COLLEGE OF BUSINESS AND ECONOMICS

THE IMPACT OF CEREAL COMMERCIALIZATION ON HOUSEHOLD FOOD AND NON-FOOD EXPENDITURE AMONG SMALLHOLDER FARMERS IN ETHIOPIA

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THE IMPACT OF CEREAL COMMERCIALIZATION ON HOUSEHOLD FOOD AND NON-FOOD EXPENDITURES AMONG SMALLHOLDER FARMERS IN ETHIOPIA

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A thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in Economics (Economic Policy Analysis)

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STATEMENT OF DECLARATION

I, Kenna Amsalu Alemayehu, hereby declare that the thesis I have submitted for consideration for Degree of Master of Science in Economics (Economic Policy Analysis) from Addis Ababa University in Addis Ababa, Ethiopia, entitled "*The Impact of Cereal Commercialization on Household Food and Non-Food Expenditures Among Smallholder Farmers in Ethiopia*" is my original work. I confirm that this thesis has never been previously published nor submitted at this or any other university. I have duly attributed and cited all sources and materials used in the preparation of this thesis.

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This is to certify that the thesis prepared by Kenna Amsalu Alemayehu entitled "*The Impact of Cereal Commercialization on Household Food and Non-Food Expenditures Among Smallholder Farmers in Ethiopia*" in partial fulfilment of the requirements for the Degree of Master of Science in Economics (Economic Policy Analysis) complies with regulations of Addis Ababa University and meets the accepted standards with respect to originality and quality.

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Abstract

This study examines the impact of cereal commercialization on the food and non-food expenditure of smallholder farmers in Ethiopia, which is measured by their food expenditure share. Contrary to the common assumption that higher sales volumes indicate welfare, this research measures the economic well-being of households by comparing the share of food expenditure and non-food expenditure from their budget to measure the impact of commercialization on their financial status. Endogenous switching regression and counterfactual analysis to understand the average treatment effect on the treated and the untreated are used to analyze the relationship between commercialization and household budgets. This study draws on data from a larger survey to provide an understanding of this relationship. The results indicate commercialization has generally a desirable impact on households improving their status. On average commercialized cereal farmers are found to have a lower food expenditure share compared to semi-commercialized and subsistent farmers but there are heterogeneity effects that make some farmers better off than others and affect food expenditure shares. The net effect of commercialization differs among households. Among the control variables, larger household sizes, household heads' literacy, crop rotation agrochemical use, and participation in the AGP program are associated with a decrease in the food expenditure share of households' budgets. Agricultural policies should be targeted at promoting cereal commercialization among smallholders while building the capacity of smallholders to withstand the economic losses they incur while adopting agricultural technologies that will improve their livelihoods.

Key words: Cereal commercialization, household budgeting, Smallholder farmers, Engle's law, food expenditure share

List of Acronyms

AGRA	Alliance for a Green Revolution in Africa[1]
AGP	Agricultural Growth program
AME	Average Marginal effects
ATT	Average Treatment Effect on the Treated
ATU	Average Treatment Effect on the Untreated
BH	Base Heterogeneity
ESS	Ethiopian Statistical Service
ESR	Endogenous Switching Regression
EWVCDP	Ethiopian Wheat Value Chain Development Project
FAO	Food and Agriculture Organization
FDRE	The Federal Democratic Republic of Ethiopia
GDP	Gross Domestic Products
HH	Household
HYV	High Yielding Varieties
ILO	International Labor Organization
IV	Instrumental Variable
NBE	National Bank of Ethiopia
OECD	Organization for Economic Co-operation and Development
PSI	Policy Studies Institute
PSNP	Productive Safety Net Programme
RCC	Survey on Building Resilience to Climate Change in Ethiopia: Exploring Options for Action
SNNPR	Southern Nations Nationalities and People Region[2]
SSA	Sub-Saharan Africa
UCPH-DERG	University of Copenhagen Development Economics Research Group
UN DESA	United Nations Department of Economic and Social Affairs
USD	United Stated Dollar

[1] AGRA is currently used as a full name not an abbreviation by the organization.
[2] At the time the survey was conducted SNNPR was a single region. It is now divided into four smaller regions.

Table of Contents

CHAPTER ONE **10**

1. INTRODUCTION **10**

1.1. BACKGROUND 10

1.2. PROBLEM STATEMENT 12

1.3. OBJECTIVE OF THE STUDY 13

1.3. RESEARCH QUESTIONS 13

1.4. SCOPE AND DELIMITATIONS 14

1.5. SIGNIFICANCE 14

CHAPTER TWO **16**

2. LITERATURE REVIEW **16**

2.1. A BRIEF BACKGROUND TO AGRICULTURAL COMMERCIALIZATION 16

2.2. THE GREEN REVOLUTION IN AFRICA 17

2.3. MEASURING COMMERCIALIZATION 17

2. 4. CEREAL CROP COMMERCIALIZATION AND COMMERCIALIZATION POLICIES IN ETHIOPIA 18

2.5. EVALUATION OF THE IMPACT OF COMMERCIALIZATION 19

2. 6. MEASURING THE ECONOMIC WELLBEING OF HOUSEHOLDS USING ENGEL'S LAW 20

2.7. CONCEPTUAL FRAMEWORK 23

CHAPTER THREE **25**

3. METHODOLOGY **25**

3.1. DATA TYPE AND SOURCE 25

3.2. DATA EXTRACTION 25

3.3. VARIABLES DESCRIPTION 26

3.3.1 Dependent variable *26*

3.3.2. Independent variable *26*

3.3.3. Control Variables *27*

3. 4. ECONOMETRIC ANALYSIS 29

CHAPTER FOUR **34**

4. RESULTS AND DISCUSSION **34**

4.1. DESCRIPTIVE ANALYSIS 34

4.2. COMMERCIALIZATION AND FOOD EXPENDITURE SHARE AMONG HOUSEHOLDS 36
4.3. ENDOGENOUS REGRESSION OF THE PARAMETER ESTIMATES 37
4.3.1. Instrumental variables and Falsification Tests 37
4.3.2. Endogenous Regression Results 38
4.4. TREATMENT AND HETEROGENEITY EFFECTS 41
CHAPTER FIVE 43
5. CONCLUSION AND POLICY IMPLICATIONS 43
5.1. CONCLUSIONS 43
5.2. POLICY IMPLICATIONS 44
REFERENCE 45

List of Tables

TABLE 1: EXPENDITURE ON FOOD AND NON-FOOD ITEMS CONSIDERED FOR THE STUDY 26
TABLE 2: DESCRIPTION OF STUDY VARIABLES 27
TABLE 3: CONDITIONAL EXPECTATIONS, TREATMENT, AND HETEROGENEITY EFFECTS 32
TABLE 4: SOCIO-ECONOMIC AND FARM CHARACTERISTICS BASED ON COMMERCIALIZATION LEVELS 34
TABLE 5: PARAMETER ESTIMATES- TEST OF VALIDITY OF SELECTION INSTRUMENTS 37
TABLE 6:PARAMETER ESTIMATES OF COMMERCIALIZATION AND FOOD EXPENDITURE SHARE EQUATIONS 38
TABLE 7: AVERAGE EXPECTED FOOD EXPENDITURE SHARE ; TREATMENT AND HETEROGENEITY EFFECTS 41

List of Figures

FIGURE 1: FACTORS INFLUENCING COMMERCIALIZATION AND ITS IMPACT ON HOUSEHOLD BUDGETS 23
FIGURE 2: PERCENTAGE OF RESPONDENTS BY REGION 35
FIGURE 3: COMMERCIALIZATION LEVELS OF RESPONDENTS 36
FIGURE 4: COMMERCIALIZATION LEVELS OF RESPONDENTS 36
FIGURE 5:HOUSEHOLD BUDGET ALLOCATION AT DIFFERENT LEVELS OF COMMERCIALIZATION 36

CHAPTER ONE

1. Introduction

1.1. Background

Smallholders are the backbone of African agriculture employing over 50% of the continent's workforce. (ILO, 2021). They constitute the biggest portion of the world's poor and hungry (Fan et al., 2020). A reality mirrored among Ethiopian farmers. In Ethiopia, agriculture engages 75% of the population, yet the sector is marked by low inputs and outputs. In contrast, developed nations, with a small fraction of their populations working in agriculture achieve surplus production and higher farmer welfare. This was not the case in the early 20th century before the era known as the Green Revolution. Agricultural technology innovation and adoption solved the problem of food insecurity and enhanced production efficiency in the green revolution. It solved the problem of expansion of agricultural land by introducing agricultural intensification. The per-plot yield of crops increased, which resulted in a surplus in agricultural production. The surplus was marketed and the commercialization of agriculture was the result. The commercialization of agriculture in turn led to economic growth and structural transformation in the countries with the Green Revolution. The agricultural sector needed a very small amount of labor force. Farmers transitioned into the manufacturing and service sectors. Food self-sufficiency and economic growth were achieved (Briggs, 2009).

The ideal scenario in smallholder farming is for subsistence farmers to evolve into more commercially viable operations like transitioning to other sectors or growing to semi-commercialized farms and gradually moving to become fully commercial farms. Alternatively, farmers might choose to exist agriculture all together and join the non-farm economy so that other transitioning or semi-commercial farms can expand. It is crucial to avoid situations where smallholder farmers become stuck in subsistence farming or where they struggle to leave the agricultural sector (AGRA, 2017; Barret, 2008).

In Ethiopia farmers remain largely confined to smallholding with very low levels of commercialization. Their participation in the output markets is driven by more than just profit maximization and the effects of this participation are not always positive. (Ouedraogo,2019). This is reflected in their household food and non-food expenditure shares. With inflation hitting agricultural inputs, smallholder farmers sell their output during harvest time to buy expensive inputs, pay taxes, repay debts, and send their children to school. Minot et al., (2022) found

that almost all rural households in Ethiopia purchase crops to supplement their production. They buy food later in the dry times at higher prices than they sell their produce. This makes them economically vulnerable in the face of shocks and adversities because most of their income is spent on food.

Most studies on technological adoption and commercialization, measure welfare by examining income change or change in food expenditure of farmers (Ahmed, 2022; Awotide et al. 2016; Ayenew et al., 2020; Ayele, 2022; Muricho et al., 2017) multidimensional poverty (F.Z. Birhanu et al., 2021). In the face of volatile input prices and the weak bargaining power of farmers, evaluating farmers' total expenditure or total gain would not give full insight into how economically well off the household is. There is also a vague distinction between commercial and subsistence farmers (Colin, 2017) in studies that do not capture the effect of stages of commercialization. There is a need to differentiate if the commercialization of smallholder farmers is the result of surplus production or a distress-sell if it is contributing to their poverty or lifting them out of it.

This can be understood by studying smallholder's household budgets. Engel's law, which was developed by Ernst Engle, a statistician in Germany, and his team, to measure the attainment of "conditions essential for health and life" for factory workers in the European Union (Lumley, 1856) has been a good measure of welfare for households and economies as a whole. A household was considered poor if it spent more than 80% of the household budget on food. Smith & Ali (2007) have suggested utilizing this measure to assess the welfare of farmers. A household spending more than 75% on food is considered food insecure, poor, and economically vulnerable.

The existing literature studies the benefit of commercialization in terms of income, welfare, multidimensional poverty, and nutrition. There is a gap in understanding the impact of commercialization on the household expenditure shares on food and non-food expenditure as an indication of economic improvement. This study is designed to fill the gap in knowledge by exploring the relationship between commercialization and household budgeting among Ethiopian smallholder farmers. It will help to understand the impact of cereal commercialization on poverty measured by the proportion of income spent on food and non-food consumption by differentiating between subsistence and semi-commercial, and commercialized cereal farmers.

The findings of this study contribute to the knowledge of the relationship between cereal commercialization and household food and non-food expenditure shares of Ethiopian smallholder cereal farmers. Understanding the link

between cereal commercialization and household budgets is crucial to designing targeted agricultural policies to support and empower smallholder cereal farmers. It will also contribute to the design of targeted interventions and support mechanisms to cater to the needs of smallholders that are on different levels of commercialization.

1.2. Problem Statement

Smallholder farmers are the backbone of Ethiopian agriculture producing 92.4% of the total agricultural output (ESS,2022). Despite their critical role, most smallholder farmers remain in subsistence farming with a significant portion of their production consumed at home. The World Bank (2020) reports that 62-77% of major cereal crop production is consumed by households while only 9-25% is sold in the market.

Low commercialization stages indicate the motives of market participation of smallholder farmers. Market involvement for smallholders is often driven by subsistence needs rather than commercial aspirations; Barrett (2008), Muriithi and Matz (2014), and Carletto et al. (2017) highlight this. Farmers must engage in the market to procure essential goods and services. The ideal progression for smallholder farmers involves transitioning from subsistence to more commercially feasible operations, possibly moving to semi-commercialized and then to fully commercialized farms. Some subsistence farmers may exit agriculture entirely and join the non-farm economy allowing the other farms to expand (AGRA, 2017; Barrett, 2008).

Several factors motivate smallholders to trade their output. To ease financial constraints, smallholders often sell at low prices during harvest times and buy the same commodities when they are scarce in the market (Stephens & Barrett, 2009; Muriithi & Matz, 2014; Carletto et al., 2017). Lack of appropriate storage facilities also forces farmers to sell large portions of their produce (World Bank, 2018). Government interventions such as imposing compulsory procurements, and input use can also drive commercialization (Von Braun & Kennedy, 1994). For smallholder farmers, commercialization does not necessarily indicate economic benefits from commercialization or a profit-maximizing motive.

Impact and welfare studies typically examine changes in household income or food expenditure change at various levels of commercialization (Ahmed, 2022; Ayenew et al., 2020; Ayele, 2022), changes in consumption expenditure (Awotide et al., 2016) and multidimensional poverty (Birhanu et al., 2021). While these approaches highlight income improvements through commercialization, they often fail to capture the economic status of farmers. For instance, studies have shown that increased income does not necessarily lead to improved economic

status if households spend a significant portion on inputs or debt repayment (Awotide et al., 2016; Chaiya et al., 2023). Depending on their crop yield households could become either better off or worse off financially by selling more crops (Ouedraogo, 2019). The decision may be influenced by costs, risks, and lack of information (Minot et al., 2022). Among Rwandan smallholder farmers, the share of food expenditure from the household total expenditure decreased as commercialized households' income increased (Bolarinwa et al., 2021). Tirkaso (2013) recommended studying the net effect of commercialization as heterogeneity among households and external shocks could bring different impacts on different households.

1.3. Objective of the study

By differentiating commercialization among different levels, this cross-sectional quantitative study aims to explore the relationship between cereal commercialization and household food and non-food expenditure shares of Ethiopian smallholder cereal farmers.

General objectives

This thesis is prepared with the general objective of investigating the impact of cereal commercialization on household food and non-food expenditure shares among Ethiopian smallholder farmers.

Specific Objectives

- To investigate the levels of cereal commercialization among the smallholder farmers in the study area.
- To assess the household budgets on food and non-food expenditure shares among the smallholder farmers in the study area by level of commercialization.
- To evaluate the relationship between cereal commercialization and household budgeting on food and non-food expenditure.

1.3. Research Questions

Main research question

What is the relationship between cereal commercialization levels and household food and non-food expenditure shares?

- What proportion of smallholders fall under the different levels of commercialization (Subsistence, semi-commercialized, and commercialized)?

- What is the household budgeting on food and non-food expenditures among different levels of commercialization?
- What is the impact of cereal commercialization on food and non-food expenditure share from household budgets?

1.4. Scope and Delimitations

The purpose of this study is to understand the impact of different levels of cereal commercialization on Ethiopian smallholder farmers' economic status, which is measured by the percentage share of non-food expenditure compared to food expenditure.

The scope of this research is limited to smallholder farmers who are producing the top five cereals namely barley, maize, sorghum, teff, and wheat (ESS, 2022; World Bank, 2020) in Ethiopia residing in Amhara, Oromia, Somali, SNNP, and Gambela regions and Diredawa City Administration. The study utilized data from an extensive agricultural household survey conducted in five regions and one city administration in 2023 to identify, evaluate, and compare the drivers of resilience to climate change in rural Ethiopia.

The main variables included in this study are household budgets measured by food expenditure share from total expenditure and cereal commercialization. Socio-demographic variables, adoption of agricultural technologies, farm and production characteristics, financial access, and income are controlled for and are evaluated to understand their impact on household food and non-food expenditure shares.

While the study is designed to provide valuable insights into the relationship between cereal commercialization on farmers' household food and non-food expenditure shares, the findings are generalized with caution. The study's cross-sectional design limits its ability to capture changes in agricultural technology adoption, commercialization, and food expenditure over time. Future research could address these limitations by employing a longitudinal design or expanding the sample to include farmers from other regions.

1.5. Significance

Even if smallholder farmers produce 92.4% of Ethiopia's total agricultural output (ESS, 2022), the biggest portion of their production remains for home consumption. Current research often highlights the positive effects of commercialization on income and poverty reduction (Ahmed, 2022; Ayenew et al., 2020; Ayele, 2022; Awotide et al., 2016; Birhanu et al., 2021) However, these studies may not fully capture the economic status of farmers,

as increased income does not necessarily translate to improved welfare if the households are forced to spend significant portions to inputs or debt repayments (Awotide et al., 2016). This study aims to fill the gap by focusing on household budgets specifically the share of food expenditure relative to non-food expenditure to provide a comprehensive understanding of the impact of commercialization on the economic status of households.

By using an endogenous switching regression model and conducting a counterfactual analysis, this research will provide robust evidence on the net effect of commercialization on household budgets. This will help in understanding whether commercialization to economic benefits for smallholder farmers or if it shifts their expenditure patterns without substantial gains. The study will also evaluate the heterogeneity effect among households as per the recommendation of Tirkaso (2013).

By examining the context of Ethiopian agriculture and more narrowly the specific context of farmers in different regions, this study generates findings that are directly relevant to policy development and intervention design. It will contribute to the development of more effective and targeted policies that support sustainable agricultural policies for improved livelihood for Ethiopian cereal-producing farmers. The study's insights into the household budgeting of different farmer groups can guide the development of targeted interventions that can address the specific needs and challenges of different types of farmers.

In conclusion, this study aims to contribute to the understanding of the effect of levels of commercialization on smallholders' household food and non-food expenditure shares, with a specific focus on cereals and smallholder farmers in selected regions of Ethiopia. The findings contribute to policies, interventions, and support mechanisms to cater to the needs of smallholders on different levels of commercialization to achieve economic improvements among smallholders.

CHAPTER TWO

2. Literature Review

2.1. A Brief Background to Agricultural Commercialization

Agricultural commercialization refers to the agricultural transformation process where farmers move from subsistence to more specialized production aimed at markets involving both input purchase and output supply (Jaleta et al.,2009) There are different levels of commercialization with different farmer objectives. In subsistence production, the farmer's objective is food self-sufficiency by using mainly non-traded and household-generated inputs. The objective and the input sources change in semi-commercial farms into generating surplus agricultural outputs and using both traded and non-traded farm inputs. In fully commercialized agriculture, however, inputs are predominantly obtained from markets and profit maximization becomes the farm household's driving objective (Pingali and Rosegrant 1995).

Commercialization is mainly affected by access to agricultural technology for smallholder farmers. Agricultural technology is a broad term covering agricultural equipment, improved seeds, farming practices, and inputs like fertilizers, pesticides, and herbicides. Studies classify them by form namely mechanical innovations, biological and methodological innovations (Ruzzante et al,. 2021; Evenson & Gollin, 2003; Sunding & Zilberman, 2001).

Innovation and adoption of agricultural technologies are part of the agriculture sector that helped food production to keep up with an ever-dynamic population and world by increasing commercialization. The green revolution was a hallmark of the agricultural technology innovation and adoption era that occurred in the late 1960s and early 1970s. It changed the course of agriculture by introducing High Yielding Varieties (HYV) seeds of rice and wheat that enhanced the productivity of farmers. Adoption was fast among Asian and Latin American farmers during the Green Revolution. Governments invested in infrastructure like irrigation and roads to help productivity and market integration. Subsidized inputs and increased availability of agricultural innovations that supplemented the availability of inputs led Asian countries and Latin American countries to transition from subsistence-dominated agriculture to commercial agriculture producing "cheap food" with "cheap labor" potentially saving their population from hunger (Wise, 1987). It resulted in lowered food prices globally which in turn contributed to an increase in average caloric intake leading to improvements in health (Evenson & Gollin, 2003).

2.2. The Green Revolution in Africa

Africa is striving to achieve food self-sufficiency and enhance smallholder commercialization, while the developed world focuses more on sustainability and value addition (Mitra et al., 2021; Sunding & Zilberman, 2001). The continent missed out on the initial benefits of the Green Revolution as the high-yielding varieties (HYVs) developed for Asian and Latin American climates weren't suitable for African conditions. Early efforts focused on rice and wheat, not staple African crops, and it took until the 1980s to breed varieties suited to Africa (Evenson & Gollin, 2003; Briggs, 2009). The Green Revolution succeeded elsewhere due to comprehensive support, including irrigation, consistent rainfall, government-backed financial services, infrastructure, and market linkages areas where Africa still faces challenges, leaving many smallholders in poverty and subsistence farming.

2.3. Measuring Commercialization

Different researchers define the distinction of commercialization differently. In a 2017 Alliance for Green Revolution Africa (AGRA) report, Commercial small farmers are defined as farmers who sell more than 50 percent of their produce. Subsistence farmers are those selling less than 5 percent of their output. Those who are in the middle are defined as semi-commercial (AGRA, 2017). Other studies adopt the definition that smallholders selling 10 percent or less are subsistent farmers, 11-50 percent are semi-commercialized and the rest are commercialized (Minot et al., 2022). Other researchers take that level higher, considering farmers that sell 30 percent or less of their output as having low commercialization levels. Farmers who sell between 30 percent and 75 percent of their output are considered semi-commercialized, and farmers who sell more than 75 percent of their output as highly commercialized (Asuming Brempong et al., 2013 cited in, Abdullah et al., 2017). Because the national level of commercialization is 9-25 percent in Ethiopia (World Bank, 2020), the second definition of commercialization levels is used for this study. Smallholders selling 0-10%, 11-50%, and 51-100% will be considered as subsistent, medium, and highly commercialized respectively.

There are different ways to measure commercialization. The widely used and the best indicator is a simple household commercialization index (HCI) which measures the degree of commercialization by the percentage of crop production marketed (Leavy and Poulton 2007; Strasberg et al. 1999, as cited in Colin, 2017; Govereh et al., 1999 as cited in Jaleta et al., 2009). The gross value of all cereal sales is divided by the gross value of all cereal production times a hundred. Zero is total subsistence and a hundred is total commercialization. For this

study, the level of cereal commercialization is directly inquired from the cereal farmers, they reported the percentage of cereal they sold on the output market and the amount and the percentage they consumed.

2. 4. Cereal Crop Commercialization and Commercialization Policies in Ethiopia

Smallholder farmers in Ethiopia play a crucial role in the Ethiopian agricultural sector. They hold 83.83 percent of the farmland, which accounts for 92.4 percent of total agricultural production in the country. They are responsible for 94.4 percent of all grain production with cereals comprising 88 percent of the produce. (ESS, 2022). During the Belg season, cereals covered approximately 1,265,120.75 hectares 74.28% of the total grain cropland area yielding about 10,882,678 quintals (81.24%) During the Meher season, cereals occupied 9,997,511.08 hectares (81.97%) of total grain cropland area and produced 290,808,263.25 quintals (88.69%) of total grain production (ESS, 2022). The top grains produced by Ethiopian farmers are barley, maize, sorghum, teff, and wheat (World Bank, 2020).

Ethiopian agriculture is mainly subsistence-oriented and vulnerable to climate shocks (UNDP,2016). According to the Ethiopian Socio-Economic Survey 2018/2019 conducted by the World Bank (2020), 62-77% of the major cereal crop production is consumed by households, while only 9-25% is put for sale. This emphasizes cereals' critical role in ensuring food security while also highlighting the limited commercial engagement of smallholder farmers.

Supporting smallholders and promoting cereal crop commercialization has been part of the Ethiopian government's top priority in agricultural development policies. Agricultural development strategies in Ethiopia have been focusing on transitioning subsistence farming practices to market-oriented (commercialized) production systems (Diao, 2010; Amdissa, 2006). Currently, The Ten-Year Development Plan of the Ethiopian government focuses on modernizing agriculture to be able to meet the food and nutritional needs of Ethiopians, strengthen the sector to be able to supply inputs for other sectors and add value to agricultural exports (FDRE, 2021). Targeted agricultural policies at specific cereals like The Ethiopia Wheat Value Chain Development Project (EWVCDP) and interventions like the Agricultural Growth Programs (AGP) focus on increasing commercialization in specific areas. Adding to these efforts, the Sustainable Land Management Program (SLMP) to combat land degradation boosts agricultural productivity and enhances resilience to climate change, and the

Productive Safety Net Program (PSNP) is also being implemented to provide direct support to households vulnerable to food insecurity.

2.5. Evaluation of the Impact of Commercialization

Commercialization can reduce poverty and improve livelihoods by decreasing multidimensional poverty (Birhanu et al.,2022). Its benefits are unevenly distributed. Cereal commercialization is influenced by different socio-economic and demographic factors. Farmers selling their produce does not necessarily mean that they are producing surplus, or they are profit maximizers. Technology adopters and non-adopters would one way or another be involved in the output market. Farmers have different needs for food and non-food items so finding farmers that sell all of their produce (autarky) is not common and feasible among smallholders (Barrett, 2008). Researchers find it hard to make a distinction between the different levels of commercialization. While most smallholders sell some crops, none of them sell all their produce (Minot et al., 2022).

There are different motivating factors for smallholders to trade their output. To finance their needs and ease their financial constraints, it is common among smallholders to sell at low prices at the time of harvest and buy the same commodities when they are scarce in the market (Stephens & Barrett 2009 Muriithi & Matz 2014; Carletto et al. 2017). The lack of appropriate storage technologies also forces smallholders to participate in the output market (Stephens & Barrett 2009). They sell a large portion of their produce to minimize post-harvest losses (Ganesh-Kumar, & Das, 2020; World Bank, 2018). Government intervention can also drive commercialization through direct measures such as; imposing compulsory procurement of agricultural produce, or enforcing specific management practices and use of inputs, (von Braun and Kennedy, 1994). For smallholder farmers, the increase in the proportion of produce sold does not essentially indicate that they are economically benefitting from their commercialization or they are participating with a motive of profit maximization.

Using the degree of commercialization as an indicator of economic improvement might not be sufficient for a conclusion. Even if different researches highlight the impact of commercialization on decreasing the probability of being poor and its impact on improving farmers' livelihood by decreasing multidimensional poverty (Birhanu et al., 2021). The net impacts are not a guaranteed gain (Jaleta et al., 2009). Depending on their food crop yield, families could become either better off or worse off financially by selling more of their crops (Ouedraogo, 2019).

Households' decision to be subsistent could also be a rational decision that is a response to challenges farmers face thereby making them economically better off. It could be a response to limits associated with cost, risk, and lack of information (Minot et al., 2022). The context of wealth and land ownership and even gender can determine who benefits and who loses as market exchanges hold. Highly segmented markets also have high price sensitivity to local productivity increases. This shows that commercialization does not indicate the economic gain of smallholder farmers.

Programs that promote agricultural commercialization need to recognize that subsistence production is not the result of ignorance of the benefits of commercialization but is often a rational decision of smallholders made in the best interest of their household. (Minot et al., 2022). Assuming that selling more of their output automatically will translate into a beneficial strategy does not universally work for all smallholders. Smallholders vary in their market participation motivation, their economic status, and their specific characteristics. There is a consensus that the net effects of commercialization are not always positive it affects different socioeconomic groups differently (Jaleta et al., 2009). A one-size-fits-all pro-commercialization strategy can exacerbate income inequalities by favoring households already better off and disposed to lesser risk (Chamberlin, 2008).

Although there have been notable successes, agricultural development initiatives promoting the adoption of agricultural technologies often struggle with sustainability with adoption failing once the promotional efforts cease (Collin, 2017). Increases in yield and technological adoption do not automatically result in positive returns for farmers. Farmers may buy inputs with money from other sources like remittances without planning to sell what they grow. This does not offset the fact that the increased use of purchased inputs is a way in which commercialization enhances livelihood outcomes for producers but needs to be approached carefully (Colin, 2017).

2. 6. Measuring the Economic Wellbeing of Households Using Engel's law

During the Industrial Revolution, the migration of workers into Europe caused governments to worry about the amount of poverty observed among workers. An international congress was held in Brussels in 1856 to discuss how to measure the extent to which workers have attained "Conditions essential for health and life" In this context, Ernst Engle wrote an article that later led to the famous Engle's Law in 1857. The main objective of his

article was to measure the state of household welfare which he suggested can be discerned from household budgets or consumption patterns (Chai and Moneta, 2010).

Economists have designed many measures to evaluate changes in living conditions. The simplest and most straightforward measure is evaluating income and expenditure (Xiaohua, 2018). Many researchers have been using Engel's law to measure the economic status of households and countries since then. The theory has proved to be a good measure of economic stability and status consistently across time and space (Kaus,2013). Engel's Law states that, as a person's economic status increases, the amount of money spent on food consumption increases but the proportion of income spent on food consumption decreases. The proportion of household expenditure dedicated to food serves as a key indicator of current stability or poverty. This is because any income reduction, irrespective of their current food consumption patterns, is likely to result in a decrease in either the quantity or quality of food intake.

According to the IFPRI technical guide to measure food security, the poorest households globally spend over 75% of their income on food underscoring their vulnerable economic status. Smith and Ali (2007) argue that food expenditure patterns are one of the key indicators of poverty and food insecurity.

This framework aligns with Engel's Law, which states that as income rises, the proportion spent on food decreases, although the absolute amount may still increase. Therefore, households with high food expenditures are likely to face economic constraints and limited access to essential goods and services. Other pieces of literature have also confirmed the same findings that food budget shares decline when income rises although the amount of money spent on food increases, (Bouis, 1994). Understanding these patterns is essential for policymakers to design targeted interventions that improve economic resilience and well-being among smallholders.

Research that evaluates the impact of commercialization on smallholder farmers' welfare uses income and consumption expenditure as a metric to compare the benefit of farmers' decision to participate in the output market. In a time when agriculture is threatened by a spike in input prices, climate change, and pest infestation, measuring the change in income and total consumption expenditure of farmers to evaluate the relationship between commercialization and welfare may not give the full picture of the contribution of commercialization to a household's economic empowerment. An increase in consumption or income does not necessarily indicate

economic stability. It can be understood by evaluating the household budget allocation on food and non-food consumption. The poorer a household is the greater must be the proportion of food spending (Zimmerman, 1932). There are ample studies done on agricultural technological adoption and commercialization that compare differences in income and consumption expenditure between adopters and commercialized farmers, but the impact of different levels of commercialization has not been studied in this light of household budgeting measured by the percentage share of food expenditure compared to non-food expenditure. In addition, the effect of commercialization has been found on the differential effects of commercialization in household assets (Tabe et al., 2022).

Household size dependency ratio in the household impacts both commercialization (Assefa et al., 2024) and welfare levels among farm households. Studies done in Fiji and Ethiopia found that larger household sizes can improve labour availability in the household having a positive effect on production which will improve the market orientation of households. (Reddy, 2024; Adeyanju et al., 2023). The dependency ratio has a converse effect on commercialization by straining resources and limiting market involvement (Dercon & Christiaensen, 2008).

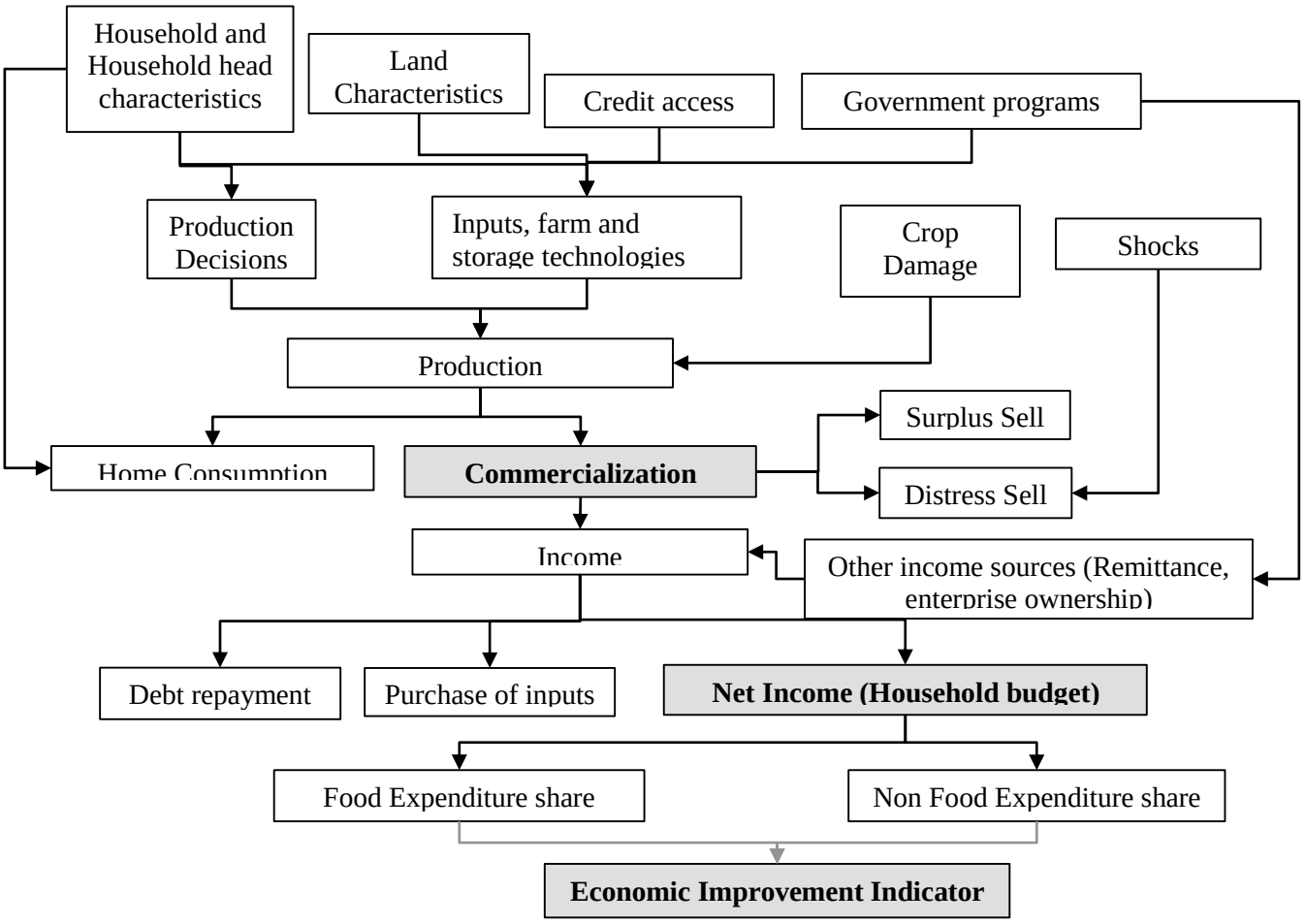
Household head characteristics like gender, literacy, and age have been found to impact the commercialization and welfare status of households. An increase in the age of the household for commercialized households was associated with higher dietary diversity (Assefa et al., 2024). Gender dynamics also plays a significant role in consumption, budgeting, and commercialization decisions (Ayele et al., 2021; Ingabire et al., 2017)

Land properties, government programs inputs, and technologies also impact commercialization levels thereby impacting the income and economic welfare of households. Soil quality is associated with welfare through increased output (Hörner &Wollni, 2021) A study conducted by Muricho, (2015) found that in Kenya soil quality and land size are associated with higher commercialization and better income for farmers. In Afar, Oromia, and Somali regional states, farmers with extension service access were more commercialized (Nigussie et al., 2016). In a study conducted to evaluate the effectiveness of PSNP involvement for farmers Hailu & Amare, (2022) found that it had a positive significant impact on program participants' food security. In an impact evaluation of the SLMP project Schmidt & Tadesse (2017) found that SLMP participation brought no difference in values of crop sales in Ethiopia. Tadesse (2023) in a study conducted in the SNNP region found that farmers that were in the SLMP program had higher yields compared to the non-participants.

When households face shocks changing consumption behavior in the short term by skipping meals and reducing the quality and quantity of foods in common (Ansah et al., 2020). Taking credit that will be utilized for smoothing consumption and bearing the shocks is also common. Osabohien et. al., (2020) found that among smallholder farmers in Nigeria, credit access during the time of shock helped farmers maintain consumption levels and kept the households from selling assets or decreasing consumption. Chaiya et., al. (2023) also found the same among Pakistan farmers. Shocks could also affect food expenditure shares negatively.

2.7. Conceptual Framework

Figure 1: Factors influencing commercialization and its impact on household food and non-food expenditures



The framework *Figure 1* shows the multifaceted factors that drive smallholder farmers toward commercialization and the impact on their household budgets. Key factors such as household and household head characteristics, land attributes, access to credit, and participation in governmental programs shape critical production decisions like consumption and production decisions, selection adoption of advanced farming and storage technologies which impact the amount of production they get from their farms and the amount of crop they will sell in the

market that will impact their income and food and non-food expenditure shares. Remittances and off-farm activities also affect the income of the household which will impact the household budget. The revenue (the total income) of the household will be divided into debt repayment, input purchase, and household budget (net income) which will be allocated to food and non-food expenditures (school fees, energy costs, clothing, social expenditures, etc.). When the household is in a better economic status, their food expenditure will be less than 75% of the household budget which could be an indicator of their economic improvement.

Chapter Three

3. Methodology

Endogenous switching regression is used to analyze the relationship between cereal commercialization and food and non-food expenditure among smallholder cereal farmers. This section exposits the overall methodology, data source, and analysis method selected to conduct the study.

3.1. Data type and Source

This research utilizes primary data from a survey titled "*Survey on Building Resilience to Climate Change in Ethiopia: Exploring Options for Action*" conducted by the University of Copenhagen Development Economics Research Group (UCPH-DERG) and the Policy Studies Institute (PSI) to understand the climate change resilience of farmers in April 2023 in Ethiopia. The survey had two rounds. There were 3995 respondents surveyed in the first round conducted in 2021, and 1995 households were surveyed in 2023.

The survey covers 40 woredas (the lowest level of administration) drawn from five regional states (Amhara, Oromia, Somali, Gambela, and Southern Nations, Nationalities and Peoples (SNNPR), and one City administration (Dire Dawa). Thirty-one of these woredas are from flagship programs, while the remaining nine are from non-program woredas.

Systematic Random Sampling was employed. Fifty households were drawn from each woreda. Inaccessible woredas and woredas with security problems were dropped before sampling. Then, the number of woredas was randomly drawn from the respective list.

The survey instruments included questions designed to capture the commercialization practices, household food and non-food expenditures, inputs, household characteristics, input utilization, shocks, agricultural programs participation, and livelihood methods of the participants. The questions explored the types of crops predominantly grown by the participants as well as the amount sold from their total produce, Additionally, the survey included questions on food and non-food expenditures which were the source of data for this paper.

3.2. Data Extraction

Variables of interests were identified from the Survey which covered 1,995 Households and a different range of questions. Households that are dominantly livestock bearers, those who did not predominantly harvest cereals

and who did not report their commercialization levels, and those with simultaneous zero food and input expenditures were removed. After cleaning the data, 1741 households were identified for analysis.

3.3. Variables Description

3.3.1 Dependent variable

Food expenditure shares

Household's food expenditure share from total budget of food was taken as an indicator for poverty according to Engel's law. It is calculated from the percentage of food expenditure from net income after deducting input costs from a household's expenditure.

$$Poverty = \left(\frac{food\ expenditure}{net\ income}\right) \times 100 < 75\%$$

If the household utilizes less than 75% of the income from the commercialization of food, it is considered as economically better off (Smith and Ali, 2017). If the household budgets more than 75% of its income on food, it is economically worse off. When a shock occurs to a household's income, an economically vulnerable household spending more than 75% of its income on food will need to decrease costs from its food consumption levels.

Table 1: Expenditure on food and non-food items considered for the study

Expenditure on food items in the last 12 months (Birr)	Expenditure on non-food items in the last 12 months (Birr)
Cereals (Maize, teff, wheat, barley, etc.) Pulses (Horse bean, field pea, chickpea, lentil Oil crops (Noug, flax, sesame, sun-flower, etc.) Vegetables (potato, tomato, onions, etc.) Fruits (Banana, orange, papaya, avocado, etc.) Meat eggs, milk and milk products Beverages and stimulants (alcoholic, coffee, tea, etc.) Fats, oils, sweeteners, snacks & honey Meals eaten away from home	Clothing (cloth, shoes, etc.) Communications (travel, phone, radio, TV, newspaper Energy (wood, electricity, charcoal, kerosene, batteries, etc.) Fees & contributions (School, health, milling, tax, dowry, associations, funeral, remittance, rent, ceremony, debt) Furniture & cleaning (utensils, detergent, repairs) Deposit to saving

3.3.2. Independent variable

Cereal Commercialization

The cereal commercialization level of smallholder farmers is obtained from farmers' responses when asked for the percentage of the produced cereals they sold. The cereals considered in this study are barley, maize, sorghum, teff, and wheat.

- Households with less than 10% commercialization index are considered subsistence farmers.

- Households with an 11% - 50 % commercialization index are considered semi-commercial farmers.
- Households with a 51%-100% commercialization index are considered commercial farmers. (Minot et al., 2022; Baisa, 2009; Girma, 2021)

3.3.3. Control Variables

Based literature, a range of control variables that could influence the household food expenditure share of smallholder farmers were identified. Hence, additional variables have been taken into account in the analysis in order to control for endogeneity and correct for any possible correlation between the main regressors and the error term.

First, farm and production characteristics and types of agricultural technologies adopted that could potentially affect income and consumption levels of households are controlled in the analysis. Farming system of the household, if the household uses mixed farming or is crop only, the total land size of the household and, the average slope of the land are accounted for.Year-round production obtained by asking the households if they harvest in the two major cropping seasons Meher and Belg, the type of cereal produced, and crop damage. The utilization of improved seeds, fertilizers, agrochemicals (fungicides, pesticides, and herbicides), irrigation, storage methods, utilization of mobile phones for extension services, and household contact with extension agents.

Second, demographic variables that could have an impact on the economic stability of cereal farmers, such as the gender of the household head, level of education of the household head, household size, and dependency ratio are controlled.

Financial access and income variables are controlled for in the analysis. Credit access is represented by “1” if the household had access to credit in the past year. Ownership of active enterprises by the household and remittances received by the household are considered. Participation in agricultural programs (AGP, PSNP, and SLMP) is also evaluated to control the effect it has on household budgeting decisions.

Table 2: Description of study variables

Category	Variables	Variable definition	Measurement
Outcome variable	Food expenditure share	"0" spends more than 75% of household budget on food, "1" spends less than 75% of household budget on food	Continuous
Treatment variable	Commercialization (*Commercialization)*	If a households that sell more than 50% of their produce "1"Barley, "2" Maize, "3"Sorghum , "4"Teff, "5"Wheat	"0" subsistence and semi-commercialized, "1" commercialized
Household and Household head characteristics	Region	SNNPR taken as a reference region due to its high number of respondents	"0"if the household is located outside of the SNNPR, "1" if the household is located in the SNNPR
	Household size	Number of household memebers	Continuous
	Head gender	Gender of the household head	"0" female, "1" male
	Head age	Age of the household age	Continuous
	Dep ratio	Number of household members aged 0-14 and 65 compared with the rest of the household members	Continuous
	Literacy of the HH head	If the household head had any form of education	"0" illiterate, "1" literate
Farm and production characteristics	Total land size	Total size of your holding?	Continuous (hectares)
	Avg land slope	What is the appearance (slope) appearance of the parcel? (slope) of the [PARCEL] 1. Flat slope 2. Medium slope 3. Steep slope	"1" Flat slope, "2" Medium slope, "3" Steep slope
	Avg soil quality	What is the soil quality of your parcel?	"1" Good (Lem), "2" Fair (Lem-tef), "3" Poor (Tef)
	Avg tillage	How many times was the plot tilled this agricultural season	Continuous
	All year production	If the household has harvested cereals in both the production seasons Belg and Meher	"0" only harvested on Meher in the year, "1" harvested in both seasons
	Crop diver index	Typed of crops the household grows	Continuous
	Crop rotation	If the household uses crop rotation to keep the soil's fertility	"0" does not use crop rotation, "1" uses crop rotation
	Fertilizer	If the household utilized fertilizers on their farm	"0" non-utilizers, "1" utilizers
	Agrochemicals	If the household has utilized herbicides, pesticides and fungicides	"0" non-utilizers, "1" utilizers
	Storage technologies	If the households use traditional (unprotected pike, heaped in house, bags in house) or modern (metallic silo, silo, pit, rented storage) to store their crops	"0" traditional, "1" modern

	Loss	If the household had incurred loss on its crop	"0" no damage, "1" damage
Government program involvement	Extension	Have you met with an extension agent within the past year?	"0" did not meet an extension agent, "1" met an extension agent
	AGP	In the last 5 years, has the household or anyone in the household been participating in the AGP?	"0" the HH does not participate in AGP, "1" the HH participates in AGP
	PSNP	In the last 5 years, has the household or anyone in the household been participating in the PSNP?	"0" the HH does not participate in PSNP, "1" the HH participates in PSNP
	SLMP	In the last 5 years, has the household or anyone in the household been participating in the SLMP?	"0" the HH does not participate in SLMP, "1" the HH participates in SLMP
	No program	Study participants that are not a part of AGP,PSNP, or SLMP	"0" participate in a flagship program "1" do not participate in flagship programs
Financial service access and income	Remittance	If the household has received income in the form of remittances	"0" did not receive remittance, "1" received remittance
	Off farm income	Over the past 5 years, did you or any member of the household own a non-agricultural business or provide a non-agricultural service from home or a household-owned shop?	"0" the household does not own an active enterprise outside of farming, "1" the household owns an active enterprise outside of farming
	Credit	Did you have access to credit last year?	"0" did not have a formal credit access in the past year, "1" had a formal credit access in the past year
	Saving	Did you have savings in the past 12 months?	"0" No, "1" Yes

3. 4. Econometric Analysis

Using non-experimental data to conduct impact evaluation is challenging as it is not possible to see what the impact would be if the treated groups were untreated and vice versa. In experimental studies, this issue is solved by randomly assigning treated and control groups ensuring unbiased comparisons.

However, in this study, households self-select into either commercialized or uncommercialized groups leading to potential systematic differences. Simply using pooled regression might yield biased results as it assumes

commercialization is exogenous while it is influenced by household characteristics so the explanatory variables would have different impacts on the household food expenditure share of commercialized and uncommercialized households. The separate household food expenditure share outcome function needs to be modeled separately.

To address this an endogenous regression model (ESR) is used which accounts for endogeneity and sample selection by estimating separated outcome equations for commercialized and uncommercialized households along with a selection equation.

This section explains the steps used to estimate coefficients for the effect of commercialization on food expenditure share. Commercialization and household characteristics and their impact on food expenditure share can be modeled in two stages. The first stage is to model the selection function for the household decision to choose commercialization, which depends on household characteristics and other socioeconomic behaviors. The most important driving force behind the decision to commercialize is the net benefit that can be obtained from the adoption of commercialization.

If A_i^*denotes the net benefit from practicing commercialization, A_i^*can be expressed in terms of explanatory variables assumed to affect the net benefit:

$$(3a)\ A_i^* = Z_i\alpha + \mu_i$$

Where:

$$A_i^* = \begin{cases} 1 & if\ A_i^* > 0 \\ 0 & Otherwise \end{cases}$$

Regime 1: (Commercialized)

$$(3b)\ Y_{1i} = X_{1i}\beta_1 + \varepsilon_{1i} \text{ if } A_i^* = 1$$

Regime 2: (Uncommercialized)

$$(3c)\ Y_{2i} = X_{2i}\beta_2 + \varepsilon_{2i} \text{ if } A_i^* = 0$$

Where:

Z is a vector of variables assumed to determine the decision whether to adopt commercialization or not.

is a parameter to be estimated.

μ is the error term in the selection equation.

Y_{1i} and Y_{2i} are the expected food expenditure share when the latent variable occurs and does not occur, respectively.

$X_{ij}$is a vector of explanatory variables assumed to affect the expected food expenditure share, including:

- Household and Household head characteristics (Region, Household size, Gender of the HH head, Age of the HH head, Dependency ratio, Literacy of the HH head)
- Farm and production characteristics (Total land size, Avg land slope, Avg soil quality, Avg tillage, All year production, Crop diver index, crop rotation, Fertilizer usage, Agrochemical usage, Storage technologies, loss dummy1)
- Government program involvement (Extension, AGP, PSNP, SLMP, No program)
- Financial service access and income (Remittance, Off farm income, Credit, Saving)

Y_{1i} and Y_{2i} will not be observed simultaneously; the covariance of the error terms ε_{1i} and ε_{2i} is undefined. However, ε_{1i} and ε_{2i} are internally correlated via the first selection equations. Therefore, ε_{1i} and ε_{2i} , and μi have a trivariate normal distribution with an expected mean of zero and a covariance matrix defined as:

$$\Omega = \begin{bmatrix} \delta_{\mu}^{2} & \delta_{1\mu} & \delta_{2\mu} \\ \delta_{1\mu} & \delta_{1}^{2} & . \\ \delta_{2\mu} & . & \delta_{2}^{2} \end{bmatrix}$$

Where δ_{μ}^{2}, : the variances of the selection equation *(3a),*

δ_{1}^{2}, and δ_{2}^{2} :Variances of the error terms in the outcome equations *(3b)* and *(3c).*

$\delta_{1\mu}$and $\delta_{2\mu}$: Covariances between the error term in the selection equation and the error term in the outcome equations (i.e., (ε_{1i} and μ_i), and (ε_{2i} and μ_i) ,respectively.

The variance of the error term in the selection equation δ_{μ}^{2} can be assumed to be one as the estimation is done up to scale (Maddala 1986). The structure of the variance-covariance relationship indicates that conditional expected values of the error terms are different from zero. Therefore, the decision to adopt or not (selection equation) depends on the covariance between $\mu_i$and ε_{ij} If the covariance. $\delta_{i\mu}$ is statistically significant (stronger), then the food expenditure shares from total household budget and the decision to adopt commercialization are correlated. If such correlation exists, it indicates the presence of heterogeneity between the groups rather than simple sample selection bias in deciding to adopt. This type of model is known as the “Endogenous Switching Regression

Model" (Maddala 1986). An efficient approach to estimate endogenous switching regression models is the use of Full Maximum Likelihood (FML) estimation (Lee 1997; Di Falco et al 2011).

Conditional expectation and the effect of heterogeneity

the Endogenous Switching Regression (ESR) model is used to estimate the actual and counterfactual effects of commercialization on food expenditure share for households that commercialized and for those that did not. Thus, it is possible to compare the role of commercialization on expected food expenditure share for commercialized and non-commercialized households in actual and counterfactual cases. Accordingly, the role of commercialization on the expected food expenditure share can be estimated in different setups, as indicated in Table 3.2.

Conditional Actual and Counterfactual Expected Food Expenditure Share

Table 3: Conditional Expectations, Treatment, and Heterogeneity Effects

Sub-samples	**Decision Stage**		
	To commercialize	Not to commercialize	Treatment Effects
Commercialized Households	$(a)\ E(Y_{1i}\mid A_i=1)=X_{1i}\beta_1+\sigma_{1\mu}\lambda_{1i}$	$(b)\ E(Y_{1i}\mid A_i=0)=X_{2i}\beta_1+\sigma_{1\mu}\lambda_{2i}$	TT
Uncommercialized Households	$(c)\ E(Y_{2i}\mid A_i=1)=X_{1i}\beta_2+\sigma_{2\mu}\lambda_{1i}$	$(d)\ E(Y_{2i}\mid A_i=0)=X_{2i}\beta_2+\sigma_{2\mu}\lambda_{2i}$	TU
Heterogeneity	BH_1 *(a)-(c)*	BH_2 *(b)-(d)*	TH

This approach enables us to estimate the role of commercialization on food expenditure share accounting for the heterogeneity of households. The row difference measures the role of commercialization when heterogeneity effects are controlled. The column differences measure the role of commercialization for households that commercialized and did not commercialize under actual and counterfactual situations.

The diagonal elements (a) and (d) represent the expected food expenditure share in the sample data set for commercialized and non-commercialized households, respectively. Similarly, cells (b) and (c) represent the counterfactual expected food expenditure share for commercialized and non-commercialized households, respectively.

The effect of the treatment “to commercialize” on the treated (TT) is the difference between (a) and (b). This represents the effect of commercialization on the food expenditure share of commercialized households. Similarly, we calculate the impact of the treatment on the untreated (TU) for smallholders that did not commercialize as the difference between (c) and (d)

Households that commercialized may have had higher food expenditure shares than those that did not, regardless of their decision to commercialize, but due to unobservable characteristics such as their skills. Carter and Milon (2005) define the effect of base heterogeneity (BH) for the group of households that decided to commercialize as the difference between (a) and (c). For the group of households that decided not to commercialize, “the effect of base heterogeneity” is the difference between (b) and (d)

Finally, we investigate the transitional heterogeneity (TH), which is whether the effect of commercializing is larger or smaller for households that commercialized compared to those that did not in the counterfactual scenario where they did commercialize, which is the difference between TT and TU.

Chapter Four

4. Results and Discussion

This chapter provides insight into the descriptive statistics and the empirical findings derived from the econometric analysis of cereal commercialization and its impact on food and non-food expenditure shares from household budgets. I present the findings on the level of commercialization, food expenditure shares among different levels of commercialization, key factors influencing commercialization decisions, and the impact of cereal commercialization decisions on the food expenditure share of households and heterogeneity effects.4.1.

4.1. Descriptive Analysis

Table 4: Socio-economic and Farm Characteristics Based on Commercialization Levels

	Total Sample		Farm households that commercialized		Farm households that are not commercialized	
Variable Name	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Outcome variable						
Food exp share	0.679	0.186	0.64	0.198	0.691	0.18
Household and Household head characteristics						
Household size	6.186	2.248	6.268	2.354	6.161	2.214
Head gender	0.825	0.38	0.83	0.376	0.823	0.382
Head age	47.325	12.778	45.209	12.088	47.97	12.917
dep ratio	1.533	1.209	1.541	1.104	1.531	1.24
literacy dummy2	0.55	0.498	0.651	0.477	0.519	0.5
Farm and production characteristics						
Avg soil quality	1.542	0.567	1.492	0.521	1.557	0.579
Total land size	1.524	1.641	1.631	1.633	1.492	1.642
Avg land slope	1.486	0.577	1.497	0.545	1.483	0.587
Fertilizer	0.862	0.345	0.919	0.273	0.845	0.362
Agrochemical usage	0.528	0.499	0.671	0.471	0.485	0.5
All year production	0.105	0.307	0.101	0.301	0.106	0.309
crop rotation	0.694	0.461	0.776	0.417	0.669	0.471
Average tillage	2.338	0.926	2.429	0.934	2.311	0.922
Crop diver index	61.406	24.836	66.602	19.825	59.821	25.975
Loss	0.122	0.327	0.125	0.331	0.121	0.326
Storage dummy	0.144	0.351	0.145	0.352	0.144	0.351
Financial services access and income						
Off farm income	0.5	0.5	0.518	0.5	0.494	0.5
Remittance	0.143	0.35	0.14	0.347	0.144	0.351
Credit	0.141	0.348	0.13	0.337	0.144	0.351
Saving	0.13	0.336	0.15	0.357	0.124	0.329
Government program involvement						

Extension	0.6	0.49	1.332	0.471	1.419	0.494
AGP	0.202	0.402	0.246	0.431	0.189	0.392
PSNP	0.296	0.457	0.26	0.439	0.307	0.462
SLMP	0.28	0.449	0.219	0.414	0.298	0.458
No program	0.222	0.416	0.275	0.447	0.205	0.404
Sample size	1741		407		1334	

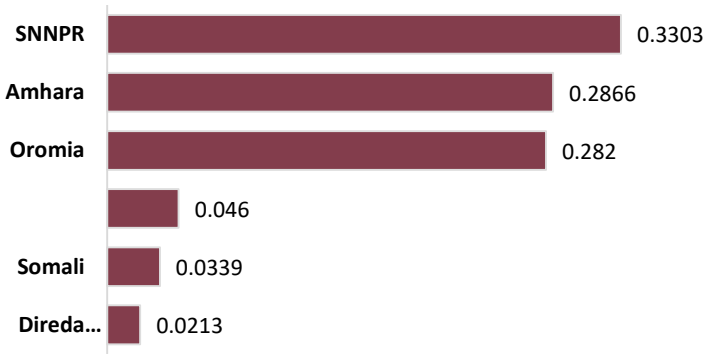
Source: Author's computation based on RCC

Household and Household head characteristics

Average household sizes, household age, and dependency ratio are fairly similar among both commercialized and uncommercialized households. An average household comprises six people. Household head gender is also similar for both most of the household heads being male (82%).

Commercialized households have slightly younger household heads with the mean age for the commercialized households being 45 years old for commercialized households and 48 years old for non-commercialized ones. There is a higher literacy observed among heads of commercialized households with 65% being able to read and write compared to non-commercialized households where literacy is 52%.

Figure 2: Percentage of respondents by region



The regional distribution of the households under study is diverse with 33% of the respondents residing in SNNPR. 28% of the respondents live in Amhara nearly equal amount of respondents in Oromia (28.2%). The rest of the respondents reside in Somali (3.4%) and Diredawa (2.1%)

Farm and Production Characteristics

Commercialized households have slightly better average soil quality and have a bigger land size compared to non-commercialized farmers. There is also a higher fertilizer and agrochemical usage among commercialized households. Higher average tillage was observed in the commercialized group Crop rotation is more common among commercialized households with higher crop diversity. Both groups have similar average land slops and almost identical storage utilization. Around the same proportion of smallholders faced losses in both groups.

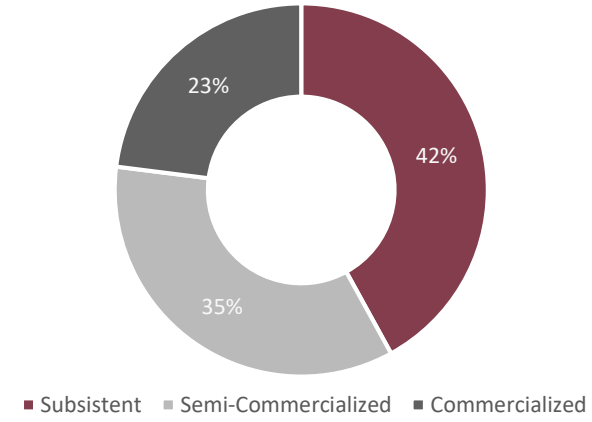
Access to financial services and Income and Government Program Participation

Off-farm income and ownership of enterprises are higher among commercialized households. Remittances, credit, and savings are similar across both groups.

There is higher participation in extension services among commercialized households and higher participation in AGP among commercialized households (0.25). PSNP and SLMP participation is slightly higher among non-commercialized households. There is a higher proportion of commercialized households that are not involved in any government programs.

4.2. Commercialization and food expenditure share among households

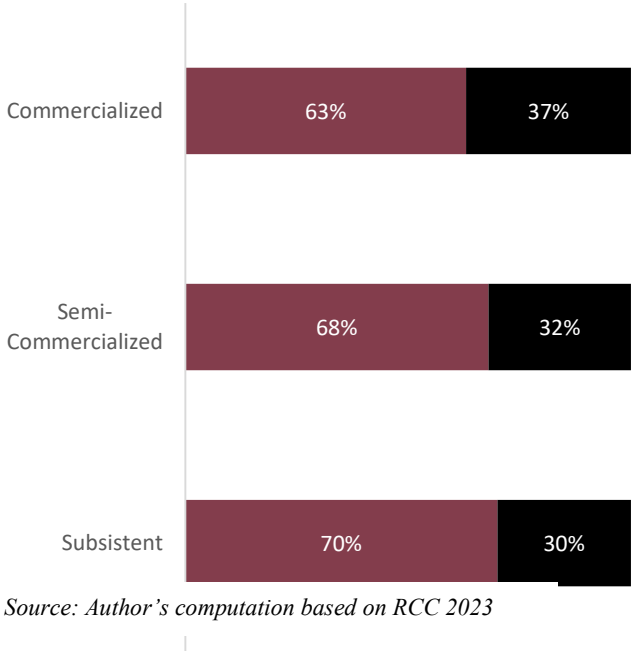
Figure 3: Commercialization Levels of Respondents



Source: Author's computation based on RCC 2023

Commercialization: The proportion of subsistent farmers is the largest with 42 percent of the respondents selling less than 10% percent of their produce. Semi commercialization comes next with 35% of the respondents selling between 11-50 percent of their produce. Commercialization is low among the respondents10% with only 23% of the respondents selling more than 50% of their produce.

Figure 5:Household Budget Allocation at Different Levels of Commercialization



Source: Author's computation based on RCC 2023

Food expenditure Share: Average food expenditure shares also vary among the different groups of commercialization where subsistence households have the highest mean food expenditure (70%) indicating they spend a larger portion of their income on food. Semi commercialized farmers spend 68% of their income on food on average and commercialized households have the lowest food expenditure share among the three groups budgeting 63% of their income on food.

4.3. Endogenous Regression of the Parameter Estimates

4.3.1. Instrumental variables and Falsification Tests

A falsification test was conducted to ensure the robustness of the instruments used in the endogenous switching regression model. The test aimed to verify whether the chosen instrumental variables (IVs) were appropriate for the analysis. Based on their results, the following instrumental variables were used for the study.

Crop diversification: The crop diversification index has been used as one of the instrumental variables because it enhances productivity by helping as natural weed protection and reduces the risk of crop failure shock. But, its impact on changing household's economic status is low (Gebiso et al.,2023; Sharma et al., 2021; Singh et al., 2022).

Average Tillage: Average tillage, representing the intensity of land preparation and cultivation practices, was chosen as an instrumental variable. It is hypothesized to be correlated with commercialization and more intensive farming practices could be indicative of market-oriented participation.

Table 5: Parameter Estimates- Test of validity of Selection Instruments

	Model 1	**Model 2**
	Commercialization 1/0	Food expenditure share
Crop diversification index	0.007***	0
Average tillage	0.097***	0.005
Constant	-1.44	0.672

***p<0.01, **p<0.05, *p<0.1

Source: Author's computation based on RCC 2023

The falsification test revealed that both instrumental variables, crop diversification index (0.007***) and average tillage (0.097***) were significantly correlated with the likelihood of commercialization (Model 1) confirming their relevance in explaining the decision to commercialize. When these variables were included in the model for food expenditure share (Model 2), they were not statistically significant. The lack of significance suggests that while these instruments are good predictors of commercialization, they do not directly affect the food expenditure share of households. The results of the falsification test validate the selection of crop diversification index and average tillage as instrumental variables for the endogenous switching regression model.

Table 6:Parameter Estimates of commercialization and food expenditure share equations

	(1)	(2) Endogenous Switching Regression	(3) Endogenous Switching Regression
		Commercialization=1 (Farmers have sold more than 50% of their produce)	Commercialization=0 (Farmers have sold less than 50% of their produce)
Model	Commercialization1/0	Food Expenditure Share	Food Expenditure Share
Region	0.427	-0.028	0.031
Household size	0.013	-0.032***	-0.036***
Head gender	-0.171*	0.026	0.013
Head age	-0.01***	0.002**	0.001*
Dep ratio	0.004	0.021**	0.01**
Literacy of HH head	0.201***	-0.081***	-0.013
Avg soil quality	-0.112	0.03	-0.015
Total land size	0.001	-0.01	-0.014***
Avg land slope	0.077	0.013	0.007
Fertilizer	0.061	-0.034	-0.001
Agrochemicals	0.528***	-0.147***	-0.012
All year production	-0.026	-0.064*	-0.014
Extension	-0.046	0.031	-0.016*
Crop rotation	0.299***	-0.066**	0.014
Loss	0.017	-0.063**	-0.019
Storage technologies	0.04	-0.06**	0.014
Off farm income	0.074	-0.017	-0.003
Remittance	0.028	0.003	-0.006
Credit	-0.24**	0.032	-0.018
Saving	0.122	-0.098***	-0.037***
AGP	0.267**	-0.066**	-0.025*
SLMP	0.01	-0.017	-0.016
No program	0.199*	-0.139***	-0.08***
Avg tillage	-0.006		
Crop diver index	0.003*		
_cons	-1.226	1.221	0.941
$\boldsymbol{\delta}$		-1.394***	-1.861***
ρj		-1.465***	0.018

***p<0.01, **p<0.05, *p<0.1

Source: Author's computation based on RCC 2023

4.3.2.1. Determinants of commercialization

The results of the estimation of the selection equation **(1)** suggest that the main drivers of farm households' decision to commercialize are region literacy usage of agrochemicals crop rotation being part of the AGP program being not involved programs and crop diversification. Being part of the PSNP program was removed from the model due to collinearity.

Households headed by females are more likely to commercialize suggesting a gendered dimension to commercialization decisions. Ingabire et al., (2017) also found similar results on the commercialization of beans in Rwanda. An increase in the age of the household head is negatively associated with commercialization, indicating that older household heads might be more risk-averse and might be less inclined to adopt market-oriented strategies. Access to credit is associated with a decrease in commercialization. This highlights how credit among smallholders is used. It is a sensible finding because at the time of crop loss, the amount of market surplus would decrease and the produced crop would be used for household consumption which is common among smallholder farmers (Osabohien et. al., 2020; Chaiya et., al. 2023). The access to credit would help them meet their financial needs which would have been gained from crop sales.

4.3.2.2 Impact of commercialization on food and non-food expenditure share of households.

We now analyze the impact of commercialization on the food expenditure share of households. The estimates provided in the final two columns of Table 6 take into account endogenous switching within the household food expenditure share function. Among the correlation coefficients (ρj) shown in the bottom row of Table 6, both are negative but only ρj1 is statistically significant, while ρj2 is not. This suggests that the hypothesis of no sample selection bias may be valid in the case of commercialized households regarding food expenditure shares but not in the commercialized ones. In other words, the factors influencing how much-commercialized households sell also impact how they budget their food and non-food expenditure shares indicating endogeneity. Conversely, the factors that affect how much the semi-commercialized and subsistent farmers sell do not affect the allocation of budgets for food and non-food expenditures.

Household and household head characteristics impact the food and non-food expenditure share of household budgets. The results show that an increase in household size is associated with a lower food expenditure share across all the commercialized and non-commercialized households. This is due to the greater labor availability in the household which will have a positive effect on production. This is consistent with other studies done in Fiji and Ethiopia that larger household sizes can improve labour availability in the household having a positive effect on production which will improve the market orientation of households. (Reddy, 2024; Adeyanju et al., 2023). On the other hand, an increase in the dependence ratio in the households is associated with a higher food expenditure share from household budgets indicating a worse economic status. Dercon & Christiaensen, (2008)

have also found dependency ratio affects commercialization negatively by straining resources and increasing consumption in the household. Literacy of the household head measured by the ability to read and write, is associated with the economic well-being of the household indicated by the lower share of food expenditure from the household budget. Households headed by older people tend to have higher food expenditure shared in both groups.

The increase in the total land size and access to agricultural extension services is associated with a decrease in the food expenditure share from household budgets for households that are subsistent and semi commercialized This is consistent with the study of Muricho (2015) which found that an increase in land size is associated with Kenyan farmers' welfare. Crop rotation, sowing cereals both in the Meher and Belg season, and utilizing agrochemicals like herbicide fungicides and pesticides significantly affect households that are commercialized and are associated with a decrease in the food expenditure share of the households. Owning modern storage facilities is associated with lower food expenditure shared from household budgets for commercialized households. This could be because modern storage facilities are associated with an economically better-off household. Ganesh-Kumar, & Das (2020) have also found that storage technologies help families to sell at better times. Incurring loss on their agricultural produce is associated with a lower food expenditure share for commercialized households this indicates how the commercialized farmers would endure shocks by reducing their expenditure on food which is usually one of the main methods farmers use to keep their other expenditures and commitments such as education and energy consumption and others relatively constant. This is consistent with the findings of Ansah et al. (2020).

Being part of the Agricultural Growth Program (AGP) significantly affects households despite their commercialization levels. Households that are part of the AGP are associated with lower food expenditure shares compared to those who are not. This shows the importance of government policies and programs in improving the livelihoods of smallholders. An interesting finding is that households that are not a part of all the three programs evaluated in this study namely AGP, PSNP, and SLMP are associated with a lower food expenditure share from their household budget. This is a sensible finding because households enrolled in the PSNP are already economically poor needing economic assistance. Those enrolled in the SLMP are living in areas where land is degraded and lower economic status is expended due to the quality of their lands. An impact evaluation of the

SLMP project has also found that SLMP activities have no impact on the value of crop production compared to non-participant households (Schmidt & Tadesse,2017).

4.4. Treatment and Heterogeneity Effects

Table 7: Average Expected Food Expenditure Share ; Treatment and Heterogeneity Effects

Decision stage			
Sub samples	To commercialize	Not to commercialize	Treatment Effects
Commercialized	(*a*) 0.64	(*b*) 0.69	ATT = -0.009 (*tt*)(min -0.674 max 0.502)
Non commercialized	(*c*) 0.67	(*d*) 0.69	ATU = 0.014 (*tu*)(min -0.553 max 0.523)
Heterogeneity Effects	BH_1 = -0.03	BH_2 = -0.01	TH = -0.023

Source: Author's computation based on RCC 2023

Table 7 presents the effect of commercialization on household budgeting under actual and counterfactual conditions. *(a)* and *(d)* represent the expected share of the food expenditure budget of the commercialized and uncommercialized households observed in the sample. *(b)* and *(c)* represent the counterfactual scenario to understand the effects of commercialization on food expenditure share if the commercialized farmers were uncommercialized *(b)* and the uncommercialized were commercialized *(c)*.

The expected share of food expenditure by households that commercialized *(a)* is 64% while it is about 69% for the households for uncommercialized households *(b)* which indicates that commercialized households have more disposable income to be spent on non-food consumption compared to those who are not commercialized.

In the counterfactual case *(c)* considering if the uncommercialized farmers were commercialized, the commercialized farmers are expected to have a 3% less food expenditure share than the uncommercialized ones which differences other than commercialization levels between the commercialized households and the rest. Similarly, in the counterfactual scenario where the commercialized farmers were not commercialized *(b)* the difference in the food expenditure share of the households is 10% with commercialized farmers spending 10% less of their budget on food. Under both conditions commercialized households would have lesser food expenditure shares in their budgets.

The last row of Table 7 which adjusts for the potential heterogeneity in the sample shows that farmers who are actually commercialized have underlying base heterogeneities that help them live a better life compared to the

semi-commercialized and subsistent farmers. In other words, farmers who are commercialized have other characteristics that help them live better if we don't consider commercialization. The transitional heterogeneity (TH) is slightly more negative showing that the effect of commercialization helps in the decrease of food expenditure shares more for commercialized households.

As indicated in the last column of Table 7, the result of the average treatment on the treated effect (ATT) is negative indicating that on average, commercialization improves the economic status of farm households indicated by a 10% lower food expenditure share from household budget. The average treatment effect on the untreated effect (ATU) is positive indicating that if the semi-commercialized and subsistent cereal farmers were to commercialize, on average their food expenditure share would have increased by 15%.

The treatment effects are not the same for all cereal-farming households. Tabe et al., (2022) also found that among maize farmers, commercialization has a generally positive but variant effect among households. As shown in the last column of Table 7 the treatment effects on the treated (*tt*) range from decreasing the food expenditure share of the households by 67% to having a 50 increase in their food expenditure shares indicating the double side of "commercialization" which could be of a profit-making motive or a distress sell for some households. The same effect is observed in the treatment effect on the untreated (*tt*) with the effect ranging from decreasing the food expenditure share of households by 55 % to increasing it by 52%.

Chapter Five

5. Conclusion and Policy Implications

5.1. Conclusions

This quantitative study examined the impact of cereal commercialization on the food and non-food expenditure share of households. Using data from a comprehensive larger survey conducted in April 2023 collected by the University of Copenhagen Development Economics Research Group (UCPH-DERG) and the Policy Studies Institute (PSI), the analysis focused on two main study variables: cereal commercialization and food expenditure share of household budgets. The investigation was guided by Engle's law which posits that households allocating more than 75% of their budget on food are economically worse off. Conversely, when the economic status of a household improves the proportion of its budget spent on food decreases. The study controlled for various household characteristics, land and production characteristics, shocks, and other financial and economic variables. The impact assessment was conducted using an endogenous switching regression model and counterfactual scenarios.

Key factors influencing commercialization include region, literacy of the household head, agrochemical use, crop rotation, participation in the AGP, and crop diversification. Gender and age of the household head had also a significant impact where female-headed households were more likely to commercialize, while those headed by older people were less likely.

Commercialization is found to have a desirable impact on households in improving their economic status. Commercialized households are found to have a lower food expenditure share compared to subsistence or semi-commercialized households. Larger household sizes and literate household heads are associated with lower food expenditure share. Increased land size and access to extension services lower food expenditure shares for subsistence and semi-commercialized households. Crop rotation and agrochemical use reduce food expenditure shared in commercialized households. Participation in the AGP program is associated with lower food expenditure shares, highlighting the program's effectiveness in improving the welfare of farmers. While commercialization generally improves the economic status of households, its impacts vary depending on the characteristics of the households,

The findings confirm and extend the knowledge that commercialization can improve the economic status of farmers. These results align with prior studies that link agricultural commercialization with better economic outcomes and welfare. Also, the finding indicates that not all farmers benefit from commercialization aligning with studies that present this argument also.

This study is specific to Ethiopian farm households with a cross-sectional design where the study participants are major cereal producers and may not be generalizable to other contexts. Future studies should explore the long-term impact of commercialization on economic status and include a broader range of variables.

5.2. Policy Implications

Based on the findings discussed above, clear and targeted policies should be put in place to stimulate commercialization and support smallholders to help them move out of subsistence and semi-commercialization.

The positive impact of female-headed households on commercialization suggests the need for targeted support for women in agriculture. This includes providing access to resources, training, and networks that empower women farmers to engage more in market activities.

Crop insurance programs, storage technologies like community warehouses and education on risk management, financial literacy promotions are needed to help farmers mitigate risks associated with production losses. There is a need to study smallholders in a narrower context to understand bases of differences and design tailored intervention that suit the different types of cereal farmers.

Facilitation of infrastructure for farmers to produce all year round, Promotion of crop diversification, and increasing access and knowledge of agrochemical use are needed for increased commercialization and improvement of lives of smallholder farmers.

The findings underscore the importance of participation in programs like the AGP and extension programs in reducing food expenditure shares. Policy makers should continue to support and expand such programs ensuring that they are accessible to all smallholder farmers.

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