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VALUE CHAIN ANALYSIS OF MALT BARLEY IN AMHARA AND OROMIA REGIONS OF ETHIOPIA: STATUS, OPPORTUNITIES AND CHALLENGES

**A Thesis Submitted to the College of Development Studies of Addis Ababa University in
Partial Fulfillment for the Degree of Masters of Arts in Rural Livelihood and Development**

By
Leulsenaye Damena

Addis Ababa University
College of Development Studies
Center for Rural Development

June 2024

Declaration

I, the undersigned, hereby declare that this thesis entitled "Value Chain Analysis of Malt Barley in Amhara and Oromia Regions of Ethiopia: Status, Opportunities, and Challenges" is my original work and has not been presented for a degree in any other university, nor has it been submitted as part of requirements for any other degree or professional qualification. All sources of materials used for this thesis have been duly acknowledged.

I confirm that the work described in this thesis is my own and has been carried out under the supervision of my advisor, Dr. Paulos Gutema, at the College of Development Studies, Addis Ababa University. I have abided by all rules and regulations of the university regarding the presentation and conduct of research and writing.

Signature: _____

Name: Leulsenaye Damena

Date: _____

Acknowledgements

First and foremost, I extend my deepest thanks to God for granting me the strength, wisdom, and perseverance needed to complete this thesis. Your guidance and blessings have been a source of inspiration throughout this journey.

I would also like to express my deepest gratitude to my advisor, Dr. Paulos Gutema, whose guidance, encouragement, and insightful feedback were invaluable throughout the entire process of this thesis. Your expertise and dedication were crucial to the successful completion of this research.

My sincere appreciation goes to the respondents in the Amhara and Oromia regions, including farmers, local administrators, and other stakeholders in the malt barley value chain, who generously shared their time, experiences, and knowledge. Without their participation, this study would not have been possible.

I would like to extend my sincere appreciation to Dr. Endeshaw Habte and Tamirat Girma for their invaluable participation in designing the study and assisting with data analysis. Your expertise and contributions significantly enhanced the quality and rigor of this research.

Lastly, to my family, for their unwavering support and encouragement. Your belief in me provided the motivation I needed to persevere.

List of Acronyms

AMF	Assela Malt Factory
ANOVA	Analysis of Variance
ANT	Actor-Network Theory
ARARI	Amhara Regional Agricultural Research Institute
ATA	Agricultural Transformation Agency
AVC	Agricultural Value Chain
CADP	Commercial Agriculture Development Project
CDC	Centers for Disease Control and Prevention
COCOBOD	Ghana Cocoa Board
COVID	Coronavirus Disease
CSA	Central Statistical Agency
EBA	Ethiopian Breweries Association
EGS	Early Generation Seeds
EIAR	Ethiopian Institute of Agricultural Research
ESS	Ethiopian Standards Agency
ESE	Ethiopian Seed Enterprise
ETB	Ethiopian Birr
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
GDP	Gross Domestic Product
GIS	Geographic Information System
GMF	Genetically Modified Food
GVC	Global Value Chain
HLW	Hectoliter Weight
IDRC	International Development Research Centre
IDS	Institute of Development Studies
IFPRI	International Food Policy Research Institute
MOANR	Ministry of Agriculture and Natural Resources
NAEB	National Agricultural Export Board
NBE	National Bank of Ethiopia
OARI	Oromia Agricultural Research Institute
OSE	Oromia Seed Enterprise
PSE	Private Seed Enterprise
RARC	Regional Agricultural Research Center
RBV	Resource-Based View
SAGCOT	Southern Agricultural Growth Corridor of Tanzania
TCE	Transaction Cost Economics
TKW	Thousand Kernel Weight
VCA	Value Chain Analysis
WB	World Bank
WUR	Wageningen University & Research

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Abstract

This thesis presents a detailed analysis of the malt barley value chain in Ethiopia's Amhara and Oromia regions, focusing on its current, status, opportunities, and challenges. Using both qualitative and quantitative data from farmers, administrators, and industry experts, it examines the complex interactions within the value chain. The seed system, crucial to this chain, is divided into formal and informal sectors. The formal sector, involving government agencies, private companies, and international organizations, faces issues like limited coverage, high costs, and logistical challenges in producing and distributing high-quality seeds. Profitability analysis reveals that Private Seed Enterprises (PSE) are generally profitable due to operational efficiencies and market-driven strategies, while public research institutes struggle with high operational costs and limited funding. Malt barley producers also cultivate various crops, with regional differences in land allocation and seed recycling practices. Regional preferences for barley varieties and productivity levels vary, with potential gains from improved seeds and agronomic practices. Challenges include diseases, pests, waterlogging, weeds, and wildlife, while agrochemical use can enhance yields. Farmers primarily sell their malt barley to cooperatives, with smaller portions going to retailers and wholesalers. Price variability indicates a need for better price stability mechanisms. Producers linked to specific malt factories tend to earn higher incomes, with regional differences in earnings. The study offers strategic recommendations for policymakers, agricultural practitioners, and stakeholders to improve productivity and sustainability. It contributes to the broader discussion on agricultural value chains in Ethiopia, emphasizing the need for integrated efforts to address identified challenges and capitalize on available opportunities.

Keywords: Malt Barley, Value Chain, Ethiopia, Amhara, Oromia, Seed System, Profitability, Agricultural Production, Sustainability, Agronomic Practices, Stakeholder Analysis, Market Dynamics

1. Introduction

1.1. Background

Agriculture assumes a central role in Ethiopia's economic landscape. Its contributions extend well beyond the boundaries of rural fields, accounting for an impressive 32.4% of the country's total GDP (National [Bank of Ethiopia NBE], 2022). Agriculture not only contributes significantly to the Gross Domestic Product (GDP), employment generation, and export earnings, but also forms the essence of rural livelihoods and national food security. Within Ethiopia's agricultural context, barley stands out as one of the most important cereal crops significantly contributing to the livelihood of farmers and the country's economy. Ethiopian agriculture has also positioned barley as a key crop for both subsistence and commercial purposes.

The cultivation of barley is characterized by dual functions: addressing primary food security needs, especially in regions where alternative cereals are scarce, and contributing as a cash crop that fuels the burgeoning brewing industry. Ethiopia, as one of Africa's leading barley producers, harvested over 2.5 million metric tons of barley in the 2019/2020 cropping season, demonstrating the crop's significance within the agricultural sector (Central Statistical Agency [CSA], 2020). The Amhara and Oromia regions, which are central to this study, are among the top contributors to this output, with Oromia alone accounting for approximately 1 million metric tons, highlighting its critical role in the national barley supply chain (CSA, 2020).

The expansion of Ethiopia's brewing industry, with a growth rate of 15% per annum over the last five years, has significantly increased the demand for malt barley, a key ingredient in beer production (Ethiopian Brewers Association [EBA], 2021). Despite the local agricultural sector's capacity to produce barley, only about 60% of the brewing industry's malt barley demand is met domestically, with the remainder supplemented through imports (EBA, 2021). This gap underscores the potential for growth in the local malt barley production and processing sectors.

The challenges facing the malt barley value chain in the Amhara and Oromia regions are multifaceted. Smallholder farmers, who constitute the backbone of barley production, often contend with issues such as limited access to quality seeds, inadequate extension services, and challenges in pest and disease management (International Food Policy Research Institute [IFPRI], 2019). Post-harvest losses in these regions are estimated to be as high as 20%, attributed to poor handling, storage, and transportation practices (IFPRI, 2019).

Market access and pricing volatility further complicate the value chain dynamics. The average farm gate price for barley in these regions has fluctuated significantly, with a 30% variance observed within a single production season, affecting farmers' incomes and incentives to produce. This means a price of barley at the beginning of the production season (mostly Meher/main season) is completely different at the time of harvest. (Ethiopian Agricultural Transformation Agency (ATA), 2020).

In addressing these challenges, the Ethiopian government and various development partners have initiated several interventions aimed at enhancing the barley value chain. These include the introduction of improved barley varieties, capacity building for farmers on best agricultural practices, and the establishment of cooperative societies to strengthen market linkages (ATA, 2020).

This study aims to build on these factual foundations, offering a comprehensive analysis of the malt barley value chain in the Amhara and Oromia regions. By identifying the current status, opportunities for growth, and persistent challenges, the research seeks to contribute to the strategic development of the sector, benefiting farmers, industry stakeholders, and the broader Ethiopian economy.

In the upcoming parts of the study, we will delve into the problem statement, research questions, and objectives in the first section. The second section will present a comprehensive review of the existing literature. The third section deals with uniquely designed research methodology and the profound significance of this study. The fourth section presents data analysis and interpretation. On the fifth and last section, conclusion and recommendations will be presented all supported by array of relevant references.

1.2. Problem statement

The malt barley sector in the Amhara and Oromia regions of Ethiopia holds a pivotal role in the agricultural economy and the expanding brewing industry. Despite its significance, there is a noticeable lack of focused research on this sector, particularly regarding its unique challenges and opportunities. Existing literature predominantly addresses general agricultural practices and value chains in Ethiopia but reveals critical gaps when it comes to malt barley production in these regions.

Smallholder farmers, who constitute the majority of malt barley producers in the Amhara and Oromia regions, often achieve yields far below their potential. The average barley yield in Ethiopia stands at about 2.1 tons per hectare, which is considerably lower than the global

average of approximately 3.0 tons per hectare (FAOSTAT, 2021). This suggests inefficiencies in production practices, seed quality, and pest and disease management. While studies have explored agricultural productivity in Ethiopia, there is a scarcity of research specifically targeting malt barley production practices, including seed quality and pest management in the Amhara and Oromia regions. Some studies might touch upon general barley production issues, but detailed research focusing on malt barley, which is critical for the malting and brewing industry, remains limited (Ayele et al., 2017; Bekele, 2019).

Additionally, malt barley farmers in these regions might face market access challenges, including limited bargaining power and information asymmetry, potentially leading to prices below their production costs. For instance, price fluctuations in local markets can see a drop of up to 30% within a single season, affecting farmers' income stability (Ethiopian Agricultural Research Organization, 2020). While issues of market access and price volatility have been discussed in the context of Ethiopian agriculture, there is insufficient focus on the malt barley market and the unique challenges faced by smallholder farmers in Amhara and Oromia. The specific challenges of malt barley, including its demand by the brewing industry and the price dynamics influenced by this demand, require more focused research.

Furthermore, there is a gap in understanding the economic implications of the malt barley value chain for smallholder farmers. Existing studies primarily focus on the sector from a supply chain perspective, often neglecting the socioeconomic outcomes for the individual actors, particularly smallholder farmers. The complex dynamics of livelihood improvement and income generation intertwined with the malt barley value chain are not well understood.

There is also a lack of comprehensive mapping of the current malt barley value chain in Ethiopia, particularly within the Amhara and Oromia regions. While various studies may touch upon aspects of production, market dynamics, or post-harvest processes, a detailed and holistic value chain analysis that encapsulates all stages of the malt barley journey from farm to final product is absent. This includes stakeholder analysis, value addition and process efficiency, supply chain dynamics, impact of external factors, and technology and innovation. Additionally, the complex relationships and interactions among various stakeholders—such as the Ethiopian Institute of Agricultural Research (EIAR), seed companies, smallholder farmers, and malting companies—have not been systematically studied. This lack of understanding poses a significant impediment to the formulation of targeted interventions and policies that could optimize the efficiency, profitability, and inclusiveness of the malt barley value chain.

Addressing these gaps through comprehensive research would provide a nuanced understanding of the current malt barley value chain in the Amhara and Oromia regions. It would identify critical bottlenecks and opportunities for intervention, supporting efforts to enhance the efficiency, sustainability, and profitability of the sector for all stakeholders involved. This study aims to unearth the unique challenges and opportunities faced by actors within the malt barley value chain, with a special emphasis on the role of smallholder farmers.

1.3. Research Objectives

The overarching objective of this study is to conduct a comprehensive value chain analysis of the malt barley sector in the Oromia and Amhara regions of Ethiopia.

Based on the gaps on the existing literatures the objectives of this study are to:

1. **Map the current malt barley value chain** in the Amhara and Oromia regions, identifying key stakeholders, processes, and interactions that define the sector.
2. **Analyze the production practices, productivity and related challenges** faced by smallholder malt barley farmers, focusing on determinants of malt barley productivity.
3. **Investigate market access and related issues** of smallholder farmers in the malt barley sector.

1.4. Research questions

- ✓ What are the key components and dynamics of the current malt barley value chain in the Amhara and Oromia regions?
- ✓ What production practices and challenges significantly affect malt barley yields and quality among smallholder farmers in these regions?
- ✓ How do market access and related challenges specifically affect smallholder malt barley farmers?

1.5. Significance of the study

The significance of this study lies in its comprehensive approach to addressing the critical gaps in the existing body of research on the malt barley value chain in the Amhara and Oromia regions of Ethiopia. By focusing on the unique challenges and opportunities within this sector, the study stands to make several important contributions to the agricultural economy, the malting and brewing industry, and the livelihoods of smallholder farmers in these regions.

This research aims to fill the critical knowledge gap by providing a detailed analysis of the malt barley value chain, specifically in the Amhara and Oromia regions. A nuanced understanding of the sector, from production practices to market dynamics, will be instrumental in identifying the bottlenecks and inefficiencies that hinder the sector's growth and sustainability.

By spotlighting the specific challenges faced by smallholder malt barley producers, including low yields, market access difficulties, and price volatility, the study could pave the way for targeted interventions. These interventions may include improved agricultural practices, enhanced seed quality, and better pest and disease management strategies, all of which could significantly boost productivity and income stability for these farmers.

The comprehensive mapping of the malt barley value chain and the detailed stakeholder analysis envisioned by this study will provide a solid foundation for policy formulation. Policymakers and other stakeholders, such as research institutions, seed companies, and malting companies, can leverage the insights gained to develop targeted policies and programs that promote efficiency, profitability, and inclusiveness in the malt barley sector.

The study's focus on the economic implications of the malt barley value chain for smallholder farmers will also highlight the importance of sustainable agricultural practices. Understanding the socio-economic outcomes for these farmers will facilitate the adoption of practices that ensure long-term sustainability, environmental health, and economic well-being.

By addressing the specific needs of the malt barley sector, this study indirectly supports the malting and brewing industry, which relies on high-quality malt barley as a key raw material. Improvements in the efficiency and sustainability of malt barley production can lead to a more stable supply of this critical input, benefiting the industry as a whole.

The study's exploration of technology and innovation within the malt barley value chain could identify opportunities for the adoption of new technologies that enhance production efficiency, value addition, and process efficiency. This, in turn, could foster a more competitive and resilient malt barley sector.

2. Literature Review

2.1. Theoretical Literature Review

2.1.1. Value Chain Analysis

Value Chain Analysis (VCA) stands as a pivotal conceptual and analytical framework in understanding how businesses can achieve competitive advantage through the identification, evaluation, and optimization of the series of activities involved in producing a product or service. From its inception by Michael Porter in the 1980s, VCA has evolved, influencing various domains, including industrial organization, strategic management, and development studies.

Origins and Conceptual Framework

Porter's Value Chain Model (1985): Michael Porter introduced the value chain concept in his book "Competitive Advantage: Creating and Sustaining Superior Performance". Porter's model divides a company's activities into primary and support activities. Primary activities include inbound logistics, operations, outbound logistics, marketing and sales, and service. Support activities encompass procurement, technology development, human resource management, and firm infrastructure. The model suggests that competitive advantage can be developed by optimizing and coordinating these activities to create value greater than the cost of providing it.

Value System: Porter also expanded the concept to include the "value system", recognizing that the value chains of various firms interact in an industry, highlighting the importance of inter-organizational linkages and buyer-supplier relationships in creating competitive advantage.

Theoretical Extensions and Adaptations

Global Value Chains (GVC)

Gereffi and Korzeniewicz (1994) extended Porter's model into the concept of Global Value Chains, emphasizing the international aspects of value creation. They highlighted how firms can gain competitive advantage by strategically positioning themselves in global production networks. This perspective considers the complexities of global production, including cross-border flows of goods, services, and knowledge.

Value Chain Governance: Gereffi, Humphrey, and Sturgeon (2005) introduced the notion of governance in GVCs, categorizing them based on the complexity of transactions, ability to

codify, and capabilities in the supply-base. This framework helps in understanding power dynamics and the role of lead firms in determining how value is distributed along the chain.

Sustainable Value Chains: In response to growing environmental and social concerns, the concept of sustainable value chains has emerged, integrating sustainability principles into value chain analysis. This approach focuses on minimizing negative environmental impacts and ensuring social equity throughout the value chain (Kaplinsky and Morris, 2001).

Critiques and Challenges

Standardization vs. Context-Specificity: Critics argue that Porter's model, primarily developed with manufacturing sectors in mind, might not directly apply to services or knowledge-intensive industries without adaptation. The need for context-specific frameworks that account for sectoral and regional nuances is emphasized (Pietrobelli and Rabellotti, 2011).

Power and Equity Considerations: While VCA provides tools for efficiency and optimization, critics highlight its limitations in addressing issues of power imbalance and equity among value chain actors. The focus tends to be more on value for companies and less on the welfare of workers or communities involved in the lower ends of the chain (Kaplinsky, 2000).

Value Chain Analysis has profoundly influenced both academic thought and practical approaches to business strategy and development policy. Its evolution from a focus on individual firms to considering global networks reflects the changing dynamics of global production and trade. Despite its contributions, ongoing debates and critiques highlight the need for further theoretical and methodological development to address contemporary challenges such as sustainability, digitalization, and equitable growth. As such, VCA remains a dynamic and evolving tool, adaptable to the complexities of modern economies.

Through time, Value Chain Analysis (VCA) has evolved beyond its initial conceptualization by Porter in 1985, incorporating insights from various theoretical lenses. This expansion has enriched the understanding of how value chains operate, their implications for competitive strategy, and their impacts on economic development and sustainability. Below are additional theoretical perspectives that complement and broaden the traditional VCA framework:

Resource-Based View (RBV)

Conceptual Linkage: The Resource-Based View of the firm argues that competitive advantage is derived from the firm's possession of unique, valuable, inimitable, and non-substitutable resources and capabilities (Barney, 1991). In the context of VCA, RBV emphasizes the

importance of internal capabilities and resources in performing value chain activities effectively and distinctively.

Application: By identifying and developing core competencies within specific value chain activities, firms can achieve and sustain competitive advantage. This perspective encourages firms to focus on those activities that they can perform with superior efficiency, quality, and innovation compared to competitors.

Institutional Theory

Conceptual Linkage: Institutional theory suggests that the performance and structure of organizations are significantly influenced by the rules, norms, and beliefs prevalent in the institutional environment in which they operate (Scott, 2008). This theory underscores the role of formal and informal institutions in shaping value chain dynamics, including regulatory frameworks, standards, and cultural norms.

Application: VCA informed by institutional theory would examine how institutional factors at the local, national, and international levels affect the configuration and performance of value chains. This includes understanding the impacts of trade regulations, quality standards, labor laws, and environmental regulations on value chain operations.

Network Theory

Conceptual Linkage: Network theory focuses on the patterns of connections among actors within networks, emphasizing the value of relationships, interdependencies, and information flow (Granovetter, 1985). In value chain analysis, this perspective highlights the significance of the relational and social capital dimensions of inter-firm linkages.

Application: Applying network theory to VCA involves analyzing how the structure and quality of relationships between firms (e.g., suppliers, buyers, competitors) and other stakeholders (e.g., government agencies, NGOs) influence competitive advantage. It explores how trust, collaboration, and information sharing across the value chain enhance efficiency, innovation, and resilience.

Development Chain Approach

Conceptual Linkage: The development chain approach integrates value chain analysis with development objectives, focusing on how value chain dynamics can contribute to economic development, poverty reduction, and sustainable livelihoods (Kaplinsky, 2000). This approach is particularly relevant in the context of global value chains where developing countries seek to upgrade their positions.

Application: This perspective involves identifying leverage points within value chains that can lead to improved outcomes for low-income producers and workers. Strategies may include enhancing access to markets, improving labor conditions, fostering environmental sustainability, and building local capacities for value-added activities.

Circular Economy and Sustainability

Conceptual Linkage: The circular economy model promotes the redesign of value chains to enable sustainable production and consumption patterns, minimizing waste and encouraging the reuse and recycling of materials (Geissdoerfer et al., 2017). This approach extends the traditional linear view of value chains into a circular model.

Application: VCA from a circular economy perspective involves analyzing how each stage of the value chain can be optimized to reduce environmental impacts, enhance resource efficiency, and create sustainable value. This includes exploring opportunities for product design innovation, sustainable sourcing, closed-loop recycling, and energy efficiency.

These theoretical perspectives enrich the traditional value chain analysis by incorporating broader considerations of resources and capabilities, institutional contexts, network relationships, development impacts, and sustainability. They offer a multidimensional view of value chains, highlighting the complexity and dynamism of modern global business environments.

2.1.2. Agricultural Value chain Analysis

The agricultural value chain (AVC) analysis benefits from a multidisciplinary approach, incorporating concepts from economics, sociology, business management, and environmental science. This expanded review introduces additional concepts and references to provide a more comprehensive understanding of AVCs.

Transaction Cost Economics (TCE)

Transaction Cost Economics (TCE) is a theoretical framework that examines the costs of transactions in the market and the governance structures that arise to manage these costs. Developed by Oliver E. Williamson in the 1970s and 1980s, TCE has become a cornerstone in understanding the organization of economic activities, particularly in the context of agricultural value chains (AVCs). In addition to Oliver E. Williamson, several other scholars such as Ronald Coase, Douglass C. North, and Benjamin Klein have significantly contributed to the development and elaboration of Transaction Cost Economics (TCE) (Williamson, 1979; North, 1991).

Core Concepts of TCE

Transaction Costs: These are the costs associated with conducting an exchange or transfer of goods and services. In AVCs, transaction costs can include search and information costs, bargaining and decision costs, and policing and enforcement costs.

Governance Structures: TCE posits that different governance structures (market, hybrids, hierarchies) evolve to minimize transaction costs based on the characteristics of transactions. These structures range from open market transactions to long-term contracts and vertically integrated firms.

Behavioral Assumptions: TCE is grounded on two critical behavioral assumptions: bounded rationality (the idea that individuals have limitations on their cognitive abilities to process information) and opportunism (the possibility that parties may act deceptively to pursue their interests). Bounded rationality, in the context of TCE, implies that economic actors, whether individuals or firms, cannot gather and analyze all relevant information before making decisions. Instead, they rely on heuristics, simplifications, and rules of thumb to navigate complex economic environments. As a result, they may make suboptimal decisions due to incomplete or imperfect information.

Dimensions of Transactions: Key dimensions influencing the choice of governance structures include the frequency of transactions, the uncertainty involved, and the degree of asset specificity (investments that are specialized for particular transactions).

Application of TCE in AVCs

Choice of Governance Structure: TCE provides insights into why certain governance structures are chosen within AVCs. For example, when transaction costs are high due to uncertainty and asset specificity, actors in the value chain might prefer more integrated forms of governance, such as long-term contracts or vertical integration, to reduce these costs.

Managing Risks and Uncertainty: TCE explains how AVC actors manage risks and uncertainties through governance structures that minimize opportunistic behaviors and ensure reliable exchanges. This is particularly relevant in agricultural markets where uncertainty (due to price fluctuations, weather conditions, etc.) is a significant challenge.

Investment in Relationship-Specific Assets: TCE sheds light on the conditions under which firms are willing to invest in specific assets that are tailored to the needs of particular partners in the value chain. Such investments are more likely when there are mechanisms in place to safeguard against the risks of opportunism.

Innovation and Adaptation: The framework also helps understand how transaction costs influence the capacity for innovation and adaptation within AVCs. High transaction costs may inhibit the flow of information and cooperation needed for innovation, suggesting that efforts to reduce these costs can enhance competitiveness and adaptability.

Through the lens of TCE, it becomes evident that managing transaction costs is crucial for the efficiency and effectiveness of AVCs. Understanding the dynamics of transaction costs and governance structures can help stakeholders in agricultural value chains design better strategies for collaboration, risk management, and value creation (Williamson, 1979; North, 1991).

Actor-Network Theory (ANT)

Actor-Network Theory (ANT) is a theoretical and methodological approach to social theory that originates from the work of scholars like Bruno Latour, Michel Callon, and John Law in the late 20th century. ANT challenges conventional sociological approaches by treating objects, ideas, processes, and humans as equally important actors (or actants) in networks of relationships. This perspective is particularly useful in understanding complex, decentralized systems such as agricultural value chains (AVCs) (Latour, 2005; Callon, 1986).

Core Concepts of ANT

Actants: ANT uses the term "actant" to denote any entity that can exert agency or influence within a network, whether it is human or non-human. This broadens the understanding of what can impact social and economic relations.

Networks: Networks in ANT are the interconnected relationships between actants. These networks are not static; they are constantly being made and remade through the interactions of actants.

Translation: This concept refers to the negotiation and alignment of interests among different actants within a network. Translation processes are how networks are formed and how actants assume roles and identities within these networks.

Heterogeneity: ANT emphasizes the heterogeneity of networks, acknowledging that they are composed of a diverse array of entities, each contributing differently to the network's function and structure.

Application of ANT in AVCs

Understanding Complex Interactions: ANT offers a robust framework for analyzing the complex, interdependent relationships that define AVCs. By considering non-human elements

such as technology, infrastructure, and natural resources as actants, ANT provides a comprehensive view of the factors influencing agricultural production and distribution.

Mapping AVC Networks: ANT can be employed to map out the networks within AVCs, identifying key actors, their relationships, and how these relationships influence the flow of goods, information, and resources. This mapping can reveal bottlenecks, inefficiencies, and opportunities for improvement.

Exploring Power Dynamics: Through its focus on translation processes, ANT helps to uncover how power is exercised and negotiated within AVCs. It sheds light on how certain actors gain influence, how decisions are made, and how these dynamics affect smallholders and marginalized groups.

Innovation and Technological Change: ANT is particularly useful in studying the role of innovation and technology within AVCs. It allows researchers to explore how new technologies are introduced, adopted, or resisted within networks and how they transform agricultural practices and relationships.

ANT's emphasis on the roles of both human and non-human actors in creating dynamic networks offers valuable insights into the complexities of AVCs. It encourages a more holistic and nuanced approach to analyzing agricultural systems, highlighting the importance of technology, natural resources, and institutional structures alongside human actors. By applying ANT, researchers and practitioners can develop more effective strategies for managing AVCs, fostering innovation, and addressing the challenges of sustainability and equity (Latour, 2005; Callon, 1986).

Systems Thinking

Systems thinking is a holistic approach to analysis that focuses on the way that a system's constituent parts interrelate and how systems work over time and within the context of larger systems. It is an invaluable framework for understanding complex systems, such as ecological environments, organizational structures, and societal issues. Systems thinking encourages practitioners to view systems in a broad context, recognizing the interactions and interdependencies that define them (Smith et al, 2021).

Core Concepts of Systems Thinking

Interconnectedness: Everything in a system is connected to everything else. Understanding these connections and how they contribute to the behavior of the whole system is central to systems thinking.

Feedback Loops: Systems are characterized by feedback loops which can either reinforce (positive feedback) or balance (negative feedback) system behavior. Recognizing these loops is crucial for predicting and influencing system behavior.

Systems Structure and Behavior: The structure of a system determines its behavior. Systems thinking emphasizes that problems within a system are often rooted in the system structure itself, rather than in individual components.

Emergence: Complex systems exhibit emergent properties that cannot be predicted from the properties of the individual elements. Systems thinking aims to understand how these properties emerge from the interactions within the system.

Holism: This principle posits that systems should be analyzed as wholes, rather than dissecting them into parts. The holistic view helps to identify solutions that consider the system's overall functioning and long-term sustainability.

Systems Thinking in Agricultural Value Chains (AVCs)

Applying systems thinking to Agricultural Value Chains (AVCs) provides a comprehensive framework for understanding the complexities and interdependencies that characterize these systems. It enables stakeholders to identify and address systemic challenges more effectively, from production to processing, distribution, and consumption. By focusing on the relationships, feedback loops, and dynamics within AVCs, systems thinking can help improve efficiency, sustainability, and resilience.

Key Applications of Systems Thinking in AVCs

Enhancing Sustainability: Systems thinking encourages a holistic view of agricultural production and its environmental impacts. By considering the entire value chain, from inputs like water and fertilizer to outcomes such as soil health and biodiversity, stakeholders can develop strategies that promote long-term sustainability. This approach can lead to practices that minimize waste, reduce carbon footprints, and conserve natural resources.

Improving Resilience: AVCs are increasingly vulnerable to various shocks, including climate change, market fluctuations, and geopolitical conflicts. Systems thinking helps identify critical feedback loops and interdependencies that affect resilience. For example, diversifying crops and markets can buffer farmers against price volatility and climatic risks, enhancing the overall resilience of the value chain.

Optimizing Efficiency: By mapping out the flow of goods, information, and resources through the AVC, systems thinking can reveal inefficiencies and bottlenecks. This holistic analysis can

lead to more integrated and coordinated approaches, such as shared logistics platforms or information sharing systems, reducing redundancy and improving the efficiency of the value chain.

Facilitating Stakeholder Collaboration: AVCs involve a wide range of actors, from farmers and processors to retailers and consumers. Systems thinking fosters a collaborative approach, recognizing that the actions of any one actor affect the entire system. By facilitating dialogue and cooperation among stakeholders, it is possible to align incentives, share risks, and collectively address challenges such as market access, quality standards, and sustainable practices.

Supporting Innovation and Adaptation: The dynamic nature of AVCs requires constant innovation and adaptation to changing conditions. Systems thinking provides a framework for experimenting with new approaches, monitoring outcomes, and learning from feedback. This could involve adopting new agricultural technologies, exploring alternative business models, or developing novel products and services that meet changing consumer preferences.

By applying systems thinking to AVCs, stakeholders can gain a deeper understanding of the complex web of interactions that define these chains. This approach not only helps address current challenges but also enhances the capacity of AVCs to adapt to future uncertainties, ensuring long-term sustainability and resilience.

Political Economy

The application of political economy theory to value chain analysis offers a nuanced understanding of how power and economic dynamics shape the distribution of value and resources along global and local value chains. This approach considers not only economic transactions but also the broader socio-political and historical contexts within which these transactions occur. It examines issues such as governance structures, power imbalances, labor relations, and the role of institutions in shaping the outcomes for different actors within the value chain (Gereffi, G., et al, 2005).

Core Aspects of Political Economy in Value Chain Analysis

Power Dynamics: A central tenet of political economy applied to value chain analysis is the exploration of power relations among actors in the chain. Power dynamics influence how value and costs are distributed, determining who benefits from certain arrangements and who bears the costs. This perspective helps identify the leverage points that more powerful actors (e.g., multinational corporations) have over smaller players (e.g., smallholder farmers).

Governance Structures: Political economy analysis pays close attention to the governance structures of value chains, which dictate how decisions are made, who gets to make them, and how resources and benefits are allocated. Governance structures can range from market-based to hierarchical, with varying degrees of control and coordination.

Institutional Context: The role of institutions—both formal (e.g., laws, regulations) and informal (e.g., norms, traditions)—is another critical aspect considered by political economy in value chain analysis. Institutions shape the operating environment of value chains, influencing everything from labor standards to environmental practices.

Historical Context: Political economy approaches also emphasize the importance of historical context in shaping current value chain structures and dynamics. This perspective considers the historical processes that have led to the current configuration of global and local value chains, including colonial legacies, trade policies, and patterns of industrialization.

Social Dimensions: Finally, political economy theory applied to value chain analysis examines the social dimensions of economic activities, including labor conditions, gender relations, and community impacts. It scrutinizes how value chain configurations can perpetuate social inequalities or contribute to social development.

Application of political economy on AVCs

The application of political economy theories to Agricultural Value Chains (AVCs) provides a comprehensive framework for understanding the complex dynamics that shape these chains from production to consumption. This approach allows for a deeper analysis of how power relations, governance structures, institutional contexts, historical legacies, and social dimensions influence agricultural value chains. Here's an overview of how political economy can be applied to AVCs:

Power Dynamics

In AVCs, power dynamics can significantly influence how value and profits are distributed along the chain. Large agribusinesses or international buyers often have more negotiating power than smallholder farmers, enabling them to dictate terms that may not always be favorable to the producers. Political economy analyses how these power imbalances can lead to exploitative practices and seeks ways to redistribute power more equitably among actors.

Governance Structures

The governance of AVCs refers to how decisions are made regarding the production, processing, distribution, and quality standards of agricultural products. Different governance

models (e.g., hierarchical, market-based, or network) can impact the efficiency, resilience, and equity of value chains. Political economy examines these governance structures to understand how they affect smallholder farmers' ability to participate in and benefit from AVCs.

Institutional Context

Institutions, both formal (laws, regulations) and informal (norms, traditions), play a critical role in shaping AVCs. They can determine access to markets, credit, and technology as well as influence labor practices and environmental sustainability. Political economy studies how institutional environments enable or constrain the development and upgrading of AVCs, focusing on creating more supportive frameworks for small-scale producers.

Historical Context

The historical context of AVCs, including colonial legacies and past economic policies, can have a lasting impact on their current structure and dynamics. Political economy analyses these historical factors to understand present-day challenges and inequalities within AVCs, providing insights into how past injustices can be addressed and rectified.

Social Dimensions

AVCs are not only economic systems but also social ones that affect and are affected by the communities in which they operate. Issues such as labor rights, gender equality, and community welfare are crucial. Political economy investigates how AVCs can contribute to or detract from social development goals, advocating for more inclusive and sustainable value chain practices.

Capability Approach

The Capability Approach, as articulated by Amartya Sen and further developed by various scholars, provides a comprehensive framework for assessing individual and collective well-being by focusing on what individuals are able to do and to be - their capabilities. In the context of Agricultural Value Chains (AVCs), this approach offers a nuanced understanding of development, emphasizing the enhancement of farmers' and stakeholders' abilities and opportunities to achieve their valued goals. This section delves deeper into the conceptual linkage and application of the Capability Approach within AVCs (Robeyns, I., 2005).

Conceptual Linkage to AVCs

Empowerment and Participation: The Capability Approach underlines the importance of empowering individuals by expanding their freedoms and opportunities. In AVCs, this translates to equipping farmers and stakeholders with the necessary skills, knowledge, and

resources to effectively participate in and benefit from the value chain. For example, educating farmers about sustainable farming practices increases their capability to maintain environmental health while ensuring long-term productivity.

Access to Resources and Information: A critical aspect of enhancing capabilities involves ensuring access to vital resources and information. In AVCs, this could mean providing smallholder farmers with access to quality seeds, appropriate technologies, financial services, and market information. These resources increase farmers' ability to make informed decisions, improve productivity, and access markets, thereby enhancing their overall well-being.

Social and Institutional Support: The approach also highlights the role of social arrangements and institutions in shaping individuals' capabilities. In AVCs, strengthening community organizations, cooperatives, and institutions can support farmers by facilitating access to markets, negotiating better prices, and advocating for supportive policies. This social and institutional support is crucial for enabling farmers to overcome systemic barriers and constraints.

Application in AVCs

Identifying Constraints: Applying the Capability Approach to AVCs involves a detailed analysis to identify the constraints that limit stakeholders' capabilities. These constraints can be economic (e.g., lack of access to credit), social (e.g., gender discrimination), or environmental (e.g., degradation of natural resources). Understanding these constraints is the first step toward designing targeted interventions.

Designing Interventions: Once constraints have been identified, interventions can be designed to remove or mitigate these barriers. This might include:

- **Capacity Building:** Training programs to enhance farmers' skills in production, management, and marketing.
- **Access to Finance:** Financial services tailored to smallholder farmers' needs, such as microcredit and insurance products.
- **Market Access:** Initiatives to improve market access, such as infrastructure development, market information systems, and support for farmer cooperatives.

Monitoring and Evaluation: Implementing a capability-focused approach requires a robust system for monitoring and evaluation. This involves tracking changes in the capabilities of farmers and stakeholders, assessing the impact of interventions, and making adjustments as

needed. It is essential to measure progress not just in economic terms but also in terms of enhanced freedoms and opportunities.

2.1.3. Theoretical Framework

In studying the value chain analysis of Malt barley in the Amhara and Oromia Regions of Ethiopia, Actor-Network Theory (ANT), Systems Thinking, and the Capability Approach provides a robust theoretical foundation to explore the status, opportunities, and challenges within these agricultural systems.

Actor-Network Theory (ANT) proves instrumental in mapping the intricate relationships and interactions among diverse actors within the malt barley value chain in Ethiopia. ANT's focus on both human and non-human actants—such as technologies, infrastructures, and natural resources—provides a comprehensive view of how innovations diffuse, power dynamics evolve, and network configurations influence value chain performance. By employing ANT, this study uncovers bottlenecks, identify influential actors, and explore how these dynamics shape the adoption of sustainable practices, technological advancements, and market access strategies in the production and distribution of malt barley.

Systems Thinking offers a holistic approach to studying the malt barley value chain by emphasizing the interconnectedness and feedback loops among its various components. This framework enables us to analyze the systemic behaviors of the value chain, identify critical points of intervention to enhance efficiency and resilience, and optimize resource allocation across different stages—from farming and processing to distribution and consumption. By applying Systems Thinking, stakeholders can develop integrated strategies that promote sustainable agricultural practices, mitigate risks associated with climate variability, and enhance the overall resilience of the malt barley value chain in Amhara and Oromia Regions.

The Capability Approach enriches the analysis by focusing on enhancing the capabilities of smallholder farmers and other stakeholders within the malt barley value chain. By improving access to resources such as quality seeds, efficient technologies, financial services, and market information, this framework empowers individuals to achieve their desired outcomes and participate more effectively in value chain activities. Applying the Capability Approach in the study enables us to identify constraints, design targeted interventions, and monitor progress towards improving stakeholders' capabilities and promoting inclusive development in the malt barley sector of Ethiopia.

2.2. Empirical literature review

2.2.1. Agricultural value chain

Agricultural value chains represent the full spectrum of activities and processes that agricultural products undergo from production to consumption. This encompasses not just the physical transformation of products but also the roles of various actors involved, including input suppliers, farmers, processors, distributors, and retailers, as well as the regulatory frameworks governing these processes. The concept of value chains has evolved to emphasize not just economic efficiency but also sustainability, equity, and resilience. This expanded perspective on agricultural value chains highlights several critical areas of interest and development.

Integration and Upgrading

Integration into global value chains has been identified as a pathway for agricultural sectors in developing countries to access international markets, which can lead to increased income and employment opportunities. However, integration alone does not guarantee equitable benefits for all actors, particularly smallholders. Upgrading within value chains, whether through process, product, functional, or inter-chain improvements, is essential for adding value and enhancing competitiveness (Gereffi, 1999; Humphrey and Schmitz, 2002).

Sustainability and Resilience

The sustainability of agricultural value chains has gained prominence, driven by increasing awareness of environmental issues and the impacts of climate change. Sustainable value chains aim to minimize negative environmental impacts while maximizing social and economic benefits. This includes practices such as sustainable farming, reduction of post-harvest losses, and eco-friendly packaging and logistics. Additionally, resilience in agricultural value chains refers to the capacity to recover from shocks such as climate events, market volatility, or health pandemics. Building resilience involves diversifying income sources, improving market access, and enhancing adaptive capacities of smallholders (FAO, 2018).

Digitalization and Innovation

The role of digital technologies and innovation in transforming agricultural value chains is increasingly recognized. Digital tools can provide farmers with access to information on weather, market prices, and agricultural techniques, improving decision-making and productivity. Digital financial services enable better access to credit and insurance, while blockchain technology offers potential for enhancing traceability and transparency in value

chains (Lowder et al., 2017). Innovations in biotechnology, such as improved seed varieties and precision agriculture, also play a crucial role in enhancing productivity and sustainability.

Inclusivity and Gender Equity

Inclusivity and gender equity are critical components of sustainable value chains. Women and youth often face barriers to participation and benefit from agricultural value chains, including access to land, credit, and training. Interventions aimed at removing these barriers and promoting equitable participation can lead to more inclusive growth and improved outcomes for marginalized groups. This includes gender-sensitive policies, targeted training programs, and support for women and youth-led enterprises (FAO, 2011).

Policy and Institutional Support

The development of effective and sustainable agricultural value chains requires supportive policy and institutional frameworks. This includes policies that facilitate market access, provide infrastructure (such as roads and storage facilities), and support research and development. Institutional support, such as farmer organizations and cooperatives, can enhance bargaining power, reduce transaction costs, and provide access to services and information. Public-private partnerships are also vital for leveraging resources and expertise from both sectors to address challenges in value chain development (World Bank, 2012).

Different countries and regions, including those in Africa, have diverse experiences that highlight the challenges and opportunities in optimizing these value chains.

2.2.2. Experiences of different countries

Vietnam: Rice Value Chain - Vietnam's rise as a leading exporter of rice is a testament to policy reforms, investment in technology, and improvements in irrigation and rural infrastructure. The Doi Moi reforms in the late 1980s transitioned agriculture from a centrally planned system to a market-oriented one, significantly enhancing productivity and market access. However, challenges such as environmental sustainability, especially in the Mekong Delta region, and the need for further value addition in rice products remain (Khoi, 2015).

Netherlands: Agri-food Value Chain - The Netherlands, despite its small size, is one of the world's largest exporters of agricultural products, thanks to high levels of technology, productivity, and a strong focus on international trade. The Dutch agri-food sector is characterized by intensive cooperation between research institutions, industry, and government, within the so-called "Golden Triangle," driving innovation in sustainable farming practices, seed development, and logistics (WUR, 2020).

India: Dairy Value Chain - The dairy sector in India, exemplified by the Operation Flood program, highlights the role of cooperatives in linking smallholder farmers to markets. The program, which helped India become the world's largest milk producer, relies on a network of cooperatives that provide inputs, extension services, and market access to millions of dairy farmers, showcasing the power of collective action (World Bank, 1998).

Brazil: Soybean Value Chain - Brazil's transformation into a global leader in soy production underscores the significance of technological innovation, infrastructure development, and international market dynamics. The adoption of no-till farming and genetically modified (GM) crops, along with investments in transportation infrastructure, has driven this growth, though it also raises sustainability concerns (Fearnside, 2001).

Tanzania: Sunflower Value Chain - Tanzania has focused on the sunflower oil value chain as part of its strategy to reduce edible oil imports, which constitute a significant portion of the country's food import bill. Efforts to improve this value chain include the promotion of high-yielding seed varieties, enhancing processing capacities at local oil mills, and improving linkages between farmers and markets. Despite these efforts, challenges in terms of quality control, access to finance, and the need for more efficient value chain coordination persist (SAGCOT, 2017).

Rwanda: Tea Value Chain - The tea sector in Rwanda has seen significant growth and is a key export earner for the country. Investments in tea processing facilities, along with partnerships between the government, private sector, and international donors, have improved quality and market access. The success of the Rwandan tea value chain can be attributed to a clear focus on quality, strategic investments in processing capacity, and effective organization of tea cooperatives, which have helped smallholder farmers achieve better livelihoods (NAEB, 2019).

Ethiopia: Coffee Value Chain - Ethiopia's coffee value chain benefits from the country's rich biodiversity and history of coffee production. Efforts to improve this value chain have focused on enhancing quality through better farming practices, certification schemes, and direct marketing strategies that aim to secure higher prices in international specialty markets. However, smallholder coffee farmers still face challenges related to market access and climate variability (Minten et al., 2018).

Ghana: Cocoa Value Chain - Ghana is one of the world's leading cocoa producers, with the cocoa value chain being a critical source of income for over 800,000 households. The Ghana Cocoa Board (COCOBOD) plays a central role in the sector, regulating quality, providing

farmer services, and marketing cocoa. Recent initiatives have aimed at improving sustainability and farmer incomes through certification schemes and productivity-enhancing programs (Kolavalli et al., 2012).

Nigeria: Cassava Value Chain - Nigeria, the world's largest producer of cassava, has focused on value addition and market linkages to improve its cassava value chain. Initiatives such as the Commercial Agriculture Development Project (CADP) have aimed to connect smallholders to processors and markets, promoting the use of improved varieties and processing technologies to enhance productivity and product quality. Despite these efforts, challenges remain in terms of processing capacity and access to finance (Nweke et al., 2002).

Kenya: Horticulture Value Chain - Kenya's success in the horticulture value chain, particularly in the export of flowers and vegetables, showcases the importance of quality standards, market access, and investment in infrastructure. The sector benefits from Kenya's favorable climate, but its growth is also attributed to strong private sector involvement, supportive government policies, and access to European markets (Jaffee, 2003).

The experiences of countries around the world and within Africa with agricultural value chains illustrate the complex interdependencies between farmers, processors, distributors, and consumers. While there are notable successes in enhancing productivity, market access, and sustainability, significant challenges remain. Addressing these challenges requires a holistic approach that encompasses technological innovation, supportive policies, sustainability considerations, and efforts to ensure inclusivity and equity.

2.2.3. Malt barley value chains

The malt barley value chain is a specialized segment within the broader agricultural landscape, pivotal for the brewing and distilling industries. This value chain spans from barley breeding and cultivation to malting and eventual use in beverage production, encapsulating a range of activities and stakeholders, including researchers, farmers, maltsters, brewers, and consumers.

Barley Cultivation and Environmental Adaptation

Research into barley cultivation has highlighted the crop's resilience and its adaptability to diverse climatic conditions, making it a staple in many regions worldwide. Nevo and Chen (2010) emphasize barley's genetic diversity, which underpins its adaptability to stressful environments, a crucial trait given the growing concerns over climate change. However, Squires and Tow (2017) argue that despite barley's resilience, shifting climatic patterns pose

significant risks to yield stability and quality, necessitating advanced breeding techniques to develop more resilient strains.

Quality Requirements and Malting Process

The transition from barley to malt requires adherence to stringent quality standards, given malt's pivotal role in determining the flavor, color, and alcohol content of the final beverage. Molina-Cano et al. (2007) detail the biochemical processes during malting, noting the importance of grain size, protein content, and germinative capacity in producing high-quality malt. Their findings underscore the necessity for close collaboration between farmers and maltsters to ensure the barley meets precise specifications.

Economic and Market Dynamics

The economic aspects of the malt barley value chain are characterized by significant volatility, driven by fluctuating demand in the brewing industry and the impacts of global climate conditions on supply. Goe and Kenkel (2004) explore the market dynamics, including price fluctuations and their impact on farmers and maltsters. They advocate for improved market information systems to aid stakeholders in making informed decisions regarding production and sales strategies.

Sustainability and Technological Innovations

Sustainability concerns, particularly regarding water use and carbon emissions, have prompted research into more environmentally friendly practices within the malt barley value chain. Gooding et al. (2003) discuss the implementation of precision agriculture techniques to optimize input use and minimize environmental impact. Additionally, the potential for circular economy practices in utilizing by-products of the malting and brewing processes for animal feed or bioenergy has gained attention (Narváez-Rivas & California, 2016).

2.2.4. Actors in malt barley value chain

The malt barley value chain comprises a series of interconnected actors, each playing a critical role in transforming barley from seed to a vital ingredient in beer and whiskey production. Understanding the roles and interactions of these actors is essential to grasp the complexity and challenges of the value chain. The primary actors include barley breeders, farmers, maltsters, brewers/distillers, and end consumers, with supporting roles played by suppliers, regulators, researchers, and trade associations.

Barley Breeders and Geneticists

Barley breeders and geneticists are at the forefront of the value chain, responsible for developing barley varieties that meet specific criteria such as yield, disease resistance, climate adaptability, and malting qualities. Advances in genomics and breeding technologies, such as marker-assisted selection and genomic selection, have enabled breeders to enhance the efficiency of developing new strains tailored to the needs of maltsters and brewers/distillers.

Farmers and Growers

Farmers and growers are tasked with cultivating barley, requiring knowledge of optimal planting times, soil management practices, and pest and disease control to ensure a high-quality crop. They must navigate the challenges posed by climate variability, water availability, and market price fluctuations, making decisions that balance productivity with environmental sustainability. The relationship between farmers and maltsters is crucial, as the quality of barley directly affects the malting process and the final product.

Maltsters

Maltsters bridge the gap between barley cultivation and beer brewing/distilling. They transform raw barley into malt through a process involving steeping, germination, and kilning. This process requires precision and expertise to achieve the desired malt characteristics, such as color, flavor, and enzymatic activity. Maltsters must adhere to strict quality standards and often work closely with brewers and distillers to produce custom malts that meet specific production needs.

Brewers and Distillers

Brewers and distillers are the most recognized actors in the value chain, turning malt (along with water, hops for beer, and yeast) into alcoholic beverages. The quality of the malt significantly impacts the flavor, color, and texture of the final product. As such, brewers and distillers often have specific malt requirements and may engage in direct relationships with maltsters to ensure their needs are met.

End Consumers

End consumers, though not directly involved in the production process, play a critical role in the malt barley value chain by driving demand for beer and whiskey. Consumer preferences can influence the types of barley cultivated, the malting process, and the variety of beers and spirits produced. Trends such as the growing interest in craft beers and artisanal spirits can shift demand, affecting the entire value chain.

Supporting Actors

- **Suppliers** of inputs such as seeds, fertilizers, and equipment are vital for the cultivation and processing stages.
- **Regulators** ensure that production meets health, safety, and environmental standards.
- **Researchers** contribute to advancements in barley breeding, disease control, and sustainable farming practices.
- **Trade associations and cooperatives** play a key role in advocacy, education, and facilitating connections between different actors within the value chain.

Understanding the roles and interdependencies of these actors is crucial for addressing challenges and leveraging opportunities within the malt barley value chain.

2.2.5. Malt barley value chain in Ethiopia

The malt barley value chain in Ethiopia has been the subject of various empirical studies, reflecting its significance to the country's agricultural sector and industrial needs, particularly for the brewing industry. These studies explore numerous aspects of the value chain, including production challenges, market dynamics, quality standards, and the roles of different stakeholders from farmers to processors and policymakers.

Production Challenges

A central theme in the literature is the range of production challenges faced by malt barley producers in Ethiopia. Alemu et al. (2017) identify several constraints, including variable climate conditions, pests and diseases, and the limited availability of high-quality seeds. These challenges are exacerbated by the smallholder nature of barley farming in Ethiopia, which often leads to suboptimal agronomic practices and post-harvest handling that can affect the quality of the barley produced.

Quality Standards and Market Access

The stringent quality requirements for malt barley, as opposed to food or feed barley, are a significant hurdle for many Ethiopian farmers. Asfaw et al. (2018) discuss how these quality standards, which include specific protein content and germination rates, dictate market access for farmers. The study notes the importance of extension services and farmer training programs in helping farmers meet these standards and thus access more lucrative markets. Moreover, Kassie et al. (2014) highlight the role of contract farming in improving market access,

providing farmers with a guaranteed market but also binding them to meet specific quality criteria.

2.2.6. Stakeholder Roles and Value Chain Dynamics

The roles of various stakeholders, including government bodies, research institutions, NGOs, and private firms, are crucial in shaping the malt barley value chain. Geremew et al. (2019) examine how public-private partnerships and collaborations with international organizations have facilitated access to improved seed varieties, financial services, and market information. These interventions aim to address production bottlenecks and improve quality, although challenges remain in terms of scalability and sustainability.

Policy and Regulatory Environment

The Ethiopian government's policy and regulatory framework significantly impacts the malt barley value chain. Dawit et al. (2019) analyze the effects of agricultural policies, including subsidies, research and development initiatives, and export-import regulations, on the barley sector. The study underscores the need for policy coherence and targeted support to address specific value chain challenges, such as quality improvement and value addition.

Sustainability and Climate Resilience

Sustainability and adaptation to climate change are emerging themes in the study of Ethiopia's malt barley value chain. Tessema et al. (2020) focus on the adoption of conservation agriculture practices among barley farmers, highlighting their potential to enhance productivity, soil health, and climate resilience. This research points to the need for greater emphasis on sustainable practices within the value chain to ensure its long-term viability in the face of climate change.

Empirical studies on the malt barley value chain in Ethiopia reveal a sector with significant potential but facing numerous challenges. Key issues include production constraints, quality standards, market access, stakeholder roles, policy impacts, and sustainability concerns.

2.2.7. Conceptual Framework

Barley Cultivation and Smallholder Dynamics form the cornerstone of this framework, recognizing smallholder farmers as pivotal actors. It underscores their challenges in accessing quality inputs, adopting sustainable farming practices, and navigating market uncertainties. Insights from agricultural sciences highlight the importance of tailored agronomic practices, resilient seed varieties, and climate-smart technologies to improve yield stability and quality, thereby enhancing smallholders' productivity and resilience against environmental shocks.

Product Flow and Value Addition within the value chain are critical dimensions. This includes the process from barley cultivation through malting to final product distribution. The framework emphasizes enhancing smallholders' access to reliable market channels, reducing post-harvest losses, and integrating value-added activities such as cooperative-based processing and packaging. Strengthening linkages between smallholders, maltsters, and brewers is essential to streamline product flow, ensure quality control, and capture greater value along the chain.

Market Access and Inclusive Growth are central themes. The framework advocates for policies and initiatives that facilitate smallholders' access to markets, finance, and information. It underscores the role of cooperative societies and farmer associations in aggregating produce, negotiating better prices, and providing market intelligence. Addressing barriers such as transportation infrastructure gaps and market volatility is crucial to fostering inclusive growth, where smallholders benefit equitably from value chain activities.

Technological Innovations and Capacity Building are integral to enhancing smallholder participation. Leveraging digital technologies for market information, financial services, and agronomic advice empowers smallholders to make informed decisions and improve productivity. Capacity-building programs on sustainable farming practices, quality standards, and business skills strengthen their resilience and competitiveness within the value chain. Collaborations with research institutions and private sectors facilitate technology transfer and innovation adoption.

By synthesizing these dimensions, this study offers a structured approach to analyze and optimize the malt barley value chain in Ethiopia's Amhara and Oromia Regions from the perspective of smallholder farmers. It aims to inform policy interventions, technological innovations, and institutional support mechanisms that promote sustainable agriculture, inclusive economic growth, and resilience among smallholders. This framework acknowledges the complexities of product flow dynamics while advocating for strategies that empower smallholders to capture greater value from their participation in the malt barley value chain.

2.3. Gaps in key studies of malt barley value chain in Ethiopia

Empirical studies on the malt barley value chain, particularly in contexts like Ethiopia, have provided valuable insights into its operation and challenges. However, these studies also reveal several gaps in the literature that need to be addressed to fully understand and improve the value chain. These gaps span across the mapping of actors, identification of production and productivity challenges, and issues surrounding market access.

1. Mapping of Actors

Comprehensive Identification and Roles: While existing studies have identified primary actors (farmers, processors, and distributors), there is a gap in comprehensively mapping all participants, including informal actors, intermediaries, and service providers. Understanding the roles and interactions of these actors could provide insights into efficiency, power dynamics, and value distribution within the chain.

Actor Dynamics Over Time: Research often provides a static picture of the value chain. There is a need for longitudinal studies to understand how relationships and roles among actors evolve due to changes in policy, market demands, or technological advancements.

2. Production and Productivity Challenges

Localized Production Constraints: Although general production challenges such as seed quality, pest pressures, and climate impacts are documented, there is a lack of detailed, location-specific research. Such granularity is necessary to tailor interventions to diverse agro-ecological zones and farming systems within Ethiopia.

Technological and Innovation Adoption: Studies tend to overlook the extent and impact of adopting new technologies and farming practices on productivity. Detailed analyses are required to identify barriers to adoption and the potential productivity gains from new agronomic techniques, digital agriculture, and mechanization.

Socio-economic Factors: The influence of socio-economic factors on production, such as household labor availability, gender roles, and access to finance, is insufficiently explored. Understanding these factors can help in designing more effective support and intervention strategies for malt barley farmers.

3. Market Access

Quality Standards and Certification: While the importance of meeting quality standards for market access is acknowledged, detailed investigations into the specific challenges faced by farmers in achieving these standards, and the role of certification schemes in enhancing market access, are lacking.

Value Chain Financing: The dynamics of financial access within the malt barley value chain, including the availability and terms of credit for smallholders and the impact of financial services on market participation, remain underexplored.

3. Research Methodology

This study aims to provide a comprehensive understanding of the malt barley value chain in Ethiopia, with a specific focus on the Oromia and Amhara regions. To achieve this goal, a mixed-methods approach encompassing both qualitative and quantitative research methods is utilized. This approach facilitates a holistic exploration of the various dimensions of the value chain, capturing the perspectives of different stakeholders and generating robust insights for policy and intervention recommendations.

3.1. Research Design

The study will adopt a concurrent triangulation design, where qualitative and quantitative data collection and analysis occur simultaneously and are integrated during the interpretation phase. This design allows for a comprehensive exploration of the research questions by leveraging the strengths of both qualitative and quantitative methods.

3.1.1. Qualitative Data Collection

Key Informant Interviews: purposive sampling is implemented to select 25 key stakeholders along the malt barley value chain in Oromia and Amhara regions. Participants will include representatives from seed companies, malting companies, agricultural research institutions, and relevant government agencies, chosen for their integral roles and expertise within the industry. This methodical approach ensures that the interviews capture diverse perspectives on the roles, challenges, and experiences within the value chain, providing robust insights necessary for enhancing the understanding and development of the malt barley sector in Ethiopia. Moreover, existing literatures on the malt barley value chains in Ethiopia and related reports will be thoroughly assessed to complement the data from the key informant interviews. This will be mainly used to map the stakeholders in the malt barley value chain, their roles, processes and interactions.

3.1.2. Quantitative Sampling Technique and Sample Size Determination

The quantitative component of this study employed a stratified random sampling technique to select smallholder farmers engaged in malt barley cultivation within the Oromia and Amhara regions of Ethiopia. This technique is chosen for its ability to ensure a representative and diverse sample, allowing for robust insights into the various dimensions of the malt barley value chain.

Sample Size Determination

The sample size is determined using Cochran sample size determining formula: (Cochran, 1977).

$$n s = \frac{Z^2 p (1 - p)}{e^2}$$

Where:

- $n s$ = Sample size
- Z = Z-score corresponding to the desired confidence level (e.g., 1.96 for a 95% confidence level)
- p = Estimated proportion of the population with a certain characteristic (in this case engagement in the malt barley value chain working with the specified maltsters)
- e = Margin of error (maximum allowed difference between the sample estimate and the true population value)

After calculating the sample sizes for each stratum, the selected smallholder farmers will be randomly chosen from within each stratum, ensuring that the final sample is representative and reflective of the diversity within the malt barley value chain and using quota sampling to determine the size of each stratum.

The total sample size will be as follows:

$$n s = \frac{1.96^2 0.5 (1 - 0.5)}{0.05^2} = 385 \approx 400$$

The assumption behind to determine estimated proportion of population (0.5) is half of the malt barley farmers directly or indirectly work with the malt companies in the study.

Sampling and method of data collection

The sampling frame for the study consisted of all malt barley producers for Gondar malt, Assela Malt and Boortmalt factories in the target areas. The study used multi stage sampling technique to select sample households. In the first stage districts and kebeles were stratified in to the three malt factories' malt supplying areas, Gondar malt factory, Boortmalt malt factory and Asela malt factory target production areas. In the second stage, the size of producers (members) under each malt barley producers were identified with the help of experts from each factory. Then the sample kebeles were determined based on probability proportional to size where kebele with large number of member farmers are likely to be in the sample. Finally sample households

were selected randomly from the identified member malt barley producers for the interview. Probability Proportional to Size (PPS) sample distribution technique were used to maintain proportionality across the three strata (malt factories) to the size of members in each malting factories.

A total of 400 households were randomly selected from the three strata i.e Boortmalt, Asela and Gondar. Based on the number of member malt barley producers of malting factories 60% of the sample were selected from Boortmalt malt, 28% and 12% of the sample households were selected from Asela and Gondar malting factory respectively. A total of 40 kebeles were covered by the study. About 59 % of the sample producers were residents of Oromia region whereas 41% of them were residents of Amhara region.

Table 1. Distribution of sample malt barley producers by strata

Strata (factories)	Number of sample kebeles per strata	Sample size (n)	Proportion of total sample (%)
Boortmalt	24	240	60
Asela	11	110	28
Gondar	5	50	12
Total	40	400	100

Study areas

The survey was conducted in systematically selected areas in Amhara and Oromia regions. The study focused in Awi, Central Gondar, East Gojam and North Shewa zones of Amhara region and Arsi, West Arsi and Bale zones of Oromia regional states. Districts including Ankasha, Wogera, Debaytilat Gin and Angolelanatera districts from Amhara and Lemu-Bilbilo, Munesa, Dodola, Kofele and Agarfa from Oromia were considered in the study. These districts are areas that smallholder farmers are producing malt barley and supply to either of Gonder, Boortmalt or Asella malt factories.

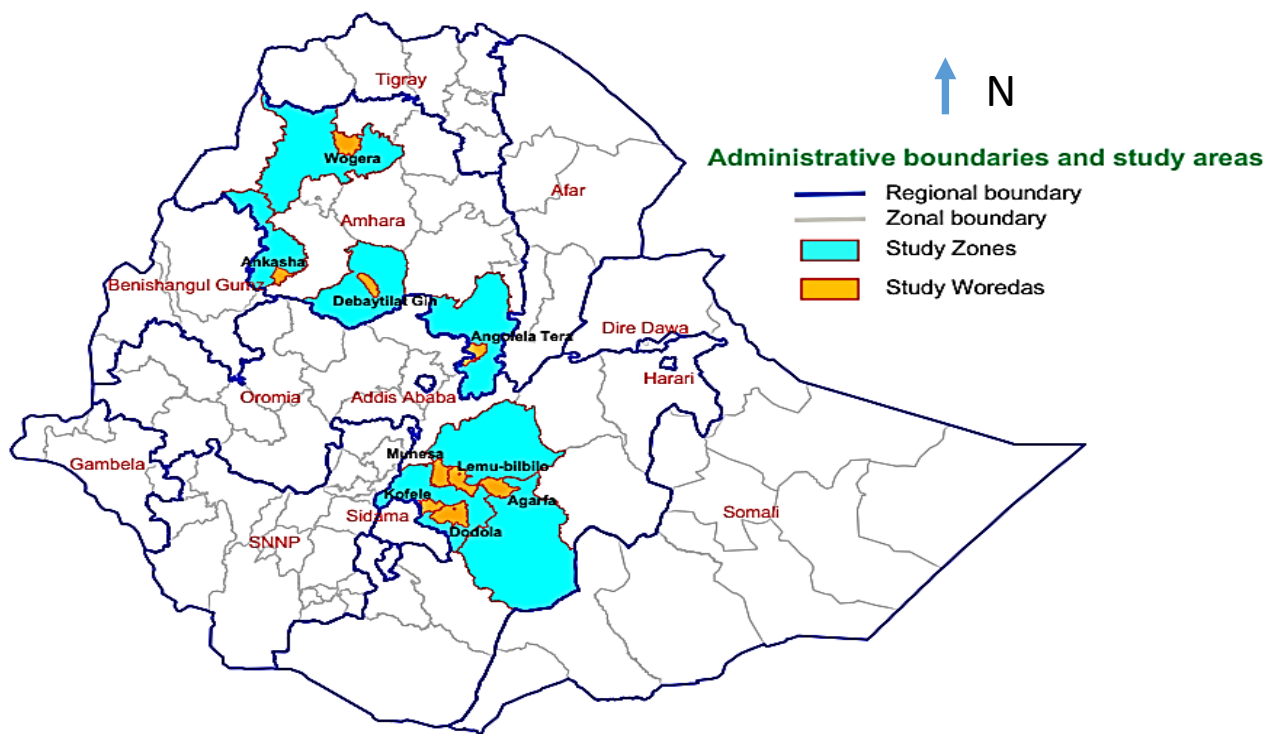


Figure 1. Map of the study areas

3.2. Methods of data analysis

Given the specific objectives of mapping the current malt barley value chain, analyzing production practices and productivity challenges, and investigating market access and related challenges, the following data analysis methods will be applied.

3.2.1. Qualitative data analysis

Qualitative data analysis will focus on identifying and understanding the complexities of the malt barley value chain, production practices, and market access challenges. This will be achieved through the following steps tailored to meet the study's objectives:

1. **Data Preparation and Familiarization:** this will involve transcription of recorded key informant interviews followed by a detailed review to identify initial insights related to the value chain, production practices, and market challenges.
2. **Coding with a Focus on Objectives:** will develop a coding scheme that specifically targets themes related to stakeholders, processes, and interactions within the malt barley value chain;
3. **Integration and Comparison:** Examine how themes related to production practices and market access challenges impact the overall efficiency and effectiveness of the malt barley value chain. This step involves drawing connections between identified themes to understand the interdependencies and causal relationships within the value chain.

4. **Reporting:** Present findings in a narrative format that sequentially maps the value chain, discusses production challenges and practices, and delves into market access issues, highlighting how each area impacts smallholder farmers' livelihoods and income stability.

3.2.2. Quantitative Data Analysis

Quantitative analysis will complement the qualitative insights by providing empirical evidence to support the themes identified. This is mostly concerned with the data collected from the sampled farmers in Amhara and Oromia regions.

Descriptive Analysis: Use descriptive statistics to outline the general characteristics of the sample, focusing on variables relevant to the study's objectives such as production volumes, yield rates, and income levels.

Comparative Analysis: Employ statistical tests (e.g., ANOVA, chi-square tests) to compare production practices, yields, and market access issues across different strata within the sample. This will help identify significant disparities and trends.

Correlation and Regression Analysis: Investigate the relationships between production practices (e.g., use of quality seeds, pest management techniques) and productivity outcomes. This analysis will help to quantify the strength and direction of these relationships.

In this context, the dependent variable is agricultural production quantity per hectare (PRODNHA), and the independent variables include factors such as age of the farmer (AGE), education level (EDU), farming experience (EXP), use of recycled varieties (RECYCLED_THE_VARIETY), seed amount (SEEDAMOUNTKG), urea fertilizer usage (UREA_KG), and several others.

Multiple Linear Regression Model

Model Specification: The general form of the multiple linear regression model is:

$$\text{PRODNHA} = \beta_0 + \beta_1 \text{AGE} + \beta_2 \text{EDU} + \beta_3 \text{EXP} + \beta_4 \text{RECYCLED_THE_VARIETY} + \beta_5 \text{SEEDAMOUNTKG} + \beta_6 \text{UREA_KG} + \dots$$

Results and Discussions

4. *Objective one: Map of the current malt barley value chain*

4.1. Seed system in Ethiopia

Before delving in to the key stakeholders and their roles in the malt barley value chain, understanding the seed system and seed classes in Ethiopia is essential. Seeds are the foundation of agricultural systems. The quality and genetic traits of seeds determine the yield and resilience of crops. The seed system in Ethiopia can be broadly divided into two categories: the formal seed system and the informal seed system.

4.1.1. The Formal Seed System

The formal seed system in Ethiopia encompasses government agencies, private companies, and international organizations that are involved in the production, certification, and distribution of high-quality seeds. Key players include the Ethiopian Seed Enterprise (ESE), regional seed enterprises, and private seed companies. These entities work together to produce and supply improved seed varieties to farmers. The formal system is characterized by:

- **Research and Development:** Institutes like the Ethiopian Institute of Agricultural Research (EIAR) play a critical role in developing new seed varieties that are high-yielding, disease-resistant, and adaptable to local conditions.
- **Certification and Quality Control:** The Ethiopian government has established regulations and standards to ensure the quality of seeds. Certified seeds undergo rigorous testing for germination rates, purity, and other quality parameters.
- **Distribution Networks:** Formal channels ensure that certified seeds reach farmers through cooperatives, agro-dealers, and extension services.

Despite these efforts, the formal seed system faces several challenges, including limited coverage, high costs, and logistical issues that hinder timely seed delivery.

4.1.2. The Informal Seed System

The informal seed system is the primary source of seeds for most Ethiopian farmers, especially smallholder farmers. This system involves the saving, exchange, and local sale of seeds by farmers themselves. Key characteristics include:

- **Seed Saving and Exchange:** Farmers save seeds from their own harvest and exchange them with neighbors or through local markets. This system is vital for

preserving traditional varieties and ensuring seed availability, particularly in remote areas.

- **Local Adaptation:** Seeds used in the informal system are often well-adapted to local conditions and farming practices, making them resilient to environmental stresses.
- **Affordability and Accessibility:** Informal seeds are generally more affordable and accessible to smallholder farmers, who constitute the majority of the agricultural population in Ethiopia.

However, the informal seed system also has its drawbacks. The lack of quality control can lead to the spread of diseases and pests, and the seeds may not always have the high-yield potential of those developed through formal research programs.

The malt barley value chain in the Amhara and Oromia regions of Ethiopia is integral to the agricultural and brewing industries. This value chain involves various stakeholders, each playing a crucial role in the production, processing, and distribution of malt barley. Understanding the profit margins and marketing dynamics for each stakeholder is essential for improving productivity, ensuring sustainability, and enhancing the livelihoods of those involved.

4.1.3. Seed classes

Breeder Seed

Breeder seed is the initial class of seed produced directly by the plant breeder or a designated research institution. These seeds are the source of all other seed classes and are characterized by:

- **Genetic Purity:** They maintain the original genetic makeup of the new plant variety developed by the breeder.
- **Quality Standards:** Breeder seeds are produced under strict supervision and control to ensure the highest possible quality.
- **Limited Quantities:** Typically, breeder seeds are produced in small quantities as their primary purpose is to serve as the foundation for the production of other seed classes.

Pre-Basic Seed

Pre-basic seed is the next stage in the seed production chain. It is produced from breeder seeds and serves to multiply the genetic material while maintaining its purity and quality. Characteristics include:

- **Intermediate Multiplication:** This class of seed is used to bridge the gap between breeder seed and basic seed production, ensuring there is enough high-quality seed for further multiplication.
- **Quality Assurance:** Pre-basic seeds undergo rigorous testing and certification processes to ensure they meet strict standards.

Basic Seed

Basic seed, also known as foundation seed, is produced from pre-basic seed and is used for further large-scale multiplication. The key features of basic seed include:

- **High Purity and Quality:** These seeds are produced under controlled conditions to ensure they retain the genetic characteristics of the original breeder seed.
- **Certification:** Basic seeds are certified by regulatory bodies to guarantee their quality and suitability for producing certified seeds.
- **Large-Scale Production:** Basic seeds are produced in larger quantities compared to breeder and pre-basic seeds to meet the needs of the commercial seed market.

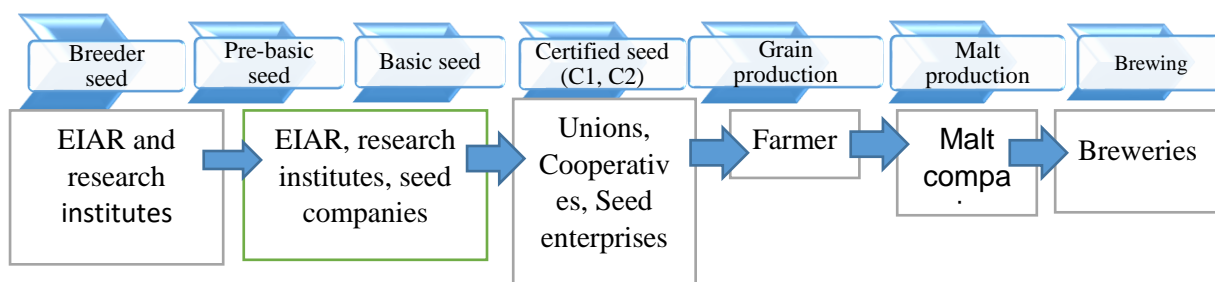
Certified Seed

Certified seed is the most commonly used seed class by farmers and is produced from basic seeds. The certification process ensures that these seeds are of high quality and true to type. Certified seeds are characterized by:

- **Widespread Distribution:** These seeds are produced in large quantities to be distributed to farmers across the country.
- **Quality Control:** Certified seeds undergo strict field inspections, laboratory testing, and quality control measures to ensure they meet the required standards for purity, germination rate, and other quality parameters.
- **Multiple Generations:** Certified seeds can be classified into different generations (e.g., C1, C2), with each generation representing a step further from the original breeder seed but still maintaining high quality.

From malt barley perspective, the seed system starts at EIAR and research institutes and ends at brewing companies.

Figure 2. seed classes and responsible actors for their production



4.2. Key Stakeholders and Their Roles

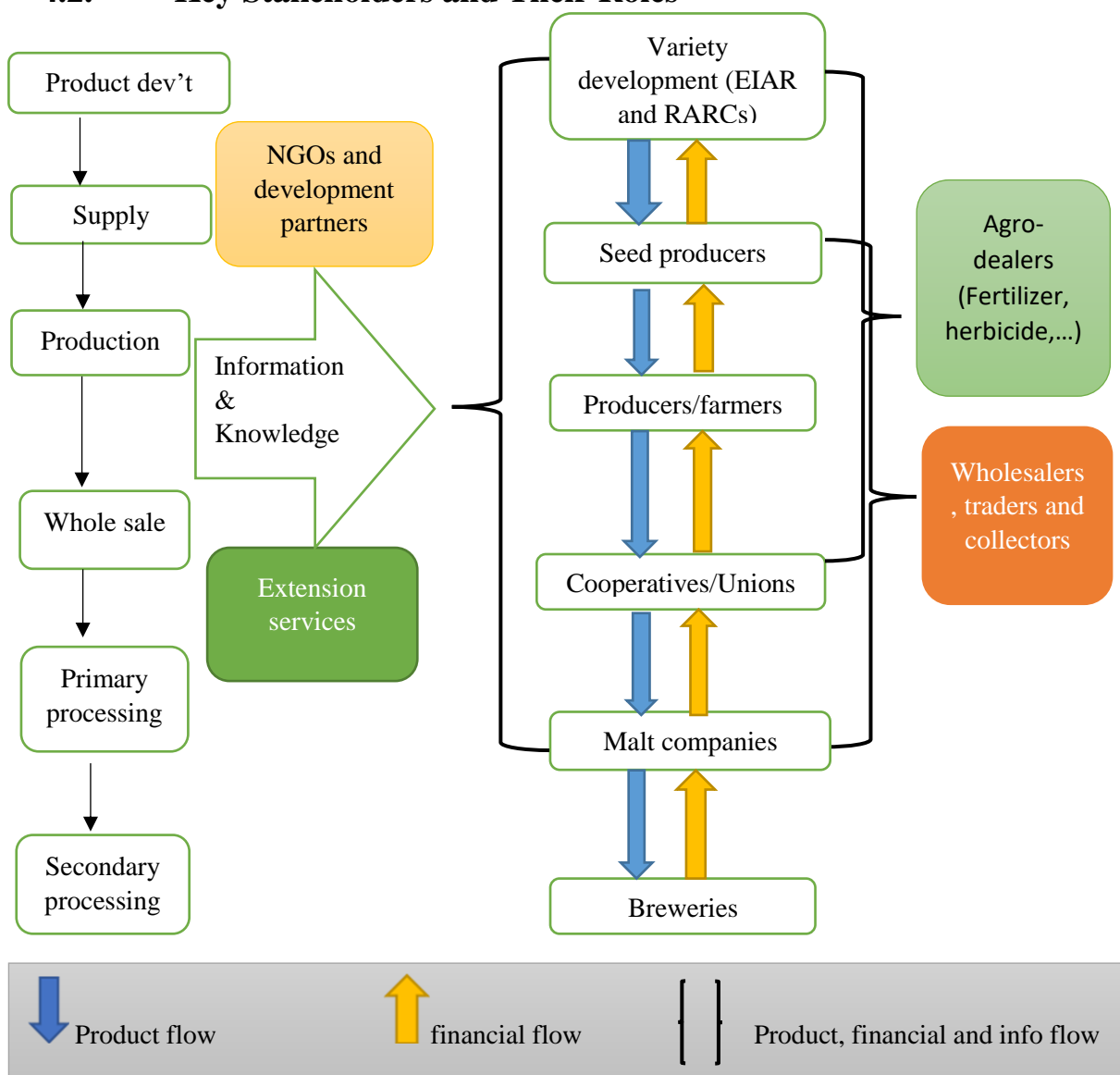


Figure 3. Key stakeholders in malt barley value chain

4.2.1. Variety development

The Ethiopian Institute of Agricultural Research (EIAR) and Regional Agricultural Research Centers (RARC) have played a pivotal role in the development of malt barley varieties in

Ethiopia. As a leading national agricultural research organization, EIAR's mission includes improving crop productivity and sustainability through scientific research and innovation. Malt barley is a key focus due to its economic importance for both local farmers and the brewing industry.

Barley has been cultivated in Ethiopia for millennia, with indigenous varieties well-adapted to the high-altitude, cool climates of the Ethiopian highlands. However, traditional barley varieties often fail to meet the specific quality requirements for malt production, such as grain size, protein content, and enzymatic activity. The expansion of Ethiopia's brewing industry in the late 20th and early 21st centuries necessitated the development of specialized malt barley varieties to ensure a consistent supply of high-quality raw materials for breweries.

One of EIAR's significant contributions has been the extensive collection and evaluation of barley germplasm. This process includes:

1. **Germplasm Collection:** Gathering diverse barley genetic resources from various Ethiopian regions and other countries to ensure a wide genetic base for breeding programs.
2. **Evaluation:** Assessing these collections for desirable traits such as yield potential, disease resistance, and malting quality parameters like grain size, protein content, and enzyme activity.

Breeding Objectives

EIAR's breeding programs for malt barley focus on several key objectives:

1. **Yield Improvement:** Developing varieties with higher yields per hectare to improve food security and profitability for farmers. The introduction of improved varieties has increased average malt barley yields from approximately 1.5 tons per hectare to over 2.5 tons per hectare.
2. **Disease Resistance:** Breeding for resistance to prevalent barley diseases such as leaf rust, net blotch, and scald, which can significantly impact yields and quality.
3. **Quality Traits:** Ensuring new varieties meet the stringent quality requirements of the brewing industry, including kernel size, uniformity, protein content, and appropriate enzyme activity .
4. **Adaptability:** Developing varieties that thrive in Ethiopia's diverse agro-ecological zones, particularly the highlands where most barley is grown.

Table 2. List of malt barley varieties released by the national agricultural research system in Ethiopia from 2010 to 2022

No	Variety Name	Releasing Institute/Center	Year of release	Yield Potential (Q/ha)	Agroecology Altitude (masl):	Production System
1	Focus	EIAR/Habesha	2022	25-45	2200-3000	Late highland potential
2	Suba	EIAR/HARC	2021	40-50	2300-3000	Late highland potential
3	Ras	ARARI/Gondor	2021	41-50	>2600	Late highland potential
4	Iftu	EIAR/Kulumsa	2020	49-64	2300-2800	Late highland potential
5	Henrike	EIAR/Boortmalt	2019	41-50	2000-2800	Late highland potential
6	Plannet	EIAR/Soufflet	2019	44	2300-3000	Late highland potential
7	Fatima	EIAR/Soufflet	2018	25-42	2300-30000	Late highland potential
8	Explorer	EIAR/Boortmalt	2017	26-41	2300-3000	Late highland potential
9	HB 1963	HARC	2016	3.5-6.0	2000-2800	Late Highland
10	HB 1964	HARC	2016	3.3-5.6	2000-2800	Medium highland
11	Singitan	OARI /Sinana	2016	3.5-5.5	2000-2800	Medium highland
12	Fanaka	HARC/ Meta Abo	2015	23-32	2000-2800	Late Highland
13	Grace	HARC/Heniken	2013	25-42	2000-2800	Medium highland
14	Traveller	EIAR/Heniken	2013	24-57	2000-2800	Medium highland
15	IBON 174/03	EIAR/HARC	2012	30-57	2300-2801	Mid highland potential
16	Fetina	Mekele Uni	2012	15-20	2000	For medium moisture
17	Sabini	EIAR/KARC/HARC	2011	25-30	2300-2800	Mid-highland potential
18	Bahati	EIAR/KARC/HARC	2011	25-30	2300-2800	Late highland potential
19	EH1847	EIAR/HARC	2011	35-40	2300-2800	Late highland potential
20	Friegebs	ARARI/Adet	2010	40	2300-3000	Mid-Late highland
21	Bekoji- 1	EIAR/KARC	2010	35-40	2300-2800	Late highland potential

Source: Breeders in the research system and National Variety registers (several years)

IBON 174/03 is the most dominant local malt barley variety in Ethiopia, covering close to 30% of the country's malt barley production despite the fact that it was released twelve years ago. This variety is favored due to its high yield and disease resistance, making it a reliable choice

for many Ethiopian farmers. In addition to IBON 174/03, HB1963 and HB1964 also contribute significantly to the malt barley sector. Another important local variety is Holker, which is predominantly cultivated in the highland areas of the Amhara region. These local varieties are generally well-suited to the Ethiopian climate and agricultural conditions, providing a robust defense against local pests and diseases.

Despite these advantages, the local varieties face stiff competition from foreign varieties, such as Traveler. Traveler is particularly popular among malt companies because it meets stringent quality parameters essential for the malting process. This variety is extensively grown in the highlands of Arsi, West Arsi, Bale, and other parts of the Amhara and Oromia regions due to its favorable malting qualities. However, farmers have noted that Traveler requires substantial agricultural inputs, including fertilizers and disease control chemicals, which can increase production costs and complicate cultivation efforts.

Table 3. Malt parameter set by malt companies in the study

No	Parameter	GMF Factory standard	AMF Factory Standard	Boortmalt Factory standard	Proposed maltsters Standard
1	Moisture	3.5-5%	2.5-5.8%	3,8-5%	3,8-5%
2	Total nitrogen	1.6-1.8%	1.5-1.9%	1,4-1,9%	**
3	Extract/yield of malt)	78-83%	min 76%	Min 77%	Min 78
4	Corn size(>2.5mm)	>85%	>80%	>80%	>80%
5	Corn size <2.2mm	max1.5%	8%max	Max 8%	Max 3%
6	fine-course difference	Max2%	Max2.6%	NA	Max 3%
7	Colour	3-4.5EBC	2.5-4.5EBC	3-4,5EBC	3-4.5%
8	Viscosity of wort	1.45-1.58cp	1.45-1.70	<1,6cp	<1,6cp
9	Soluble nitrogen	0.65-0.75%	0.4-0.8%	0,61-0,80%	0.65-0.75%
10	Freeamino acid/FAN	>160mg/l	>160mg/l	>150mg/l	>160mg/l
11	Diastatic power	>220 WK	>200WK	>220WK	>220WK
12	Friability	>80%	Min70%	>75%	>80%
13	β -glucan content	<250mg/l	<250mg/l	<250mg/l	<250mg/l
14	α -A Amylase	>30 du	-	> 35DU	
15	Kolbach index	38-44%	35-45%	35-48%	35-48%

** - *Should be in line with barley; NA-not applicable; WK- Windisch-Kolbach; du- dextrin units*
 Source: *interview with malt companies and breeders*

The preference for Traveler by malt companies is driven by its superior malting quality, which is crucial for producing high-quality malt for the brewing industry. This preference underscores a significant challenge for local varieties to meet the same quality standards without the need for intensive agricultural inputs. Efforts to improve local varieties by enhancing their malting qualities while maintaining their resilience to diseases and lower input requirements are critical for sustaining and potentially increasing their dominance in Ethiopia's malt barley production.

There are a few local varieties, such as Suba, that have been recently introduced to the malt barley market since 2020. However, these new varieties are not yet widely cultivated or adopted by farmers. One of the primary reasons for this slow uptake is the lack of awareness among both farmers and malt companies about the potential advantages these new varieties offer compared to the existing ones. This issue is compounded by limited extension services, which are essential for educating farmers about new agricultural technologies and practices.

Moreover, the production of early-generation seeds, such as breeder and basic seeds, is currently insufficient. These seeds are critical for ensuring that farmers have access to high-quality planting materials that can enhance productivity and crop performance. Without adequate availability and dissemination of these seeds, the adoption of new varieties like Suba remains hindered.

As of 2019, only about 15% of the potential demand for early-generation seeds in Ethiopia was being met, according to a report by the Ethiopian Institute of Agricultural Research (EIAR). This shortfall in seed production and distribution is a significant barrier to the wider adoption of improved malt barley varieties (EIAR, 2019).

Additionally, extension services in Ethiopia reach only a fraction of the farming population. For instance, in 2018, it was estimated that extension services were accessible to only 30% of Ethiopian farmers. This limited reach means that many farmers are not receiving the necessary information and support to switch to and effectively cultivate new barley varieties (FAO, 2018).

Both federal and regional agricultural research centers in Ethiopia operate with a semi-autonomous structure. These centers are responsible for conducting research and releasing new crop varieties. When a center develops and releases a new variety, it is also tasked with promoting its adoption and ensuring the production of breeder and pre-basic seeds. However, a significant challenge arises from the lack of coordination between the crop research teams and seed multiplication teams. These teams often work in silos, which hampers the effective promotion and distribution of new varieties in collaboration with extension services.

Additionally, there is a persistent shortage of early generation seeds (EGS) for varieties already available in the market. This shortage is a critical bottleneck in the agricultural value chain, as it limits farmers' access to high-quality planting materials necessary for optimal crop performance. The Ethiopian Institute of Agricultural Research (EIAR) has recognized this issue and has initiated efforts to decentralize EGS production. By shifting some of the production responsibilities to regional centers, the burden of maintaining EGS is no longer concentrated on a single center. This decentralization aims to enhance the availability and distribution of early generation seeds, thereby supporting the broader adoption of improved crop varieties.

4.2.2. Seed companies

Both public and private seed companies in Ethiopia are integral to the process of further seed multiplication after acquiring early generation seeds (EGS) from research centers. However, the production of malt barley varieties is predominantly managed by public companies and seed-producing cooperative unions.

Public seed companies like Oromia Seed Enterprise and various cooperative unions play a critical role in this sector. For instance, Oromia Seed Enterprise alone is responsible for a significant portion of seed production in the country, supplying about 25% of the total seed demand for major crops, including malt barley. Cooperative unions also contribute substantially by organizing local farmers and ensuring the availability of high-quality seeds.

The dominance of public entities in malt barley seed production can be attributed to several factors. Firstly, malt barley is a self-pollinating crop, which simplifies the seed production process by maintaining genetic purity. This characteristic makes it an attractive option for large-scale, organized seed producers who can manage and monitor the production process efficiently.

In the Amhara and Oromia regions, numerous cooperatives and unions are engaged in malt barley production. For instance, there are 24 Seed Producer Cooperatives (SPCs) and 5 Unions with over 3,778 members involved in malt barley seed business across these regions.

Private seed companies tend to focus on crops with higher profit margins and more stable markets. According to the Ethiopian Seed Association, private seed enterprises are more inclined to produce seeds for crops like maize and wheat, which have well-established markets and higher return on investment.

Seed enterprises and cooperative unions play a role in linking the research institutes both in Amhara and Oromia regions to the malt barley final producers, farmers.

Role of Seed Enterprises

Seed enterprises in Ethiopia, particularly in the Amhara and Oromia regions, are instrumental in the multiplication and distribution of high-quality malt barley seeds. These enterprises work closely with research institutes to obtain breeder seeds of newly developed barley varieties. For instance, the Ethiopian Seed Enterprise (ESE) and the Oromia Seed Enterprise (OSE) are key players in this sector.

Seed enterprises undertake the multiplication of breeder seeds to produce foundation seeds, which are further multiplied to generate certified seeds for distribution to farmers. This process ensures that the genetic purity and quality of the seeds are maintained.

These enterprises have extensive distribution networks that reach remote farming communities. In 2021, the ESE distributed over 60,000 quintals of malt barley seeds to farmers across the country, with a significant portion allocated to Amhara and Oromia regions.

Role of Cooperative Unions

Cooperative unions act as a bridge between seed enterprises, research institutes, and farmers. They play a multifaceted role in the agricultural value chain, particularly in the dissemination of improved malt barley varieties.

Cooperative unions aggregate the demand for improved seeds from their member cooperatives, which consist of individual farmers. They then procure these seeds from seed enterprises and distribute them to their members. For instance, the Oromia Cooperative Union, one of the largest in the region, supports over 2 million farmers.

Cooperative unions provide training and extension services to farmers, helping them adopt best practices in barley cultivation. They organize workshops and field demonstrations in collaboration with research institutes, ensuring that farmers are aware of the latest agronomic practices and technological advancements.

These unions also assist farmers in marketing their produce. By negotiating better prices and finding reliable buyers, they help farmers achieve higher income levels. In 2020, cooperative unions facilitated the sale of over 100,000 quintals of malt barley from the Amhara and Oromia regions to major breweries in Ethiopia.

Seed enterprises and cooperative unions collaborate with research institutes to conduct field trials and demonstrations. These activities help validate the performance of new barley varieties under different agro-ecological conditions in the Amhara and Oromia regions. Research institutes work closely with cooperative unions to transfer knowledge and technology to farmers. Through joint workshops and training sessions, they ensure that farmers are equipped with the necessary skills to optimize barley production.

4.2.3. Agro-dealers

Agro-dealers serve as primary channels for the distribution of agricultural inputs, including seeds, fertilizers, pesticides, and herbicides, to malt barley farmers. They source these inputs from manufacturers, wholesalers, and government agencies and make them available to farmers at accessible locations within rural communities. This distribution network ensures that farmers have timely access to quality inputs, crucial for optimizing malt barley yields and quality.

In the Oromia and Amhara regions distribute a substantial portion of malt barley seeds to farmers. For instance, in 2023, agro-dealers in these regions collectively distributed over 50,000 quintals of certified malt barley seeds. They distributed approximately 200,000 metric tons of fertilizers in 2023, with a significant portion being utilized for barley cultivation.

Agro-dealers also have an impactful relationship with farmers. They conduct regular farm visits to provide on-site advisory services to farmers. On average, each agro-dealer in these regions conducts around 50 farm visits annually, reaching thousands of malt barley growers. Agro-dealers also facilitate the sale of malt barley to buyers such as breweries and grain traders. They play a crucial role in price negotiations between farmers and buyers.

4.2.4. Extension services

Extension services play a pivotal role in the malt barley value chain, facilitating the flow of information, knowledge, and technologies among stakeholders to enhance productivity, quality, and sustainability. The malt barley value chain encompasses various actors, including farmers, input suppliers, maltsters, brewers, researchers, policymakers, and consumers. Extension services act as a bridge connecting these stakeholders, fostering collaboration, and addressing challenges throughout the value chain.

Extension services provide crucial support to farmers by disseminating information on best agricultural practices, such as seed selection, land preparation, planting techniques, irrigation, pest and disease management, and harvesting methods tailored to malt barley cultivation. They

also offer guidance on soil health management, nutrient management, and sustainable farming practices to improve yields and quality while minimizing environmental impact.

Maintaining consistent quality is essential in the malt barley value chain to meet the stringent requirements of maltsters and brewers. Extension services educate farmers on quality parameters such as grain size, protein content, moisture levels, and absence of contaminants. By promoting adherence to quality standards, extension services ensure that farmers produce barley that meets the specifications of maltsters, thereby enhancing market competitiveness and profitability.

Extension services play a vital role in technology transfer by introducing farmers to innovative agricultural technologies, machinery, and equipment for barley cultivation, harvesting, and post-harvest handling. This includes the adoption of precision farming techniques, mechanization, and digital tools for efficient resource utilization, data management, and decision-making. By embracing technology, farmers can improve productivity, reduce production costs, and enhance the overall efficiency of the value chain.

Over 100,000 farmers in Oromia and Amhara have received training through extension services on topics such as agronomy, post-harvest handling, and business skills development. This includes the establishment of 500 farmer field schools to promote peer learning and knowledge exchange.

4.2.5. Farmers and Producer Groups

Malt barley farming in the Oromia and Amhara regions is predominantly carried out by smallholder farmers, often operating on fragmented landholdings. According to the Ethiopian Central Statistical Agency (CSA), smallholder farmers account for over 95% of agricultural production in Ethiopia, including malt barley cultivation in these regions.

Malt barley is a major crop in both regions, with significant land allocated for its cultivation. In Oromia, for instance, malt barley is grown extensively in zones like West Shewa, East Shewa, and West Arsi. Similarly, in Amhara, areas like North Shewa, South Wollo, and West Gojjam are known for their malt barley production. The CSA reports indicate that Oromia and Amhara together contribute to the majority of Ethiopia's malt barley production, with millions of hectares dedicated to its cultivation.

Despite being primarily rainfed, malt barley farming in these regions has seen improvements in yield and productivity in recent years. The adoption of improved varieties, conservation

agriculture practices, and better agronomic techniques has led to an increase in average yields per hectare.

Malt barley farmers play a crucial role in the malt barley value chain, serving as the primary producers of raw material for maltsters and brewers. Their participation in the value chain involves various activities, including land preparation, seed selection, planting, crop maintenance, harvesting, and post-harvest handling. Farmers often engage in contractual agreements with maltsters or cooperatives.

Market access is facilitated through various channels, including direct sales to maltsters, cooperatives, or local markets. Extension services and farmer organizations play a vital role in connecting farmers to markets and ensuring fair prices for their produce.

4.2.6. Malt companies

The malt barley value chain has become significantly more dynamic over the past decade, providing income opportunities for farming households in the Ethiopian highlands. Two new malt factories owned by Boortmalt Ethiopia and Soufflet opened in 2021 with an annual malting capacity production of 110,000 tons, a steep increase in demand for barley in Ethiopia from 100,000 tons in 2019 to 210,000 tons in 2022.

The malt companies in this study are Assela Malt Factory, Gondar Malt Factory and Boortmalt Ethiopia.

Assela Malt Factory

Assela Malt Factory transferred from being a government-owned public enterprise to become the Oromia Agricultural Cooperative Federation on June 1, 2018. In 1984, it was established in as a public enterprise owned by government with annual capacity of 10,000 tons of annual malt production only for domestic consumption. As private limited company Assela Malt Factory is now owned by the Oromia Federation of Cooperatives and is a for-profit venture. Currently, it has an annual capacity of 36,000 tons and produces malt according to international standards for domestic breweries only.

Boortmalt Ethiopia

Boortmalt is an international company implemented on 5 continents with 27 malting plants with headquarters in Belgium. As Boortmalt belongs to a French farmers cooperative, the company developed first the malting barley supply chain that will feed their malting plant located in Debre Berhan. This development started in 2014 and thus allowed them to acquire 6 years of experience in the Ethiopian agricultural sector and current challenges that this one

is facing for scaling up the barley production. Boortmalt's approach with their smallholder farmers partners is to be as close partner as they can. In this purpose, the company deploys a field team of 47 agronomists permanently on the ground in order to be close to field reality, support farmers technically through a wide R&D and training program but also to support administratively their aggregators for making impact all along the value chain.

Gondar Malt Factory

Founded in 2008, Gondar Malt Factory supplies malt to local breweries only as of now. So, it does not have international experience in selling its product abroad. But the company imports some quantities of barley from Europe to fulfil their barley requirement.

Gondar is working with smallholder farmers of the barley growing areas of Amhara. They work with these farmers on contractual farming bases. Gondar Malt is owned 90 % by Tired (an endowment company stationed in Bahirdar) and Tikur Abay Transport company based in Kombolcha.

Malt companies are responsible for sourcing raw malt barley from farmers and cooperatives. They engage with farmers directly or through intermediaries to procure the necessary quantities of barley. This involves establishing contracts with farmers, offering them stable prices, and sometimes providing them with agricultural inputs and technical support to ensure a consistent and high-quality supply of barley.

Once the barley is procured, malt companies process it into malt. This involves cleaning, soaking, germinating, drying, and kilning the barley. The processing transforms raw barley into malt, which is a key ingredient in beer production. Malt companies employ advanced technologies and adhere to strict quality control measures to ensure that the malt meets the specific requirements of breweries.

4.2.7. Breweries

Breweries are the primary consumers of malt barley, creating substantial demand for this crop. In the Oromia and Amhara regions, breweries have significantly boosted the local agricultural economy by providing a stable and growing market for barley farmers. This demand encourages farmers to allocate more land to malt barley cultivation, thereby increasing production volumes.

4.2.8. Supporting Institutions

Government agencies, NGOs, and international organizations provide regulatory oversight, research, development support, and financial services. These institutions support the value

chain's sustainability and efficiency through development programs, funding, and training initiatives.

4.3. Profit Margins and Marketing Dynamics

In the malt barley value chain, profit margins and marketing dynamics can be categorized into two segments based on the actors' contributions. The first segment encompasses Agricultural Research Institutes, Public Seed Enterprises, and Cooperative Unions, which are primarily involved in the development and production of Early Generation Seeds (EGS) of malt barley. Agricultural Research Institutes focus on breeding new varieties with desirable traits, while Public Seed Enterprises produce and distribute quality seeds, and Cooperative Unions provide support to farmers.

Table 4. Barley EGS cost of production of public seed producers and cooperative unions (ETB/ha)

Barley	Pre-basic seed				Basic seed	
	Cost Items	EIAR	ARARI	OARI	PSE	PSE
Material costs	6,744.2 (17.2%)	8,854.9 (13.3%)	10,288.2 (40.9%)	10,869.1 (32.5%)	17,086.1 (45.4%)	8,133.9 (12.5%)
Operational costs	26,238.6 (66.7%)	32,483.0 (48.8%)	7,700.0 (30.6%)	16,570.3 (49.6%)	12,050.4 (32%)	51,320.2 (78.9%)
Total variable costs	32,982.7	41,337.9	17,988.3	27,439.4	29,136.5	59,454.1
Total fixed costs	6,326.8	25,171.6	7,190.9	5,991.5	8,532.2	5,594.2
Total costs	39,309.5	66,509.5	25,179.2	33,430.9	37,668.7	65,048.3
Fixed costs (%)	16.10%	37.81%	28.57%	17.89%	22.64%	8.59%
Variable costs (%)	83.90%	62.19%	71.43%	82.11%	77.36%	91.41%

Numbers in parenthesis refer to the percentage share of total production costs.

Source: Tekeste K., et al (2024).

In this segment of the value chain, profit margins may be influenced by factors such as government funding for research, subsidies for seed production, and the efficiency of cooperative operations. Profit margins here might not be as high as in downstream segments due to the focus on research and initial production stages.

In terms of total costs, Pre-basic seed barley generally incurs higher expenses than Basic seed barley across different entities. Total costs for Pre-basic seed barley range from 39,309.5 to 66,509.5, while for Basic seed barley, they range from 25,179.2 to 37,668.7. These variations highlight differences in production processes, efficiencies, and resource utilization among different entities, impacting the overall costs of barley production.

Table 5. Profitability analysis of barley EGS production by public producers and Unions

Items	Barley					
	Pre-basic seed				Basic seed	
	EIAR	ARARI	OARI	PSE	PSE	Unions
Total revenue (ETB/ha)	34,220.1	52,745.0	22,227.1	101,138.7	85,988.8	63,243.8
Total variable costs (ETB/ha)	32,982.7	41,337.9	17,988.3	27,439.4	29,136.5	59,454.1
Total fixed costs (ETB/ha)	6,326.8	25,171.6	7,190.9	5,991.5	8,532.2	5,594.2
Total costs (ETB/ha)	39,309.5	66,509.5	25,179.2	33,430.9	37,668.7	65,048.3
Cost per quintal	6,535.60	7,741.30	3,887.40	1,492.50	1,786.20	6088.9
Net return/profit (ETB/ha)	(5,089.4)	(13,764.5)	(2,952.1)	67,707.8	48,320.1	(1,804.5)
Gross margin (ETB/ha)	1,237.5	11,407.1	4,238.8	73,699.3	56,852.3	3,789.8
Profit margin (%)	3.6	21.6	19.1	72.9	66.1	6.0
Benefit-cost ratio	0.87	0.79	0.88	3.03	2.28	0.97

Numbers in parenthesis indicate negative returns.

Source : Tekeste K., et al (2024).

The profitability of barley seed production has been evaluated, distinguishing between pre-basic and basic seed production. The findings indicate that while both pre-basic and basic barley seed production by Private Seed Enterprises (PSE) are generally profitable, the scenario differs significantly for public research institutes when it comes to pre-basic seed production.

Private Seed Enterprises (PSE) have successfully achieved profitability in both categories of barley seed production. This success can be attributed to their operational efficiencies, market

strategies, and possibly better access to resources and technologies that enhance production outcomes. As a result, the net returns from both pre-basic and basic seed production for PSE are positive, indicating that the revenues generated exceed the associated costs, thereby ensuring a profitable venture.

Conversely, public research institutes face a challenging economic landscape regarding pre-basic barley seed production. Despite the critical role these institutes play in ensuring the availability of high-quality early generation seeds (EGS), the financial analysis reveals a negative net return for their pre-basic seed production efforts. This negative net return indicates that the total project costs incurred by public research institutes surpass the financial benefits gained from selling pre-basic seeds. In other words, the expenses associated with producing pre-basic barley seeds, including research, labor, materials, and other operational costs, are higher than the income generated from their sale.

The discrepancy in profitability between PSE and public research institutes can be attributed to several factors:

- **Operational Efficiency:** PSE may have more streamlined and cost-effective operations compared to public research institutes, which often face bureaucratic hurdles and may lack the flexibility to optimize production processes.
- **Market Orientation:** PSE are typically more market-driven, focusing on demand and profitability, while public research institutes may prioritize research and development objectives, which do not always align with immediate financial returns.
- **Funding and Resources:** Public research institutes might rely on limited and inconsistent funding, affecting their ability to invest in advanced technologies and infrastructure that could reduce production costs.
- **Economies of Scale:** PSE might benefit from economies of scale due to larger production volumes and more extensive distribution networks, reducing the per-unit cost of seed production.

In summary, while PSE have found both pre-basic and basic barley seed production to be profitable, public research institutes struggle with the financial viability of pre-basic seed production. The negative net return indicates that the costs involved in producing these seeds outweigh the revenues, making it an unsustainable venture for public research institutes without additional funding or strategic changes to improve efficiency and reduce costs.

The second segment involves farmers, malt companies, breweries, and other stakeholders engaged in value addition processes. Farmers are the primary producers of malt barley, with

profit margins affected by yield, input costs, and market demand. Malt companies process barley into malt, while breweries use malt to produce beer. In this segment, profit margins tend to be higher compared to upstream activities due to the value addition processes involved in malt production and beer brewing. However, competition among malt companies, breweries, and other stakeholders can influence profit margins in this segment.

Table 6. Profit and marketing margin of stakeholders in the malt barley value chain

Item(ETB/qt)	Producer/ farmers	Primary cooperative	Union	Malt factory	Horizontal sum
Purchase price (PP)	0	3680	3900	4300	
Production cost(PC)	850	0	0	0	850
Marketing cost(MC)	0	0		430	430
Total cost/qt (TC)	850	3,680	3900	4730	13160
Share of cost (%)	6.4%	28%	29.6%	36%	100%
Selling price/ qt (SP)	3680	3900	4300	5500	7598
Marketing margin (SP-PP)	2830	220	400	1200	4650
Margin (%)	60.8%	4.7%	8.6%	25.8%	100%
Profit margin (SP-TC)	2830	220	400	770	4220
Share of profit (%)	67%	5.3%	9.5%	18.2%	100%

Source: own calculation

In the profit distribution structure of the barley value chain in the Amhara and Oromia regions, the producers and malt factories capture the largest portions of the profit margins. Specifically, producers take the largest share with 67% of the profit, reflecting their crucial role in the production process. Malt factories, which process the raw barley into malt, secure the second largest share with 18.2%. This significant share highlights the added value brought by processing activities.

In comparison, the primary cooperatives and cooperative unions receive much smaller shares of the profit. Primary cooperatives, which are the local organizations that often support farmers with inputs and market access, obtain only 5.3% of the profit margin. This indicates their limited financial gain relative to their role in the value chain. Cooperative unions, which are larger federations of primary cooperatives that might offer additional services such as bulk marketing and supply chain coordination, capture 9.5% of the profit. Although their share is higher than that of the primary cooperatives, it is still significantly less than the shares of the producers and malt factories.

This profit margin distribution underscores a disparity in earnings within the barley value chain, where those directly involved in production and processing reap the most financial benefits, while intermediary organizations like cooperatives receive a smaller fraction of the profits. These findings are consistent with studies on the malt barley value chain, which highlight that the largest profit shares go to the producers and malt factories due to their pivotal roles in the supply chain, while primary cooperatives and unions receive relatively smaller margins.

Implications for the Malt Barley Value Chain

The distribution of profit margins highlights a disparity within the value chain. Producers and malt factories, which are directly involved in production and processing, reap the most financial benefits. This aligns with the general understanding that those closer to the beginning (producers) and the end (processors) of the value chain tend to capture larger shares of the profit.

The significant share captured by malt factories emphasizes the value added through processing activities. This reinforces the importance of processing in enhancing the economic value of raw barley. Additionally, primary cooperatives and cooperative unions play crucial roles in supporting farmers and coordinating market activities, their smaller profit shares indicate challenges in fully benefiting financially from their intermediary roles.

5. Objective two: production practices, productivity and related challenges of smallholder malt barley farmers

5.1. Socio-economic characteristics of sample farmers

The average age of the household head was 47 years. The years of schooling of the household head in Oromia region was found higher than that of Amhara region where the mean schooling years of respondents were 5 years. Malt barley producers in Oromia region had to travel longer distance to get an extension experts, cooperative office and main market places compared to producers in Amhara region. Producers had more than 20 years of experience in crop production and 8 years in malt barley production (Table 7).

Table 7. Socioeconomic and other characteristics of the sampled malt barley producers

Socioeconomic variables	Amhara	Oromia	Total
	Mean	Mean	Mean
Age of household head [years]	46.49	47.00	46.79
Sex of the farm households (%male)	93.41	92.92	93.12
Education of household head [years]	2.30	5.51	4.19
Family size of household [No.]	4.81	5.51	5.23
Distance from nearest market place [KM]	6.66	6.61	6.63
Distance from main market place [KM]	9.58	11.53	10.73
Distance to Extension service [KM]	2.19	3.18	2.77
Distance to cooperative [KM]	2.40	3.51	3.05
Experience in grain crop production [years]	25.31	21.49	23.05
Experience in malt barley production [years]	6.41	9.08	7.98

5.2. Major crops produced in the study areas

The highest per household area of land is allocated for food barley (0.5 ha) and followed by triticale (0.48 ha) and maize by Amhara regional state sample producers. Malt barley is in the fifth place following food barley, triticale, maize and red *teff* in the region in terms of area allocation. In Oromia regional state, sample farmers allocated the highest area for bread wheat (1.16 ha) which is followed by malt barley (0.9 ha). In general, bread wheat (0.73 ha), malt barley (0.66), food barley (0.59 ha), potato (0.5 ha) and emmer (0.48 ha) are among the top five major crops produced by sample farmers in the study areas based on per capita area allocated (Fig.3). In terms of productivity, malt barley has second highest performance both in Oromia and in Amhara regions among grain crops. On average the productivity of potato, malt

barley, triticale, food barley and bread wheat is found 5.0, 2.9, 2.6, 2.5 and 2.3 tons per hectare of land respectively (Fig.4).

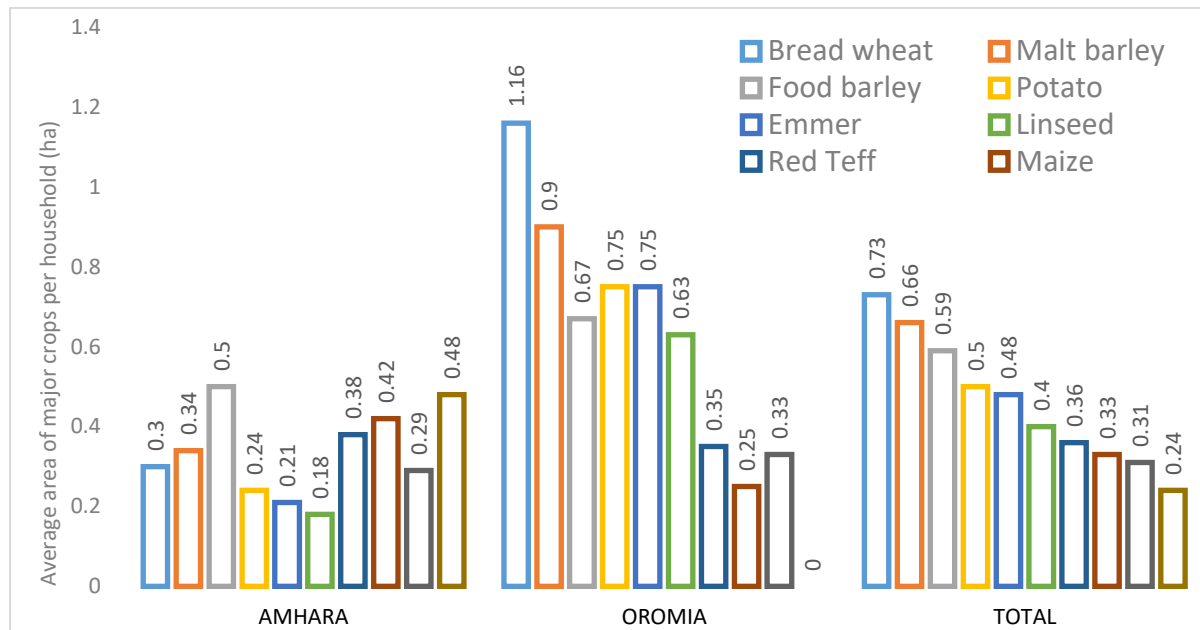


Figure 4. Average per household area allocation for major crops grown in the project areas

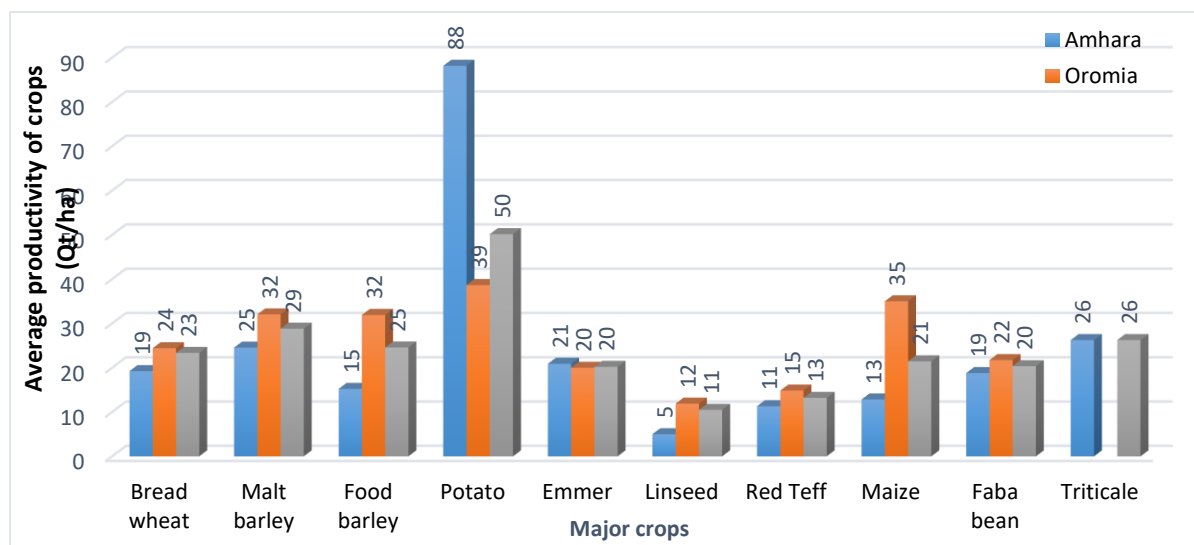


Figure 5. Average productivity of major crops grown in the project areas

5.3. Malt barley cultivation practices

Plowing: Proper land preparation is one of the most critical agronomic management in crop production. Malt barley producers in Amhara region on average plows 4 times before planting the malt barley where as in oromia region average plowing frequency is 3 times before planting. The frequency of plowing is highest in Awi zone of Amhara region in which producers are plowing their land 7 times before planting. Considering the study strata malt factories, average

plowing frequency before planting was found 4, 5 and 4 times for Asella, Gonder and Boort malt malt barley producers respectively. The study showed that the productivity of the crop has been declined if plowing frequency exceeds 5 (Fig 6).

Table 8. Average malt barley productivity across plowing frequency

Regional states	Administrative zones	Mean	Std. err.	Groups
Amhara	Awi	7.3	0.13	
	East Gojam	3.4	0.12	AB
	North Shewa	3.1	0.18	A
	Central Gondar	3.1	0.21	A
Oromia	Bale	4.0	0.30	BC
	Arsi	3.9	0.10	C
	West Arsi	3.4	0.09	AB
Overall		3.9	1.58	

Note: Means sharing a letter in the group label (zones) are not significantly different at the 5% level of significance. It means that any observed differences in the average values between these administrative groups are small enough that they could be due to random variation rather than a real underlying difference.

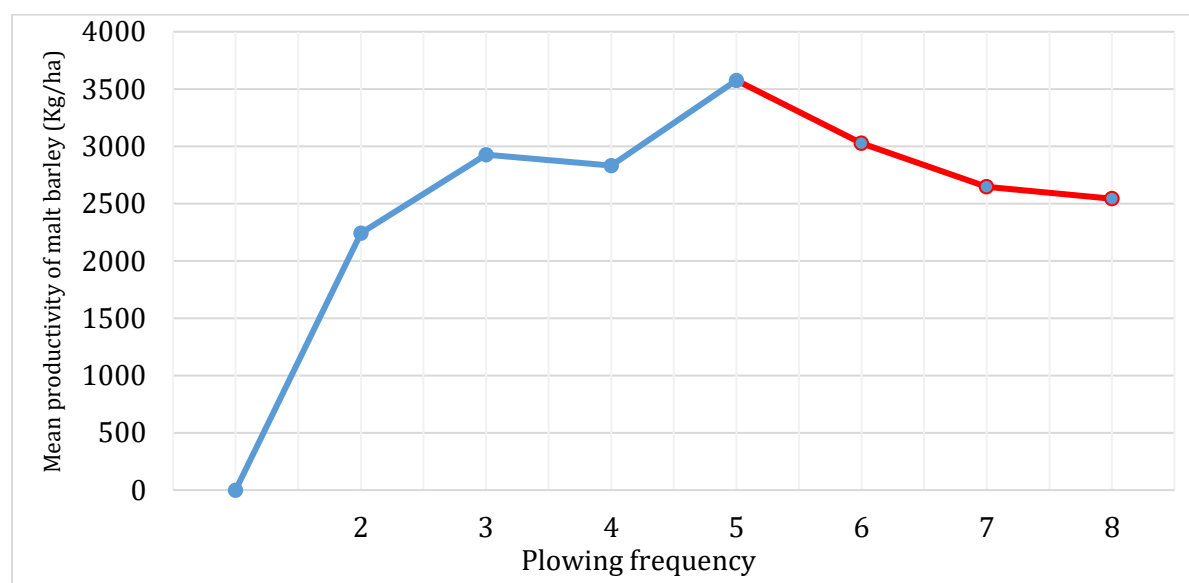


Figure 6. Average malt barley productivity across plowing frequency

5.4. Input use practices and malt barley Productivity

The land allocation for malt barley is found to be higher in Oromia region compared to Amhara region. The average area of malt barley per household is 0.66 hectare. Producers on average used 202 kg of malt barley seed per hectare and the seed rate used is higher than the range of

the national recommendations which proposes 100 to 150 kg of seed in row planting. The average Urea application rate is found to be 62 kg per hectare of malt barley. The rate of Urea application is significantly higher in Amhara region compared to Oromia region. The use of NPS has no significant variation across regions and the average application rate is 131 kg/ha (Table 9).

The average malt barley productivity in the study area was found 2.88 ton per a hectare of land and it ranges between 2.75 ton and 3.01 tons with 95% level of confidence. Though productivity is slightly above the national average of barley (2.60 ton/ha) (ESS, 2021), it is far below the productivity potential showed by some malt barley varieties (MOANR, 2016). On average producers in Oromia get about 3.20 ton/ha whereas it is 2.45 ton/ha in Amhara. The productivity of malt barley is found significantly higher in Oromia region compared to that of Amhara region at 1% level of significance (Table 9).

Table 9. Input use practices and malt barley productivity across regional states

Variables	Recommended rate for row planted malt barley	Plots	Amhara	Oromia	Total
Average plot area (ha/HH)	-	399	0.34	0.90	0.66***
Seed (Kg ha⁻¹)	100-150	398	202.85	201.09	201.85
UREA (Kg ha⁻¹)	40-80	398	111.37	25.14	62.19***
NPS (Kg ha⁻¹)	100	398	135.27	128.55	131.44
Herbicide (Kg ha⁻¹)	-	283	0.98	1.08	1.05
Fungicide (Kg ha⁻¹)	-	144	1.50	1.10	1.10
Insecticide (Kg ha⁻¹)	-	26	1.02	0.78	0.81
Production (Kg ha⁻¹)	-	398	2455.26	3203.48	2882.01***

*Note: HH is household; *** is t-test significant at 1% level of significance*

Except rate of Urea application, input use practices were not found significantly different across members of Asella, Gonder and Boortmalt malt factories. Malt barley productivity were found significantly different across members of malt factories. The productivity of malt barley across malt factories were 3.15 tons, 2.98 tons and 2.24 tons per hectare for Asella, Boortmalt and Gonder malt factories respectively (Table 10).

Table 10. Average input use and malt barley productivity across malt factories

Variables	Asella malt factory [P=93]	Gonder malt factory [P=79]	Boortmalt factory [P =227]	Total [P =399]
Average plot area (ha/HH)	0.86	0.34	0.69	0.66***
Seed (Kg ha ⁻¹)	206.22	205.73	198.71	201.85
UREA (Kg ha ⁻¹)	18.06	112.48	62.98	62.19***
NPS (Kg ha ⁻¹)	138.15	134.20	127.73	131.44
Herbicide (Kg ha ⁻¹)	1.07	0.96	1.05	1.05
Fungicide (Kg ha ⁻¹)	1.08	-	1.12	1.10
Insecticide (Kg ha ⁻¹)	0.72	1.20	0.83	0.81
Production (Kg ha ⁻¹)	3154.33	2256.18	2985.49	2882.01***

Note: HH is household; P is number of malt barley plots; *** is F-test significant at 1% level of significance

5.5. Seed recycling and adoption of malt barley varieties

Seed is one of the most important input of crop production. About 55% of sample producers used malt barley seed for one season; which means zero recycling that farmers are buying malt barley seed every year from available seed sources rather than reusing it for the next season. However, on average producers recycle seed of malt barley once (reuse for at least one additional cropping season) before they replace it buying from available seed sources. Seed recycling is more common in Amhara region compared to that of Oromia region (Table 11). Among 21 improved malt barley varieties that has been distributed to producers by different stake holders, sample producers were using about 13 varieties. Traveler is the dominant malt barley variety used by the farmers followed by Holker, IBON, HB 1963 and Henerike among others. Among 150 malt barley farm plots in Amhara region and 227 malt barley farm plots in Oromia region, farmers reported that Holker was dominantly cultivated malt barley variety in Amhara region; whereas Traveler was dominantly cultivated by Oromia region sample producers (Fig.7).

Table 11. Seed recycling in malt barley production

Seed recycling (frequency)	Region		Total (%)
	Amhara (%)	Oromia (%)	
0	55	54	55
1	8	36	21
2	10	9	10
3	13	1	7
Higher than 3 times	15	0	7
Average recycling	2	1	1***

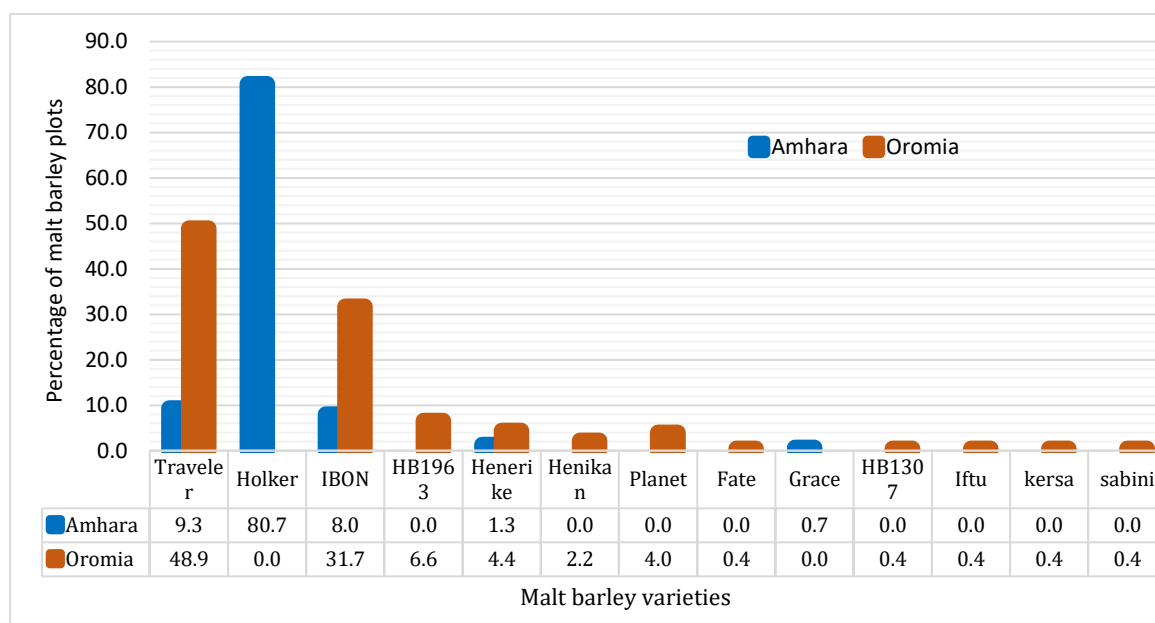


Figure 7. Major malt barley varieties cultivated by the producers across regions

5.6. Major sources of malt barley seed and fertilizers

Own saved seed is the major sources of the seed. 43% of the producers used their own saved seed to produce malt barley in the survey year. Among others cooperatives, private seed suppliers, local market and government extension were top five seed sources in the areas (Fig.6). Fertilizer is supplied by cooperatives for more than 75% the producers. The government extension and local market were also significant sources of fertilizers (Fig.8).

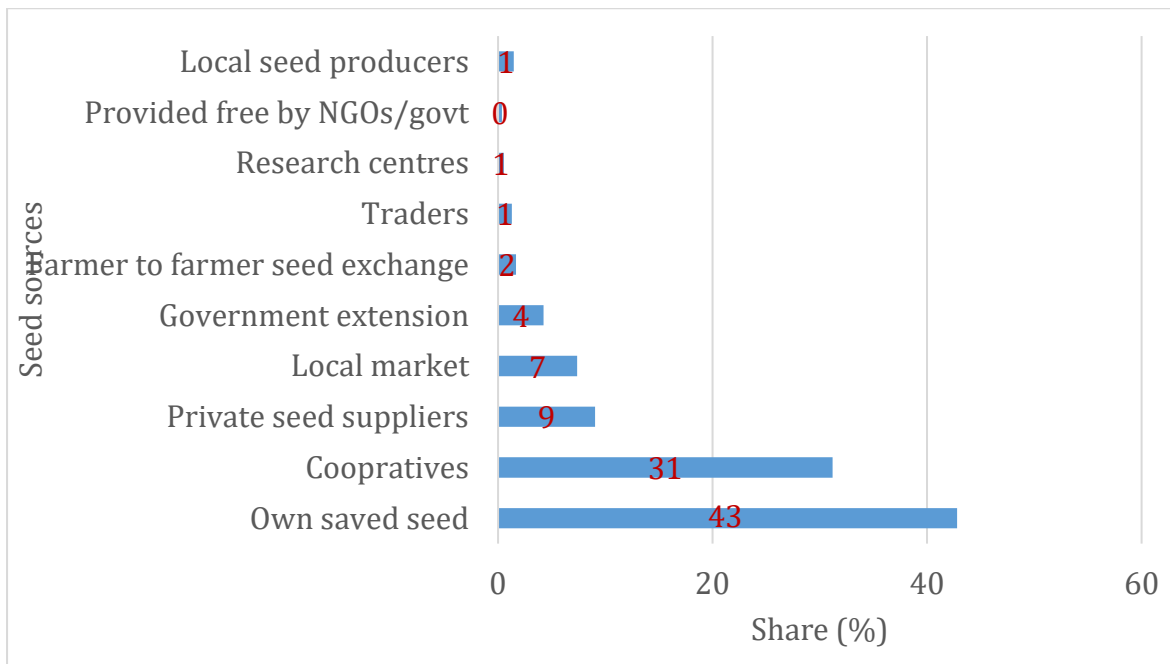


Figure 8. Major malt barley seed sources

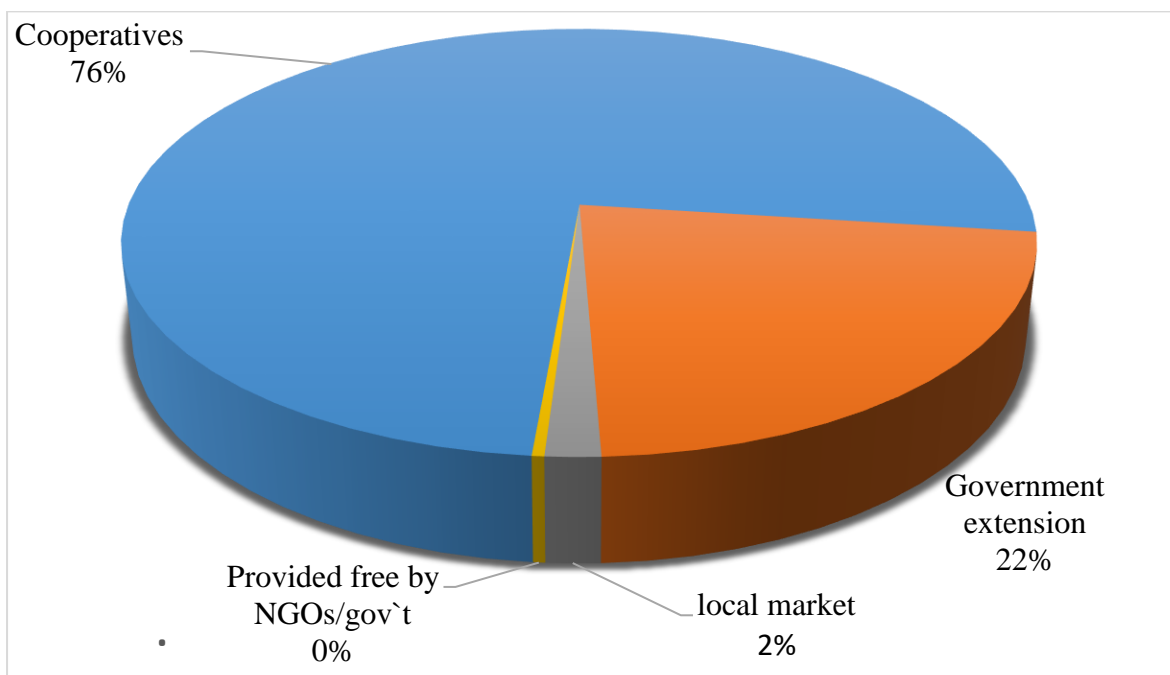


Figure 9. Major sources of fertilizers

5.7. Adoption of improved crop management practices in malt barley production

The study revealed that manure was applied on larger number of malt barley plots in Amhara region compared to Oromia region. On average 22% of the malt barley plots were fertilized by manure. Legume rotation, row planting and herbicide are used on larger number of malt barley plots in Amhara region whereas use of fungicide is found to be higher in Oromia region

(Appendix Table 16). Adoption of manure/compost and row planting was significantly higher for Gonder malt factory malt barley supplier farmers compared to others whereas use of herbicides were significantly below Asella and Boortmalt malt barley supplier sample farmers. The average adoption rate of legume rotation, row planting, herbicides and fungicides is 32%, 13%, 71% and 36% respectively (Table 12).

Table 12. Adoption of improved management practices across members of factories in percent

Technologies	Factory			Total (P =399)	chi2
	Asella (P =93)	Gonder (P =79)	Boortmalt (P =227)		
Manure/compost	8.60	53.16	16.30	21.80	59.11***
Legume rotation	29.03	35.44	32.60	32.33	0.82
Row planting	5.38	40.51	7.05	13.28	63.53***
Use of herbicide	94.62	26.58	76.65	70.93	104.27***
Use of fungicide	66.67	1.27	36.12	36.34	78.98***

Note: P is number of malt barley plots; *** is chi-square test significant at 1% level of significance. The significant results at the 1% level for herbicide and fungicide use indicate that the differences in productivity for these technologies are very likely to be real (not due to chance), with a high confidence level of 99%.

Table 13. Malt barley productivity across technology adoption

Technologies	Mean malt barley productivity (tons/ha)	
	[P=398]	
	Non adopters	Adopters
Manure/compost	2.919	2.748
Legume rotation	2.806	3.041
Row planting	2.869	2.970
Use of herbicide	2.378	3.089***
Use of fungicide	2.567	3.438***

Note: P is number of malt barley plots; *** is t-test significant at 1% level of significance

The malt barley productivity was not found statistically significantly different across adoption of manure/compost, legume rotation and row planting. The malt barley productivity for herbicide and fungicide adopters were significantly higher than non-adopters. Though there are many biotic and abiotic factors that determine crop productivity, weeds and disease might have

crucial adverse relationship with the productivity of malt barley as it might the case in this study.

5.8. Main malt barley production stresses observed on farm plots

Malt barley plots that was damaged by natural stress were 78% in Oromia region and 48% in Amhara region. Generally 66% of the plots were affected by natural stress. The majority of malt barley plots (40%) were affected by malt barley disease. Diseases (such as scald, net blotch, spot blotch, and rusts) and insect pests (such as aphids and barley shoot fly) reportedly can cause more than 50% yield losses (Rashid et al., 2015).

Table 14. Number of malt barley plots affected by identified production stresses

Main stresses	Amhara	Oromia	Total
Insects/pests	7 (4.09)	32 (14.22)	39 (9.85)
Disease	16 (9.36)	142 (63.11)	158 (39.9)
Waterlogging	16 (9.36)	6 (2.67)	22 (5.56)
Drought	3 (1.75)	0 (0)	3 (0.76)
Frost	6 (3.51)	1 (0.44)	7 (1.77)
Hailstorm	5 (2.92)	0 (0)	5 (1.26)
Animals	21 (12.28)	0 (0)	21 (5.3)

Percepts in parenthesis

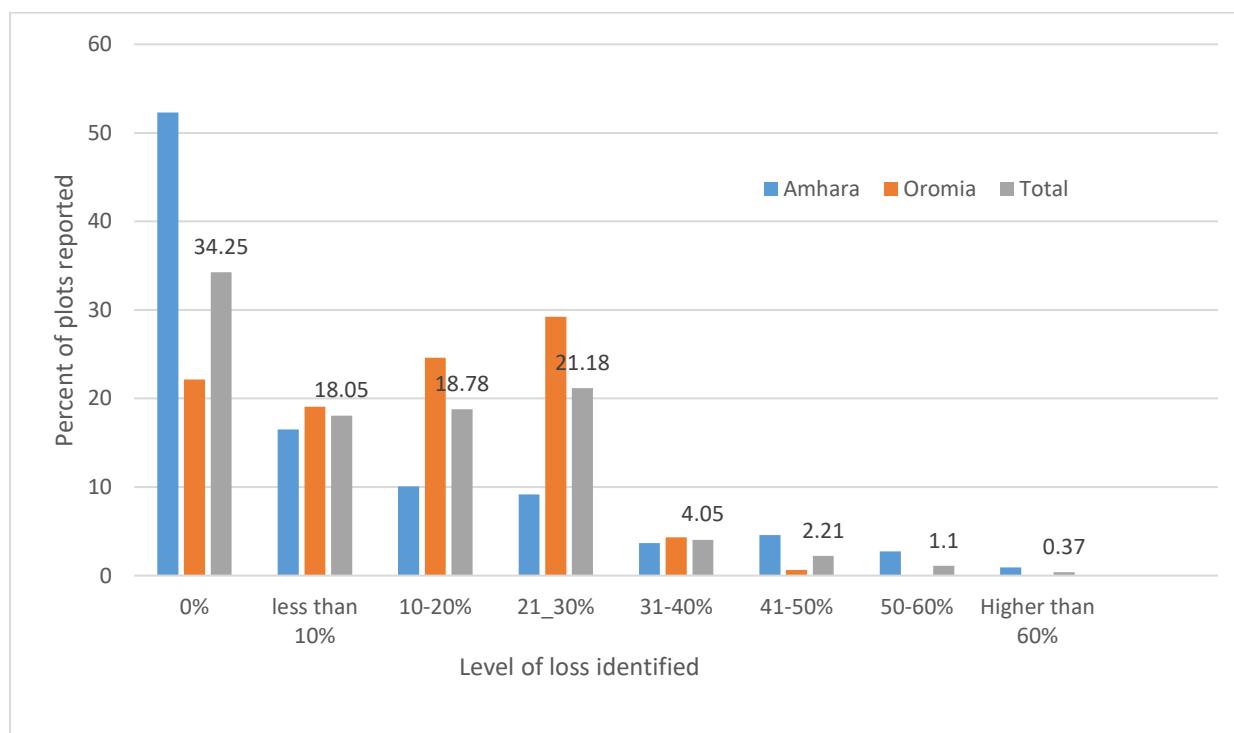


Figure 10. Producers reported level of grain loss caused by various stresses on malt barley plots

The adverse effect of insect pest, waterlogging and animals were also found prevailing in malt barley production (Table 14).

The producers indicated that they lose 10 to 20% of grain from about 18% of malt barley plots and 21 to 30% of malt barley grain that could be obtained from 21% of malt barley plots under the crop cultivation (Fig.8).

5.9. Multiple Linear regression output

The model used in the provided regression analysis is a multiple linear regression model. This type of model is used to understand the relationship between one dependent variable and multiple independent variables.

Table 15. Variables for regression

Variable	Description
PRODNHA	Production Per Hectare(dependent variable)
AGE	Age of the farmer (years)
EDU	Education level of the farmer (years of schooling)
EXP	Farming experience of the farmer (years)
RECYCLED_THE_VARIETY	Proportion of recycled seed varieties used
SEEDAMOUNTKG	Amount of seed used (kilograms)
UREA_KG	Amount of urea fertilizer used (kilograms)
NPS_KG	Amount of NPS (Nitrogen, Phosphorus, Sulfur) fertilizer used (kilograms)
FUNGKG	Amount of fungicide used (kilograms)
HERBKG	Amount of herbicide used (kilograms)
ROTATION	Practice of crop rotation (binary variable: 1 if practiced, 0 if not)
IMPVARIETY	Use of improved seed varieties (binary variable: 1 if used, 0 if not)
LABOR	Amount of labor input (number of labor units or hours)
_cons	Constant term in the regression (intercept)

Variables (PRODN/HA)	Coefficient	Std. Error	t-value	P-value
AGE	-11.06681	7.053432	-1.57	0.117
EDU	8.104637	8.871003	0.91	0.361
EXP	4.592583	12.39784	0.37	0.711
RECYCLED_THE_VARIETY*	-91.88322	33.03856	-2.78	0.006
SEEDAMOUNTKG*	3.288173	0.9023067	3.64	0.000
UREA_KG*	16.7681	2.295431	7.30	0.000
NPS_KG	0.7862992	1.081848	0.73	0.468
HERBKG	-190.7365	166.3275	-1.15	0.252
FUNGKG	296.0759	196.3019	1.51	0.132
ROTATION*	415.0492	197.3709	2.10	0.036
IMPVARIETY*	935.3211	201.0699	4.65	0.000
LABOR*	58.99208	14.44264	4.08	0.000
_cons	540.6835	344.3404	1.57	0.117

Table 16. OLS regression output

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of PRODNPerHa

chi2(1) = 1112.00

Prob > chi2 = 0.0000

Ramsey RESET test using powers of the fitted values of PRODNPerHa

Ho: model has no omitted variables

F(3, 384) = 74.22

Prob > F = 0.0000

Shapiro-Wilk W test for normal data

Variable	Obs	Shapiro-Wilk W	W Critical Value	Z-score	p-value
residuals	400	0.81144	0.975	9.398	0.00000

Variable	VIF
SEEDAMOUNTKG	3.77
NPS_KG	3.73
FUNGKG	1.47
HERBKG	1.40
IMPVARIETY	1.34
EXP	1.33
ROTATION	1.25
UREA_KG	1.23
LABOR	1.17
AGE	1.16
RECYCLED_T~Y	1.09
EDU	1.01
Mean VIF	1.66

Mean VIF shows the analysis is not significantly subject multicollinearity (rule of thumb VIF<3)

The above OLS regression output is affected by heteroscedasticity, which refers to the presence of non-constant variance in the error terms. Heteroscedasticity is a common issue in OLS regression and can lead to inefficient estimates and misleading statistical inferences. Specifically, when the error variance is not constant across observations, the standard errors of the coefficients are biased, resulting in unreliable hypothesis tests and confidence intervals.

To address the issues arising from heteroscedasticity and improve the reliability of the regression results, robust regression techniques are employed. These methods are designed to provide more reliable parameter estimates by adjusting for the non-constant variance of the errors.

Table 17. Robust OLS regression estimates

Variable (Production/ha)	Coef	Robust Std. Err.	t	P>t
AGE	-11.06681	8.087017	-1.37	0.172
EDU	8.104637	7.242525	1.12	0.264
EXP	4.592583	14.37918	0.32	0.750
RECYCLED_THE_VARIETY*	-91.88322	35.0481	-2.62	0.009
SEEDAMOUNTKG	3.288173	1.986058	1.66	0.099
UREA_KG	16.7681	9.444453	1.78	0.077
NPS_KG	.7862992	4.27948	0.18	0.854
HERBKG	-190.7365	118.8744	-1.60	0.109
FUNGKG	296.0759	159.7079	1.85	0.065
ROTATION*	415.0492	182.0612	2.28	0.023
IMPVARIETY*	935.3211	294.4581	3.18	0.002
LABOR*	58.99208	27.8732	2.12	0.035
_cons	540.6835	395.5821	1.37	0.172

Based on the robust regression analysis, several key factors significantly (P-value<0.05) influence agricultural production Per hectare (PRDNHA), revealing important insights for optimizing farming practices.

Recycled Variety Use: Using recycled varieties has a notable negative impact on production. This suggests that relying on recycled seeds reduces crop yields. Recycled seeds, which are often less vigorous and genetically diverse, tend to perform poorly compared to hybrid and improved varieties. Recent studies support this finding, highlighting that improved seed varieties significantly enhance crop performance by increasing resistance to diseases and environmental stresses (Heisey & Fuglie, 2018). This underscores the importance of investing in high-quality seeds to achieve better yields.

Crop Rotation: Implementing crop rotation strategies positively affects production. Crop rotation improves soil health, reduces pest and disease cycles, and enhances nutrient availability, leading to better crop performance over time. Recent research by Smith et al. (2021) shows that diverse crop rotations can significantly increase soil organic matter and fertility, which in turn boosts crop yields. This practice is crucial for long-term agricultural sustainability and productivity.

Improved Seed Varieties: Using improved seed varieties has one of the most substantial positive impacts on production. Improved varieties are bred for higher yields, disease resistance, and adaptability to different environmental conditions, making them highly beneficial for enhancing agricultural productivity. Studies, such as those by Pingali (2019), demonstrate that improved seed varieties can lead to dramatic increases in crop yields and resilience, particularly in the face of climate change and variable growing conditions.

Labor Input: Increasing labor input positively influences production. This suggests that labor-intensive practices, which might include more careful planting, weeding, and harvesting, can significantly enhance crop yields. In small-scale farming systems, where mechanization is limited, the role of manual labor is crucial. Recent findings by Lowder et al. (2021) highlight that labor-intensive farming practices can improve crop management and productivity, especially in regions with high labor availability and less access to advanced agricultural technologies.

The analysis indicates that factors such as seed amount, urea fertilizer, crop rotation, improved seed varieties, and labor are crucial for increasing agricultural production. Conversely, relying on recycled seed varieties can negatively impact yields. These insights are supported by recent agricultural research, which emphasizes the importance of optimized inputs and practices for sustainable and enhanced crop production.

6. Objective three: investigation market access and related issues of smallholder farmers in the malt barley sector

6.1. Market places for malt barley

Our sample producers sold their malt barley grain in various market places including farm gate, their residential places, village market and district markets. Sample producers indicated that they mainly (60%) used village markets to sell their malt barley grain. About 19% of the cases producers sell at district markets where as 10% of the cases they sell at a farm gate. Producers that sold in village market had got significantly higher sale income from malt barley compared to others (Table 18). Farmers selling in village markets earn significantly higher average incomes (51,918 ETB) than those selling in district markets, at the farm gate, or other places. This is statistically significant at the 5% level, suggesting that selling in village markets is associated with higher returns.

Table 18. Share of market places for malt barley grain in percent

Market places	Amhara [SF=206]	Oromia [SF =264]	Total [SF =470]	Average income from malt barley (ETB)
Village market	42.47	74.24	60.43	51,918**
District market	24.76	14.77	19.15	43,255
Farm gate	15.05	6.44	10.21	30,253
Others (at home)	0.97	3.03	2.13	39,213
Did not sell	16.5	1.52	8.09	-

Note: SF is selling frequency in which the farmers sold their malt barley grain; ** is t-test significant at 5% level of significance

6.2. Market outlets used by malt barley producers

In Amhara producers sell their produce through farmers' cooperatives, retail traders, wholesalers, malt factories and farmers whereas producers in Oromia have an additional market outlets including collectors, NGOs, farmer cooperative unions and brokers. In general, the majority (71%) of farmers sell their produce to farmers' cooperatives followed by retail and wholesalers traders. Farmers indicated that cooperatives give better price and share dividends for producers as most of the producers are shareholders. The average price paid for malt barley by malt factories, cooperatives, retail traders and wholesalers were 38, 37, 36 and 34 ETB per one kilogram of malt barley grain respectively.

Table 19. Major market outlets for malt barley produces

Malt barley buyers	Amhara		Oromia		Total		Average buying price (ETB/Kg)
	F	%	F	%	F	%	
Cooperatives	129	84.87	146	62.13	275	71.06	37
Retail traders	9	5.92	37	15.74	46	11.89	36
Wholesalers	7	4.61	30	12.77	37	9.56	34
Malt factories	6	3.95	9	3.83	15	3.88	38
Others	1	0.66	13	5.54	14	3.11	34

Note: others include collectors, NGOs, union, brokers and farmers; F= is frequency of sale that farmers made

6.3. Market share of malt barley grain

Malt barley grain produced in the study areas reach the end users through cooperatives, retail traders, wholesalers, malt factories, collectors, brokers, NGOs and unions. The largest (70%) amount of malt barley is bought by the farmers' cooperative. About 11% and 10% of malt barley grain produced is bought by retails and wholesalers respectively. The remaining malt barley grain is bought by Malt factories, Collectors, Brokers, NGOs and Unions. The average market price of malt barley grain that producers received is 37 birr/kg. However, the price varies in the range of 20 birr/kg to 54 birr/kg.

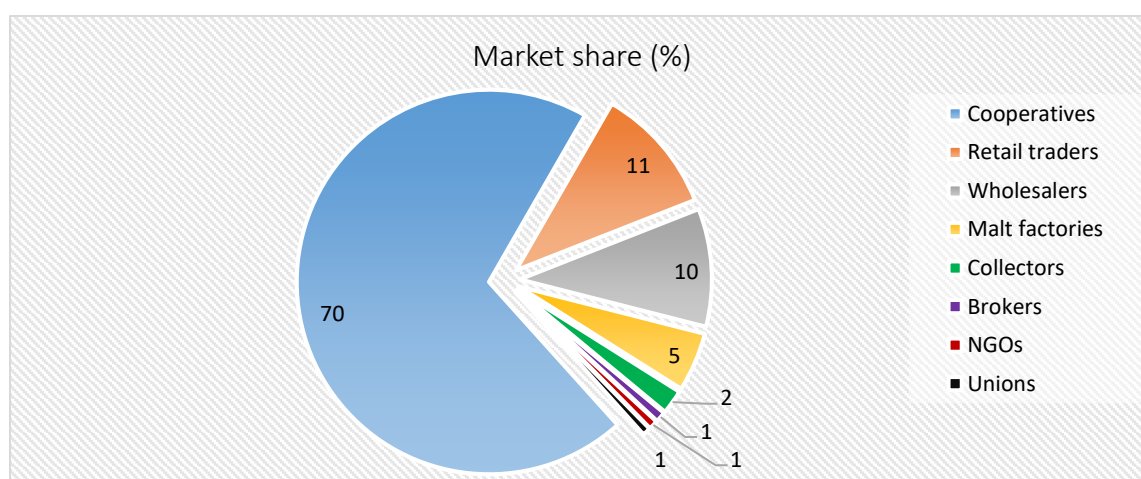


Figure 11. Market share of malt barley buyers

6.4. Training on malt barley production and marketing

Capacity building in terms of training is mandatory to improve production and productivity of crop production as it boosts skill of producers on improved crop production management practices like proper land preparation and utilization; use of fertilizers, agro chemicals, pest and disease management. Training is crucial tool to improve marketing strategy of producers. In the study area, malt barley producers were dominantly trained on improved agronomic managements like land preparation and fertilization. The proportion of malt barley producers trained on agronomic managements, improved crop varieties, pest and disease management and marketing is 71%, 67%, 59% and 40% respectively (Fig.12). However, the study showed few producers were trained on marketing strategies in the study areas.

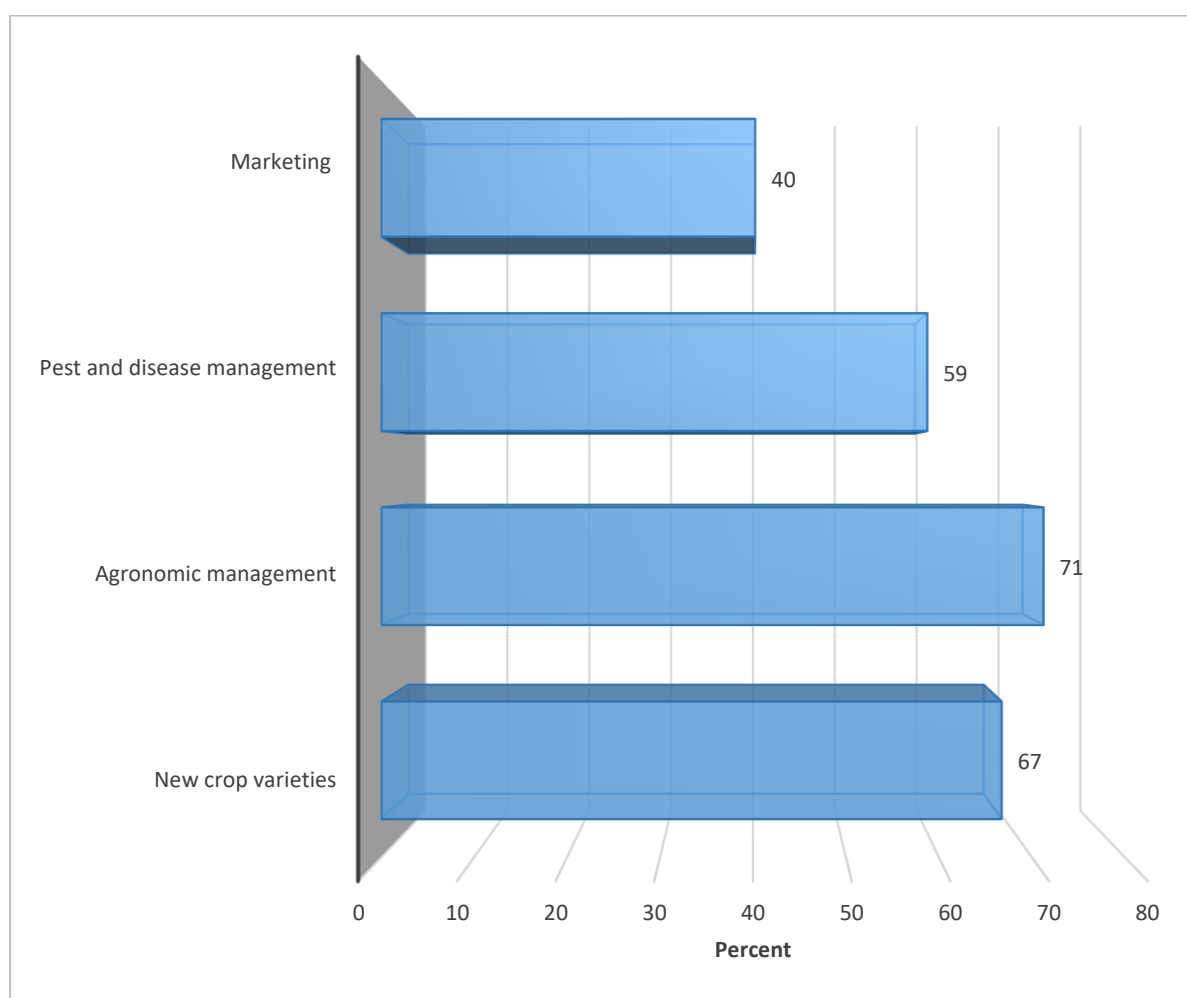


Figure 12. Training status of farmers on production and marketing issues

The result in table 20 indicated that malt barley producers that got training on improved production managements had got higher malt barley amount per hectare of land keeping other things constant. For instance, malt barley producers that are trained on pest and disease

management produces 0.522 ton of grain higher from a hectare of malt barley farm plot compared to those of not trained.

Table 20. Malt barley productivity and producers training

Training Topic	Average malt productivity (tons/ha)			t- test
	[N=311]			
	trained	not trained	total	
Improved crop varieties	2.994	2.421	2.756	3.828***
Agronomic managements practices	2.917	2.441	2.756	3.021***
Pest and disease management	3.018	2.496	2.756	3.528***

*** is t-test significant at 1% level of significance

6.5. Annual income from malt barley

Average malt barley income obtained by the sample producers was 44,585 ETB per a year. It is identified that Asella malt factory supplier farmers got the highest income (58,537 ETB) from malt barley production per year whereas the lowest income (26,137 ETB) was received by Gonder malt factory supplier farmers. Sample producers that reside in Oromia received higher annual malt barley income compared to their counter parts in Amhara region (Table 21).

Table 21. Producers' annual income from malt barley

Factories	Mean (ETB)	F	Prob > F
Asella malt	58,536.62		
Gonder malt	26,136.72	5.62	0.0040
Boortmalt	45,659.99		
Regions			
Amhara	26,871.92		
Oromia	59,191.39	26.62	0.0000
Average	44,585.47		

The F-statistic for regions is 26.62, and the associated probability value is 0.0000, indicating a highly significant difference in income between the two regions. Producers selling to Asella malt and those in Oromia region tend to have higher incomes compared to their counterparts. This could be due to various factors such as market demand, pricing strategies, or production efficiency.

6.6. Household Level Annual Food and Non-Food Related Expenditure

6.6.1. Food expenditure

Food expenditure includes the total cost of the items that each members of the household eats and drinks annually. The households were asked whether they eat or drink of the food items the last seven days grouped in different categories. Among the food item categories staple food embraces the expenditure of the households on grain crops like cereals, pulses, and oil corps. Vegetables, fruits, beverages and drinks, livestock products, and spices were also the items that were include under food expenditure.

The average per household food expenditure was found to be 62,530 birr and food expenditure was significantly higher in Amhara region compared to that of Oromia region. The study revealed that the highest per household food expenditure was found in Bale zone of Oromia whereas lowest per household food expenditure was found in Awi zone of Amhara region (Table 22).

Table 22. Annual average household level per capita food related expenditure

Zones	Amhara	Oromia	Total	t-test
Total average	64196.72	61293.46	62530.03	12.38***
Awi	32946.33	.	32946.33	
Central Gonder	88587.60	.	88587.60	
East Gojam	87815.57	.	87815.57	
North Shewa	61140.00	.	61140.00	
Arsi	.	55341.50	55341.50	
West Arsi	.	63127.35	63127.35	
Bale	.	98076.00	98076.00	

The t-test results indicate the significance of differences in average expenditure between zones. The t-test statistic is 12.38 ***, indicating a highly significant difference at the 1% level. The t-test results suggest that there are significant differences in average household-level per capita food-related expenditure between zones in the Amhara and Oromia regions.

6.6.2. Non-food expenditure

Under non-food expenditure category, all household expenditures on goods other than food including clothing, energy, health and education expenses, contributions to associations, transportation, communication, hygiene, rental services, material purchase and repairs, tax, ceremony expenses, remittance and interest paid were included.

Most of the respondents had little expenditure on non-food expenditure items. The main share of non-food expenditures relied on clothing, energy, contributions to associations and hygiene related items. On average a household spent 12,490 birr per annum. Households in Oromia region spent more on non-food expenditure than Amhara region households (Table 23)

Table 23. Annual average household level per capita nonfood expenditure

Zones	Amhara	Oromia	Total	t-test
Total average	6,723.46	16,503.64	12,490.64	6.17 ***
Awi	6,448.05		6,448.05	
Central Gonder	6,452.00		6,452.00	
East Gojam	7,211.17		7,211.17	
North Shewa	6,452.00		6,452.00	
Arsi		9,772.25	9,772.25	
West Arsi		23,292.91	23,292.91	
Bale		9,077.64	9,077.64	

The t-test results indicate the significance of differences in average expenditure between zones. The t-test statistic is 6.17***, indicating a highly significant difference at the 1% level. The t-test results suggest that there are significant differences in average household-level per capita non-food expenditure between zones in the Amhara and Oromia regions.

6.6.3. Average total annual household expenditure

This is the combination of food and non-food expenditure that the household spent in a year. Households in Oromia region had more expenditure compared to that of Amhara region.

Table 24. Overall annual average household level per capita expenditure

Zones	Amhara	Oromia	Total	t-test
Total annual expenditure (Birr/HH)	70930.29	78187.16	75096.27	13.80***
Awi	39394.38	.	39394.38	
Central Gonder	95039.60	.	95039.60	
East Gojam	95080.96	.	95080.96	
North Shewa	67592.00	.	67592.00	
Arsi	.	65215.04	65215.04	
West Arsi	.	86796.69	86796.69	
Bale	.	107153.64	107153.64	

The t-test results indicate the significance of differences in average expenditure between zones. The t-test statistic is 13.80***, indicating a highly significant difference at the 1% level. The

t-test results suggest that there are significant differences in average overall annual household-level per capita expenditure between zones in the Amhara and Oromia regions.

Households in Oromia region spent 78,187 birr per annum whereas in Amhara households spent 70,930 birr per annum. The total average per household food and non-food expenditure was found 75,096 birr per annum. The highest average per household food and non-food expenditure was recorded in Bale zones of Oromia while the lowest average per household food and non-food expenditure was found Awi zone of Amhara (Table 24).

6.7. Summary on malt barley smallholder farmers and productivity related issues

Malt barley producers cultivate diverse crops like bread wheat, food barley, potato and emmer beside malt barley production. Producers on average allocate 0.66 hectare of land for malt barley production. The study revealed that the average area allocated for malt barley production is 0.9 hectare in Oromia region and 0.34 hectare in Amhara region. On average producers recycle seed of malt barley for additional one season before they replace it. Seed recycling is more common in Amhara region compared to that of Oromia region. Major source of malt barley seed is own saved seed in the study areas. Traveler is the dominant malt barley variety followed by IBON in Oromia region. Whereas Holker is the dominant variety in Amhara region.

On average, producers are harvesting 2.9 tons of malt barley grain from a hectare of land. However, there is variation of productivity across regional states. In Amhara region producers obtain about 2.4 tonha⁻¹ whereas in Oromia region they get 3.2 ton ha⁻¹ of malt barley grain. Even though detail investigation is required, the potentials of the available varieties indicated that there is possibility of increasing the productivity of the crop up to 4 tonha⁻¹ if producers would use improved technologies like improved seed and proper agronomic managements. The productivity gap among producers could be narrowed through experience sharing, increasing accessibility of improved malt barley production technologies for producers. Diseases such as scald, net blotch, spot blotch, rusts and insect pests such as aphids and barley shoot fly were found be a challenge to malt production. The adverse effect of waterlogging, weeds and wild animals were also found prevailing in malt barley production. The study indicated that producers that applied agro chemicals could obtain better malt barley productivity than their counterparts.

Producers sell the majority (71%) of malt barley grain to farmers' cooperative and they sell 11% and 10% of malt barley grain to retails and wholesalers respectively. The average market price of malt barley grain that producers offered is 37 birr/kg. However the price varies in the

range of 20 birr/kg to 54 birr/kg. The price variability indicates that the supply of malt barley throughout the year is not stable and producers need to cooperate and strengthen cooperatives to have equipped and proper warehouses to manage price fluctuation and obtain faire profit margin.

The study indicated that Asella malt factory supplier producers got the highest annual malt barley income whereas the lowest income was received by Gonder malt factory supplier producers. Region wise, producers that reside in Oromia received higher annual malt barley income compared to their counter parts in Amhara region. The income discrepancy among the producers may result due to production and productivity differences among producers which indicates the need of intervention.

The regional differences in malt barley production in Oromia and Amhara regions highlight the varying needs and practices that impact productivity and sustainability. In Oromia, with larger plots dedicated to malt barley and higher yields, there is a focus on the utilization of improved seed varieties, complemented by effective crop management and disease control practices. In contrast, Amhara, characterized by smaller plots and lower yields, sees more common seed recycling and faces different challenges that influence its productivity. This variation indicates a landscape where local agricultural practices and resource availability significantly shape the outcomes of malt barley cultivation.

Market dynamics also play a crucial role in the malt barley value chain, where strong connections between producers and malt factories, such as those supplying Asella malt factory, correlate with higher incomes for farmers. This relationship underscores the importance of efficient market linkages, where formalized arrangements and reliable supply chains contribute to economic stability. The role of farmers' cooperatives is pivotal in aggregating and negotiating better prices, while improved storage and transportation infrastructure help manage price fluctuations and reduce post-harvest losses. This interconnected system of production, processing, and marketing defines the efficiency and profitability of the malt barley value chain, with regional practices and market linkages being key determinants of success.

6.7.1. Implication to malt barley value chain

The summary of the study on malt barley production in the Amhara and Oromia regions highlights several key implications for the malt barley value chain, encompassing production practices, regional productivity disparities, market dynamics, and the role of cooperatives. These factors collectively influence the efficiency and profitability of the value chain, with significant implications for all stakeholders involved.

The regional disparity in land allocation correlates with productivity differences, as Oromia farmers harvest an average of 3.2 tons per hectare compared to 2.4 tons per hectare in Amhara. The higher productivity in Oromia suggests more effective use of land and better farming practices, which have direct implications for the value chain by ensuring a more consistent and higher-quality supply of raw barley to processors.

Seed recycling is prevalent, especially in Amhara, leading to lower yields due to decreased seed vigor over time. Introducing improved seed varieties and encouraging proper seed management practices can significantly boost productivity. There is a substantial opportunity for value chain enhancement through the dissemination of high-yield seed varieties and modern farming techniques, thereby increasing the overall output and quality of malt barley.

The presence of diseases like scald, net blotch, and rusts, along with pests such as barley shoot fly, poses significant challenges to malt barley production. Effective pest and disease management strategies, including the use of agrochemicals, have been shown to improve productivity, highlighting the need for widespread adoption of these practices. Addressing these challenges through better agronomic practices and infrastructure improvements can help stabilize and enhance production, thereby reducing variability and ensuring a more reliable supply of malt barley within the value chain.

Producers primarily sell their malt barley to farmers' cooperatives. The average market price of 37 birr/kg, with fluctuations between 20 and 54 birr/kg, indicates an unstable supply throughout the year. Strengthening cooperatives and improving storage infrastructure are crucial for managing price volatility and ensuring fair profit margins for farmers. The ability of cooperatives to aggregate produce, negotiate better prices, and provide access to markets is vital for maintaining a stable and profitable value chain.

7. Conclusions and Recommendations

7.1. Conclusions

The malt barley value chain in Ethiopia, particularly in the Amhara and Oromia regions, demonstrates a complex interaction between various stakeholders, each playing a crucial role in ensuring the successful cultivation, processing, and distribution of malt barley. Central to this value chain is the seed system, which is divided into formal and informal categories. The formal seed system, involving government agencies, private companies, and international organizations, focuses on the production, certification, and distribution of high-quality seeds. Despite its structured approach and rigorous quality control, it faces challenges such as limited coverage, high costs, and logistical issues.

The malt barley value chain in the Amhara and Oromia regions shows a clear division in profit margins and marketing dynamics. The first segment, including Agricultural Research Institutes, Public Seed Enterprises, and Cooperative Unions, focuses on developing and producing Early Generation Seeds (EGS). These entities face limited profit margins due to reliance on government funding, subsidies, and operational inefficiencies. Public research institutes, in particular, struggle with negative net returns in pre-basic seed production, while Private Seed Enterprises achieve profitability through operational efficiency and market-driven strategies.

The second segment comprises farmers, malt companies, breweries, and other stakeholders involved in value addition processes. Farmers capture the largest share of profits, followed by malt factories, due to their crucial roles in production and processing. In contrast, primary cooperatives and cooperative unions receive smaller profit shares, reflecting their intermediary roles in the value chain.

The malt barley value chain in Ethiopia presents several opportunities for enhancing its efficiency and profitability. Investing in high-quality, disease-resistant seed varieties can significantly boost productivity, potentially increasing yields from the current 2.9 tons per hectare to 4 tons per hectare. The formal seed system, despite its current limitations, offers a structured approach to producing and distributing these seeds, ensuring farmers have access to better planting materials.

Producers face challenges such as diseases, pests, waterlogging, weeds, and wild animals, with agrochemical use improving yields. Most malt barley is sold to farmers' cooperatives, and market prices vary widely, highlighting the need for better price stability. Producers linked to

Asella malt factory earn the highest incomes, with those in Oromia earning more than those in Amhara, indicating regional disparities in production and income.

The regression analysis on agricultural production (PRODNHA) identifies several crucial factors influencing yields. Using recycled seed varieties negatively impacts production due to their reduced vigor and genetic diversity, highlighting the importance of investing in high-quality seeds. Crop rotation enhances soil health and nutrient availability, leading to better crop performance. Improved seed varieties, bred for higher yields and disease resistance, substantially increase productivity. Additionally, increased labor input positively influences yields, underscoring the role of labor-intensive practices in regions with limited mechanization. These findings underscore the necessity of optimized inputs and practices for sustainable and enhanced agricultural production.

7.2. Recommendations

The malt barley value chain in Ethiopia's Amhara and Oromia regions requires a holistic approach to address its complexity and ensure success across all stages, from cultivation to distribution. A key focal point lies in the formal seed system, which necessitates concerted efforts to overcome challenges such as limited coverage, high costs, and logistical issues. Collaborative initiatives involving government agencies, private companies, and international organizations should prioritize enhancing the efficiency and accessibility of high-quality seeds, vital for improving yields and sustaining production levels. Moreover, targeted interventions are needed to bolster the capacity and profitability of entities involved in early seed generation, particularly public research institutes, which face financial constraints and operational inefficiencies. Supporting these institutions with adequate resources and incentives can enhance their contribution to the value chain and foster innovation in seed development.

It's crucial to address the profitability challenges faced by government research institutes along the value chain. These institutions play a critical role in early seed generation and development, yet often struggle with limited profitability due to financial constraints and operational inefficiencies. By improving the financial viability of these institutes through targeted investments, incentives, and capacity-building initiatives, they can become more effective contributors to the value chain. Empowering government research institutes to operate more efficiently and competitively will not only enhance their own sustainability but also drive innovation and improve seed quality, ultimately benefiting the entire malt barley value chain.

The disparities in profit margins and marketing dynamics within the malt barley value chain underscore the need for equitable distribution of benefits among stakeholders. While farmers

and malt factories capture significant shares of profits due to their pivotal roles in production and processing, primary cooperatives and cooperative unions often receive smaller returns, reflecting their intermediary functions. To address this imbalance, strategies should be devised to empower these intermediary entities, enabling them to negotiate fairer terms and enhance their value-added services. Additionally, efforts should focus on improving price stability mechanisms to mitigate market fluctuations, ensuring more predictable incomes for producers. Collaborative platforms and partnerships can facilitate knowledge exchange and capacity building among stakeholders, fostering a more inclusive and resilient value chain that benefits all participants.

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9. Annexes

9.1. Annex 1. OLS regression and related test STATA outputs

Source	SS	df	MS	Number of obs	=	400
Model	628270926	12	52355910.5	F(12, 387)	=	19.28
Residual	1.0507e+09	387	2714946.71	Prob > F	=	0.0000
				R-squared	=	0.3742
				Adj R-squared	=	0.3548
Total	1.6790e+09	399	4207908.03	Root MSE	=	1647.7

PRODNPerHa	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
AGE	-11.06681	7.053432	-1.57	0.117	-24.93465	2.801034
EDU	8.104637	8.871003	0.91	0.361	-9.336755	25.54603
EXP	4.592583	12.39784	0.37	0.711	-19.78297	28.96813
RECYCLED_THE_VARIETY	-91.88322	33.03856	-2.78	0.006	-156.8408	-26.92568
SEEDAMOUNTKG	3.288173	.9023067	3.64	0.000	1.514137	5.06221
UREA_KG	16.7681	2.295431	7.30	0.000	12.25502	21.28117
NPS_KG	.7862992	1.081848	0.73	0.468	-1.340735	2.913334
HERBKG	-190.7365	166.3275	-1.15	0.252	-517.7551	136.2821
FUNGKG	296.0759	196.3019	1.51	0.132	-89.8758	682.0277
ROTATION	415.0492	197.3709	2.10	0.036	26.99575	803.1027
IMPVARIETY	935.3211	201.0699	4.65	0.000	539.995	1330.647
LABOR	58.99208	14.44264	4.08	0.000	30.59623	87.38794
_cons	540.6835	344.3404	1.57	0.117	-136.3286	1217.696

Variable	VIF	1/VIF
SEEDAMOUNTKG	3.77	0.265387
NPS_KG	3.73	0.268354
FUNGKG	1.47	0.678514
HERBKG	1.40	0.714214
IMPVARIETY	1.34	0.748143
EXP	1.33	0.749443
ROTATION	1.25	0.797436
UREA_KG	1.23	0.812044
LABOR	1.17	0.857032
AGE	1.16	0.863872
RECYCLED_T~Y	1.09	0.919718
EDU	1.01	0.986299
Mean VIF	1.66	

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
residuals	400	0.81144	51.909	9.398	0.00000

Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
residuals	400	0.0000	0.0000	.	0.0000

Linear regression

Number of obs = 400
 F(12, 387) = 10.24
 Prob > F = 0.0000
 R-squared = 0.3742
 Root MSE = 1647.7

PRODNPerHa	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
AGE	-11.06681	8.087017	-1.37	0.172	-26.96679	4.833179
EDU	8.104637	7.242525	1.12	0.264	-6.134984	22.34426
EXP	4.592583	14.37918	0.32	0.750	-23.6785	32.86366
RECYCLED_THE_VARIETY	-91.88322	35.0481	-2.62	0.009	-160.7917	-22.97469
SEEDAMOUNTKG	3.288173	1.986058	1.66	0.099	-.6166403	7.192987
UREA_KG	16.7681	9.444453	1.78	0.077	-1.800763	35.33696
NPS_KG	.7862992	4.27948	0.18	0.854	-7.627642	9.20024
HERBKG	-190.7365	118.8744	-1.60	0.109	-424.457	42.98396
FUNGKG	296.0759	159.7079	1.85	0.065	-17.92787	610.0798
ROTATION	415.0492	182.0612	2.28	0.023	57.0964	773.0021
IMFVARIETY	935.3211	294.4581	3.18	0.002	356.3832	1514.259
LABOR	58.99208	27.8732	2.12	0.035	4.190221	113.7939
_cons	540.6835	395.5821	1.37	0.172	-237.0756	1318.443

9.2. Annex 2: Questionnaire for household survey of malt barley producers

Value Chain Analysis of Malt Barley in Amhara and Oromia Regions of Ethiopia: Status, Opportunities and Challenges
 Addis Ababa University College of Development Studies Center for Rural Development
 Questionnaire for farmers

PART A: HOUSEHOLD AND VILLAGE IDENTIFICATION

Household identification Code	
Region	<input type="text"/>
Zone	<input type="text"/>
District	<input type="text"/>
Keble	<input type="text"/>
Name of household head (include grandfather name)	
Sex of household head 1. Male 0. Female	<input type="text"/>
Name of respondent	
Sex of respondent 1. Male 0. Female	<input type="text"/>
Cell phone number	
Name of enumerator	
Name of supervisor	
Date of interview	

PART B : HOUSEHOLD COMPOSITION AND CHARACTERISTICS (Household members=Persons who live together and eat together from the same pot (share food), including hired labour, students and spouse living and working in another location but excluding visitors)

ID CODE	Name of household member [Start with HEAD]	Sex 1 = M 0 = F	Relationship to the household head CODE 1	Age (complete years)	Marital status? CODE 2	Education (years) CODE 3	Main Occupation (In order of importance) [Code 4]	
	A1	A2	A3	A4	A5	A6		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
CODE 1			CODE 2		CODE 3		CODE 4	
1.Household head 2.Spouse 3.Son/daughter 4.Son/daughter-in-law 5.Grandson/granddaughter 6.Grand Mother/Father 7.Brother/sister Nephew/niece			8.Cousin 9.Brother/sister-in-law 10.Mother/father-in-law 11.Maid 12.Other relationship (specify		1.Married living with spouse 2.Married living without spouse 3.Single/never married 4.Divorced/separated 5.Widowed		0. None/Illiterate 100. Religious education 1. Adult education or one year of education * Give other education in years	0. child 1.student 2. farmer 3. employed in GOV 4. employed in NGO 5.trader 6. unemployed 7.Daily laborer

PART C1: PHYSICAL, FINANCIAL, AND SOCIAL CAPITAL

C.2 Share of agriculture in total family income _____ (%)

C.3 Are you model farmer? _____ (1=Yes, 0=No)

C.5 Is household head a member of any community leadership? _____ (1=Yes, 0=No)

C.6 Is the household head a member of any organization or association? _____ (1=Yes, 0=No).

C.7 If yes to C.6 state the name of organization or association _____

C.8 Are your friends or relatives in leadership positions in administration or formal and/or informal institutions. (1=Yes, 0=No)

C.9 Do you know people planting any improved barley varieties in your village? _____ (1=Yes, 0=No)

C.10 Do you have reliable sources for borrowing in times of need? _____ (1=Yes, 0=No)

C.11. If yes to C10, List sources 1. _____ 2. _____
3. _____

C.12 If yes to C.10, what is the maximum amount you can borrow from them? _____ ETB.

C.13 If your crop fails, can you rely on government support (subsidies, food aid, etc.)? _____ (1=Yes, 2=No)

C. 14. Considering your own production & all income sources, how do you rate your family's food security?

1. Food secure, produce enough for family and able to sell significance portion of our production
2. Self-sufficient produce enough for the family
3. Face food shortage occasionally
4. Face severe food shortages for most months in a year

C. 15. Distance of resident from nearest market place? _____ km _____ minute of walk

C. 16. Distance of resident from main market place? _____ km _____ minute of walk

C. 17. Distance of resident from district town? _____ km _____ minute of walk

C. 18. Distance of resident from extension agent? _____ km _____ minute of walk

C2: How many of the following assets do you have

Asset Category	Asset type	Does the household own (1=Yes0=No)	No. owned (use Ha for land)
Farm implements	Mofer (plow)		
	kenber		
	Spade or shovel		
	Traditional maresha		
	Ibar plow (modern maresha)		
	Water pump		
	Tractor		
	Thresher		
Transport	Cart (any)		
	Bicycle		
	Motorbike		
	Bajaj		
	Car		
Communication and solar power	Functional Radio		
	Functional Mobile phone		
	Functional TV		
	Functional Solar energy		
Land	Total Land owned (ha)		
	Cultivated land owned (ha)		
	Irrigable land owned (ha)		
House	Thatched roof		
	Tin (corrugated) roof		
Livestock	Indigenous cows		
	Crossbred/exotic cows		
	Oxen		
	Bulls		

Asset Category	Asset type	Does the household own (1=Yes0=No)	No. owned (use Ha for land)
	Heifers		
	Calves		
	Small livestock (goats + sheep)		
	Donkeys		
	Horse		
	Mule		
	Poultry (local chicken, improved chicken, ducks, etc.)		
	camel		
Bee hives with colony	Modern Bee hives		
	Transitional Bee hives		
	Traditional Bee hives		

PART D: IMPROVED CROP VARIETY KNOWLEDGE AND ADOPTION/ DISADOPTION

D.1 Barley variety knowledge, sources of information, seed, adoption and dis-adoption

D.1.0. How long have you been in crop production (years)?

D.1.1 Have you grown food barley in the last 5 years? 1. Yes 2.No _____

D.1.2 Have you grown malt barley in the last 5 years? 1. Yes 2.No _____

D.1.2.1How long have you been in malt barley production (years)? _____

D.1.3 Have you grown improved food barley varieties in the last 5 years? 1. Yes 2.No _____

D.1.4 If yes to D1.3, who was the source of improved food barley seed?

1. Own saved 2.local market 3. Seed enterprise 4. Cooperative 5.NGOs 6. Research 7. Universities 8. Private company specify_____

D.1.5 If yes to D1.3, how certain are you about the origin and purity of seed? 1. Very 2.Modest 3.Not sure_____

D.1.6 Have you grown improved malt barley varieties in the last 5 years? 1. Yes 2.No _____

D.1.7 If yes to D1.6, Who was the source of improved malt barley seed?

1. Own saved 2.local market 3. Seed enterprise 4. Cooperative 5.NGOs 6. Research 7. . Universities 8. Private company specify_____

D.1.8 what is the name of your most preferred food barley varieties (that you know)? _____, _____, _____(Annex2a);

D1.9 Do you cultivate that varieties? (1=Yes, 0=No) _____ ;

D1.10 If No to D1.9, why not? _____ 1. Seed not available 2. Seed price 3. Lack of access to credit 4. Susceptible to disease/pest 5. Low/poor yield 6. Taste in consumption 7. Other, specify _____

D1.11 what is the name of your most preferred malt barley variety (that you know)? _____, _____, _____ (Annex2b);

D1.12 Do you cultivate that varieties? (1=Yes, 0=No) _____ ;

D1.13 If No to D1.12, why not? _____ 1. Seed not available 2. Seed price 3. Access to credit 4. Susceptible to disease/pest 5. Low/poor yield 6. Taste in consumption 7. Other, specify _____

D1.14_1 In your opinion, what do you think is the most important problem related to food barley varietal acquisition? _____

D1.14_2 In your opinion, what do you think is the most important problem related to malt barley varietal acquisition? _____

D1.15 Is there improved food barley variety you terminated to use in the last 5 years? (1=Yes, 0=No)

D1.16 If yes D1.15, what are the name of the varieties? _____ why? _____

Low yield

1

Low disease resistance

2

Shortage of seed

3

Lack of market demand

4

Change in agro ecology (climate)

5

High cost of production

6

D1.17 Is there improved malt barley variety you terminated to use in the last 5 years? (1=Yes, 0=No)

D1.18 If yes D1.17, what are the name of the varieties? _____ why? _____

Low yield

1

Low disease resistance

2

Shortage of seed

3

Lack of market demand

4

Change in agro ecology (climate)

5

High cost of production

6

D1.19 Do you think food barley would receive good price in the market? (1=Yes, 0=No)

D1.20 Do you think malt barley would receive good price in the market? (1=Yes, 0=No)

D1.21 Do you get input market (seed, fertilizer and chemicals) information as soon as you need it?
(1=Yes, 0=No)

D1.21 Do you get honest output market (grain and straw) information as soon as you need it? (1=Yes,
0=No)

E1.2: BARLEY Plot Information: Agricultural practices, crops and varieties cultivated and cropping area

(Definitions: A plot is a piece of land physically separated from others; a sub-plot is a sub-unit of a plot that mainly planted one main crop)

Meher =crop harvested between September 2022 (meskerem 2014 E.C) and February 2022(Yekatit 2014 E.C.), Belge =crop harvested between march 2022 (megabit 2014) and August 2022 (nehase 2014)

E0.What is the total number of plots (gardens) cropped in (2022/2)2014 Meher and Belg seasons? _____

Serial No	Season	Plot name (start with plots that	Plot ID	Sub-plot ID	How did your HH acquire [PLOT] (tenure)	Main crop grown [Sub-plot]	Frequency of plowing the Sub-plot	Name of variety grown [Sub-plot]?	When did you first use this [VARIETY] ? (Year in Eth calendar)	For how long have you cultivated this [VARIETY] ? (In number of years)	is Variety grown [Sub-plot] or	Source of the seed	How many times (season) you recycle the	Sub-plot area (hectare)	Sub-plot area (hectare)	Seed amount used (kg / sub-plot)	Chemical fertilizer	Was Manure/compost applied to plot ?	Sub-plot distance to residence (walking minutes)	Rotation on this sub-plot 0=No 1=Yes	Method of planting on this sub-plot 0=Broadcasting	Production per plot (kg)
	1. meher										1. Own sa											
	2. belg										2.local market											
	start										3. Seed enterp											

		Grey	Grass strips	Box ridges
		Other, specify	Trees on boundaries	Other, specify

PART-E: CROP PRODUCTION and UTILIZATION FOR BARLEY GROWN BY THE HOUSEHOLD DURING THE 2021 SEASON (MEHER AND BELG)

ODUCTION (CONTINUED)

CODE 1			CODE 2			CODE 3
1. Own cash	4. Credit from money lender	9. Credit from coops	1. Own saved seed	5. Gift from family/neighbor	10. Farmer groups/Coops	1. Government extension
2. Money got as gift from relative & non-relatives	5. credit from seed dealers	10. Government extension	2. Government extension	6. Farmer to farmer seed exchange	11. Local seed producers	2. local market
3. Credit from bank	6. Credit from relative/neighbour/friend	11. Other, specify.....	3. Trader	7. Local market	12. Provided free by NGOs/govt	3. Farmer groups/Coops
	7. Credit from micro-finance		4. Private seed suppliers	8. On-farm trials	13. Research centres	4. Provided free by NGOs (gov't)
	8. Credit from NG			9. Extension demo plots	14. Other (specify).....	

E1.2: BARLEY Plot information: Input use, seed sources and prices

Serial No	Season 1.Meher	Plot ID	Sub-plot ID	Seed use				Price of fertilizers				
				Non-bought	Total Estimated	Bought seed including using credit	Main source	Main source				

	2.Belg	[same order as in above]	[same order as in above]	seed (kg) (Own saved, farmers to farmers exchange, etc.)	value in birr	Bought seed Quantity (kg)	Total cost of bought seed (ETB)	Main method of payment for seed if bought CODE 1	of seed CODE 2	of fertilizer CODE3	Price of UREA (birr/100kg)	Price of DAP (birr/100kg)	Price of NPS (birr/100kg)

PART-E: CROP PRODUCTION AND UTILIZATION FOR ALL GRAIN CROPS GROWN BY THE HOUSEHOLD DURING THE 2020/21 MEHER AND BELG SEASON PRODUCTION (CONTINUED)

E2.1. Utilization of crop produced during 2014/15 EC

SN.	Crops	Stock from last year 2014(Quintal)	Gift, tithe, donations received (Quintal)	Production in 2015(Quintal)	Sold (Quintal)	Stored for seed (Quintal)	Gift, tithe, donations given out (Quintal)	Consumption(Quintal)	Stock carry over	Sold price (ETB/kg)
	Malt barley									
	Food Barley									

E2.2. Marketing of Malt and Food Barley Produced During 2014/15 EC

Particulars	? Code: A [list major 3]	To whom did you sell? Code:B [list major 3]	Amount (Kg)	Average Price/Kg	Why did you prefer this market actors?
Where did you sell Malt barley?					
Food Barley					

--	--	--	--	--	--

Code:A 1. village market 2. district market/capital 3. farm gate 4. Capital city (AA) 5. others (specify)	Code:B 1. Malt factories 2. Retail traders 3. Wholesalers 4. Cooperatives 5. Brokers	6. Collectors 7. NGOs 8. Unions 9. other farmers 10. Consumers 11. Others (specify)
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PART- F3: ACCESS TO INCOME SOURCE

F3_1. INCOME SOURCES IN 2014 EC

Source code	Sources	Did you receive income from the following items? Yes/No	If yes, actual amount received (Birr)	If payment was in-kind, what is the estimated value? (in Birr)	Total income (ETB)
	1	2	3	4	5= 3+4
F1	1. Rented/share cropped out land				
F2	2. Rented out trucks, tractors, etc.				
F3	3. Salaried/wage employment				
F4	4. Income from trade				
F5	5. Pension income				
F6	6. Drought/flood relief				
F7	7. Government transfer (SEFTNET)				
F8	8. Remittances				
F9	9. Sales of animals and by products				
F10	10. Sale of crop residues /hay				
F11	11. Quarrying (mining, hunting and fishing)				
F12	12. Rental property other than land				
F13	Sales from food barley				
F14	Sales from malt barley				
F15	Sales from other grain crops				
F16	Sales of fruit and vegetables				
F17	Other perennial crops (coffee, chat...)				
F18	Other sources (specify) ----- ----				

PART- G: ACCESS TO FINANCIAL CAPITAL, INFORMATION AND INSTITUTIONS

G1. MODULE G: Household credit needs, access and sources IN THE PAST 12 MONTHS

G01. How likely is it for you to get credit if you need to purchase inputs for cultivation of malt barley?
(Write the code for appropriate response)

1. Highly most likely (100%)
2. Most likely (75%)
3. Not sure (50%)
4. Unlikely (25%)
5. Highly unlikely (~0%)

G01Code	G02 Reasons for loans	G03 Did your household ask for credit to [REASONS] 0. No >> G04 1. Yes >> G05	G04 Why not? (Code G04) (Maximum of 2 reasons; enter '0' under G04_2 if no second reason)		G05 Did you receive credit? 0. No 1. Yes >> continue to G06	G06 Did you get the amount requested? 0. No 1. Yes	G07 How much did you get? (ETB)
			G04_1 Reason 1	G04_2 Reason 2			
1	Buy seeds						bir
2	Buy fertilizer						bir
3	Buy pesticides						bir
4	Buy agric.equipment						bir
5	Invest in transport						bir
99	Other, specify						

Codes G04: REASONS	1. Do not need credit 2. Borrowing is risky	3. Interest rate too high 4. Too much paper work/procedures 5. Expected to be rejected, so did not try it	6. I have no asset for collateral 7. No financial institution in the region	8. Lenders don't provide the amount needed 99. Other (specify)
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G2. Access to extension services for Barley and other crops production

G2.1 what is number of contacts with extension agent related to food barley production in 2013/14 EC?
 _____No. of contact/belg & meher season

G2.1 what is number of contacts with extension agent related to malt barley production in 2013/14 EC?
 _____No. of contact/belg & meher season

G2.2 Have you attended farmers training in the last 5 years? 0. No 1. Yes

Variable code	Issue [Training points]	In the last 5 years, did you receive crop specific training or information on [.....]?						Main source of information in the last 5 years (codes B)	
		Food Barley	Malt barley	Other crops	vegetables	fruit	spice	Barley	Other crops
G2.3	New crop varieties								
G2.4	Agronomic management (plowing, sawing, fertilizer...)								
G2.5	Pest and disease control								
G2.6	Marketing and prices								

Codes B 1. Government extension service 2. Farmer Coop or groups	3. Neighbor farmers 4. Seed traders/growers 5. Relative farmers	6. NGOs 7. Private trader 8. School	9. Research center 10. Newspaper 11. Radio/TV	12. Seed Enterprise 13. Mobile phone 14. Other, specify.....
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G2.7 Have you visited demonstration fields or attended participatory food barley variety selection field days in the last 3 years?_____ 1= yes; 0= No

G2.7 Have you visited demonstration fields or attended participatory malt barley variety selection field days in the last 3 years?_____ 1= yes; 0= No

G2.8 Have you hosted barley demonstration/ barley participatory variety selection in the last 5 years?_____ 1= yes; 0= No

G2.9 Have you participated in cluster farming in the last 3 years? 1= yes; 0= No

G2.10 If yes to G29, how do you rate cluster farming? 0. Not important 1.Important

G2.11 Did you observe any problems related to cluster farming?

G2.12 Are you member of farmers' cooperative? 1. Yes 0.No

G2.14. Do you usually sell outputs through cooperatives? 1. Yes 0.No

PART H. Farmers' perceptions on access constraints to key production inputs and services in barley production

Variable code	Input and production constraints	Is it a constraint now? 1=Yes; 0=No	If yes in column 2, rate the problem 0 = not important 1=important 2= most important	Was it a problem 10 years ago? 1=Yes; 0=No	How did the situation change over the years? (1=improved, 2=Same 3=worsened)
	1	2	3	4	5
O1	Timely availability of certified seed of improved varieties				
O2	unavailability or inaccessibility of improved seed				
O3	High prices of seed of improved varieties				
O4	Absence or inaccessible improved seed suppliers				
O5	Getting seed for your preferred crop and variety each year				
O6	Getting required quantity of seed				
O7	Getting quality seed				

O8	Availability of credit to buy Barley certified seed				
O9	Timely availability of fertilizers				
O10	Price of fertilizers				
O11	Availability of credit to buy fertilizers				
O12	Availability of herbicides				
O13	Access to markets and information				
O14	Low barley prices				
O15	Drought				
O16	High rain fall				
O17	Pest and disease				
O18	Acidity of soil				
O19	Low fertility of soil				
O20	Erosion				
O21	Other specify(_____)				

MODULE Z: HOUSEHOLD EXPENDITURE FOR THE LAST 7 DAYS

PART A: FOOD CONSUMPTION HOUSEHOLD EXPENDITURE FOR THE LAST 7 DAYS

ZA00		ZA00_b		ZA01	ZA02	ZA03		ZA05	ZA06	ZA07	ZA08	ZA09			
Item		What is the market price per unit of [FOOD] in this Kebele? 97=Don't know		Did members of HH eat or drink any of the following items in the last 7 days (yes=1 No=0)	How much in total did your household consume in the past 7 days?	How much of the total consumed came from own production? (Use same unit as in ZA02_b)		If you had to purchase the [FOOD] came from your own production how much would you have had to pay for it? (BIRR)	How much of the total consumed came from purchases? (Use same unit as in ZA02_b)	When you bought [FOOD], how much did you spend?	How much of the total consumed came from gifts and other sources? (Use same unit as in ZA02_b)	If you had to purchase the [FOOD] came as gifts or payment in-kind how much would you have had to pay in total for it?			
		ETB	ZA01_b Unit		ZA02_a Qty	ZA02_b Unit	ZA03_a Qty	ZA03_b Unit		ZA06_a Qty	ZA06_b Unit		ZA08_a Qty	ZA08_b Unit	

				1. kg 2. Litre 3. Num ber			1. kg 2. Litre 3. Num ber									
0		1			2		4	5	6	7		8	9	10	11	12
Staple foods																bir
1	bir	Maize grain								bir		bir				bir
2	bir	Teff								bir		bir				bir
3	bir	Wheat								bir		bir				bir
4	bir	Barley								bir		bir				bir
5	bir	Rice								bir		bir				bir
6	bir	Sorghu m								bir		bir				bir
7	bir	Millet								bir		bir				bir
8	bir	Cassava								bir		bir				bir
9	bir	Potatoes								bir		bir				bir
10	bir	Beans								bir		bir				bir
11	bir	Cowpea grain								bir		bir				bir

12	bir	Ground nuts								bir		bir				bir
13	bir	Pigeon pea								bir		bir				bir
14	bir	Lentils								bir		bir				bir
15	bir	Enset								bir		bir				bir
16	bir	Vetch								bir		bir				bir
Vegetables																bir
17	bir	Tomatoes								bir		bir				bir
18	bir	Onions								bir		bir				bir
19	bir	Cabbage								bir		bir				bir
20	bir	Kale								bir		bir				bir
21	bir	Carrot								bir		bir				bir
22	bir	Pumpkin								bir		bir				bir
23	bir	Green Pepper								bir		bir				bir
24	bir	Garlic								bir		bir				bir
25	bir	Fenugreek/ Abish								bir		bir				bir

Fruits															
26	bir	Oranges							bir		bir				bir
27	bir	Mangoes							bir		bir				bir
28	bir	Papaya							bir		bir				bir
29	bir	Pineapple							bir		bir				bir
30	bir	Sugar cane							bir		bir				bir
31	bir	Bananas							bir		bir				bir
Beverages and drinks															
32	bir	Tea							bir		bir				bir
33	bir	Coffee							bir		bir				bir
34	bir	Ginger							bir		bir				bir
35	bir	Red Pepper (berbere)							bir		bir				bir
Other food expenditure items															

36	bir	Honey										bir				bir
37	bir	Beef/ goat/ sheep meat								bir		bir				bir
38	bir	Poultry meat								bir		bir				bir
39	bir	Fish								bir		bir				bir
40	bir	Milk								bir		bir				bir
41	bir	Eggs								bir		bir				bir
42	bir	Cheese								bir		bir				bir
43	bir	Butter								bir		bir				bir
44	bir r	Edible oil														
45	bir r	salt														
46																

Section B1: non-food expenditure in the LAST ONE MONTH

Ask these questions of the household member most knowledgeable about household expenditures on goods other than food

I would now like to ask you some questions about a list of non-food items that your household may have purchased or received by other means for household use in the last 30 days. Received by other means should include gifts, aid, in-kind wages, gathering, collecting and other transfers. (Please exclude from your answers any item purchased or received for processing or resale in a household/individual business.)

ITEM CODE	ITEM	Have members of your household purchased any [ITEM] in the last 30 days?	How much did the household pay in TOTAL for [ITEM]?	Have members of your household received [ITEM] by other means in the last 30 days?	If you had purchased this amount of [ITEM], how much would you have had to pay for it?
		Yes...1 (>>ZB02) No...0 (>>ZB03)	(Don't Know...97) Total amount in BIRR	Yes...1 (>>ZB04) No...0 (>>Next item)	(Don't Know...97) Total amount in BIRR
ZB00		ZB01	ZB02	ZB03	ZB04
1	Clothing or Fabric for Making Clothing, FOR /Wraps (that women wear, netela, sharp)		bir		bir
2			bir		bir
3	Footwear and Repairs of Footwear		bir		bir
4			bir		bir
6	Fuel wood		bir		bir
7	Charcoal		bir		bir
8	Kerosene		bir		bir

ITEM CODE	ITEM	Have members of your household purchased any [ITEM] in the last 30 days?	How much did the household pay in TOTAL for [ITEM]?	Have members of your household received [ITEM] by other means in the last 30 days?	If you had purchased this amount of [ITEM], how much would you have had to pay for it?
		Yes...1 (>>ZB02) No...0 (>>ZB03)	(Don't Know...97) Total amount in BIRR	Yes...1 (>>ZB04) No...0 (>>Next item)	(Don't Know...97) Total amount in BIRR
ZB00		ZB01	ZB02	ZB03	ZB04
9	Batteries (dry cel)		bir		bir
10	School fees		bir		bir
11	School books and supplies		bir		bir
12	Grain milling		bir		bir
13	Contributions to associations like idir,equb,.../cooperatives/ other groups		bir		bir
14	Newspapers, magazines etc		bir		bir
15	Travel expenses		bir		bir
16	Mobile phone air time (voucher)		bir		bir
17			bir		bir

ITEM CODE	ITEM	Have members of your household purchased any [ITEM] in the last 30 days?	How much did the household pay in TOTAL for [ITEM]?	Have members of your household received [ITEM] by other means in the last 30 days?	If you had purchased this amount of [ITEM], how much would you have had to pay for it?
		Yes...1 (>>ZB02) No...0 (>>ZB03)	(Don't Know...97) Total amount in BIRR	Yes...1 (>>ZB04) No...0 (>>Next item)	(Don't Know...97) Total amount in BIRR
ZB00		ZB01	ZB02	ZB03	ZB04
18	Household hygiene (soaps, toothpaste , Soap or Detergent, lotions etc)		bir		bir
19	Petrol and engine oils for cars		bir		bir
20	House rent		bir		bir
21	Other rental services				
22	Utility bills (water, telephone, electricity etc)		bir		bir
23	Cigarettes, tobacco etc		bir		bir
24	Remittances paid out		bir		bir
25	Interest paid on borrowed money		bir		bir
			bir		bir

B2. Non-Food Consumption: Expenditure on non-food items in the LAST 12 MONTHS

I would now like to ask you some questions about a list of non-food items that your household may have purchased or received by other means for household use in the last 12 MONTHS. Received by other means should include gifts, aid, in-kind wages, gathering, collecting and other transfers. (Please exclude from your answers any item purchased or received for processing or resale in a household/individual business.)

ITEM CODE Non- Food Consumption IN LAST 12 MONTHS	ITEM	Have members of your household purchased any [ITEM] in the last 12 months?	How much did the household pay in TOTAL for [ITEM]?	Have members of your household received [ITEM] by other means in the last 12 months?	If you had purchased this amount of [ITEM], how much would you have had to pay for it?
		Yes...1 (>>ZB07) No...0 (>>ZB08)	Total amount in Birr	Yes...1 (>>D05) No...0 (>>Next item)	(Don't Know...97) Total amount in Birr
ZB05		ZB06	ZB07	ZB08	ZB09
1	Beddings		bir		bir
2	Health care (medicare, treatment etc)		bir		bir
3	House building/construction		bir		bir
4	Kitchen utensils		bir		bir
5	Furniture (tables, chairs, beds etc)		bir		bir
6	Home repairs		bir		bir
7	Purchase of bicycle, motorcycle etc		bir		bir

8	Repairs for vehicles, bicycles etc		bir		bir
9	Ceremony and other entertainments		bir		bir
10	Livestock (chicken, small ruminants, cattle, equines,)		bir		bir
11	Tax		bir		bir
13	Religious contributions		bir		bir
X02.Enumerator: Please write the time you END the interview (hh:mm)			X02_a (hh):	X02_b (mm):	

Annex1 Crops Grown

Cereals	Pulses/legumes	Oil Crops
Food barley	Faba bean(bakela)	Niger seed (Nug)
Malt barley	Field pea(Ater)	Sunflower
Maize	Haricot bean	Sesame
White eff	Soybean	Linseed
Red Teff	Pigeonpea	Rapeseed (Gomenzer)
Mixed Teff	Groundnut	Lupin
Bread wheat	Cowpea	Fenugreek
Durum wheat	Lentil (Miser)	Turmeric
Sorghum	Grass pea (guaya)	

Finger Millet	Kabuli –check pea	
Pearl millet	Desi - check pea	
Rice		
Triticale		
Emmer.		
Oats		

A. Malt barley (*Hordeum distichon.*) varieties

S.N	Variety name	Breeder center	Year of release	Altitude (masl)	Rainfall (mm)	Grain yield (qt/ha)	
						Research field	On farm
1	HB1963	HARC	2016	>2,300	500–700	35-60	-
2	HB1964	HARC	2016	>2,300	500–700	33-56	-
3	Singitan	SARC	2016	2,200–2,600	750–1,000	31-41	21–35
4	Fanaka	HARC	2015	2,000–2,600	500–1,000	26-38	23–31
5	Traveler	HARC	2013	2,000–2,600	500–1,000	25-45	20–40
6	Grace	HARC	2013	2,000–2,400	500–1,000	20-40	18–35
7	IBON17/03	HARC	2012	2,000–2,800	500	30-57	-
8	Sabini	KARC	2011	2,300–2,500	>700	49	25–40
9	EH1847	HARC	2011	2,200–2,800	>500	44	35
10	Bahati	KARC	2011	2,300–2,800	>700	48	25–40
11	Bekoji-1	KARC	2010	2,300–2,800	>700	50	23–28
12	Kiflu-B (Miscal-21)	HARC	2006				
13	Haruna Nijo	KARC	2006	Specific to north			
14	CDC Select	HARC	2006				
15	HB- 1533	HARC	2004				
16	HB-52	HARC	2001				
17	HB-120	HARC	1994				
18	Holker	HARC	1979	2,300–3,000	500–800	2.4–3.1	-
19	Beka	HARC	1976				

9.3. Annex 3: Interview guide for stakeholders in malt barley value chain

General Questions for All Stakeholders:

1. Can you describe your role and experience in the malt barley value chain?
2. What do you perceive as the main challenges and opportunities in the malt barley sector in the Amhara and Oromia regions?
3. How do you assess the current state of malt barley production and marketing in these regions?
4. In your opinion, what are the key factors that limit malt barley productivity and quality?

Specific Questions for Seed Producers and Barley Breeders/Researchers:

1. Can you discuss the current varieties of barley seeds available for malt production? How well do they meet the industry's needs?
2. What are the main challenges in developing and distributing high-quality barley seeds to farmers?
3. How do climate change and environmental factors impact barley breeding and seed production?
4. What steps are being taken to ensure farmers have access to high-yielding, disease-resistant barley varieties?

Questions for Malt Companies:

1. How do you evaluate the quality of malt barley supplied by farmers in these regions?
2. What are the primary criteria used in selecting barley for malting purposes?
3. Can you describe any initiatives or support programs you have for farmers to improve barley quality and yields?
4. How do market demand and price fluctuations impact your procurement strategies?

Questions for Local Administrations:

1. What policies or programs are in place to support malt barley farmers in your region?
2. How does the local administration facilitate market access and fair pricing for malt barley producers?
3. Are there any specific challenges in your region that affect malt barley production and commercialization?

4. What kind of assistance or collaboration do you think is necessary from other stakeholders (e.g., research institutions, malt companies) to enhance the malt barley value chain?