfeeding and the nutritional status of under-five children, where babies who received more exclusive breast milk tended to have better nutritional status, particularly BMI and HAZ.

A possible reason for the higher proportion of stunted and underweight children among non-exclusively breastfed children might be the initiation of complementary foods in the first six months may affect optimal breastfeeding practices and reduce the intake of essential nutrients from breast milk needed for optimal growth. Another study conducted by Hazir et al. (2012) showed that inappropriate timing of introducing complementary foods deprives infants from optimum nutrition, which ultimately leads to undernutrition and increases morbidity and mortality rates. Moreover, early initiation of complementary feeding might increase the risk of infection, as there might be poor hygienic practices. This may result in loss of appetite, decreased nutrient

intake, and increased energy demand. Hence, exclusive breastfeeding is considered an important determinant of malnutrition.

On the contrary, the variable showed no association with wasting of under five children at both study sites. A possible explanation could be the multifactorial nature of malnutrition, which is linked to various sociodemographic, health, and environmental factors (Tripoli et al., 2021) and hence, the high proportion of wasted children who were exclusively breastfed in the present study may have resulted from various dietary and non-dietary factors affecting the nutritional status of children. This result is consistent with the reports of previous studies conducted in Ethiopia (Haile and Amboma, 2018; Mohammed et al., 2020) and other developing countries (Giashuddin et al., 2003; Korir, 2013; Saaka and Galaa, 2017).

Apart from this, FGD participants from both research sites perceived that mother and/or caregivers preferred to give exclusive breast milk for about six months because they think that infants' intestines are immature and small in size to handle other liquid, solid, and semi-solid foods. Failure to do this may lead the child to be sick or may lead to death. Most mothers in the study areas had a positive perception of exclusive breastfeeding. On the other hand, some of the mothers from FGD argued that not attending Exclusive Breastfeeding does not harm the infant. These groups of mothers (participants) believed that infants should receive additional foods besides breast milk to nurture them with the required micronutrients and not become weak in their future lives.

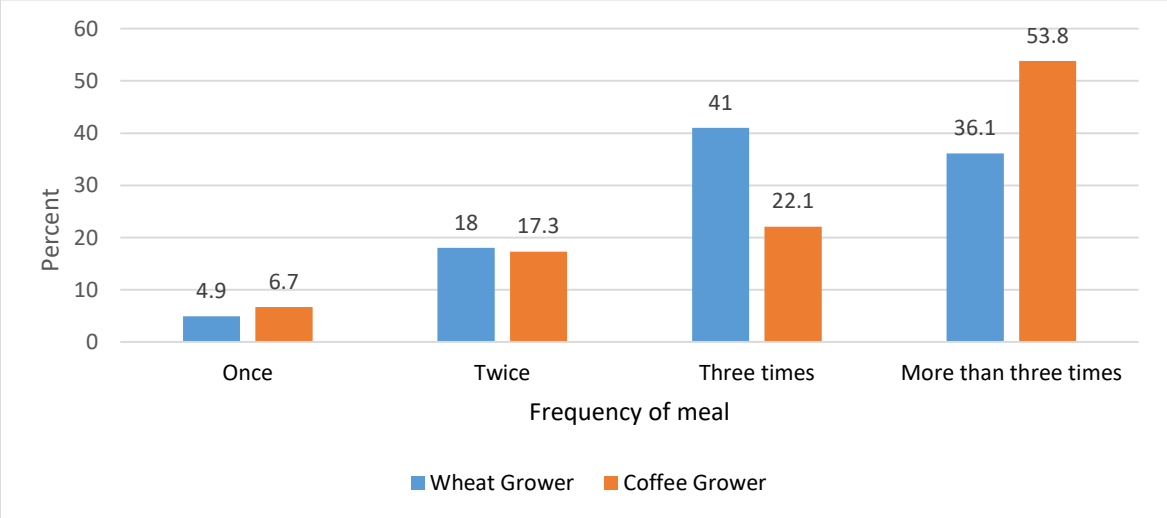

Figure 6 Distribution of sample children by frequency of meal in 24 hours

3.3.3.4 Frequency of Meal

The frequency of meals was measured in terms of the number of meals of any kind other than breastfeeding consumed by five children 24 hours before the survey date. This variable was found to be a predictor of malnutrition in under-five children at the study sites. The minimum and maximum frequency of meals for under-five children per day was one and more than three times a day, respectively. According to Table 8, close to half (53.8%) and 36.1% of under-five children of coffee grower HHs and wheat grower HHs, respectively fed more than three times in 24 hours. On the other hand, 41% of under-five children in wheat grower HHs and 22.1% of under-five children in coffee grower HHs fed at least three times in 24 hours. One in five children with coffee grower HHs (22.9%) and 24% (one in four) children had poor meal frequency (less than two times in 24 hours). The variation in the number of meals served to the child per day depends on several factors, including the wealth status of the household (Eshete et al., 2018; Kuche et al., 2020; Kundu et al., 2021), women's decision-making role in the household (Sema et al., 2021; Usman & Callo-Concha, 2021), maternal educational status and/or awareness of child nutrition and health (Amare et al., 2019; Haile & Amboma, 2018; Muche et al., 2021), and the age and sex of the child (Dinku et al., 2020).

The study showed that meal frequency in 24 hours was associated with underweight ($p< 10\%$), stunting ($p<5\%$), and wasting ($p<5\%$) of under-five children of wheat-growing rural households. Conversely, among children of coffee growers, the variable was shown associated with only stunting of children at $p< 5\%$. This finding is also consistent with a study conducted in the Oromia region of Ethiopia (Berhanu et al., 2022). This finding could be explained by the fact that if the child was not getting complementary food (for breast-feeding children) or regular daily meals (for non-breastfeeding children) as recommended, the possibility of getting adequate nutrient intake would be highly affected, which may significantly influence the child's nutritional status, which may manifest in the form of underweight, stunting, and wasting. The data generated from qualitative sources were in line with this finding. The FGD discussants and key informants indicated that most malnourished children were found in resource-poor rural households, where their children get food once or twice a day. However, other studies, including those in other areas of Ethiopia, have found no association between a child's daily meal frequency and stunting

(Tesema et al., 2013; Ayana et al., 2015). This could be due to the difference in the study population and period across the study areas and/or the difference in methods of assessment of feeding patterns between the studies or other factors.

3.3.3.5 Child dietary diversity score

Based on the food types consumed by the child during the past 24 hours, the child's dietary diversity score was computed and categorized as low (less than four food groups), medium (5-6 food groups), and high (> 6 food groups). Most children had either low or medium dietary diversity scores (Table 8). One of the possible reasons for the poor or medium dietary diversity of under-five children could be the consumption of monotonous diets mainly resulting from various reasons, including low HH income, access to different food groups in the market, low awareness of child nutrition and health, and so forth.

In the current study, it was found that this variable had a strong and statistically significant association with underweight, stunting, and wasting of under-five children of wheat grower farm households at p<5%, p<5%, and 10%, respectively (Table 8). However, it only affected the stunting of children in coffee-growing households at p< 5%. The highest underweight (45.5%), stunting (66.7%), and wasting (41.2%) of children were recorded in low CDDS children of wheat growers. Similarly, the lowest percentages of underweight (BMI), stunting, and wasting were recorded in high CDDS children of wheat growers, which were 18.2%, 4.8%, and 17.6%, respectively. Although children's DDS was not significantly associated with underweight and wasting, higher DDS was significantly associated with stunting of coffee growers' children aged 24–59 months in the area.

This indicated that the likelihood of a child being underweight, stunted, and wasted decreased as the number of food groups consumed increased and the possible contribution of the consumption of diversified food for child health and nutrition. The current study and many other studies emphasize the association of low dietary diversity scores with stunting in under-five children. A systematic review examining the relationship between dietary diversity and undernutrition across all sub-Saharan African countries also found that children with adequate dietary diversity were

less likely to suffer from stunting than those with inadequate dietary diversity (Gassara and Chen, 2021). These findings are also consistent with studies conducted in Ethiopia, which found an association between DDS and stunting (Motbainor et al., 2015; Mohammed et al., 2020). Many studies have demonstrated that DDSs are important tools and useful indicators for assessing the adequacy of nutrient intake or for improving dietary quality (Bandoh and Kenu, 2017; Heidari-Beni et al., 2022) and a higher DDS is associated with a lower risk of stunting (Hein et al., 2019).

As stunting begins early in a child's life and reflects long-term nutritional status, we must insist on improving dietary diversity in children at an early stage of life to prevent the onset of stunting (Gassara et al., 2023). Hence, the contribution of HDDS should be considered as one of the prominent and possible approaches to preventing poor growth outcomes and malnutrition in children under five years of age in similar settings. This study further implied actions that are designed to educate farm households in rural settings on the importance of diversified food for child health and nutrition and advocate for interventions that encourage diversification of farm production in rural areas. On the other hand, some studies have confirmed that a poor diet cannot be the only risk factor for malnutrition and have drawn attention to the fact that genetics can also directly influence malnutrition (Jelenkovic et al., 2016; Hall et al., 2017; Chu et al., 2013). Other studies have also found no significant association between dietary diversity and wasting (Siéa et al, 2018; Zeinalabedini et al., 2023).

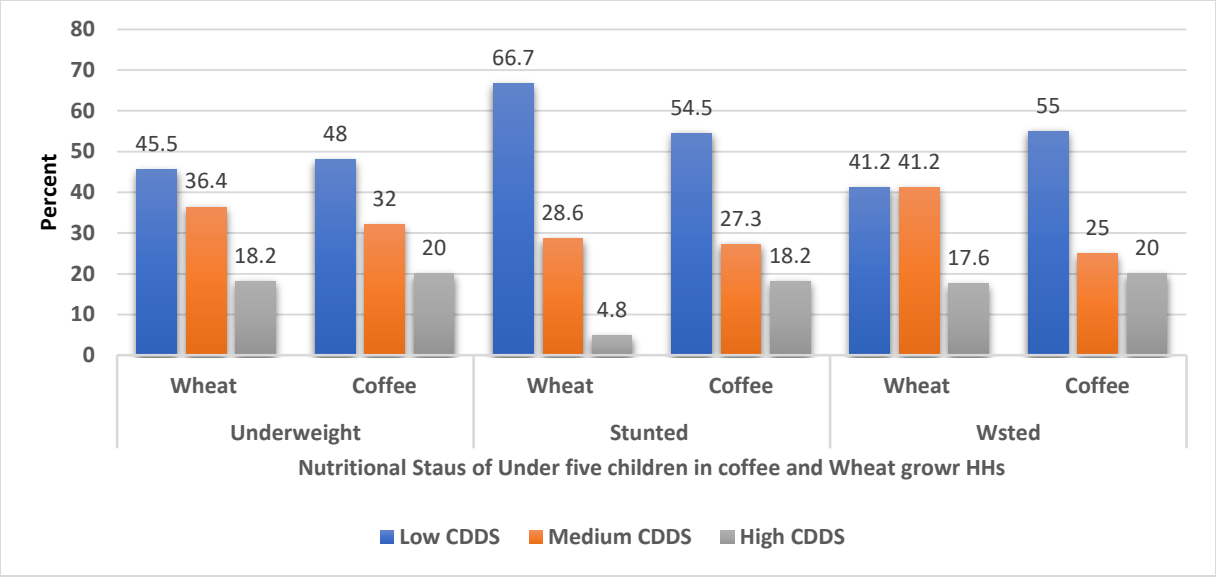

Figure 7 Distribution of sample children by dietary diversity level and nutritional status in coffee and wheat growers

3.3.4 Relationship between anthropometric and mother characteristics

3.3.4.1 Mothers' education

The educational level of mothers of children under five in this study was categorized as no education at all (including informal education), attended basic education, primary education, or secondary education. As can be depicted in Table 9, the highest percentage of educational level (primary education in this case of mothers/caretakers of under-five children were 35.2% and 35.6%, in what and coffee grower HHs, respectively followed by basic education (32% in wheat growers and 34.6% in coffee growers) and non-formal education (29.5% in wheat grower HHs and 11.5% in coffee grower HHs). The percentage of mothers who attended secondary school was higher among coffee grower HHs (18.3%) than wheat grower HHs (3.3%). Visible differences were observed among mothers who had no formal education (29.5% of wheat growers and 11.5% of coffee grower HHs) and among mothers who attended high school (3.3% in wheat production and 18.3% in coffee grower HHs).

Mothers/caretakers of under-five children were better off in school enrollment and status (basic, primary, and secondary education) than wheat grower HHs. Similarly, mothers/caretakers of under-five children from coffee grower HHs are better off applying child nutrition knowledge to

keep their children healthy and improve their nutritional status. In contrast, a higher proportion of employed mothers was found in wheat grower HHs than in coffee grower HHs. A higher proportion of mothers among coffee growers were malnourished (lower BMI) than the mothers/caretakers of wheat grower HHs.

Table 9 Maternal characteristics of under-five children in wheat and coffee grower HHs

		Wheat grower		Coffee grower	
		Frequency	Percent	Frequency	Percent
The educational level of the mother	No formal education	36	29.50	12	11.50
	Basic education	39	32.00	36	34.60
	Primary education	43	35.20	37	35.60
	Secondary education	4	3.30	19	18.30
Mother's awareness on balanced diet and nutrition	Know nothing about it	4	3.30	3	2.90
	Heard of it but little knowledge about it	83	68.00	45	43.30
	Aware but unable to apply	26	21.30	36	34.60
	Completely aware and applying the knowledge	9	7.40	20	19.20
Current employment status of the mother	Employed	90	73.80	58	55.80
	Unemployed	32	26.20	46	44.20
Mother's current physiological status	Pregnant	56	45.90	23	22.10
	Lactating	34	27.90	54	51.90
	Nonpregnant and non-lactating	32	26.20	27	26.00
Nutritional status of Mothers/caregivers	Underweight	25	20.50	24	23.10
	Healthy weight	90	73.80	69	overweight
	over weight	7	5.70	11	10.60

Findings regarding this variable stated that educated mothers, unlike uneducated mothers, had informed action about their child nutritional status, had greater ability to use health systems, were more empowered to make decisions regarding their children's nutritional status, and might also develop better childcare practices (Gurmu and Etana, 2013; Abel et al., 2019). Likewise, the current research showed that mothers' education had a significant impact on their child's

nutritional status. From Table 10, mothers/caretakers who didn't have any formal education belonged to 60 and 55% of underweight and stunted children of wheat grower households. On the other hand, 45.5 and 42.9% of mothers of underweight and stunted children of coffee growers were illiterate. The chi-square test revealed that the educational status of mothers had a significant effect on the nutritional outputs of children under five in wheat-growing households, while it was not associated with the wasting of children under five in coffee-growing households. This implies that education helped mothers to be more aware and proactive in watching child nutrition in wheat grower households, and children who came from educated mothers had a lower chance of being underweight, stunted, or wasted.

On the other hand, a possible explanation for the non-significant association between mother's education and child nutrition status in coffee growers, as can be seen from FGD and Key informants' results, is that women in coffee growing areas do not have access to control over household resources. Income obtained from the sale of cash crops, such as chats and Coffee, is controlled by the head of the household (male). Besides, women do not have control over household resources and are unable to decide how and what to give to their children under five. Their major role in the household focused only on managing children and preparing food for already produced and purchased food items for the household, including those under-five children. Although their literacy enabled them to know about the importance and consequences of child nutrition, they could not protect their child from the trap of poor nutritional outcomes, such as underweight, stunting, and wasting. Besides, most illiterate women (mothers in this particular case) are busy with government and NGO training, and workshops, and mostly given political assignments at the expense of their under-five children demanding their critical support. Income obtained from various payments for such workshops, training, and different assignments could not even cover their household food demands, especially for under-five children. Here, we can see that their education is mainly spilled outside home issues, which adversely affects their nutritional status.

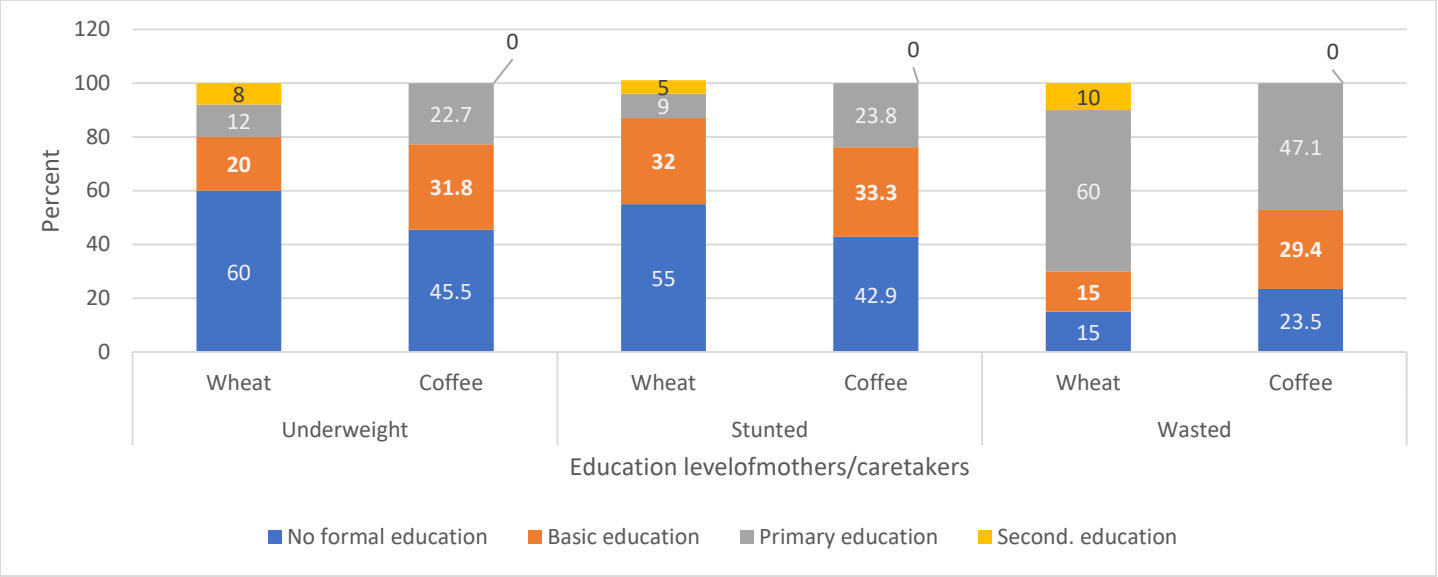

Figure 8Educational status of mothers of under-five children in Wheat and coffee grower HHs

A high percentage of mothers who didn't attend any kind of education was recorded in underweight children of wheat grower HHs (60%), underweight children of coffee grower HHs (45.5%), stunted children of wheat grower HHs (55%), and of stunted children from coffee grower HHs (42.9%). The highest percentage of mothers who attended primary education was recorded in wasted children of wheat grower HHs (60%) and coffee grower HHs (47.1%).

3.3.4.2 Mother/caretaker's awareness of child nutrition

Mothers/caretakers' awareness of child nutrition is of paramount importance for keeping children in good health and nutrition. This study established a strong association between nutritional status and maternal nutritional awareness. The chi-square analysis showed that maternal awareness of child nutrition had influenced the nutritional status of their children both in coffee- and wheat-growing households at $p<5\%$ (Table 10 and Fig. 10). Mothers/caretakers who didn't have an awareness of child nutrition were to 68.2% of underweight and 81% of stunted children of wheat grower households. On the other hand, 70.6% of mothers of wasted children heard little about child nutrition and they had little knowledge about it. One in four mothers (27.3%) who had little information about child nutrition was found in underweight children of wheat grower households.

None of the mothers of underweight, stunting, and wasting children of wheat grower households were completely aware of or applied nutrition knowledge.

In contrast, mothers of under-five children in coffee grower households had better awareness of child health and nutrition than those of wheat grower households. For instance, 63.6% of mothers of stunted children had heard of child nutrition and had little knowledge about it. Similarly, close to half (48%) of mothers of underweight children and 45% of mothers of wasted children were aware of child nutrition, although they failed to apply the knowledge. Besides, 16% and 15% of mothers of underweight and wasted children, respectively, were completely aware of child nutrition and applied this knowledge to maintain their children's nutritional status.

The results showed that the prevalence of stunting, wasting, and underweight in mothers with little or no nutritional awareness was much higher, with large differences compared to mothers who had child nutritional awareness at both study sites. Similarly, child malnutrition was lower among the children of mothers who were aware of child nutrition but were unable to apply for many reasons. On the other hand, the probability of child malnutrition was lower among the children of mothers who had high child nutrition awareness.

The key informant's interviews and FGD conducted at the respective research sites also confirmed this finding. Data generated from health extension workers, NGO representatives, and government offices working at the research sites stated that several stakeholders are working on health-related programs and projects in areas where their primary focus is child and maternal nutrition. Thus, children whose mothers were aware of nutrition and related issues either from training, workshops, home-to-home, or demand-driven visits were less vulnerable to multiple bad nutritional outcomes such as low BMI, stunting, and wasting, and attained better nutritional status compared to mothers who were unaware of child and maternal nutrition. However, very limited work has been conducted on educating mothers about child nutrition.

Other studies in similar contexts also confirmed that mothers' awareness was significantly associated with their child's nutritional status (Ahmed et al., 2020; Berhane et al., 2020). Under-five children depend on their mothers or caretakers for food; hence, nutrition provided by their

mothers helps in their development and prevents child malnutrition (Santoshi and Sunita, 2015). Hence, it was suggested that the gap between the awareness and practice levels of mothers should be minimized to improve the nutritional status of children. Thus, emphasizing maternal awareness of nutrition is an important variable for child well-being.

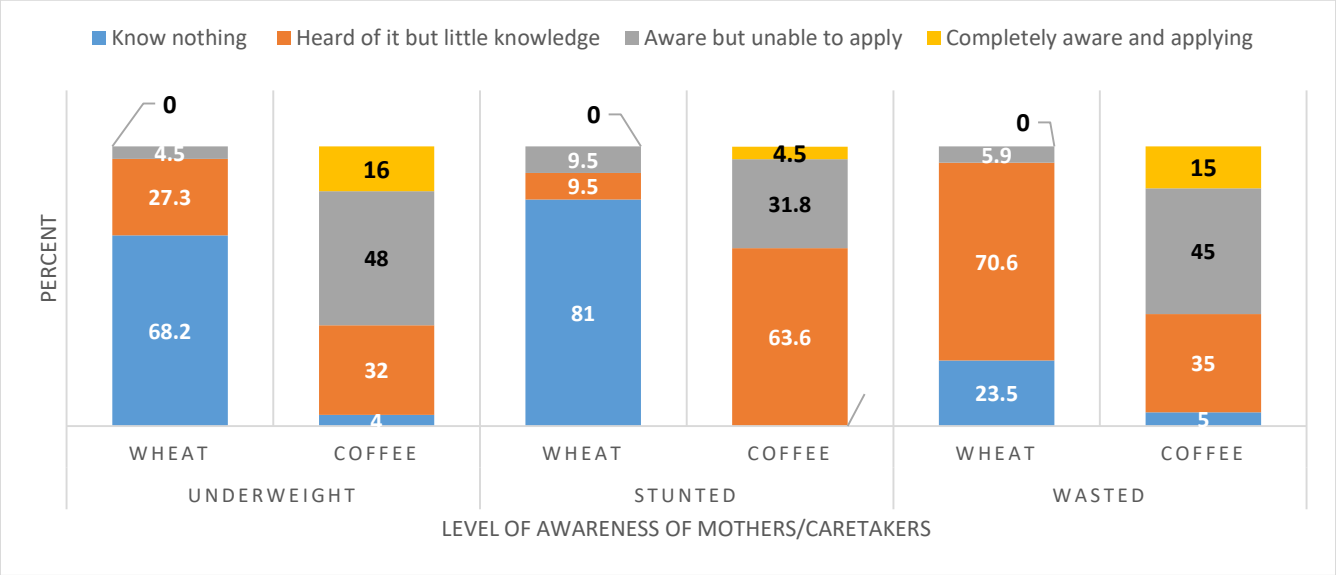

Figure 9 Maternal Level of Awareness on Nutritional Status of under-five Children in Wheat and Coffee Growing Rural Households

Figure 10. Maternal Level of Awareness on Nutritional Status of under-five Children in Wheat and Coffee Growing Rural Households

a large majority of mothers of underweight (68.2%) and stunted children (81%) from wheat grower rural households didn't have any awareness of child nutrition and health. majority of mothers/caretakers of stunted children from coffee grower households (63.8%) and 70.6 % of wasted children from wheat grower households were aware of child health and nutrition, but they didn't apply this knowledge. Only 16%, 4.5%, and 15% of mothers/caretakers of underweight children of coffee grower HHs, stunted children of coffee grower HHs, and wasted children of coffee grower households are completely aware and apply child nutrition knowledge. No mother of underweight, stunted, or wasted children of wheat grower HHs was completely aware and applied the knowledge.

3.3.4.3 Maternal Employment status

Mothers/caretakers of under-five children in coffee- and wheat-growing households were either employed and earned income from different sources or unemployed and stayed at home for proper handling of their children. Close to a quarter (26.2%) and 44.2% of mothers or caretakers of under-five children in wheat and coffee-growing rural households, respectively, were 73.8% and 55.8%. As can be seen in Table 10, unemployed mothers belonged to 63.6% of underweight children, 71.4% of stunted children, and 58.8% of wasted children in wheat grower households. Similarly, 68%, 63.6%, and 60% of unemployed mothers/caretakers of underweight, stunted, and wasted children, respectively, were found in coffee grower rural households. The proportion of stunted children was slightly higher among wheat growers' children whose mothers or caregivers were unemployed, while the prevalence of wasted children from unemployed mothers was nearly equivalent to that of their counterparts in coffee-growing areas. In addition, a considerable proportion of the children of unemployed mothers were underweight, stunted, and wasted at both locations, which showed that the prevalence of malnutrition was higher among the children of unemployed mothers.

The current study also confirmed a significant association between maternal employment status and underweight and stunting of wheat growers' children at $p<5\%$, and with wasting of under-five children in coffee growing households at $p<5\%$. This finding was in agreement with several studies, including Zelalem et al., 2023); Wondaerash et al. (2017); Negash et al. (2015) ; where they found a significant association between maternal employment and nutritional status of under-five children.

The poor nutritional status of under-five children in both wheat and coffee grower HHs could be attributed to the fact that these mothers are likely to face financial difficulties and thus cannot afford nutritious foods for their children, which ultimately leads to an increased risk of malnutrition (Forh et al., 2022). This finding is in line with other findings from Gurage (Ahmed et al., 2022) and Wolayta Sodo (Sodo et al., 2017) who reported that the likelihood of employed mothers having stunted children is lessened. According to these studies, women's employment increases household income, with the consequent benefit of decreasing childhood malnutrition. Employment may also increase women's status and power of decision-making, which may bolster a woman's preference to spend her earnings on under-five children's health and nutrition (Sodo et al., 2017).

Table 10 Relationship between maternal characteristics and child nutrition

Variable	Response	Underweight					Stunting					Wasting				
		Underweight (22)		Normal weight (100)		Chi-square	Stunted (21)		Not Stunted (101)		Chi-square	Wasted (17)		The educational		Chi-Square
		F	P	F	P		F	P	F	P		F	P	F	P	
Educational level of mother (Wheat)	No formal education	15	60	9	11	9.9.455 (0.024) **	7	55	32	12	6.334 (0.096)*	3	15	33	11	The educational8.088 (0.044)**
	Basic education	5	20	17	22		12	32	24	29		3	15	25	39	
	Primary education	3	12	22	28		2	9	10	37		12	60	9	30	
	Second. education	2	8	31	39		1	5	18	The education al		2	10	17	20	
Educational level of the mother (Coffee)	No formal education	10	45.5	36	36.0	12.915 (0.0405) **	9	42.9	40	39.6	11.543 (0.007)**	4	23.5	32	27.8	1.709 (0.635)
	Basic education	7	31.8	31	31.0		7	33.3	35	34.7		5	29.4	34	29.6	
	Primary education	5	22.7	29	29.0		5	23.8	22	21.8		8	47.1	35	30.4	
	Secon. education	0	0.0	4	4.0		0	0.0	4	4.0		0	0.0	4	3of	
Mother's awareness on balanced diet and nutrition (Wheat)	Know nothing about it	15	68.2	3	3.0	12.559 (0.0465) **	17	81.0	7	6.9	3.266 (0.0352)**	4	23.5	3	2.6	1.930 (0.0487)**
	Heard of it but little knowledge about it	6	27.3	9	9.0		2	9.5	24	23.8		12	70.6	9	7.8	
	Aware but unable to apply	1	4.5	20	20.0		2	9.5	4	4.0		1	5.9	22	applyi ng	
	Completely aware and ofplying the knowledge	0	0.0	68	68.0		0	0.0	66	65.3		0	of	71	61.7	
Mother's awareness on	Know nothing about it	1	4.0	2	2.5	2.990	0	0.0	3	3.7	6.672	1	5.0	2	2.4	1.777 (0.0320)**

Variable	Response	Underweight					Stunting					Wasting				
		Underweight (22)		Normal weight (100)		Chi-square	Stunted (21)		Not Stunted (101)		Chi-square	Wasted (17)		The educational		Chi-Square
		F	P	F	P		F	P	F	P		F	P	F	P	
balanced diet and nutrition(Coffee)	Heard of it but little knowledge about it	8	32.0	16	20.3	(0.0393) **	14	63.6	31	37.8	(0.0483)** *	7	35.0	38	45.2	
	Aware but unable to apply	12	48.0	24	30.4		7	31.8	29	35.4		9	45.0	27	32.1	
	Completely aware and applying the knowledge	4	16.0	37	46.8		1	4.5	19	23.2		3	15.0	17	20.2	
Employment status of the mother (Wheat)	Employed	8	36.4	24	24.0	8.425 (0.0233) **	6	28.6	26	25.7	9.472 (0.0378) *	7	41.2	25	21.7	2.281 (0.131)
	Un employed	14	63.6	76	76.0		15	71.4	75	74.3		10	58.8	80	69.6	
Employment status of the mother (Coffee)	Employed	8	32.0	38	48.1	1.996 (1.58)	8	36.4	38	46.3	0.700 (0.403)	8	40.0	24	28.6	8.855 (0.0355) **
	Caretakers	17	68.0	41	51.9		14	63.6	44	53.7		12	60.0	60	71.4	
Nutritional status of Mothers (Caretakers) Wheat	Underweight	10	40.0	15	60.0	0.555(0.758)	7	28.0	18	72.0	11.210(0.004) ***	6	24.0	overweight	76.0	3.33(0.189)
	Healthy weight	12	13.3	78	86.7		14	15.6	76	84.4		11	12.2	79	87.8	
	Caretakers	0	0.0	7	100.0		0	0.0	7	100.0		0	0.0	7	100.0	
Nutritional status of Mothers (Care takers) Coffee	Underweight	6	25.0	18	75.0	2.032(0.362)	5	20.8	19	79.2	5.502(0.064)*	4	overweight	20	83.3	5.595(0.0610)*
	Healthy weight	17	24.6	52	75.4		15	21.7	54	78.3		14	20.3	55	79.7	
	over weight	2	18.2	9	81.8		2	18.2	9	81.8		2	18.2	9	81.8	

In contrast, some studies argue that if mothers are engaged in proper employment, they will have less time to take care of their children. However, in the present study, mothers' employment had a positive effect on child nutrition at both sites. Therefore, nutrition intervention should focus on encouraging women's education as it increases the probability of being employed, and income-generating activities should be weighted and enhanced by providing priority to mothers who have limited income sources (Ahmed et al., 2022).

3.3.4.4 Nutritional status (BMI) of mothers

Body mass index (BMI) was analyzed to measure maternal nutritional status in coffee- and wheat-growing households. The mother's nutritional assessments were determined following the international BMI cutoff points proposed by (FAO et al., 2023) where, maternal nutritional status was classified as underweight (≤18.4), normal (18.5–24.9), overweight (25.0–29.9), or obese (≥30 kg/m2). Mothers' minimum, maximum, and meacaretakers13.0, 29.9, and 20.83 ± 3.3 kg/m^2, respectively.

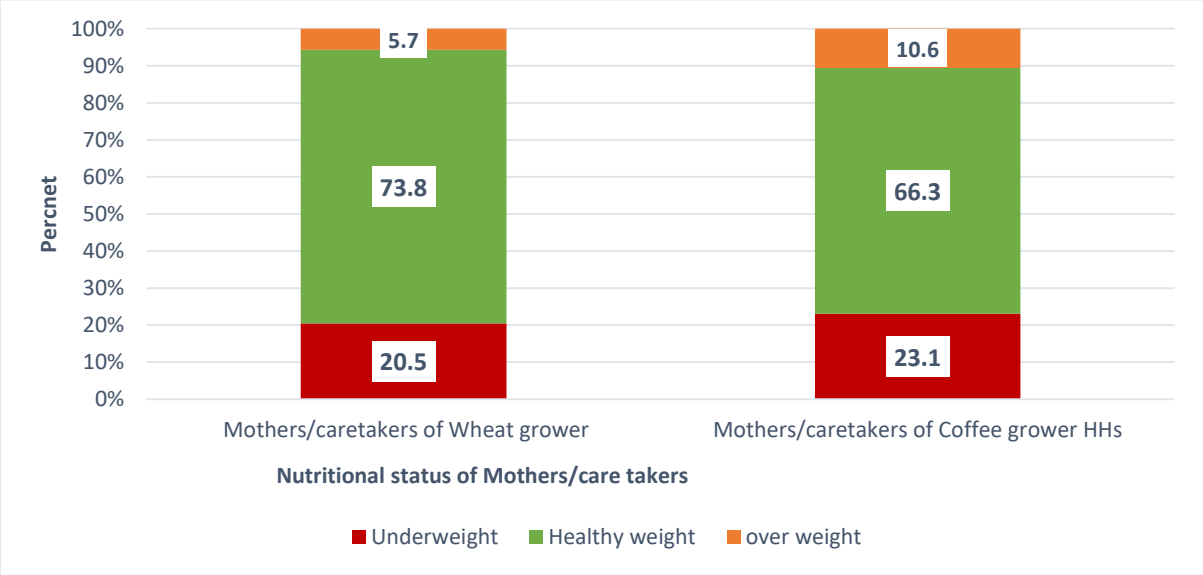

Figure 10 Nutritional status of mothers/care takers

According to the WHO classification, 20.5%, 73.8%, and 5.7% of mothers in wheat growing rural households were under under-five healthy weight, and overweight, respectively. Similarly, 23.1%,

66.3%, and 10.6% of mothers of under five children in coffee grower HHs were underweight, healthy weight, and overweight, respectively. The prevalence of both underweight and overweight mothers was higher in coffee-growing rural households than in their counterparts (Fig. 11). Mothers' BMI was significantly correlated with stunting of children at both study sites ($p<5\%$ in coffee grower HHs and $p<10\%$ in coffee grower HHs) and wasting of children in coffee growing HHs at $p<10\%$). However, no relationship was found between the nutritional status of mothers with underweight children in both study sites and the wasting of wheat grower HHs (Table 10).

The results showed that 40%, 28%, and 24% of underweight, stunted, and wasted children of wheat grower rural households were born from underweight mothers. Similarly, 25%, 21.7%, and 20.3% of underweight, stunted, and wasted coffee growers' children emerged from underweight mothers/caretakers. Healthy weight mothers managed to have 13.3% and 24.6% of underweight, 15.6% and 20.8% of stunted, and 12.2% and 16.7% of wasted children in wheat and coffee growing households, respectively. Likewise, the study found that 18.2% of underweight, stunted, and wasted children of coffee growers were born to overweight mothers. Children with underweight mothers/BMI were more likely to have malnourished children. In contrast, the proportions of underweight, stunted, and wasted children were lower among children managed by well-nourished mothers (Table 10 and Fig. 11). The present study further confirmed the earlier suggestion that maternal BMI is closely associated with child nutritional status (Negash et al., 2015; Tariku et al., 2017; Zufan et al., 2019; Damite and Alebel, 2021). A similar relationship between maternal and child nutrition has also been observed in some sub-Saharan Africa (Lartey, 2008).

In addition, the findings were consistent with those of other studies that demonstrated the influence of maternal nutritional status on children's nutrition, growth, and development (Vir, 2016; Tigga and Sen 2016; Heslehurst et al., 2019). According to Vir (2016), maternal undernutrition is estimated to be responsible for approximately 20% of childhood stunting and can greatly affect the outcomes of pregnancy and child health (Fig. 12). The results of the present study emphasize the importance of improving maternal nutritional status, which should improve both maternal and child health outcomes. Therefore, strategies to enhance the nutritional status of children should include improving the maternal nutritional status.

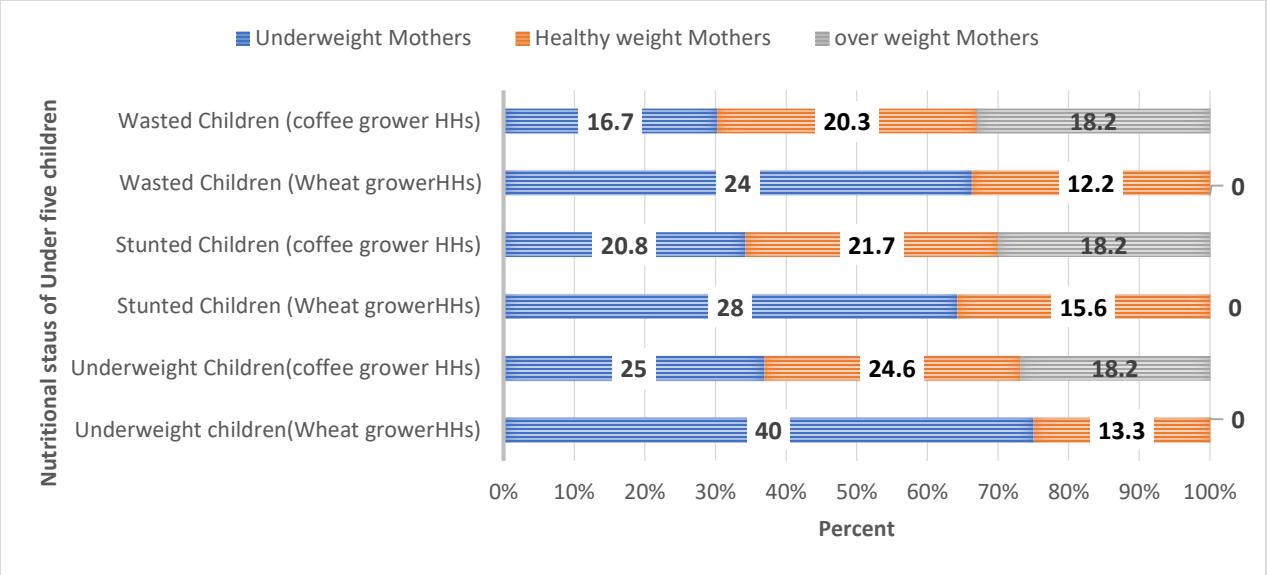

Figure 11 Distribution of under-five children by nutritional status of respective mothers/caretakers

3.3.5. Food Security

Household food security status was used as a proxy measure to categorize rural households in their respective production systems as food secure, mildly food insecure, moderately food insecure, or severely food insecure. However, the above measurement does not indicate per capita food distribution in the respective households. Percapita food distribution is a major concern and a limitation of this measurement. This study assessed the influence of household food security status on the nutritional status of children under five years of age. The results of the present study indicate that food insecurity is a common bottleneck for most coffee and wheat growers. Close to half (48.4%) of wheat growers and 48.1% of coffee growers achieved their household food security. The remaining 17%, 18%, and 6.6% of wheat growers and 23.1%, 23.1% and5.8% of coffee grower rural households faced mild, moderate, and severe food insecurity, respectively (Fig. 13). Although food insecurity was a common feature in both wheat- and coffee-growing rural households, no evidence was found to explain its association with the nutritional status of under-five children at both sites. The chi-square and associated p-values for this variable revealed that the state of household food security did not show a significant association with any of the nutritional outcomes of children under five. The results showed that the proportion of underweight, stunting, and wasting decreased along with the food security status of rural

households in both research sites. As shown in Fig. 13, the incidence of underweight, stunting, and wasting increases from severely food-insecure households to food-secure households. This indicates that achieving food security at the household level might not always lead to a child's nutritional status at the household level (Fig. 13).

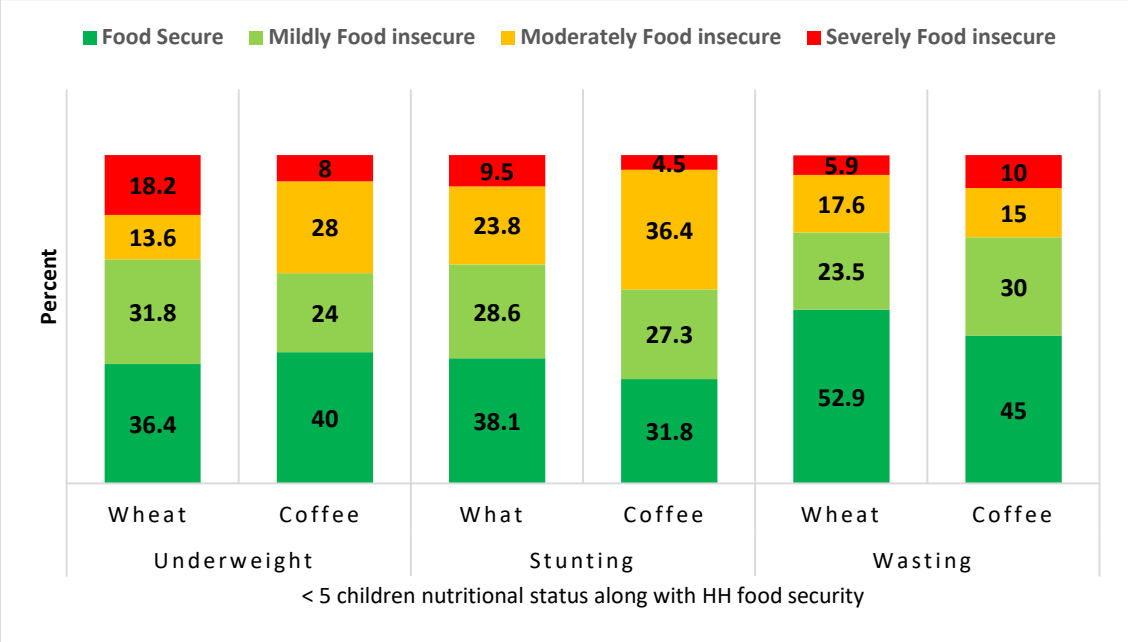

Figure 12 Household food security status and under-five children

There are controversial findings regarding the relationship between food insecurity and malnutrition in children. Studies in Ethiopia and other sub-Saharan countries have found a positive relationship between food insecurity and stunting or being underweight (Ali et al., 2019; Gassara and Chen, 2021). On the contrary, Mulu and Mengistie (2017) reported that household food insecurity was associated with only underweight children but not with stunting and wasting. In contrast, Chandrasekhar et al. (2017) and Tafese et al. (2020) found no statistically significant association between food insecurity and nutritional outcomes in children under five years of age.

For most rural households at the study sites, food crops produced during the main season (from June to December) did not serve them all year round for several reasons, including shortage of farmland, plant disease, post-harvest loss, agricultural debt, and so forth (Mequanent and Degefa, 2022). Accordingly, a significant decline in food items in the household or food insecurity leads

to inadequate dietary diversity, which leads to lower nutrient intake and multiple forms of malnutrition in children (Ali et al., 2013). This finding was consistent with those of Chandrasekhar et al. (2017) and Tafese et al. (2020), who showed no statistically significant association between food insecurity and nutritional status (underweight, stunting, and wasting) in under five children. In this regard, further studies that aim to understand such controversies should be designed to align household food security with the nutritional attainment of under-five children. Moreover, the government of Ethiopia needs to adopt multi-sectoral strategies and policies to combat food insecurity at the household level, along with nutritional achievement for under-five children, which is further supported by nutritional interventions for women and children.

3.4 Conclusion and Recommendations

The current research focused on a comparative analysis of the nutritional status of under-five children and its determinants between selected coffee and wheat farmers in the Goma and Dodota districts of the Jimma and Arsi zones, respectively. These children had peculiar characteristics in terms of child-related and maternal-related characteristics, as well as anthropometric results.

Generally, the prevalence of nutritional status in children under five children fell below the WB recommendations. The magnitudes of underweight, stunting, and wasting were higher among coffee-growing rural households. Child nutritional status was affected by several factors, including child-related characteristics such as birth order of under-five children, sex of under-five children, duration of exclusive breastfeeding, how often the child eats solid and semisolid food items in 24 hours, and diversity. On the other hand, among several mother- or caretaker-related characteristics, education level, awareness of child nutrition and health, and employment status influenced either underweight, stunting, or wasting, or a combination of two or more outcomes were observed in both under-five children of coffee- and wheat-growing rural households.

Birth order of under five children showed a strong and significant association with underweight and stunting of under-five children in wheat-growing rural households and stunting of under-five children in coffee-growing rural households. Sex of children under five, on the other hand, was one of the prominent variables affecting underweight, stunting, and wasting in wheat and coffee

grower households. On the other hand, the duration of exclusive breastfeeding had a strong and significant association with nutritional underweight and stunting of wheat grower children and stunting of children in wheat grower households. The frequency of meals given to children under five in 24 hours and child dietary diversity determine the nutritional status of children under five in both wheat farm households (underweight, stunting, and wasting) and coffee farm households(stunting).

Maternal education level, level of awareness of child nutrition, balanced diet, and employment status showed a strong and significant association with under-five children's nutritional status. The educational level of mothers determines the nutritional status (underweight and stunting) of children in both wheat- and coffee-growing rural households and the wasting of children in wheat-grower households. Mothers or caretakers' awareness of child nutrition and balanced diet contributed to alleviating the nutritional status of under-five children (underweight, stunting, and wasting) of wheat grower households, and for unknown reasons, the variable does not show significant association with all outcomes of malnutrition.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethics approval and informed consent

Before the start of the research activities, the researchers obtained support letters from Addis Ababa University, Center of Rural Development. The letters were submitted to the Arsi and Jimma zones Health and Agricultural Offices and concerned governmental and non-governmental

organizations working in the area of child health and nutrition at the respective study sites. Verbal informed consent was obtained from the study units: household heads, members of the focus group discussions, and key informants before the start of the data

Data availability statement

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Additional information

Authors' contribution

The corresponding Author,Mequanent Muche designed the research, carried out data collection, data entry , analysis, interpretation , presentation of the results and preparing the manuscript. The co-Author (Prof Degefa T) and involved in data analysis and interpretation of results and supervised the overall work of the research.

Notes on the current manuscript

I am PhD candidate working on household food security and under-five children nutritional status of wheat and coffee growing households of Ethiopia. The whole research work is divided in to three chapters. The current manuscript, which is dealing with nutritional status of under five children, is the second chapter of the whole thesis. The first chapter of is already published in this publisher ([https://doi.org/10.1080/23311932.2022.2149134]). Thus, that is why data from large study was published separately.

CHAPTER FOUR: COMPARATIVE ANALYSIS OF DETERMINANTS OF DIETARY DIVERSITY AMONG CHILDREN UNDER FIVE IN SELECTED WHEAT AND COFFEE GROWER RURAL HOUSEHOLDS OF ETHIOPIA[3]

Abstract

The study attempted to address a comparative analysis of children's dietary diversity between selected wheat and coffee grower households in Ethiopia. Measuring dietary diversity and its determinants were major intents of the study. The study employed a mixed research design and an ordinal logit model. From a total of 220 children, 79.6% of them consume food containing grains, nuts, and tubers followed by milk and milk products and foods cooked in oil (60.6% and 60.2%) and eggs (46.9%), respectively. The model result indicated that the Purpose of production and household food security status; maternal age, physiological status, and employment status; and sex of the child and frequency of meals had strong and significant effects on child dietary diversity. Substantial effort should be made to ensure malnutrition-free children by enhancing dietary diversity in coffee and wheat-growing rural households of the study areas and in Ethiopia at large.

Keywords: Dietary diversity, under-five children, Ethiopia, Gomma, Dodota, Arsi, Coffee growers, Wheat growers

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4.1 introduction

Globally children's health and well-being are highly affected by several factors including malnutrition mainly emanating from poor dietary diversity. Food items that are rich in essential nutrients and diverse diets are optimal for optimal complementary feeding for under the age of five children to meet their nutrient requirements and overall growth and development (Habte etal., 2016)). Child undernutrition and poor dietary diversity remain high in Ethiopia and hence poor dietary diversity among under the age of five children remains a critical public health concern (Ali et al., 2013).

According to WHO (2016) and Black et al (2013), chronic malnutrition, wasting, and other physical and mental disorders are claimed to be major causes of child morbidity in developing nations including Ethiopia. Besides, meeting the minimum dietary diversity standard has been a major challenge in developing countries including Ethiopia (Bedada Damtie et al., 2020). The importance of nutrition has been emphasized for the intellectual and physical development of children (Frempong & Annim, 2017).

Dietary diversity is defined as the number of food groups or items consumed over a reference period(Di Marcantonio et al., 2020; Ruel, 2003; Usman & Callo-Concha, 2021). Dietary diversity can be measured at different units of analysis vis-à-vis individual or household level using a standardized questionnaire. Several food groups regardless of the types of food items consumed over a period of time are used most often (Frempong & Annim, 2017; Kundu et al., 2021).

DD refers to the consumption of foods from major nutritionally significant types of food while maintaining a balance between plant and animal source meals, according to the World Health Organization. It is a predictor of children’s micronutrient intake and nutritional status (Seboka et al., 2021a). Dietary diversity is a simple metric that is widely used as a proxy for dietary quality, micronutrient sufficiency, and food availability which is a useful indicator of dietary quality for infants and young children in developing countries (FANTA, 2006). Measuring under-five children's dietary diversity was calculated based on eight food groups namely: grains, roots, and tubers; Legumes and nuts; Dairy products; flesh foods such as meat, fish, and poultry; Eggs;

Vitamin-rich fruits and vegetables; Other fruits and vegetables and finally, fats and oils (FANTA, 2006).

Several studies have been conducted and examined the relationship between the dietary diversity of under-five children with socioeconomic, demographic, and institutional factors. Under five children dietary diversity are determined by several factors including age of the child (Bedada Damtie et al., 2020; Dinku et al., 2020; Eshete et al., 2018; Kassahun Belew et al., n.d.; Kuche et al., 2020; N. et al., 2018; Seboka et al., 2021a; Sema et al., 2021; Woldegebriel et al., 2020); frequency of meal of under-five child in 24hours (Aemro et al., 2013; Seboka et al., 2021a; Temesgen et al., 2018); household food security status (Kuche et al., 2020); household income(Eshete et al., 2018; Kuche et al., 2020; Kundu et al., 2021; Rakotonirainy et al., 2018); sex of the child (Di Marcantonio et al., 2020; Dinku et al., 2020; Sema et al., 2021); decision making role of women ion key household resources (Di Marcantonio et al., 2020; Sema et al., 2021; Usman & Callo-Concha, 2021) and maternal employment status (Belete et al., 2022; Di Marcantonio et al., 2020; Kuche et al., 2020; Woldegebriel et al., 2020); maternal educational level (Belete et al., 2022; Cordero-Ahiman et al., 2021; Kundu et al., 2021; Seboka et al., 2021a; Sema et al., 2021). Besides, factors like remittance (Dereje et al., 2021) and size of cultivated land (Cordero-Ahiman et al., 2021; Dereje et al., 2021; Usman & Callo-Concha, 2021) affected child dietary diversity in coffee and wheat grower rural households of both Gomma and Dodota districts. The findings of (Sema et al., 2021; Temesgen et al., 2018; and Wuneh et al., 2019) revealed that a history of post-natal care of the mother had a significant association with the attainment of higher child dietary diversity scores. Previously researchers tried to address the identification of factors that may affect child dietary diversity without relating to either with production of wheat or coffee. Coffee and wheat are major crops that are vital sources of income for coffee and wheat grower households in Ethiopia. Thus, this paper was conducted with the aim of comparative analysis of the under-five children's dietary diversity in coffee growers of the Gomma district and Wheat growers of the Dodota districts, Ethiopia. Conducting a comparative analysis will help researchers, NGOs working in the area and other stakeholders understand common and unique factors of child dietary diversity in the two production systems, i.e. coffee and wheat growers, and guide policymakers for appropriate policy options on major determinants.

4.2 research methodology

4.2.1 Description of the study areas

The study was conducted in coffee-growing rural households of Gomma and Dodota districts of Jimma and Arsi zones, respectively, in Ethiopia. The study areas have been earlier described by Mequanent and Degefa (2022).

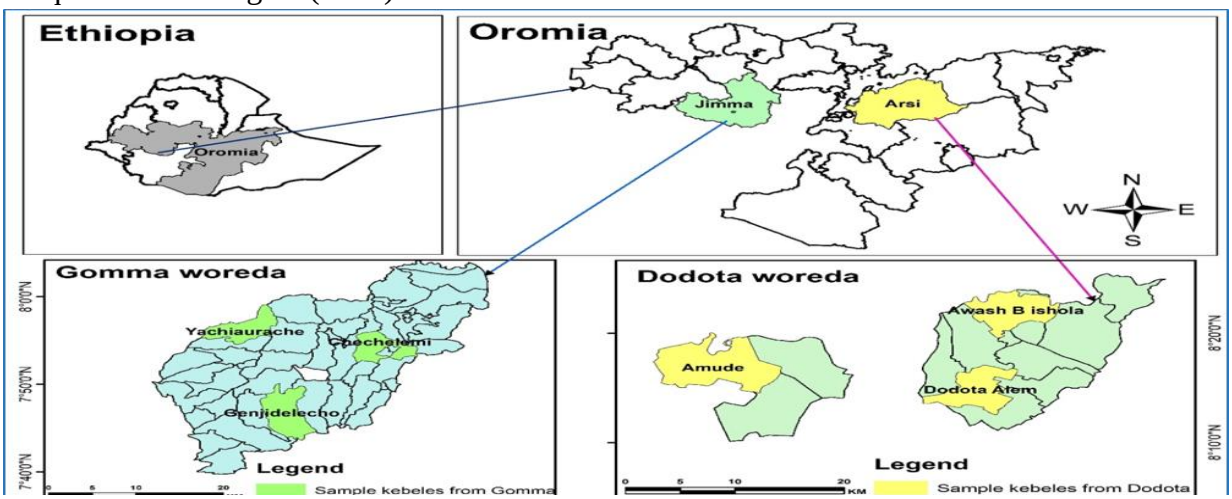

Figure 13 Map of the study sites

4.2.2 Study design

To assess dietary diversity and identify determinant factors among under five years children, the cross-sectional research design was applied. Such kind of research design allows the comparison of data obtained from qualitative and quantitative sources to clearly understand the research problem (Creswell et al., 2011; Morse and Niehaus, 2009). Data were collected by interviews with the primary caregivers of the children using a pretested structured questionnaire, interviews with key informants, direct observation, and focus group discussions with mothers and/or persons responsible for preparing food and feeding under-five children in the particular household.

The questionnaire was intentionally designed to assess the types and number of food groups the child consumes 24 hours before the survey. Besides, demographic, and socio-economic characteristics of the household were also assessed. For triangulation purposes, Focus Group

Discussion (FGD) and key informant discussions (KIs) along with personal observation were also been used. Moreover, this research has adopted pragmatism philosophy as a methodological underpinning to conduct a comparative study of child dietary diversity (6-59 months) between wheat growers and coffee growers' rural households.

4.2.3 Sampling procedure

A multistage sampling technique was employed to approach the study participants at the two research sites vis-a-vis coffee growers and wheat growers of the Jimma and Arsi zones, respectively. A non-random, purposive sampling method was used to identify the study zones primarily based on their wheat and coffee production potentials and prominent contributions of produce for income and livelihood diversification of Dodota and Goma rural households, respectively. The sampling procedure involved a stratified random sampling method to select the Gomma district from the Jimma zone and the Dodota district from the Arsi zone. Six kebeles, three per district were selected randomly using the lottery method. Accordingly, Genjidelecho, Yachiyaurache, and Chochelemi were taken from the Gomma district and Awash Bishola, Dodota-Alem, and Amude were obtained from the Dodota district. The sampling frame was rural households that have at least one under the age of five children in their household. Accordingly, households in particular mothers and/or caregivers of under-five age children living in the sample kebeles were identified using stratified random sampling followed by systematic random sampling method. When there exists more than one under-five children in the household, only the youngest under-five children will be considered for this study.

4.2.4 Sample size determination for sample households

The study applied Ymane's (1967) sample size determination formula to identify representative sample households and under-five children.

$n_1 = \frac{N_1}{1+N_1(e^2)}$ And $n_2 = \frac{N_2}{1+N_2(e^2)}$

Where, n is the sample size, N_1 (2928) and N_2 (2566) are population sizes of the Goma and Dodota districts, respectively and e is the level of precision which is 0.07, while n_1 and n_2 were sample sizes of the districts in the same order.

A total of 376 households were sampled from the two districts (188 from each district). The sampled households were further refined to obtain households that have at least one under-five children. Accordingly, a total of 226 rural households were selected for this study. A total of 122 and 104 households and respective children were obtained from Dodota district wheat grower households and Goma district rural households, respectively. The distribution of households and under-five children at kebele level was presented as D/Xitu (57), Dodota Alem (31), and L/Sharbee (34)] from Dodota district wheat grower households and; Galcho Dalocha (48), Bulbulo (29) and Bulado Choche (27) were from Goma district of coffee growers.

4.2.5 Data collection methods and procedures

Face-to-face interviews using semi-structured and structured interview schedules were carried out from June to September 2020. The survey obtained various information including household demographic characteristics, socioeconomic, institutional variables, child feeding, and health-related issues. Furthermore, different aspects of qualitative data that weren't obtained using household surveys were generated using FGD and KI along with personal observations. Dietary diversity assessment of sample children was conducted using 24-hour dietary recall to obtain information on the child's food intake in the past day before the survey. Data were collected from trained health professionals working in the community and the researcher at the home of the respondents. Mothers/caregivers of sample children were asked about all foods eaten and beverages and other drinks the child has taken in the past day (24 hrs.) before the interview date.

Dietary Diversity terciles were derived from the 14 food groups into; low, medium, and high dietary diversity terciles. Individual DDS were then judged based on their position on the scale. Measuring the dietary diversity of 6-59-month-old children was emphasized in the instrument. Before data collection, necessary steps and procedures including ethical concerns and informed consent were obtained from caretakers of sample children. Enumerators who were aware of the local areas speak the local language and are well acquainted with local and cultural contexts were recruited for data collection. A pre-test on non-sample respondents was also made under the supervision of the researcher. Finally, the formal survey was conducted on 226 households and

respective under five children after necessary modifications and adjustments were made from the pretest. Necessary steps and procedures including ethical concerns and informed consent were also obtained before taking data from sample children and their households.

Six focus group discussions, three from each district, were held to supplement the information *collected using the questionnaire and* still some data were applied for standalone analysis. Each group was composed of eight discussants purposively selected from among mothers or caregivers within the households with children under five years, experts from government offices and NGOs. Participants are typically selected based on criteria, such as willingness to participate in the study, knowledge of study sites, and child nutrition. Food production constraints in the area, cultural aspects of food, and causes of child malnutrition were major issues addressed by FGD.

Data that demand in-depth insight, feelings, and perceptions of respondents on various aspects of child malnutrition were collected using in-depth key informant interviews. Thus, a total of sixteen community members were engaged in key informants' interviews i.e. eight key participants per district. Willingness to participate in the study, awareness about the study sites, having explicit information about child health and nutrition, active involvement in community affairs, and being a parent of under five years age of child were some of the criteria to select the key informants. Accordingly, participants in KI involved three health extension workers, three community members one NGO expert, and one government-based expert at each study district. Checklists were developed and used to guide discussions with focus groups and individual key informants. The participants were encouraged to use the local language that they were most familiar with. Health extension agents most familiar with the local language facilitated the group discussions. Data were collected from the study areas between April 2019 and September 2022.

The collected data were then made ready for conversion to compare with the standard to level the respective child's nutritional status as nourished malnourished and other nutritional outcomes such as underweight, stunting, and wasting standards.

4.2.6 Measuring diversity of children (6-59 months)

A scale of eight food groups was used to assess the dietary diversity of under-five children. Child dietary score of children was analyzed using food consumption data from 24-hour recall and FAO guidelines for measuring household and individual dietary diversity (FAO, 2007). The dietary diversity of children was analyzed by counting several food groups (out of eight food groups) and each food group was given 0 and 1 values, where "1" denotes the child consumed the food group in the past 24 hours before the survey date and "0" otherwise.

Semi-structured interview schedules, questionnaires, and checklists were used as data collection instruments from different sources. Dietary data terciles were derived from the eight groups as low, medium, and high diversity terciles. The dietary diversity of sample respondents was assigned based on the number of food groups they consumed over 24 hours. Accordingly, children who consumed less than four food groups were regarded as low dietary diversity; those who consumed four to six were medium and those who consumed six and above were labeled as high dietary diversity tercile.

4.3 Method of data analysis

Data obtained from various sources were classified as socio-demographic, institutional, and child dietary diversity. The data were cleaned and entered into SPSS (version 26) and part of it was exported to STATA (Version 16.0), ENA, WHO Anthro 3.2.2, and Epi lnfo 6.04 computing software for further analysis and interpretation of key results. Descriptive statistics such as mean, minimum, maximum, frequencies, and percentage, inferential statistics such as chi-square, t-test, and other related tests and an ordered logit econometric model were applied to identify important variables that determine child dietary diversity.

Determinants of child dietary diversity

Regression models such as linear, logistic, and ordinal regression are vital to estimating the magnitude and effect of explanatory variables on dependent variables (Chen and Hughes, 2004).

The ordinal regression model is a type of logistic regression model that is used to analyze ordinal dependent variables when the outcome variable is an ordinal scale, it is a preferred modeling tool that does not assume normality or constant variance (McCullagh and Nelder, 1989). The model requires the assumption of parallel lines across all levels of the outcome variable and it is rooted in the general framework of generalized linear models meant for analysis of ordinal dependent variable.

Several econometric models could be applied to analyze ordinal dependent variables like child dietary diversity among under the age of five children in coffee and wheat growers can be labeled as low, medium, and high. However, after assessing several alternative models that can fit ordinal response dependent variables in the same category, the ordinal regression model was chosen to estimate the dependent variable of current research. The dependent variable, child dietary diversity has three ordered categories (low dietary diversity, medium dietary diversity, and high dietary diversity). The values attached to each category have meaningful sequential categories and it applied logit link function which is generally suitable for analyzing ordered categorical data when all categories are evenly distributed (SPSS, 2022).

When the logit link is applied, the general form of the ordinal regression model is formulated as:

$$f(\gamma j(x)) = \log\left(\frac{f(\gamma\, j(x)}{1 - f(\gamma\, j(x)}\right) = \log\left(\frac{pr(y \le jX}{pr(y > jx}\right) = \alpha j + \beta x,\ j = 1,2 \ldots k-1$$

$$\gamma j(x) = \frac{e^{\alpha j + \beta x}}{1 + e^{\alpha\, \mathrm{j} + \beta x}}$$

According to McCullagh and Nelder, (1989), referring to this particular formula, j indicates the cut-off points for all categories (k) of the dependent variable, child dietary diversity in this case, the function f (yi(x)) is the link function that links the systematic components (i.e aj+bx) of the linear model, the alpha j a represents a separate intercept or threshold for each cumulative probability and b represents the regression coefficient.

Secondary data were obtained from pertinent non-governmental sources such as GIZ, CRS (Catholic Relief Service), Self Help Ethiopia, USAID; and Government organizations like Zonal

and district-level health and agriculture offices. Data obtained from the above sources were analyzed and triangulated with other data obtained from primary sources. Besides, electronic and printed documents from various sources were collected for further analysis of subtle ideas.

4.4 result and discussion

4.4.1 Distribution of under five children by their food group consumption

The study has indicated that out of the total children considered for analysis, the majority (79.6%) of them consume food that contains grains, nuts, and tubers followed by milk and milk products and foods cooked in oil (60.6% and 60.2%) and eggs (46.9%). It has been observed that the consumption of vegetables and fruits, meat, poultry, fish, or seafood were food groups consumed by children in respective research sites in rare amounts and less diversified food groups (Table 11).

Table 11 Distribution of under five children of wheat and coffee grower HHs by their food group consumption

Food Group	**Total (226)**		**Wheat grower (122)**			**Coffee grower (104)**		
	F	**%**	**F**	**% from total**	**% from Occupation**	**F**	**% from total**	**% from Occupation**
Grains, nuts, or tubers	180	79.6	103	57.2	84.4	77	42.8	74
Vitamin A- Rich plant foods	89	39.4	50	56.2	41	39	43.8	37.5
Other fruits and vegetables	66	29.2	32	48.5	26.2	34	51.5	32.7
Meat, poultry, fish or seafood	47	20.8	21	44.7	17.2	26	55.3	25
Eggs	106	46.9	53	50	43.4	53	50	51
Pulses, legumes, or nuts	80	35.4	36	45	29.5	44	55	42.3
Milk and Milk products	137	60.6	68	49.6	55.7	69	50.4	66.3
Foods cooked in oil	136	60.2	65	47.8	53.3	71	52.2	68.3

Table 11. has shown that a fair number of children in wheat-growing households consume grains, nuts, or tubers (57.2%) and foods containing vitamin A-rich plant foods (56.2%). On the other hand, among all children from wheat growers, the majority (84.4%) consume grains, nuts, or tubers followed by milk and milk products (55.7%) and foods made with food oil (53.3%). Similarly,

close to half of children from wheat-growing rural households consume fruits and vegetables (48.5%), eggs (50%), milk and milk products (49.6%), and foods made from food oil (47.8%).

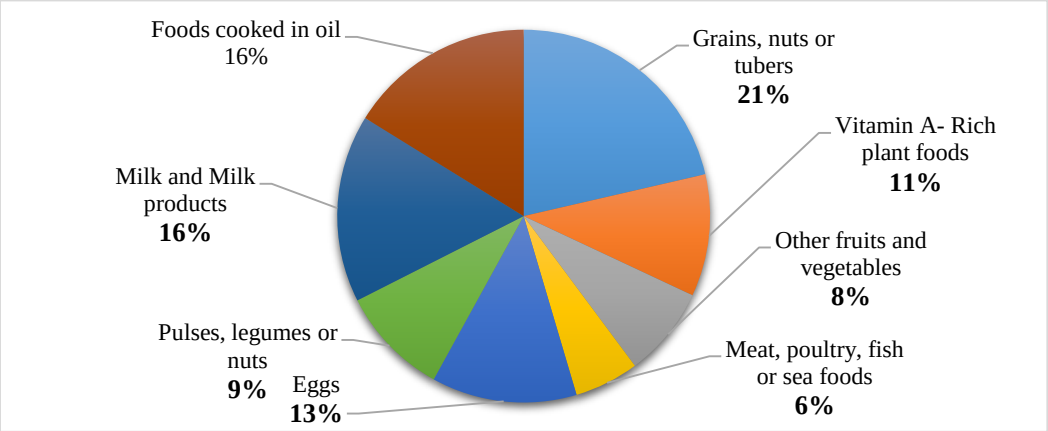

Figure 14 Major food groups consumed by under-five children in coffee and wheat grower HHs

The analysis has shown that children of both wheat and coffee grower households have shown comparable patterns of food group consumption. Grains, nuts; milk and milk products, foods cooked in oil and eggs were major food groups consumed by a fair number of children from both research sites (Table 11). On the other hand, meat, poultry, fish, seafood, and fruits and vegetables were food groups rarely used by a small number of children in both research site**s.**

4.4.2 Household characteristics related variables against the household occupation

The assessment of this study revealed that most households were led by men and the respondents were dominated by male respondents. The majority of respondents who were involved in this study were married and mainly Muslim religion followers, though Orthodox Christianity, protestant, and catholic were also found in fewer numbers. From the findings, it can be depicted that the sample rural have access to basic infrastructure and services like safe drinking water, the nearest market, financial institutions like MFIs and Banks, and health services. Likewise, most of the sample households had better off food security and the distribution of state of household food security both in coffee and wheat-growing rural households was disperse (Table 12).

Table 12 Characteristics household related variables against the household occupation

		Household Occupation					
		% of Wheat grower CDDS			% of Coffee grower CDDS		
Variable	Response categories	Low	Med.	High	Low	Med.	High
Household headship	Male Headed	93.4	100	89.5	89.8	93.8	100
	Female-headed	6.6	0	10.5	10.2	6.3	0
Sex of respondent	Male	85.2	85.7	78.9	83.7	81.3	87
	Female	14.8	14.3	21.1	16.3	18.8	13
Marital status of the respondent	Married	91.8	97.6	89.5	89.8	93.8	100
	Divorced	4.9	2.4	10.5	6.1	6.3	0
	Widow/widower	3.3	0	0	4.1	0	0
Religion of the HHH	Orthodox	14.8	9.5	5.3	10.2	18.8	13
	Muslim	80.3	85.7	78.9	85.7	81.3	87
	Protestant	4.9	4.8	5.3	4.1	0	0
	Catholic	0	0	5.3	0	0	0
	Wakefena	0	0	5.3	0	0	0
Access to drinking water	Yes	98.4	97.6	94.7	95.9	93.8	95.7
	No	1.6	2.4	10.6	4.1	9.4	4.3
Access to the nearest market	Yes	91.8	78.6	94.7	91.8	81.3	95.7
	No	8.2	21.4	0	8.2	15.6	4.3
Access to MFIs and/or banks	Yes	73.8	59.5	78.9	85.7	65.6	87
	No	26.2	40.5	16.1	14.3	34.4	13
Access to health institutions	Yes	90.2	83.3	94.7	91.8	84.4	95.7
	No	9.8	16.7	5.3	8.2	15.6	4.3
Food security status	Food secure	73.8	71.4	78.9	83.7	78.1	56.5
	Mild. food insecure	19.7	26.2	10.5	10.2	15.6	17.4
	Mod. food insecure	4.9	2.4	0	6.1	6.3	21.7
	Sev.food insecure	1.6	0	10.5	0	0	4.3

4.5 Econometric Model result

4.5.1 Household occupation/production system

The model result has shown that household occupation in the form of coffee or wheat production had an influence on the level of under-five child dietary diversity among coffee growers and wheat grower households of Goma and Dodota districts rural households, respectively. The p-value associated with this variable (0.013) confirmed statistical difference in under five child dietary

diversity values along with coffee grower and wheat grower households at p<5%. The choice of crop production by a particular household is determined by several factors including, land size, fertility status, proximity to various market centers, and so forth. Engaged in either coffee or wheat production was associated with child dietary diversity both in coffee and wheat growers of Gomma and Dodota districts of Jimma zone and Arsi zones, respectively. As can be depicted from the model result, children from coffee grower households had better status of dietary diversity than their counterparts, wheat growers.

4.5.2 Purpose of production

As rational producers, farmers produce their major crops for consumption, market, or both for consumption. Here it should be taken into consideration that most farmers sell their produce, which is which remained not consumed by the household. In this particular study farmers in Gomma and Dodota district were engaged in the production of coffee and wheat, respectively. The model output has found that under five children dietary diversity score was highly influenced by the purpose of production of their respective major crops, i.e. wheat and coffee. The p-value associated with this variable indicated that the purpose of production has a significant contribution to the value of under-five child dietary diversity score both in coffee and wheat-growing rural households at p<5%. The model result indicated that the probability of higher dietary diversity increases with the purpose of production of either coffee or wheat. Households, producing for their consumption may target their under-five children in their production plan to enhance the dietary diversity and nutritional status of their children. On the other hand, it has been observed from the regression analysis that households whose production meant mainly for the market and both for consumption and market had low dietary diversity scores, children.

4.5.3 Household food security status

The model result has revealed that the level of household food security and child dietary diversity in respective study sites had strong and statistical associations. The *p-value* associated with the status of household food security (*0.029*) revealed that the status of household food security determines the status of under-five child dietary diversity at p<5%. In this particular study, it has

been observed that there is a clear demarcation in the level of child dietary diversity along with household food security status. Household food insecurity, poverty, and bad livelihood outcomes were common development challenges in both groups of sample households. Children from food-secure households were found poor in their dietary diversity score mainly due to a lack of access to different food groups. The result has shown that the probability of poor dietary diversity increases across food insecure rural households. The result is consistent with studies from Ghana (Antwi et al., 2022) and Ethiopia (Kuche et al., 2020).

Table 13 Child and maternal characteristics of coffee and wheat growers

Variable		Household Occupation					
		% of Wheat grower DDS			% of Coffee growers DDS		
	Response categories	Low	Med.	High	Low	Med.	High
Nutritional status	Severely Malnourished	19.7	19	21.1	20.4	18.8	17.4
	Mod. malnourished	27.9	23.8	52.6	34.7	18.8	52.2
	Nutritionally secure	52.5	57.1	26.3	44.9	62.5	30.4
Underweight	Underweight	13.1	23.8	21.1	24.5	15.6	34.8
	Normal weight	86.9	76.2	78.9	75.5	84.4	65.2
Stunting	Stunted	23	14.3	5.3	24.5	12.5	26.1
	Not Stunted	77	85.7	94.7	75.5	87.5	73.9
Wasting	Wasted	11.5	16.7	15.8	22.4	15.6	17.4
	Normal	88.5	83.3	84.2	77.6	84.4	82.6
	1st	18	16.7	15.8	26.5	40.6	30.4
Birth order of the child	2nd-3rd	34.5	38.1	37.1	34.7	21.9	34.8
	4th and beyond	47.5	54.8	47.4	38.8	37.5	34.7
Sex of the child	Male	60.7	45.2	47.4	57.1	50	39.1
	Female	39.3	54.8	52.6	42.9	50	60.9
	< 6 months	21.7	31	63.2	42.9	46.9	30.4
Duration of EBF	6 months	16.7	7.1	10.5	36.7	31.3	47.8
	> 6 month	61.7	61.9	26.3	20.4	21.9	21.7
Child still being breastfed?	Yes	47.5	47.6	26.3	30.6	28.1	47.8
	No	52.5	52.4	73.7	69.4	71.9	52.2
	Once	3.3	9.5	5.3	4	9.4	21,7
Frequency of meal (Number)	Twice	11.7	23.8	26.3	10.2	21.9	26.1
	Three times	48.3	35.7	31.6	34.7	12.5	8.7
	four times	36.7	31	36.8	51	56.3	43.5
Child been sick in the past 15 days?	Yes	13.1	9.5	15.8	26.5	21.9	13
	No	86.9	90.5	84.2	73.5	78.1	87
	No formal education	31.1	26.2	31.6	6.1	15.6	17.4
Maternal education	Basic education	26.2	40.5	31.6	36.7	28.1	39.1
	Primary education	41	28.6	31.6	40.8	28.1	34.8
	Secondary education	1.6	4.8	5.3	16.3	28.1	8.7
Mother's awareness on balanced diet and nutrition	Know nothing	0	9.5	0	6.1	0	0
	Heard of , little knowledge	77	61.9	52.6	36.7	46.9	52.2
	Aware but not apply	13.1	21.4	47.4	38.8	31.3	30.4
	Completely aware and apply	9.8	7.1	0	18.4	21.9	17.4
Maternal employment	Employed	88.5	90.5	78.9	75.5	75	60.9
	Unemployed	11.5	9.5	21.1	24.5	25	39.1

4.5.4 Child related characteristics

4.5.4.1 Sex of the child

Sex of the under-five child was one prominent variable that was hypothesized to affect the value of child dietary diversity in both coffee and wheat-growing rural households. The model output has shown that the status of the child diversity score was influenced by the sex of the child. The p-value (0.002) indicated the existence of statistical difference in the value of under-five child dietary diversity along with boys and girls under-five children in respective study sites and female Under-five age children have a higher probability of diversifying to food than their male counterparts at p< 5%. Studies conducted in Ethiopia by (Dinku et al., 2020; Sema et al., 2021; Wuneh et al., 2019), and Somalian Camp (Di Marcantonio et al., 2020) confirmed that the sex of the child is one of the key factors along with other variables which influences the level of dietary diversity of under-five children. The study finds out that female under-five children had the better status of dietary diversity compared to males.

4.5.4.2 Frequency of meals of under-five children

Meal frequency was one of the prominent variables that was hypothesized to have association with under-five child dietary diversity. The model result indicated that the number of meals the child consumes in 24 hours had been related with attainment of higher child dietary score. The result further confirmed that without compromising quality and quantity of food, the higher the number of meals offered to the under-five child, the higher the dietary diversity of that particular under five-child in production systems. The higher the number of meals per 24 hour increases the probability of attainment of higher dietary diversity. The p-value associated with this variable (0.055) implied increase in meal frequency of under-five child increases the likelihood of high dietary diversity among children from wheat and coffee farmers at p<10%. The finding is in line with (Seboka et al., 2021a; Temesgen et al., 2018).

4.5.5. Maternal related characteristics

4.5.5.1 Maternal Age

Mothers from various age groups had been participated in the current study. The model output regarding this variable indicated that age of mothers had strong influence on under five child dietary diversity score in respective production systems. Mothers' knowledge and skill on child raising and general house management is assumed to increases with age. The p-value associated with this variable (0.014) indicated that age of mother/care giver of under-five child had prominent role to attain higher dietary diversity and it has shown statistically significant association with under five child dietary diversity at $p<5\%$ (Table 14). The odds ratio in favor of high dietary diversity increases with factor of 2.3 with unit increase of age of mother/care giver of the child. The finding is in line with (Dinku et al., 2020; Kassahun Belew et al., n.d.; Seboka et al., 2021b).

Table 14 Regression model estimates on determinants of child dietary diversity

Variables	Response categories	Estimate	Std. Error	Wald	Sig.
Household Category	Wheat growers	2.63	1.789	2.16	0.142
	Coffee Growers	4.507**	1.807	6.219	0.013
Family size (AE)	AE	0.208	0.143	2.102	0.147
Age of under-five child(Years)		-0.002	0.034	0.005	0.946
Age of the mother(Years		0.083**	0.034	6.044	0.014
Purpose of production	Consumption	0.697*	0.337	4.269	0.039
	Market	0.394	0.561	0.493	0.483
Birth order of under-five child(Numbers)	1st	0.994	0.66	2.273	0.132
	2nd to 3rd	0.218	0.6	0.132	0.716
	4th and above	-0.174	0.506	0.118	0.732
Sex of under-five child	Male	-0.91***	0.299	9.238	0.002
Education level of the mother	No formal education	-0.096	0.621	0.024	0.877
	Basic education	-0.147	0.522	0.08	0.778
	Primary education	-0.259	0.515	0.253	0.615
Mother's awareness on child nutrition	Know nothing	-0.266	0.969	0.075	0.784
	Heard but little knowledge about it	0.419	0.474	0.781	0.377
	Aware but unable to apply	0.739	0.493	2.249	0.134
Mother's employment status	Employed	-0.6*	0.337	3.166	0.075
	Unemployed	0.301	0.408	0.543	0.461
Mother's current physiological status	Lactating	0.838**	0.395	4.511	0.034
Frequency of meal of under-five child	Once	0.658	0.62	1.126	0.289
	Twice	0.588	0.41	2.053	0.152
	Three times	0.77*	0.402	3.671	0.055
Sickness in the past two weeks	Yes	-0.409	0.42	0.95	0.33
Food security status of the household	Food secure	-0.853	0.62	1.895	0.169
	Mild food insecure	-0.831	0.639	1.693	0.193
	Moderately food insecure	-1.482**	0.677	4.793	0.029

4.5.5.2 Maternal physiological status

The study included several mothers with different physiological statuses vis-a-vis pregnant, lactating, and neither pregnant nor lactating. The model result has shown that the mother's physiological status at the time of data collection determined the status of the under-five child's dietary diversity score both in coffee and wheat-growing rural households. The p-vale associated with this variable (0.034) infers the likelihood of attainment of higher under-five child dietary diversity was highly associated with the mother's physiological status at p<5%. From this finding, one can understand that children nurtured and taken care of by pregnant mothers have shown higher dietary value as compared to other physiological status groups of mothers. The odds of higher under-child dietary diversity increase with a factor of 2.31 when mothers become lactating as compared to other groups of mothers. The finding was in congruent with (Di Marcantonio et al., 2020).

4.5.5.3 Maternal Employment Status

Data from several sources has shown that women in the study sites in general and mothers of under five children were engaged in several non-farm and off-farm activities. On one hand, farm income as the only source of family income couldn't fulfill the family's basic needs requirements, especially for the provision of diversified food for under five children in a particular household. Thus, to cope with the shortage of money in the household, mothers of under the age of five children would be forced to be involved in some sort of income-generating scheme. Employed mothers would have additional income sources to obtain the dietary diversity of their children. The study included both employed and unemployed mothers who had been engaged in non-farm and off farm sources. The model results concerning maternal employment signify that the likelihood of high dietary diversity is highly associated with maternal employment. The p-value associated with this variable (0.075) has indicated a statistically significant difference between under- five children diversity and maternal employment at p<10 percent Other findings like (Belete et al., 2022; Di Marcantonio et al., 2020) confirmed that children taken care by employed mother had better off in their dietary diversity than their counterparts.

4.6 conclusion and policy recommendation

The current research was focused on a comparative analysis of child dietary diversity and its determinants between selected coffee and wheat farmers of the Goma and Dodota districts, respectively. These farmers have peculiar characteristics in terms of their demographic, socioeconomic, and institutional features, maternal characteristics, and child-related variables as well as the level of dietary diversity and factors determining child dietary diversity.

The majority of wheat farmers produce wheat with the prior purpose of consumption and market, indicating the crop has multiple roles among the smallholders especially to diversify food of under-five children. On the other hand, coffee farmers applied market-oriented production to buy household food and non-food items to keep their under-five children healthy and well-diversified. The model result indicated that Children from coffee growers' households had better status of dietary diversity than their counterparts, wheat growers. Besides, households whose production was mainly for the market and both for consumption and market had low dietary diversity scores in their children. Thus, policies and strategies designed to address the needs of smallholders to enhance their production and facilitation of market would enhance under five child dietary diversity status and hence improve health and nutritional status of children.

Children from food-insecure households were found poor in their dietary diversity score mainly due to a lack of access resources to supply diversified foods to under five children. The result has shown that the probability of poor dietary diversity increases across food-insecure rural households. Thus, policies and strategies designed to address food security status of households would be important step to address under five children dietary diversity both in wheat and coffee grower zones of the country.

The study found that female under five children has shown better dietary diversity score as compared to male under five children both in wheat and coffee growing areas of Ethiopia. In this, policies and strategies designed to raise awareness of mothers and/or caretakers of under-five children through health extension workers and development partners working in the area would have paramount importance in reducing malnutrition in children through food diversification.

The frequency of meals given in 24 hours determines the dietary diversity of children under five in both wheat farm households. Thus, an increase in meal frequency of under-five children increases the likelihood of high dietary diversity among children from wheat and coffee farmers. In this regard, policies and strategies designed to enhance dietary diversity in the form of alternative income sources, training, and related interventions should be designed to maintain healthy and children with highly diversified food should be implemented.

The age of the mother/caregiver of the under-five child had a prominent role in attaining higher dietary diversity and it has shown statistically significant association with under-five child dietary diversity. Besides, children nurtured and taken care of by pregnant mothers have shown higher dietary value as compared to other physiological status groups of mothers. In line with this children taken care of by employed mothers had better off in their dietary diversity than their counterparts. Policy and strategies designed to address various aspects of mothers/caretakers including creating employment schemes, and educating them should be applied to ensure the health and higher dietary diversity scores in wheat and coffee growing households of Ethiopia.

CHAPTER 5: SYNTHESIS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Re-capping the purpose of the study

The production of wheat and coffee, which serves as a major source of income and sustenance, primarily relies on rainfall. Rural households obtain food through various means, including their production, market purchases, or a combination of both. Achieving food security at the household level, along with ensuring adequate nutrition and dietary diversity for children, is not only a national priority but also a global concern. This study aims to assess the food security status in wheat and coffee-growing regions of Ethiopia, analyze the nutritional status and dietary diversity of children under five, and explore the interconnections among these development issues.

To address these objectives, the study employed conceptual frameworks, descriptive and inferential statistics, and econometric models. Various tests, including multicollinearity, contingency coefficients, and heteroscedasticity, were conducted before estimation procedures. The Household Food Insecurity Access Scale (HFIAS) was utilized to measure food security in both wheat and coffee-producing households. An ordered logit model was used to identify key factors affecting food security in these households. Children's nutritional status was evaluated through anthropometric measures, while dietary diversity for children under five was assessed using individual dietary diversity scores. Factors influencing children's dietary diversity were analyzed using an ordinal logit model. Pearson correlation analysis was performed to explore relationships between household food security and nutritional status, between food security and dietary diversity for children under five, and between child nutrition and dietary diversity.

5.3.1 Synthesis

Food security is a critical global agenda (FAO et al., 2023). Evaluating household food security, the nutritional status of children under five, and dietary diversity are essential for development and academic research. Ensuring food security, alongside addressing nutritional issues and dietary diversity for young children in wheat and coffee-dominated farming households, is crucial for

improving life quality in these communities. This study aims to compare food security, nutritional status, and dietary diversity among children under five, and to identify key determinants affecting these aspects within the same households.

Most wheat farmers in the study areas are resource-poor (Dagne, 2016; Semahegn et al., 2021), primarily producing wheat for consumption and market sale. According to Gooding (2009), wheat plays a multifaceted role, meeting household food demands, providing income for other expenses, and purchasing additional food items (Kassaye, 2014; Semahegn et al., 2021). In contrast, food-secure coffee farmers engage in market-oriented production (Shumeta, 2017). These resourceful farmers have better financial capacity, access to land rental for coffee cultivation, and thus can supply produce to the market to cover both food and non-food expenses, contributing to household food security and child nutrition. However, Ethiopia's coffee producers are affected by global coffee price fluctuations (Nicolas, 2007). Food-insecure coffee-growing households often struggle with limited resources, small, infertile, erosion-prone land, and rely on off-farm and non-farm income sources to meet their food needs. Increasing annual farm income is crucial for achieving food security. Both coffee and wheat are significant crops influencing household food security, though their impact varies among rural households.

Food-insecure wheat farmers, often the poorest and most resource-deprived (Eshetu and Young-Bohk, 2017), face challenges such as small, infertile plots and limited income sources. Many of these households participate in the Productive Safety Net Program (PSNP) (Mequanent and Degefa, 2022; Dagne, 2016; Semahegn et al., 2021). They employ various strategies to support their livelihoods and improve food security, including off-farm and non-farm activities (Mengistu et al., 2022; Abdalla, 2021). Accumulating assets and facilitating employment opportunities can benefit both coffee and wheat farmers by improving their ability to achieve food security, better child nutrition, and enhanced dietary diversity.

Resource-poor households growing both wheat and coffee often lack access to markets, market information, and technical support (Urago and Bozoglu, 2022; Nour and Abdalla, 2021). High prices for agricultural inputs like fertilizers, agrochemicals, and improved seeds exacerbate their difficulties. These factors contribute to a cycle of poverty, food insecurity, child malnutrition, and

poor dietary diversity. Institutions that facilitate marketing and provide access to agricultural inputs could help these households achieve food security.

The study also found that children under five in these households are frequently undernourished. Despite the research sites being identified as highly food and nutrition-insecure regions in Ethiopia, both household food security and child nutrition remain below World Bank standards (Lemessa et al., 2023; Tsegaye et al., 2019; Haile and Amboma, 2018). Among the two groups, coffee-growing households exhibit higher rates of underweight, stunting, and wasting, although they tend to offer more diverse diets compared to wheat-growing households. The challenges faced by wheat-growing households often prevent them from maintaining adequate child health and nutrition. Key factors influencing child nutritional status include the child's sex (Dinku et al., 2020; Sema et al., 2021; Wuneh et al., 2019) and the duration of exclusive breastfeeding, which impacts dietary diversity (Fikadu et al., 2014; Kahssay et al., 2020; Mohammed et al., 2020; Biniyam et al., 2022). Awareness of child nutrition (Amare et al., 2019; Haile & Amboma, 2018; Muche et al., 2021) and maternal education (Amare et al., 2019; Haile & Amboma, 2018; Muche et al., 2021) are crucial for improving child nutrition and dietary diversity. Ethiopian health extension programs provide rural mothers with training and health services, which support exclusive breastfeeding and enhance child nutrition, dietary diversity, and household food security.

A strong link exists between household food security and child dietary diversity (Antwi et al., 2022; Kuche et al., 2020). Food insecurity often forces households to provide inexpensive, non-nutritious, and undiversified food to their children. Educational attainment, employment status, and income influence household food security and child nutrition. Female children, who often stay at home, may have better food access compared to boys. Focus group discussions and interviews reveal that many females in low-income families manage malnutrition and poor dietary diversity. Maternal age and physiological status are significant determinants of household food security, child nutrition, and dietary diversity in both coffee and wheat-growing areas (Di Marcantonio et al., 2020). Knowledge and experience from various sources, combined with financial stability from employment and other income sources, are essential for managing food security, nutritional status, and dietary diversity for children under five.

Jimma and Arsi zones, known for their coffee and wheat production, respectively, were selected for this study. Despite these zones not being classified as food-insecure districts, the study revealed significant issues with household food insecurity, child malnutrition, and low dietary diversity.

5.2. Conclusions

This dissertation synthesizes key research findings and highlights the overall impact of the study, considering the objectives and research questions outlined previously. It employs a pragmatist philosophy to evaluate household food security and the nutritional status and dietary diversity of children under five in wheat and coffee-growing rural households in Ethiopia.

The dissertation is structured around three empirical objectives. The first objective investigates the main factors affecting household food security in wheat-growing households in Dodota District, Arsi Zone, and coffee-growing households in Goma District, Jimma Zone. These areas offer multiple income sources, including crop sales and non-farm activities. Despite this potential, many households remain poor, food insecure, and have malnourished children with low dietary diversity scores. The study uses ordered logit models and other analytical techniques to identify key determinants of both household food security and dietary diversity for children under five. It finds that 60.5% of food-insecure households are coffee growers. Factors such as education level, land degradation, market access, agricultural advisory services, and credit positively affect food security for both wheat and coffee growers. However, the purpose of production significantly impacts only wheat growers' food security, while remittances are strongly associated with food security among coffee growers.

The dissertation also examines the prevalence of underweight, stunting, and wasting among children under five in the coffee-growing households of Goma District and the wheat-growing households of Dodota District. The prevalence rates for stunting, wasting, and underweight are 19%, 16.43%, and 20.8%, respectively. Stunting is more common among coffee growers (21.2%) compared to wheat growers (17.2%). Contributing factors include the more consistent availability of food grains in wheat-growing areas, whereas coffee-growing households often face food shortages and rely on market purchases. This disparity highlights that stunting, linked to prolonged

inadequate food intake and poor dietary quality, is more prevalent among coffee-growing households, illustrating the significant impact of agricultural production type on children's nutritional status.

Finally, the dissertation assesses the dietary diversity of children under five in both wheat and coffee-growing households. Nearly half (49.1%) of the children had low dietary diversity, consuming four or fewer food groups. A third (32.7%) consumed five to six food groups, while only 18.1% had access to more than six food groups out of eight. The proportion of children with high dietary diversity (six or more food groups) was higher in coffee-growing households (22.1%) compared to wheat-growing households (14.8%). Ordered logit estimation reveals that factors such as household category (coffee grower), production for consumption, and the age of the mother/caretaker, lactation status, and household food security positively influence children's dietary diversity. Additionally, having an employed mother and being a male child also significantly positively affect dietary diversity.

5.3. Recommendations

This research conducted a comparative analysis of household food security, the nutritional status of under-five children, and dietary diversity between farm households predominantly growing wheat and those growing coffee in Ethiopia. Consequently, the recommendations derived from this study must address both the needs of these households and the specific requirements of under-five children in the study areas, as well as in similar contexts. The policy recommendations emerging from this research encompass broad, cross-cutting strategies while also addressing particular developmental issues pertinent to each context. Thus, to address the issues of household food security, nutritional status, and dietary diversity among under-five children in the wheat and coffee-growing rural households of Ethiopia, each stakeholder has distinct yet interconnected roles:

Community Members are the frontline agents of change in their local context. To enhance household food security, they should adopt improved agricultural techniques and sustainable practices that increase crop yields and resilience against climate variability. Engaging in both off-

farm and non-farm activities can also provide additional income, which is crucial for securing food and other necessities. Community members need to actively participate in educational programs about balanced diets, including the importance of breastfeeding and introducing a variety of foods to children's diets. They should also support community initiatives aimed at improving nutrition and share knowledge on effective feeding practices to ensure all children benefit from better nutrition.

NGOs Working on Food and Nutrition Security play a critical role in bridging gaps in resources and knowledge. These organizations should implement targeted food security programs that address the specific needs of households involved in wheat and coffee farming. This includes facilitating access to essential resources like seeds, fertilizers, and irrigation, as well as supporting financial services such as microloans. NGOs are also instrumental in improving child nutrition by conducting workshops and providing resources to educate mothers on best practices for feeding children. They should run interventions that address common nutritional deficiencies and promote the cultivation of diverse crops to ensure a varied diet for children.

Private Organizations can drive significant improvements through investment and innovation. By investing in advanced agricultural technologies and improving infrastructure related to food storage, processing, and transportation, private organizations can enhance food security at the household level. Collaboration with NGOs and government agencies to support nutrition-focused programs can amplify the impact of these efforts. Additionally, private organizations can help increase dietary diversity by developing and promoting market opportunities for a variety of crops, thereby encouraging farmers to grow and consume a broader range of foods. Educational campaigns funded by these organizations can raise awareness about the benefits of dietary diversity.

Government Organizations are responsible for setting and implementing policies that shape the broader environment in which food security and nutrition efforts operate. They should develop and enforce policies that support agricultural productivity, such as providing subsidies for inputs, investing in rural infrastructure, and ensuring market access for farmers. Strengthening health policies and programs to focus on child nutrition is also crucial, as it ensures that under-five

children receive appropriate dietary and health interventions. Government efforts should also include promoting agricultural diversity to ensure a variety of crops are grown and consumed, which directly impacts dietary diversity.

Other Stakeholders**,** including international development agencies and research institutions, can support these initiatives by facilitating collaborations and providing additional resources. They should work to create comprehensive food security strategies that integrate health and nutrition components. Financial support and technical assistance from these stakeholders can help implement effective programs and innovations. Advocacy for policies that support dietary diversity and the sharing of best practices and research findings can also help in addressing the needs of rural households and improving outcomes for under-five children.

By clearly defining and acting on these roles, each stakeholder can effectively contribute to enhancing household food security, improving the nutritional status of under-five children, and increasing dietary diversity in Ethiopia's wheat and coffee-growing rural communities. Generally, attaining household food security, child nutrition and dietary diversity in the study areas demands the implementation of diverse policies and strategies across all variables that had shown significant association with household food security, child nutrition, and dietary diversity.

5.4. Suggested Future Research Area

This study was conducted in the major wheat and coffee-growing regions of Ethiopia, specifically in the Jimma and Arsi zones of the Oromia Regional State. Although the research aimed to identify a range of factors, including demographic, socioeconomic, institutional, and child-specific elements, the findings may not fully represent similar conditions across the country. Given these limitations, future research should be designed to explore the intricate relationships between household food security, child nutrition, and dietary diversity more comprehensively.

To gain a broader perspective, future studies should include other coffee and wheat-growing areas not covered in this research and compare results across different regions to form a national picture. Additionally, research should extend to farming communities growing other types of crops that

were not addressed here. This study focused on factors affecting household food security, child nutrition, and dietary diversity within selected coffee and wheat farming households. However, it did not account for seasonal variations, which could significantly influence food security, child nutrition, and dietary diversity.

Future research should incorporate seasonal variations to enhance the reliability of findings and develop robust policy tools aimed at improving household livelihoods and child health and nutrition. Addressing both household food security and child nutrition requires collaboration among various stakeholders. Therefore, future studies should involve health professionals, economists, statisticians, and experts from multiple disciplines to gain deeper insights and address the existing challenges effectively.

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APPENDIX: STUDY TOOL (DATA COLLECTION INSTRUNMENT)

PART I: Demographic characteristics

SECTION A: DEMOGRAPHIC AND SOCIOECONOMIC INFORMATION

1. Demographic and Socioeconomic characteristics of the HHH

<table>
<tr><th>S/N</th><th>Question items</th><th>Response options</th><th>Skip</th></tr>
<tr><td>1</td><td>Age of respondent</td><td></td><td></td></tr>
<tr><td>2</td><td>Household composition: Number of</td><td>
<table>
<tr><th>Age group</th><th>Male</th><th>Female</th><th>Total</th></tr>
<tr><td><5</td><td></td><td></td><td></td></tr>
<tr><td><15</td><td></td><td></td><td></td></tr>
<tr><td>15-64</td><td></td><td></td><td></td></tr>
<tr><td>>64</td><td></td><td></td><td></td></tr>
</table>
</td><td>
<table>
<tr><th>Years</th><th>Male</th><th>Female</th></tr>
<tr><td><10</td><td></td><td></td></tr>
<tr><td>10-13</td><td></td><td></td></tr>
<tr><td>14-16</td><td></td><td></td></tr>
<tr><td>17-50</td><td></td><td></td></tr>
<tr><td>>50</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>3</td><td>What is the religion of your household member? (Multiple response is possible)</td><td>1. Orthodox
2.Muslim
3. Protestant
4. Catholic
5.Other, specify</td><td></td></tr>
<tr><td>4.</td><td>Current marital status</td><td>1. Married
2. Divorced
3. Widowed/widower
4. Separated
5. Others, specify</td><td></td></tr>
<tr><td>5.</td><td>Do you undergo polygamy?</td><td>0. No
1. No</td><td>➔ Skip to Q# 7</td></tr>
<tr><td>6.</td><td>If, yes what is the order of current spouse?</td><td>1. First wife
2. Second wife
3. Third wife
4. Others, specify</td><td></td></tr>
<tr><td>7.</td><td>Can you read and /write/or /Have you had any formal education?</td><td>0. No
1. Yes</td><td>➔ Skip to Q# 10</td></tr>
<tr><td>8.</td><td>What is the highest level of schooling you have achieved?</td><td>_____</td><td></td></tr>
<tr><td>10.</td><td>Has your spouse had any formal education?</td><td>0. No
1. Yes</td><td>➔ Skip Q# 12</td></tr>
<tr><td>11.</td><td>What is the highest level of schooling your spouse has achieved?</td><td>_____</td><td></td></tr>
<tr><td>12.</td><td>Do you own cultivated land?</td><td>0. No
1. Yes</td><td>➔ Skip to Q# 14</td></tr>
</table>

13.	Size of your land in "Timad" and "Hectare"	_____ Timad _____ha	
14	What is your usual occupation? (Multiple response is possible)	1. What grower 2. Coffee grower 3. Tenant farmer 4. Agricultural labor 5. Daily labor 6. Self employed 7. Paid employed 8. Non-farming 9. Civil servant 10. Unemployed 11. Other, specify	Do you own cultivated land?
15.	What is the average monthly income of your household? (If possible ask exact amount :_____	1. < 500 Eth Birr 2. 500-1000 Eth Birr 3. 1001-1500 Eth Birr 4. >1500 Eth Birr 5. Other, specify	
16.	Do you have any of the below animals? Ox Cow Cow Heifer Calve Ox Bull Goat Sheep Donkey Horse/Mule Other, specify	 0. No 1. Yes _____ 0. No 1. Yes _____ 0. No 1. Yes _____ 0. No 1. Yes _____ 0. No 1. Yes _____ 0. No 1. Yes _____ 0. No 1. Yes _____ 0. No 1. Yes _____ 0. No 1. Yes _____ 0. No 1. Yes _____ 0. No 1. Yes _____ 0. No 1. Yes _____	
17.	What type of house do you live in?	1. Thatched grass roof 2. Corrugated iron roof and would walls 3. Walls covered with cement and corrugated iron roof 4. Other, specify	
18.	How many rooms does your main house have?	_____rooms	
19.	Where do domestic animals spend at night?	0. No domestic animal 1. Same house, same section 2. Same house , separate section 3. Separate place 4. Others, specify	
20.	Does your house have sufficient ventilation?	0. No 1. No	
21.	What kind of toilet facility does your household use?	0. No toilet 1. Traditional pit latrine 2. Latrine with shade	

		3. VIP latrine 4. Flush to sewerage /septic tank 5. Other, specify	
22.	What is your source of drinking water for the household?	1. Piped into dwelling 2. Piped into yard, plot 3. Public tab/stand pipe 4. Protected well 5. unprotected well 6. Protected Spring 7. Unprotected spring 8. Rain water 9. Surface water (river, stream, dam, lake, pond, irrigation channel…) 10. Other, specify	
23.	How long does it take to fetch water (get water and come back)?	_____hours _____Minutes	
24.	Who is mostly responsible for fetching water?	1. Spouse 2. Husband 3. Children 4. Maid 5. Others, specify	

2. Maternal health and Nutrition

No	Question	Response options(Code)	Skip
1.	Do you suffer from any sickness in the last two weeks or currently?	0. No 2. Yes	➔ skip to Q# 3
2.	If yes for Q 1, what was your sickness? Please mention all	_____; _____; _____; _____	
3.	What is your current physiological status?	1. Pregnant 2. Lactating 3. Pregnant 4. non pregnant , non-lactating	
4.	Where did you go for antenatal care for your last pregnancy?	1. I didn't go anywhere 2. Government hospital 3. Private 4. health center 5. Government clinic 6. Private clinic 7. health post 8.Others, specify	➔ Skip to Q# 6
5.	How many times did you attend antenatal care during your last pregnancy?	_____number of times	
6.	Did you take iron/foliate during your last pregnancy?	0. No 1. Yes 2. Don't know	

7.	Did you receive any nutrition and health related awareness from health professionals or any other bodies?	0. No 1. Yes	➔Skip to Q# 9
8.	If yes, for Q# 7, on what area was the message you got?	1. On Exclusive breastfeeding 2. On Complementary Feeding 3. On Hygiene & Sanitation 4. On Family planning 5. On child caring practices 6.Other, specify _____	
9.	During your pregnancy, do you stop eating any food for cultural reasons?)	0. No 1. Yes	➔Skip to Q#11
10.	If 'Yes' for Q #9, what foods do you stop eating and why?	_____ _____ _____ _____	
11.	How you do you rate your feeding during your pregnancy?	1. As usual 2. Less than usual 3. More than usual	
12.	If you eat more than usual during your last pregnancy, why did you consume extra meal? (more than one answer is possible)	_____ _____ _____ _____	
13.	If you eat less or the same as usual during your last pregnancy, what was the reason?	_____ _____ _____	
14.	How was/is your food intake during your periods of lactation?	1. Less than normal 2. Same as normal 3. More than normal 4. Don't know	
15.	If you increased intake during lactation, what was the reason?	_____ _____ _____ _____	
16.	If the mother consumed same as or less than usual during lactation, ask why?	_____ _____ _____ _____	
17.	Where did you give birth to (name youngest child)?	1. Own home 2. Parents' home 3. Government hospital/clinic/health center 4. Private hospital/clinic/health center 5. Other place (specify)_____ 6. Don't know	

18.	Was (name) weighed immediately after birth?	0. No 1. Yes 2. Don't know	
19.	Do you know what 'balanced diet' mean/what a 'varied diet mean?	0. No 1. Yes	
20.	What are foods rich in iron? (More than one answer is possible)	1 Teff 2 Wheat 2. Barley 3. Pulses (chickpeas, lentil, beans) 4. Green vegetables 5. Vegetables, fruits 6. Fish, meat, poultry 7. Diary (butter, milk, cheese, yoghurt) 8. Fats and oils 9. Salt 10. Other (specify)_____ 11. Don't know	

3. Youngest Child Nutrition (Child feeding practices)

[Note: This section is to be administered only to mother with a live birth in the 2 years (0-23.9 months) preceding the date of interview. Use pencil and write the name of the youngest child under age 2 years here_____ and use this name where indicated in the following questions below.]

No	Question	Response options(Code)	Skip
1.	What is the sex of the youngest child (Name)?	1.Female 2.Male	
2.	Child date of birth? (from immunization card)	_____	
3.	Did you ever breastfeed (Name of child)?	0. No 1. Yes	➔ Skip to Q#4
4.	If 'no', why (Name) was not breastfeed?	_____ _____	
5.	How long after birth did you first put (Name) to the breast?	1. Immediately 2. One to twenty-four hours 3. More than 24 hours 4. Don't know/remember	
6.	What did you do with the 'first milk' (Colostrum)? [Colostrum is the first yellowish milk or 'Inger']	1.Gave to the baby 2.Discarded it	➔ Skip to Q# 8
7.	If you discard, why was the reason?	_____	

8.	In the first 3 days after delivery, was (name) given anything to drink other than breast milk?	0. No 1. Yes	➔ Skip to Q# 10
9.	What was (Name) given to drink? (More than one answer is possible)	1. Milk (other than breast milk) 2. Plain water 3. Sugar or glucose water 4. Fruit juice 5. Infant formula 6. Tea/infusion 7. Honey 8. Raw butter 9. Fenugreek water (Abish water) 10. Other (specify)_____	
10.	For how long did you give the child breast milk only (exclusively breastfed)?	_____ Months.	
11.	Is (Name) still being breastfed?	0. No 1. Yes	Skip to Q# 13
12.	How many times did you breastfeed (Name) yesterday day and night? [How many times from morning to sunset? _____ How many times from sunset to sunrise? _____ (If the answer is not in number, probe for approximate number and sum the two, then write the total)	_____ Number of times.	
13.	If you stopped breastfeeding, how long did you breastfeed (Name)?	In days _____ In months _____	
14.	Since this time yesterday, how many times did (name) eat solid, semisolid, or soft foods other than liquids?	1. Once 2. Twice 3. Three times 4. Four times 5. Other (specify)_____ 6. Don't know	
15.	What age did you first give solid or semi-solid food to (name)?	When (Name) was _____ months old.	
16.	Has (name) been sick in the past two weeks?	0. No 1. Yes	
17.	If 'Yes'/child has been sick, ask mother to specify what the sicknesses were	_____ _____ _____	

4. Questions related to wheat production and consumption

No	Question	Response options(Code)	Skip

1.	Do you grow any cereal crops? Probe: what, maize, Barley, sorghum, Teff …etc….	0. No 1. Yes	➔ **Skip to Q# 6**
2.	What cereals do you grow? Probe for common cereals and list as many as possible [cereals include: what, maize, Barley, sorghum, Teff …etc….and others**]**	_____ _____ _____ _____	
3.	How much wheat did you harvest in your last harvesting season? [Encourage respondent to provide an estimate of the amount of wheat/coffee produce in quintal or 'madaberiya']	_____quintals _____ Madaberiya (_____kg)	
4.	What do you do with the produce?	1. Sell it at the local market 2. Use if for household consumption 3. Both for market and household consumption 4. Other (specify)_____	
5.	Who is mainly in charge of wheat production in your community, men or women or both?	1. Men 2. Women 3. Both 4. Don't know	
6.	Do you have access to your own piece of land where you grow some crops?	0. No 1. Yes	➔ Skip to Q# 8
7.	What do you grow in your piece of land? [probe to include everything the mother grows in her land	_____ _____ _____	
8.	Do you consume any wheat or food made from wheat for yourself and for (Name of child)?	0. No 1. Yes	
9.	If mother replied 'No' for Q #408, ask 'why?'	1. We produce only for market purpose 2. We don't produce enough for both consumption and for market 3. It takes a lot of time to prepare food from wheat 4. Consumes a lot of fire wood. 5. Problem with flatulence/bloating. 6. Other, (specify) _____	
10.	Where do you mostly get your supply of wheat for household consumption?	1. Own production 2. Purchase from market 3. Food aid	

		4. Own production and purchase 5. Other, specify _____	
11.	What are the most common foods you prepare from wheat? Which wheat food products are most commonly used to make meals? [write everything the mother mentions and probe for more]	_____ _____ _____ _____	
12.	How do you eat wheat/foods made from wheat or what other food items do you eat wheat with?	_____ _____ _____	
13.	What is your attitude toward the consumption of wheat or foods made from wheat	1. Like 2. Dislike it 3. Not like it much but eat it anyway 4. Don't know 5. Other, (specify)	
14.	Do you know any nutritional benefit of eating wheat compared to other cereals?	0. No 1. Yes	➔ Skip **to Q# 16**
15.	Can you tell me some of the nutritional benefits of wheat? [probe and write as many as the mother can mention]	_____ _____ _____	
16.	Now or in the future, do you currently intend to eat more wheat (foods made from wheat) for yourself and young children?	0. No 1. Yes	
17	Please state the reason for Q# 16	Why_____? Why Not_____ _____ _____ _____ _____	
18.	What are your major challenges with regard to production of wheat crops [why can't you produce/produce more?]	1. Poor soil infertility and productivity 2. Lack of farm input 3. Lack of water source/irrigation facility 4. Don't have good market access 5. Other, specify _____	
19.	Does your household or you currently have any intention/plan to produce more wheat in the future?	0. No 1. Yes	
20.	Why or why not for Q# 19	_____ _____ _____ _____	

5. Questions on the constructs of the Health Belief Model

No	**Question**	**Response options(coding)**

	To what extent do you agree with the following statements? Please answer honestly and circle on the right option. *(Key: 1-23=susceptibility; 24-26=severity; 27-29 =benefit; 30-32=barriers; 33-35 =cues for action; 36-38=self-efficacy)*	**SD**	**D**	**NS**	**A**	**SA**
1	If I eat *less than usual* during pregnancy and lactation, I may become malnourished.	1	2	3	4	5
2	If my child and I continue without changing what we are currently eating, both my child and myself may become malnourished sooner or later.	1	2	3	4	5
3	Not eating more than usual during pregnancy will help me to have small (light weight) baby at birth and hence, not eating more than usual during pregnancy is a good practice.	1	2	3	4	5
4	I am scared of giving birth to a small sized baby because I did not eat well during pregnancy.	1	2	3	4	5
5	Not eating from varieties of food groups (including wheat) during pregnancy and lactation may severely affect my health and my child's health	1	2	3	4	5
6	If my child is malnourished at early years (0-5 years), it doesn't bother me a lot because he/she will well when grown up.	1	2	3	4	5
7	If my child and I regularly eat wheat along with other food groups, our nutritional health will be good even if we are not eating meat and meat products.	1	2	3	4	5
8	I believe wheat is good sources of protein and other important micronutrients beneficial to my and my child's nutritional health.	1	2	3	4	5
9	Wheat crop is not only good for my and my child's nutrition but also for increasing the productivity of our farm, our household income and food security.	1	2	3	4	5
10	I don't believe eating wheat is that much beneficial for me and my child's nutritional health.	1	2	3	4	5
11	Eating wheat often is boring and wheat is foods only for poor people (e.g. people we cannot afford animal source foods).	1	2	3	4	5
12	Wheat is not cheap and preparing them is time consuming and they are not good for our stomach (e.g. flatulence) so I don't think I will eat more wheat in the future.	1	2	3	4	5
13	We produce wheat for household consumption and for market	1	2	3	4	5
14	Even if we don't grow wheat crop, we will plan to produce/purchase more in the future for household consumption.	1	2	3	4	5
15	Usually get nutrition education on the important roles of wheat in my diet from local nutrition educators.	1	2	3	4	5
16	If different food is available at home, I know how to prepare balanced diet by including variety of foods in a meal.	1	2	3	4	5
17	I know how to prepare different foods from wheat crops by cooking them together other foods to increase their diet quality.	1	2	3	4	5
18	I have a better understanding of how I should eat during pregnancy and lactation for the benefit of both my and my child's health.	1	2	3	4	5

2. Socio Economic characteristics of the HHH

2.1 1 Physical capita

2.1.1 Land

Plots	land		Perceived soil quality	Type of crops	Amount harvested (Quintal)	Amount consumed (Quintal)	Amount sold	Total income from sale
	Size (Timad /Kert)	Access*	1. Fertile 2. Moderate 3. Infertile					Birr
Plot 1								
Plot 2								
Plot 3								
Plot 4								
Plot 5								
Total income form from all crops of all plots								

***** Access to land: - 1= purchased; 2= inherited; 3= given by relative or friend; 4= allocated by government or chief; 5= rented; 6= sharecropped; 7=encroached/squatted; 8=borrowed; 9= other (Specify) _____

2.1.2 Livestock holding (Please indicate the number of livestock holding for the last 12 months)

Livestock	goat	sheep	cow	calf	oxen	donkey	poultry	Mule/horse	Other	TLU*
Number owned										
Number										
Number sold										
Total Income										

* use conversion table

2.1.3 Asset ownership

ASSETS	**What is the total current value in Birr for all of the items?**
1. Furniture (Tables, Chairs/bench (*agdami wenber*), Bed, Sofa (set) including both local and modern, Shelves (Komodino) etc…	
2. Lighting(Rechargeable battery, Solar , Main electricity , Lamp (*fanos, masho*), Battery torch	
3. Cooking (Improved charcoal/wood stove/ (eg. *Lakech*, Gonze, etc), Solar cooker/biogas, Kerosene wick stove (*buttagas*) and Electric cooker	
4. Other electronics(Radio, Tape Recorder / Cassette Player Television , Camera, Mobile Phone, CD/DVD Player, Refrigerator, Clock (including Wall clock), Sewing Machine (including weaver)	
5. Transport(Bicycle, Wheelbarrow , Animal-drawn cart (*Gaari*), Motorcycle, Tractor/ Trailer for motor vehicle, Three-wheel Taxi (*Bajaj*), Other vehicles)	
6. Farm Equipment (Animal-drawn plough(*yebere eka*-set), Hoe (mekotkocah, maresha or medekdekia), Hand pump/Tridle pump to lift water, Knapsack sprayer, *Winnowing tools (Layda or mensh)*, Spade (Akafa), Sickle (*Machid*), Slasher(*Gejera*), Rake (*mebuatecha*), Axe (*Metrebiya*), Saw (Megaz) ,Water Pump (powered), Miller (grain mill) , Motorized Thresher/combiner , Grain winnower (*tiliku wenfit*)	
Total current value of all assets	

3. Social issues

3.1 Do any members of your family be exposed to infectious diseases? 1) Yes 2) No
3.2 Do any members of your family be exposed to water borne diseases? 1) Yes 2) No
3.3 Do your families encounter food scarcity within the last 12 months? 1) Yes 2) No
3.4 If your answer is yes, for how many months? _____
3.5 Do women manage the sale of crop produce? 1) Yes 2) No
3.6 Indicate the responsibility of male or female for each activity in the household

S/N	**Areas of responsibility**	**Responsible family member 1) male 2) female 3) Both**
1	Land preparation	
2	Sowing/planting	
3	weeding	
4	Harvesting	
5	Post-harvest management	
6	Selling produce	
7	Manage income from sale of produce	
8	Purchase of food items in the household	
9	Decision who eat what	
10	Taking care of children	
11	Handling household chorus	
12	Attending social gatherings	
13	Attending government meetings	
14	Taking credit	

15	Access to training	
16	Others, specify	

Dietary Diversity Score

S/N	Food group	Example	1=Yes 2= No
1	Cereals	Corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + local foods e.g. porridge, paste, Bread, Enjera, kitta, Kollo,	
2	White tuber and roots	White potatoes, white yam, white cassava, or other foods made from roots	
3	Vegetables	Pumpkin, carrot, squash, or sweet potato that are orange inside + other locally available vitamin A rich vegetables (e.g. red sweet pepper); Dark green leafy vegetables, including wild forms + locally available vitamin A rich leaves such as amaranth, cassava leaves, kale, spinach; other vegetables (e.g. tomato, onion, eggplant) + other locally available vegetables	
4	Fruits	ripe mango, cantaloupe, apricot (fresh or dried), ripe papaya, dried peach, and 100% fruit juice made from these + other locally available vitamin A rich fruit; other fruits, including wild fruits and 100% fruit juice made from these	
5	Meat	Liver, kidney, heart or other organ meats or blood-based food; Beef, pork, lambs, goat, rabbit, game, chicken, duck, other birds, insects	
6	Eggs	Eggs from chicken, duck , guinea fowl or any other egg	
7	Fish	Fresh or dried fish or shellfish	
8	Legumes, nuts and seeds	Dried beans, dried peas, lentils, nuts seeds or foods made from these (e.g. hummus, peanut butter)	
9	Milk and milk products	Milk, cheese, yogurt or other milk products	
10	Oils and fats	Oil, fats or butter added to food or used for cooking	
11	Sweets	Sugar, honey, sweetened soda or sweetened juice drink, sugary foods such as chocolates, candies, cookies and cakes	
12	Spices, condiments and beverages	Spices (black pepper, salt) condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages	

Food balance Model

Grain

S/N	Type of grain/Livestock (1)	Own produce(2)	Bought (3)	obtained through gift(4)	Obtained through food aid(5)	Reserved for seed(6)	Sold(7)	Given out(8)	Post-harvest loss(9)
1	What								
2	maize								
3	Barely								

4	Sorghum								
5	Teff								
6									

Livestock and livestock products

S/N	Type of livestock (10)	Own produce(11)	Bought (12)	obtained through gift (13)	Reserved for farm activities and/or cultural concerns(14)	Sold (15)	Given out (16)
	Cattle						
1	Cow						
2	Heifer						
3	Calve						
4	Ox						
5	Bull						
	Other livestock						
6	Goat						
7	Sheep						
8	Chicken						
9	Livestock products						
10	Milk						
11	Meat/beef						
12	Skin/hide						
13	Egg						
14	Honey						
15	Butter						
16	Yoghurt						
17	Cheese						

Summary:

NGLA= (2+3+4+5+11+12+13)-(6+7+8+9+14+15+16) =_____

Part V: Household (HH) Food Security (Introductory)

No	Question	Response options(Coding)	
1.	How many times do you cultivate within a year?	1.Yearly 2.Biannual 3.Three-times	
2.	What % of your main food source is from…?	1.Own production _____% 2. Purchase _____% 3. Food aid/donation_____% 4. Other (specify) _____%	

3.	If your source of staple food is purchase; what is the income source? (More than one answer is possible).	1. Salary/ wage 2. Own business 3. Sale of livestock 4. Remittance 5. Other/specify	
4.	Have you or your HH been involved in any food security program in the 'District'?	0. No 1. Yes	
5.	If 'yes' for Q #4, in which of the following food security programs has your HH been involved?	1.Productive safety net package program (PSNP) 2.Enhanced outreach strategy for under 5 children 3. Relief 4. Income generation activities 5.Others, specify_____	
6.	How long does your food store usually last after harvest?	1. Less than two months 2. Two to four months 3. Five to eight months 4. Nine to twelve months	

Household Food Insecurity Access Scale (HFIAS) Measurement Tool

NO	QUESTION	RESPONSE OPTIONS	CODE
1	In the past four weeks, did you worry that your household would not have enough food? ባለፉት አራት ሳምንታት ቤት ውስጥ በቂ ምግብ አይኖረኝም ይሆናል ብለው ሰግተው ያውቃሉ?	0 = No (skip to Q2) 1=Yes	….|___|
1a	How often did this happen? ባለፉት አራት ሳምንታት ውስጥ ይሄ ስጋት ስንት ጊዜ ደርሶብዎታል	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|___|
2	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources? ባለፉት አራት ሳምንታት ቤት ውስጥ በቂ ምግብ ወይም ገንዘብ ባለመኖሩ ምክንያት ርስዎ ወይም ማንኛውም የቤተሰብ አባል የወደዱትን ምግብ ሳይበሉ ቀርተው ያውቀሉ?	0 = No (skip to Q3) 1=Yes	….|__|
2a	How often did this happen? ባለፉት አራት ሳምንታት ውስጥ ይህ ስንት ጊዜ አጋጥሞዎታል?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|___|
3	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0 = No (skip to Q4) 1 = Yes	….|___|

	ባለፉት አራት ሳምንታት ቤት ውስጥ በቂ ምግብ ወይም ገንዘብ ባለመኖሩ ምክንያት ርስዎ ወይም ማንኛውም የቤተሰብ አባል የተወሰኑ የምግብ አይነቶች ብቻ በልታችኋል?		
3a	How often did this happen? ባለፉት አራት ሳምንታት ውስጥ ይህ ስንት ጊዜ አጋጥሞዎታል?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	**….|___|**
4	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food? ባለፉት አራት ሳምንታት ቤት ውስጥ በቂ ምግብ ወይም ገንዘብ ባለመኖሩ ምክንያት ርስዎ ወይም ማንኛውም የቤተሰብ አባል መብላት የማትፈልጉትን ምግብ በልታችኋል?	0 = No (skip to Q5) 1 = Yes	**….|___|**
4a	How often did this happen? ባለፉት አራት ሳምንታት ውስጥ ይህ ስንት ጊዜ አጋጥሞዎታል?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	**….|___|**
5	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food? ባለፉት አራት ሳምንታት ቤት ውስጥ በቂ ምግብ ባለመኖሩ ምክንያት ርስዎ ወይም ማንኛውም የቤተሰብ አባል ሳትጠግቡ ለመነሳት ተገዳችኋል?	0 = No (skip to Q6) 1 = Yes	**….|___|**
5a	How often did this happen? ባለፉት አራት ሳምንታት ውስጥ ይህ ስንት ጊዜ አጋጥሞዎታል?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	**….|___|**
6	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food? ባለፉት አራት ሳምንታት ቤት ውስጥ በቂ ምግብ ባለመኖሩ ምክንያት ርስዎ ወይም ማንኛውም የቤተሰብ አባል ቁርስ፤ ምሳ ወይም ራት መብላት ሳትችሉ ቀርታችኋል?	0 = No (skip to Q7) 1 = Yes	**….|___|**
6a	How often did this happen? ባለፉት አራት ሳምንታት ውስጥ ይህ ስንት ጊዜ አጋጥሞዎታል?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks)	**….|___|**

		3 = Often (more than ten times in the past four weeks)	
7	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food? ባለፉት አራት ሳምንታት ቤት ውስጥ በቂ ምግብ ወይም ገንዘብ ባለመኖሩ ምክንያት በቤተሰቡ ውስጥ የሚላስ የሚቀመስ ያልነበረበት ጊዜ ነበር?	0 = No (skip to Q8) 1 = Yes	**….**|___|
7a	How often did this happen? ባለፉት አራት ሳምንታት ውስጥ ይህ ስንት ጊዜ ኢጋጥሞዎታል?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	**….**|___|
8	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food? ባለፉት አራት ሳምንታት ቤት ውስጥ በቂ ምግብ ወይም ገንዘብ ባለመኖሩ ምክንያት ርስዎ ወይም ማንኛውም የቤተሰብ አባል እየራበው ወደ መኝታ የሄደበት ጊዜ ነበር?	0 = No (skip to Q9) 1 = Yes	**….**|___|
8a	How often did this happen? ባለፉት አራት ሳምንታት ውስጥ ይህ ስንት ጊዜ ኢጋጥሞዎታል?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	**….**|___|
9	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food? ባለፉት አራት ሳምንታት ቤት ውስጥ በቂ ምግብ ወይም ገንዘብ ባለመኖሩ ምክንያት ርስዎ ወይም ማንኛውም የቤተሰብ አባል ቀኑን ሙሉ ሳይበላ ውሎ ሳይበላ ያደረበት ጊዜ አለ?	0 = No (questionnaire is finished) 1 = Yes	**….**|___|
9a	How often did this happen? ባለፉት አራት ሳምንታት ውስጥ ይህ ስንት ጊዜ ኢጋጥሞዎታል?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	**….**|___|

Extension, training and participation in organizations

1. Did you/ any member of the household receive any extension service or technology during the past three years? **1=Yes 0=No**
2. Please fill the below table

	Extension services and Technologies	Did you access any [*Extension and Technology*] during the ***past 3 years?*** 1= Yes, 0=No	Are you applying the technology/extension now? 0=No 1=Yes	Do you think you have benefited from the use of the technology/extension services 0=No 1=Yes
01	Improved variety seed use			
02	Fertilizer use			
03	Proper/recommended application of fertilizer			
04	Proper/ recommended planting method			
05	Minimum/ Zero Tillage			
06	Herbicide, pesticide and insecticide			
07	Threshers/ Sheller			
08	Grain storage facility			
09	Water conservation			
10	Small scale irrigation			
11	Dairy farming			
12	Bee keeping			
13	Livestock fattening			
14	Animal fodder			
15	Fish production			
16	Post-harvest handling			
17	High value crop (vegetables, onions) production			
18	value adding technologies/ agro processing			
19	Improved livestock/poultry management			
20	Agro forestry			
21	Soil conservation (terracing, soil bund …)			
22	Market information			
23	Organic fertilizer (Compost preparation)			
24	Credit access			

Access to market

Product market：Complete the table with crops sold in 2010 E.C

Crop	Where sold [*see codes)*	Distance from the farm, in KM (≈6km takes 1hr)	Means of transport *[See code]*	Total Cost incurred in marketing *(loading/ unloading, broker, transportation fees*)	Marketing decision maker *(See cods)*	Quantity sold within *4 weeks* after harvest		If you sold *within 4 weeks* of harvest, what were the reasons? See code)
						Qty	Unit	

Where sold code: 1=farm-gate; 2=local market; 3=cooperative; 4=farmer association; 5 = Cereal Stock Exchange; 6= tenders; 7=city/big town market, 8 =other; (specify) _____

Transportation code: 0= not applicable 1=human power, 2= pack animals, 3= other animals, 4= animal cart, 5= hand driven cart, 6= car, 7= track (lorry), 8= other (Specify) _____

Decision maker code: 1=household head; 2= spouse; 3= male child; 4= female child; 5=relative; 6=husband & wife; 7=other (specify) _____

Unit code: 1=Kilogram, 2=Quintal, 3=Liter, 4=hectare, 5=number, 6=*tasa*, 7=*qunna*, 8=*bottle*, 9=*sini*, 10=*kubbayya*, 11=*feresulla*, 12=grams, 13= donkey pack, 14=human pack, 15=*Kimmir*, 16=box (*saxin*), 17=milliliter, 18=other (Specify) _____

Qualitative study checklists

PART I

1. What is your role in the households?
2. What are the major activities you undertake in the household?
3. Whose responsibility is to take care of the children?
4. How do you define children? Are they blessings or responsibilities?
5. Do you think their number should be limited? How about distance between them?
6. Who decide the number of children and distance between children?
7. How do you classify child (Children age) as per care required to them? E.g Ejole Tiqo, Diman,
8. Which age group has got special attention? Why?
9. Do you think children deserve special care? Why?
10. How do you understand food, nutrition and malnutrition?
11. Do you think their food supplied to them will have implication (effect) on their current as well as their future life?
12. What are valuable foods required to maintain children in good condition?
13. Who is malnourished people in your area? How do you know whether he/she is malnourished or not?
14. What is the most important thing in your life? Is food indispensable part of your life? How?

15. Who is the most important member of the household? Father, Mother, Daughters, Brother? Why?
16. How do mothers valued in your community and in the household in theory and practice?
17. Do mothers be prioritized in the family in terms of food and care? Mention some of the special foods supplied to them and related cares.
18. Do you think there exists relationship between mothers' nutritional status and their children nutritional status?
19. How do you see the effect of age of the mother during first birth with their and their children nutritional status?
20. How does age of birth for the first child and poor physical condition will affect child's nutritional status?
21. How do you see social tie and local leadership in the community?
22. Who is the most respected person in your community, whose words are respected by the community?
23. What are the areas these elders will be involved?
24. Do these people involved in development intervention areas? Are they involved in food and nutrition security? How and in what way?

PART II

1. How many hours in a day do women spend on household chorus?
2. Who is responsible to prepare food for the household, for the under-five child/children?
3. What are kinds of food are served in the household? Which one are most frequent food items? Why they become frequently used?
4. How often do you use fruits and vegetables in the household? How do you see the perception of community/households towards fruits and vegetable consumption? How about giving to your kids?
5. Do women in the community are aware of nutrition and malnutrition? Under five children?
6. What are the major bottlenecks that hinder you not to attend you children nutritional status?

Are husbands supportive in this regard?

Thank you for your patience and cooperation!