WHEAT VALUE CHAIN ANALYSIS: THE CASE OF WOMBERA DISTRICT, METEKEL ZONE OF BENISHANGUL GUMUZ, ETHIOPIA

BY

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Wheat Value Chain Analysis: The Case of Wombera District, Metekel Zone of Benshangul Gumuz, Ethiopia

A Thesis submitted to Jimma University College of Agriculture and Veterinary Medicine School of Postgraduate Program in Partial Fulfillment of the Requirements for MSc Degree in Agribusiness and Value Chain Management

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We, the undersigned, member of the Board of Examiners of the final open defense by **Ureji Aregeta** have read and evaluated his/her thesis entitled **"Wheat Value Chain Analysis: The Case of Wombera District, Metekel Zone of Benshangul Gumuz, Ethiopia"** and examined the candidate. This is therefore to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree Master of Science in **Agribusiness &Value chain Management**

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DEDICATION

I dedicated this thesis to my wife Shewaye Bekana and my family for their constant support, encouragement, and partnership in the success of my life. I will always be grateful to them for everything they have done for me.

STATEMENT OF THE AUTHOR

I declare that the thesis I have written is entirely my own, as evidenced by my signature below. I have prepared, collected, analyzed and compiled this thesis in accordance with all ethical and technical scientific guidelines. All academic materials included in this thesis have been acknowledged by citation.

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BIOGRAPHICAL SKETCH

The author was born in Benshangul Gumuz Region Metekel zone, Wombera district on December 16, 1987 and attended his elementary education at Lomicha elementary school, primary education in Wombera primary school, and secondary and preparatory education in Wombera secondary and preparatory school. He joined Debremarkos university Burie campus in 2016 and graduated with a BSc in Agribusiness and Value chain Management in 2019. After his graduation he worked at Wombera trade road and transportation office until he rejoined Jimma University on October 2022 to pursue his MSc degree in Agribusiness and Value chain Management program.

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LIST OF ACRONYMS AND ABBREVIATIONS

CC	Contingency Coefficient
DA	Developmental Agents
FGD	Focused Group Discussion
GDP	Growth Domestic Product
HHH	Household Head
Kg	Kilogram
MVP	Multivariate Probit Model
NGO	Non -Governmental Organization
NPS	Nitrogen Phosphorous Surplus
Qt	Quintal
RLLP	Resilience Landscape Livelihood Project
SNNP	Southern Nations Nationalities And Peoples Region
SPSS	Statistical Package For Social Science
TLU	Tropical Livestock Unit
VCA	Value Chain Analysis
VIF	Variance Inflation Factors

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ABSTRACT

In Ethiopia, wheat is a crucial cash crop and for food security in rural areas, particularly in the Wombera district in the Metekel zone. However, productivity and market linkages are low due to use of low quality improved seeds, lack of market information, lack of extension and training services, low fertilizers application. Previous studies have focused on analyzing of wheat value chain without considering wheat product upgrading techniques and value addition practices. The objective of this study was to analyze wheat value chain in Wombera district. Quantitative and qualitative data were collected using structured questionnaires, focus group discussions, and key informant interviews from primary and secondary sources. A multi-stage sampling procedure was used to select 187 wheat producers from 3 kebeles, while purposive and random sampling was used to select 25 traders and 22 consumers respectively. Descriptive statistics and econometric models were used for data analysis. Multivariate probit models (MVP) were used to examine factors influencing wheat producers' participation in product upgrading and value addition practices. The major wheat value chain actors were input suppliers, smallholder farmers, local collectors, cooperatives, retailers, and consumers while, the key service providers were district agriculture, cooperatives, microfinance, and trade road and transportation offices. The result of MVP models revealed that variables like sex, education, family size, farming experience, extension contact, training service, credit service, and TLU positively whereas age and market distance negatively influence household's participation in product upgrading techniques. Variables like family size, farming experience, market information, extension contact, training, credit service, adoption of improved seed, and fertilizer application positively while age negatively influenced households' participation in value addition practice. Production and market constraints were shortage of improved seed, high input costs, inadequate credit services, low soil fertility, low yield, and balance cheating. The study emphasizes the importance of value addition practice and product upgrading in strengthening the wheat value chain. So, promoting farmer membership in cooperative, increasing extension and training visits, and raising awareness about livelihood improvements through product upgrading and value addition practices.

Keywords: - Ethiopia, Multivariate probit model, Product upgrading, Value addition, Value chain analysis, Wheat

1. INTRODUCTION

1.1. Background of the study

Agriculture contributes significantly to the global GDP, accounting for 31.3%, with over 60% of the population relying on it for survival (Shifera, 2020). Latin America and Sub-Saharan Africa are the most heavily reliant, accounting for 90% with small-scale agriculture playing a crucial role in rural economies depending on agriculture, mostly providing food and income sources (Tuan, 2023). According to Tafese (2023) and Gosa *et al.* (2023), the agricultural sector accounts for over 43% of Ethiopia's GDP, contributes over 90% of its export revenue, supplies 70% of the nation's industrial raw materials, and 84% of employment.

Cereal crop production and marketing are common worldwide especially in the agricultural sector. According to Ulisido and Abebe (2020), in the global cereal markets, 410.9 million tons were exchanged while Africa contributed 7.03% (28.89 million tons) of the global output of cereal crops. Production and commercialization of cereal crops contribute significantly to the national GDP, accounting for about 30% (Abate *et al.*, 2022). The majority of people consume cereal grains in both developed and developing countries (60 and 30 percent respectively) (Olugbire *et al.*, 2021). In Ethiopia cereal crop production and marketing are important to Ethiopia's economic development and growth. According to Ulisido and Abebe (2020), the majority (60%) of employment opportunities in the rural sector covers 40% of a household's food expenses.

Wheat (*Triticum aestivum L.*) is one of the cereal crops that is grown and sold on a global scale, which accounts for 15% of the world cereal crop sowing areas (Alemu *et al.*, 2022). In terms of industrial and food production, wheat is the second most significant cereal crop in the world after rice, and it is traded globally(Abate *et al.*, 2022). In Africa including Ethiopia and sub-Saharan countries, wheat is one of the systemic food security crops that attempt to bridge the determined food gap. It moreover plays a critical part in the improvement of the agricultural sector and enhancement of the income levels and job circumstances of farmers in developing nations (Addis *et al.*, 2019).

In Ethiopia, wheat production and marketing are getting jobs for millions of farmers. The government encourages increased wheat production for poverty alleviation (Senbeta and Worku, 2023). It is estimated that 15-20% of Ethiopia's sold wheat is produced by large-scale commercial farmers. Furthermore, to achieve national food self-sufficiency through rain-fed and irrigation sources, wheat has been chosen as one of Ethiopia's target crops. With 80% of the wheat produced going towards consumption, only 20% of the grain is sold, despite its enormous potential (Minot *et al.*, 2019).

Ethiopia is the second largest wheat-producing country in Africa next to South Africa, ranked fourth next to teff, maize, and sorghum in area coverage, and in 2021/22 wheat was grown on 2.1 million hectares of area. The total yearly production of grain is 6.7 million tons, with average productivity of 3.0 and 4.0 per ha under rain-fed and irrigated circumstances, respectively (Tadesse *et al.*, 2022). According to Mohammed (2018), wheat is the primary food crop for both urban and rural households in Ethiopia. Smallholder farmers typically sell the majority of their harvested wheat to cover costs such as taxes, loans, and other expenses. According to Anteneh and Asrat (2020) and Rabo Usha (2022), the main wheat-growing regions in Ethiopia are Oromia (57.4%), Amhara (27.4%), SNNP (8.7%), and Tigray (6.2%). However, in Ethiopia about 95% is produced by small-scale subsistence farmers who depend on rain-fed, mixed farming with modest inputs and traditional technology (Abebe *et al.*, 2022).

According to Elias and Haji (2021), two primary types of wheat are developed in Ethiopia: durum wheat (*Triticum turgidum var durum L.*) and bread wheat (*Triticum aestivum L.*). Durum wheat is favored for spaghetti and macaroni and is additionally traditionally developed on heavy black clay soils of the highlands. Bread wheat is the foremost commonly grown wheat assortment in Ethiopia. It is among the foremost important crops grown within the nation both as a food source for consumers and as a source of income for farmers.

Similarly, in Metekel Zone, wheat is among the most important cereal crops grown by smallholder farmers next to maize and teff. It ranked third in area coverage after maize and teff and it is a major source of livelihood for farm households in the zone (Kebede, 2022). There is potential for the production of field crops, grains (maize, teff, rice, wheat, and

barley), lowland legumes (field bean, soybean, pigeon pea, and cowpea), and oilseeds (sesame, soybean, peanut, noug). The agricultural production area coverage in the 2020/21 production season in the Metekel zone was 157,896.65 hectares, of which 105,975.29 hectares were cereals. In the production season of 2020/21, the grain harvest was 3,907,236.26 quintals, with grain taking a large share, yielding 3,065,158.00 quintals (Kebede, 2022).

In Wombera District, wheat makes a significant contribution to meeting important farmer goals, such as food supply and cash needs. The area allocated in the district for the production of bread wheat in 2021/2022 was 8,714 hectares of land and the production was 387,948 quintals with an average productivity of 38.5 quintals per hectare (Agriculture, 2023). The sector is characterized by its rain-fed and smallholder agriculture. The study area includes mixed agricultural zones where crops are grown for food and cash. Livestock are raised for supplemental purposes as a security measure during food shortages and to meet farmers' cash needs.

Despite its importance, many problems hinder Ethiopia in general and the study area in particular from producing and marketing wheat: lack of improved seed; low wheat product prices; high cost of fertilizer; pesticide; and seeds; high combiner harvest costs; reduced soil fertility; lack of sustainable outlets; lack of infrastructure; lack of access to credit; lack of market information; low input quality; weak market linkage; weak producer bargaining power; weak extension services; and insufficient financial resources are the major limitations in wheat production and marketing as identified by (Anteneh and Asrat, 2020, Senbeta and Worku, 2023). To achieve the desired level of outcome from the production and marketing of wheat, a modern marketing system including better communication, transportation, storage facility, and financial arrangement are critical factors.

Hence, it is essential to upgrade the standard wheat production system to change the method of production and improve the quality of the final product. In addition, the encouragement of multi-actor linkage and interactions facilitates the sharing of information and knowledge, improvement of capacity, collaborative learning, and ongoing solving of problems thereby allowing poor producers to participate in competitive marketplaces.

Therefore, this study aimed to identify wheat value chain actors, supporters and their roles, assess the factors influencing the participation decision of wheat producers in product upgrading and value addition practices as well as identifying major constraints and opportunities in wheat production and marketing in Wombera district of the Metekel Zone.

1.2. Statement of the problem

Several actors are involved in the cereal crop value chain in Ethiopia. Agricultural producers in general and wheat producers in particular depend on their ability to access resources in a value chain, find a market for their surplus production and produce value added or high quality goods. A producer's position in a value chain therefore determines their access to resources, knowledge/information and markets (Mamo *et al.*, 2018).

Ethiopia struggles with weak market linkages and production in wheat due to a lack of coordination, lower demand for superior products, a low rate of wheat variety adoption, low utilization of recommended farm inputs, lack of knowledge, infrastructure, financial resources, market information, weak extension services, and inability to meet international standards resulting in low value-added products before reaching to the final consumers (Tafese, 2023).

In Wombera district, weak linkages in the wheat production and marketing value chain prevent various actors from benefiting from the current market channels. The reasons for this are lack of support, inadequate infrastructure, low value addition practices, inaccurate market information, lack of collaboration, low producer prices and high consumer prices. In addition, smallholder farmers were selling weakened wheat without value addition at low market prices, wheat variety dissemination was low, fertilizer use was low and wheat production was traded at low quality (Agriculture, 2023, Districit and Trade, 2023).

Therefore, value chain analysis is a useful technique that helps to understand the general trends along the chain and to identify the causes of inefficiency in order to identify possible areas where technological and legal solutions can be applied. It also identifies constraints and opportunities in the flow of goods, information and money across the different stages of the chain that can improve the performance of individual actors as well as the overall contribution of the chain (Ulisido and Abebe, 2020).

Different researchers published findings on the value chain, supply chain, and market chain analysis of wheat in different parts of Ethiopia in different years. Among those, Usman (2016) analyzed the value chain of wheat in Sinana district, Habte *et al.* (2016) analyzed the supply chain of wheat in Arsi and East shewa zones, Tadesse and Aman (2017) analyzed the value chain of bread wheat in Minjar shenkora district, Amhara region, Mohammed (2018) analyzed the value chain of wheat in Lanforo district, Addis *et al.* (2019) analyzed value chain of wheat in Dembecha district, Ulisido and Abebe (2020) analyzed value chain of wheat in Denaba kebele, Dodola district, Elias and Haji (2021) analyzed the market chain of wheat in Misha district, Molla *et al.* (2022) assessed the determinants of the wheat value chain in north shewa zone, and Tafese (2023) analyzed the market chain of wheat in Basoliban district. However, these studies were not without shortcomings. First, most of the studies were concentrated on the Bale and Arsi zones. Second, those researchers constructed a value chain map of wheat, identified wheat value chain actors and their roles, identified constraints and opportunities in wheat production and marketing, identified the market channels and their profit margin, identified factors affecting wheat market supply and identified determinants of market outlet choice decisions in the different regions of Ethiopia. But, they are no considering key factors affecting product upgrading and value addition techniques in wheat value chains, which are crucial for achieving competitive advantage and improving the position of smallholder farmers in the value chain.

Furthermore, previous studies have addressed the methodological gap in understanding household participation in product upgrading and value addition of cereal crops. Akite *et al.* (2021) used logit models to assess factors affecting non-technological upgrading strategy for the rice market improvements, Atnafu Delele (2020) used probit model to analyze participation decision of households on value addition of soybean, Molla *et al.* (2022) used logit model to assess factors affecting the decision of participation in wheat value addition, Maku *et al.* (2023) used probit model to analyze the factors influencing youth participation in maize value addition. Various models have been used considering product upgrading and value addition as a single activity but there are different techniques of wheat product upgrading and value addition practices. Hence, a multivariate probit model would fill this gap and provide a more comprehensive understanding.

As far as the researcher is aware, no research has been done in the study area that specifically addresses wheat value chain analysis in general and the factors influencing wheat producers' choices to upgrade their products, and value addition practices in particular.

Therefore, the motivation behind this study was to fill information and knowledge gaps by identifying wheat value chain actors, supporters and their roles, assessing determinants of smallholder wheat producers' participation decisions in product upgrading and value addition practice, and identifying major constraints and opportunities in wheat production and marketing for future intervention in the study area.

1.3. Research questions

1. Who are the wheat value chain actors, supporters and what are their roles?
2. What factors are affecting the participation decision of wheat producers in product upgrading practices?
3. What factors are affecting the participation decision of wheat producers in value addition practices?
4. What are the key constraints and opportunities in wheat production and marketing?

1.4. Objectives of the study

1.4.1. General objective

The general objective of the study was to analyze the wheat value chain in the Wombera district of Metekel zone, Benshangul Gumuz, Ethiopia.

1.4.2. Specific objectives

1. To identify wheat value chain actors, supporters and their respective roles in the study area.
2. To assess factors affecting smallholder wheat producer's participation decision in product upgrading techniques in the study area.
3. To assess factors affecting smallholder wheat producer's participation decision in value addition practices in the study area.
4. To identify major constraints and opportunities in wheat production and marketing in the study area.

1.5. Significance of the study

The study produced useful information on the value chain analysis of wheat, which was to identify wheat value chain actors, supporters and their roles, assess factors influencing wheat producers' participation decisions in product upgrading and value addition practice, and identify major constraints and opportunities in wheat production and marketing at various levels to make relevant decisions to intervene in the value chain.

The study finding is also helpful to extension service providers, government and non-governmental organizations, input suppliers, producers, traders, consumers, and marketing agents in helping them to make their own decisions through improved marketing linkage by closing information gaps. It also helps to close knowledge gaps on the topic at hand and advance understanding of the factors that influence product upgrading and value addition practice. Furthermore, it could be used as a reference for further research on similar topics and corresponding issues.

1.6. Scope and limitations of the study

This study was focused on analyzing the wheat value chain in the Wombera district Metekel zone, Benshangul Gumuz, Ethiopia. Specifically, it focuses on the roles of value chain actors and supporters in wheat value chain, assessing factors that influence participation decisions of wheat producers in product upgrading and value addition techniques and identifying major constraints and opportunities in wheat production and marketing by using cross-sectional data which was collected data from three (3) kebeles of Wombera district at one time.

However, the study was limited to only one of the seven (7) districts of the Metekel zone due to time, financial limitations, and other resource limitations. Hence, the generalizations of the findings are only possible in the study area and location with similar socioeconomic characteristics.

1.7. Organization of the thesis

This thesis is organized into five sections: section one illustrates the study introduction background, statement of problem, research question, research objectives, scope and limitations, and significance of the study. Section two provides a comprehensive review of theoretical and empirical concepts related to the market chain and value chain analysis of wheat. Section three details research methodologies, including a description of the study area, research design, sample size, data collection, analysis, and hypothesis, while section four provides detailed results and discussion, and section five presents a summary, conclusions, and recommendations.

2. LITERATURE REVIEW

This section of the thesis tries to present key terminologies, and relevant literature, such as the concept and definition of value chains, value chain analysis, value chain mapping, governance and upgrading, and numerous relevant subjects that are in line with this study. Additionally, it makes an effort to examine the findings of relevant empirical studies that were conducted in different parts of Ethiopia which are nearly related to the topic of wheat value chain analysis.

2.1. Definition and basic concepts related to value chain

Supply chain: refers to an integrated process variety of different corporate organizations (such as suppliers, manufacturers, distributors, and retailers) collaborate in the supply chain to obtain raw materials, transform these materials into specific final goods, and then transport these final products to retailer (Mohammed, 2018, Nitsuh, 2019, Zainol *et al.*, 2023).

Value chain: refers to the full range of actions necessary to move a good or service through the many stages of production, such as physical transformation, the input of diverse producer services, and consumer demand response (Addis *et al.*, 2019, Udhayan *et al.*, 2023, Crescenzi and Harman, 2023).

Value addition: The process of changing a product's current place, time, and form characteristics to increase its economic value and make it more appealing to consumers in the marketplace is known as value addition. This process involves adding value to raw materials that already have intrinsic value (Addis *et al.*, 2019, Atnafu Delele, 2020). Value-adding activities include a variety of processes, such as manufacturing a product in a way that increases its value or changing the physical characteristics of the product (such as turning strawberries into jam or milling wheat into flour) (Mohammed, 2018).

Value chain actors: are those involved in input supply, production, processing, marketing, and, consumption of agricultural products. Direct participants in the value chain include rural and urban farmer cooperatives, processors, traders, retailers, cafes, and consumers, while indirect participants include credit agencies, business service providers, the government,

researchers, and extension agents who provide financial or non-financial support services (Atnafu Delele, 2020, Tuoi and Son, 2023).

Value chain map: a straightforward diagram to show the relationships between participants in a value chain and other market participants. Actor relationships, product flows, information flows, service flows, and other things like cost and margin of value chain actors are all things that need to be mapped (Addis *et al.*, 2019, Atnafu Delele, 2020).

Value Chain upgrading: it is a technique by which businesses or sectors improve their position and competitiveness in a value chain. It involves strategically improving business processes, outcomes, roles, or overall positioning to improve value generation, profitability, and sustainability (Akite *et al.*, 2021, Lule *et al.*, 2024).

Wheat: is a crucial cereal crop for the majority of the population, enhancing income levels and livelihoods for smallholder farmers (Addis *et al.*, 2019, Anteneh and Asrat, 2020).

2.2. Value chain analysis and its importance

Porter's value chain analysis, first proposed in 1985, is a technique to illustrate how the construction of value relates to the ultimate consumers. Value chain analysis looks at all of the steps that must be taken to create a product or service, the actors who carry out those steps in a vertical chain, and the final users of the good or service. This technique enhances competitiveness, reduces costs, and increases market share, ultimately leading to increased profitability. According to Ulisido and Abebe (2020), Value chain analysis generally addresses value chain mapping of actors, identifying the distribution of benefits of actors in the chain, value chain upgrading, and value chain governance.

2.2.1. Value chain mapping

It is a schematic snapshot of the key value chain actors, and their functions and indicates the flow of raw material, products, money, and information at a given point in time (Haji *et al.*, 2020), It systematically maps the actors engaged in different activities of input supplying, production, distribution, processing, marketing, and consumption of a particular product (Kasahun, 2020).

Value chain actors: are those who directly deal with the products (produce, sell, buy, and process) and they can take title to the product for a specific period. These actors include input suppliers, producers, traders, processors, and consumers (Tafese, 2023).

Chain supporters: are indirect actors who provide services or support the functioning of the value chain. These include financial or non-financial service providers such as banks and credit agencies, business service providers, government, researchers, and extension agents (Wondim, 2021).

Chain influencers: those whose activities impede or foster the value chain activities for instance land tenure, tax, standards, infrastructure, policy, rule and regulation, waste disposal system (Mabharwana *et al.*, 2023).

2.2.2. Value chain governance

Value chain governance refers to the set-up of connections and communication channels between its participants. Inter-firm connections and institutional procedures are how non-market coordination of chain activity takes place (Usman, 2016). Value chain governance is particularly important for the generation, transfer, and diffusion of knowledge leading to innovation, which enables firms to improve their performance (Kabeta, 2018).

2.2.3. Value chain upgrading

Upgrading is the process of acquiring technological skills and market connections that allow businesses to become more competitive and engage in higher-value activities (Akite *et al.*, 2023). It also makes an effort to understand the potential and constraints of relationships within value chains for upgrading the businesses of developing nation firms (Akite *et al.*, 2023). According to Mehta (2022), one important element in the upgrading of value chains is "know-how" production. The five categories of upgrading are as follows:

Process upgrading: improving efficiency (i.e., producing more for the same level of inputs or producing the same amount of output for fewer inputs), meeting standards, and receiving certifications. It produces the same product more efficiently by utilizing new technologies or different management strategies (Kedir, 2018).

Product upgrading: it includes new product development, new product variety development, and line expansion. It does it faster than competitors by developing new products or upgrading existing ones (Kedir, 2018, Lule *et al.*, 2024).

Functional upgrading: Increasing value added by shifting the locus of activities to different links in the value chain, such as from manufacturing to design, or by changing the mix of activities carried out within the production (for example, taking responsibility for or outsourcing accounting, logistics, and quality functions) (Usman, 2016).

Inter-sectoral upgrading: operating in the new market channel while maintaining the same value chain. Inter-sectoral upgrading in wheat goes beyond improvements within the wheat production chain itself. It focuses on how the wheat sector can leverage connections with other industries to create a more dynamic and high-value wheat economy (Kedir, 2018).

Chain upgrading: chain upgrading in cereal crops refers to improvements made at various stages in the process of getting cereal grain from field to market. This can involve several actors from the farmers themselves to processors, distributors, and retailers. new value chain was entered by the idea of upgrading formally acknowledges relative endowments and the consequent presence of value (Usman, 2016, Kedir, 2018).

2.4. Product upgrading practices

Product upgrading techniques are a set of strategies used to enhance a product's value proposition in the market. According to Lule *et al.* (2024), a key strategy for raising quality and satisfying consumer demands is the adoption of improved varieties crucial for wheat product upgrading due to their enhanced quality product, increased yields, meeting market demands, and improved profitability. Ethiopian smallholder farmers and other smallholder farmers in developing countries share the practice of producing local varieties. The utilization of low-quality, locally-grown seed varieties reduces wheat productivity and quality, which influences market prices.

Fertilizer application is significant for wheat product upgrading by enhancing grain quality, yield quantity, and disease resistance, to increased protein content. Balanced nitrogen and

potassium levels also contribute to disease resistance. In Ethiopia fertilizers are used to produce cereal crops including teff, maize, wheat, barley, and sorghum, using more chemical and inorganic fertilizers can increase productivity and production, especially in wheat grain yields. This results in meeting market demands, increased profitability, and enhanced resource efficiency (Dabessa Iticha *et al.*, 2021).

The application of herbicides is currently the most common method for weed control in agriculture among farmers. Chemicals that kill or suppress unwanted plants (weeds) that compete with crops for water, nutrients, and sunlight and they help crops grow better and produce higher yields. It offers an economically feasible to manage weeds and produce crops (Munaweera and Jayasinghe, 2018).

The application of pesticides in the production of wheat is crucial to control a variety of pests from disease and pests that reduce yield, low quality; low market returns, and damage to the crop. Pests and diseases are affecting agricultural products, affecting quantity and quality. Pesticides are used to control diseases, increase production, and maintain aesthetics. However, misuse and excessive use by small-scale farmers harm human health and the environment. To address these issues, appropriate pesticide application in the right quantities and at the right time is necessary (Radosavac and Knežević, 2017).

2.5. Value adding practice to agriculture

Value addition can take several forms, encompassing various aspects such as innovativeness, delivery flexibility, quality, pricing, and delivery timeframes. It can also include implementing innovative techniques for managing products that improve a farmer's ability and dependability to satisfy market demand. Changing the form of the commodity to create form utility by cleaning wheat involves removing dust, weed seeds, stones, broken kernels, chaff, and large debris through various methods and it ensures higher purity of grains before they are marketed. (Time utility) proper wheat storing allows farmers to keep wheat for a period of time through various materials that give farmers the freedom to wait for better market conditions or for higher prices before selling their crop. This can be especially valuable if the immediate post-harvest prices are low. (Place utility) transporting wheat in bulk through cooperatives is often more efficient and cost-effective than individual farmers

handling their transportation through various transportation means. This reduces overall costs and increases profit margins for farmers because cooperatives connect them with a wider market, offering the right place to sell their wheat for potentially higher prices. Farmers should take note of value addition since it has the potential to turn unprofitable farming into one (Maku *et al.*, 2023, Molla *et al.*, 2022).

2.6. Challenge and opportunity of wheat production and marketing in Ethiopia

Tadesse and Aman (2017) and Ulisido and Abebe (2020) major constraints in wheat production include diseases, weeds, low soil fertility, lack of improved seed variety, reduced farmer awareness of improved farming practices, high cost of combined harvesting as wheat farmers in the region follow a mechanized wheat production system, lower availability, and effectiveness of many pesticides available in the region market: The untimely supply of fertilizers, a lack of capital to buy agricultural inputs, as well as high prices for seeds, chemical fertilizers, and pesticides were the factors affecting the production and productivity of wheat in Ethiopia. Marketing and production opportunities for wheat, demand growth, the establishment of infrastructure facilities including telecommunication, power, and financial institutions, management of storage subsidized seed delivery, subsidized fertilizer distribution, and government policies aimed at industrialization and towards agriculture.

2.7. Empirical Reviews

2.7.1. Wheat value chain actors in different areas

The value chain approach was employed by Tadesse and Aman (2017), to examine the value chain analysis of bread wheat in Minjar shenkora district, and identify the actors and their responsibilities in the chain such as smallholder farmers, whole bread wheat grain traders; processors, processed bread wheat trader, and consumers were major actors. In his study area, he also studies chain governance and value chain enablers. In a similar vein, the authors discovered that chain actors transmitted information in both directions. The author did not identify input suppliers and did not study upgrading strategies in the study area.

Mohammed (2018) studied on wheat value chain in Lanforo district. The result of his study identifies value chain actors, such as input suppliers (like agricultural and rural development offices, primary cooperatives, and private input suppliers), producers, rural assemblers, wholesalers, retailers, primary cooperatives; union, flour (factories, wholesalers, and retailer), brokers, and consumers are major wheat value chain actors in his study area. A value chain approach was also used to study value chain enablers such as input and equipment providers, financial services, extension services, and technology supplies. The researchers also studied value chain governance but did not study wheat value chain upgrading in the study area.

Addis *et al.* (2019) also used a value chain approach to study the analysis of wheat value chain in the Dembecha district, west Gojjam zone, and identified value chain actors and supporters, such as input suppliers (Cooperatives Agricultural Developments Office, individuals, and private shops) who provide different inputs like seeds and fertilizers, producers, traders (collectors, local alcohol processors, hotels/restaurants/bread sellers/bakers, flour sellers, wholesaling, are the actors in wheat value chain in his study area. The authors also discovered that chain actors in his study area had a two-way flow of information. The author did not study chain governance or upgrading in their study area.

Ulisido and Abebe (2020) analyzed wheat value chain in Denaba kebele, Dodola district, the result of their study identifies the value chain actors such as producers, collectors, wholesalers, retailers, and consumers are the major actors in the wheat value chain in his study area. The author has identified value chain supports. A value chain approach was also used to study value chain supporters such as banks, universities, NGOs, research institutes, and cooperatives. The author did not study value chain upgrading or value chain governance and did not identify input suppliers in the study area.

Elias and Haji (2021) market chain analysis of wheat in Misha district, the result of his study identifies the value chain actors such as producers, local collectors, wholesalers, retailers, processors, and consumers are the major actors in the wheat value chain in his study area. The author did not identify value chain supports, value chain upgrading, or value chain governance and did not identify input suppliers in the study area

As concluded from the above literature, value chain actors of the same product, their roles, and linkages are different from place to place. Moreover, some functions or roles are performed by more than one actor, and some actors perform more than one role.

2.7.2. Factors affecting participation decision in product upgrading techniques

In this section empirical review of documents and studies relevant to this study is made. Some empirical studies have been conducted by different researchers on value chain upgrading but product upgrading particularly on wheat is very limited as a result of this the review mainly included the studies conducted on agricultural products with many related crops. Different studies were conducted to assess factors affecting agricultural producers' participation decisions in different aspects of upgrading.

Doti (2018) studied on determinants of dairy value chain upgrading by smallholder in central Ethiopia used a probit model to analyze factors affecting smallholder farmers' decision to participate in dairy value chain upgrading (process and value added upgrading) in central Ethiopia. The result of the model revealed that the household's experience, quality of milk supplied, level of education, total income generated, and access to market information found to significantly and positively influence the probability of smallholder participation in dairy value chain upgrading. Likewise, distance to the main road and operational cost had a significant and negative influence on the probability participation in upgrading.

Steffens *et al.* (2020) adopting the innovative, strategic approach to value chain upgrading and its impact on Tanzanian agricultural households. The factors influencing upgrading strategies that seek to improve certain aspects of crop production, postharvest processing, sale, and consumption were assessed by the authors using a logistic regression model. Therefore, upgrading methods were positively and significantly impacted by perceptions of land security, membership in agricultural organizations, communal processing, microcredit groups, and collective processing. However, employment and knowledge of off-farm pay were found to have a negative and significant impact.

Akite *et al.* (2021) used logit models to assess factors affecting non-technological upgrading strategy (horizontal, vertical, and inter-chain upgrading strategies) for the rice market

improvements in Uganda. The author found that distance to the output market, access to credit service, access to market information, and spot marketing positively and significantly influenced horizontal linkage upgrading. Likewise, family size, crop farm income, access to market information, spot market, marketing under farmer groups, and individual marketing significantly and positively influenced rice vertical linkage upgrading. In contrast, experience rice farming had a significant and negative effect on it. Moreover, revealed that using hired labor, access to market information, and contract farming significantly and positively affect inter-chain upgrading.

Lule *et al.* (2024) studied on tomato value chain analysis in jimma zone used mvprobit to analyze factor affecting tomato product upgrading techniques founded that age and market distance had a significant negative correlation with product upgrading while family size, farming experience, year of school, access to market information, training, seed, and pesticide had a significant positive influence on one or more techniques for product upgrading.

2.7.3. Factors affecting participation decision in value addition practices

Studied on wheat value chain analysis in the Sinana district and used probit model to analyze the variables influencing farmers' participation in wheat value addition. Variables like market information ,access to extension service, access to credit service were positively and significantly affect probability of farmers to participate in wheat value addition whereas, market distance and quantity of produced wheat affect negatively and significantly (Usman, 2016).

Atnafu Delele (2020) analyze soybean value addition in the Pawe district of northwestern Ethiopia used probit model to analyze the variables influencing farmers' participation in soybean value addition. According to the study, farmers' propensity to add value to soybeans was positively and significantly influenced by the age, selling price, and quantity of soybeans produced and negatively and considerably impacted by the distance nearest to the urban market, disease, and storage.

Molla *et al.* (2022) studied on determinants of wheat value chain in North Shewa Zone ,Ethiopia used logistic regression model to assess factors affecting the decision of

participation in wheat value addition. The result of his study indicated that family size and access to market information positively and significantly affect the participation of households in value addition activities. The decision to engage in wheat value addition was influenced by total livestock production and distance from the market negatively and significantly other independent variables were found insignificant in his study.

Maku *et al.* (2023) conducted on youth participation on maize value addition in Gulu district used probit model to analyze the variables influencing youth participation in maize value addition in Gulu district, Uganda. The result of the model revealed that access to market information, training, extension service, location, age, education, and land size was influencing youth participation in maize value addition significantly.

2.8. Conceptual framework

This section is to accomplish the predefined objectives by examining the causal relationship between the dependent variables and hypothesized independent variables.as figure 1 below show that factors influencing the likelihood of smallholder wheat producers participation in product upgrading techniques and value addition practice include demographic factors ,socio economic factors, and institutional factors were reviewed factor affect decision of participation as determined by theoretical and empirical assessments. The likelihood of value addition and product upgrading may be influenced by the relationships among value chain actors.

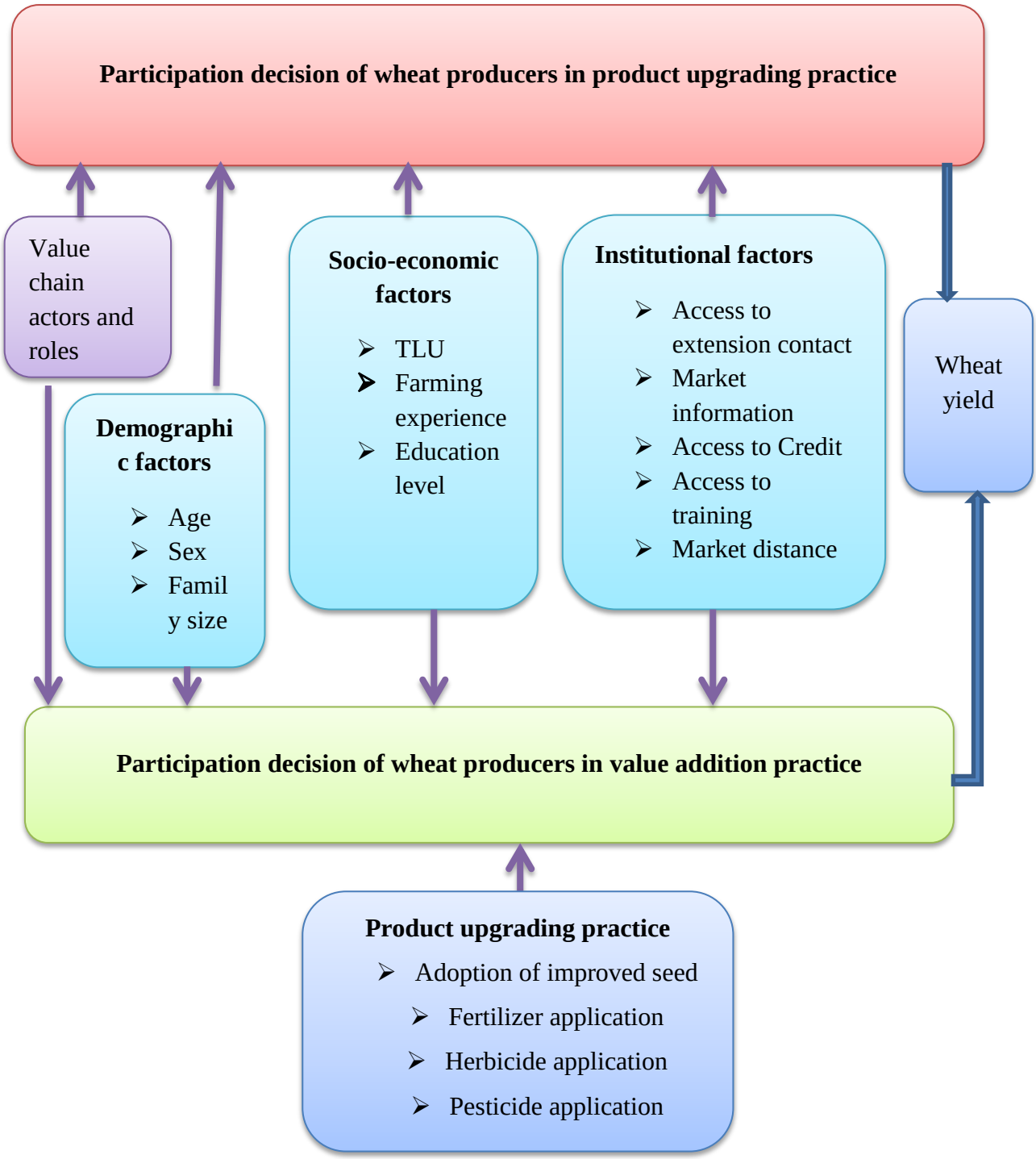

Figure 1: Conceptual framework of wheat value chain

Source: own sketch by reviewing (Tadesse and Aman, 2017, Addis *et al.*, 2019, Atnafu Delele, 2020, Elias and Haji, 2021)

3. RESEARCH METHODOLOGY

In this chapter, the description of the study area, research design, data types, sources, methods of data collection, sampling technique, and sample size determination are mostly described. It also describes the methods of data analysis.

3.1. Description of the study area

Metekel zone: is one of the three administrative zones of the western Ethiopia Benshangul Gumuz Regional State. It shares borders with the Awe zone in the east, Kamashi zone in the south, Western Gondar in the north, and North Sudan in the west. It has three agroecologies, Dega, Kola, and Woynadega, and has seven districts. One of the seven districts in the Metekel zone is Wombera (Melak, 2016).

Wombera District: is located in the Metekel zone's northwest and is bordered by the Kamashi Zone on the south and west, the Beles River on the north, which divides it from Guba and Dangur, and Bulen on the east, the Abay River marks the border between Wombera and the Kamashi Zone (Woldie, 2018). This is 675 km from Addis Ababa, 525 km from Assosa, and 190 km from Metekel Zone. It was composed of three types of Agroecology: 17% Dega, 11% Wendiga, and 72% Kola. The annual mean temperature fluctuates between 6-36 °C, while the annual mean rainfall ranges from 900 to 1740 millimeters. Between 2000 and 3000 meters above sea level, the altitude ranges. The district has 36 kebeles, of which 2 are urban, 17 are Dega, and 17 are kola (Agriculture, 2023). The main annual crops farmed by the majority of farmers in Wombera are maize, wheat, teff, sorghum, sesame, beans, coffee, and barley lists wheat, teff, maize, and barley as other marketable crops (Agriculture, 2023).

One of the most common cereal crops farmed and sold by households in the Wombera district was wheat. In terms of area covered, wheat production is second next to teff in the district, and compared to teff which supplies less than 30% of the market nearly half of the district's produce is wheat. Additionally, the district's demand for wheat has increased as a result of growing alcohol (areqi and tella) production which is increasingly becoming an important business for women. As a result, all households in the district produce and supply wheat and they use maize and teff as substitutes for wheat for household consumption (Agriculture, 2023).

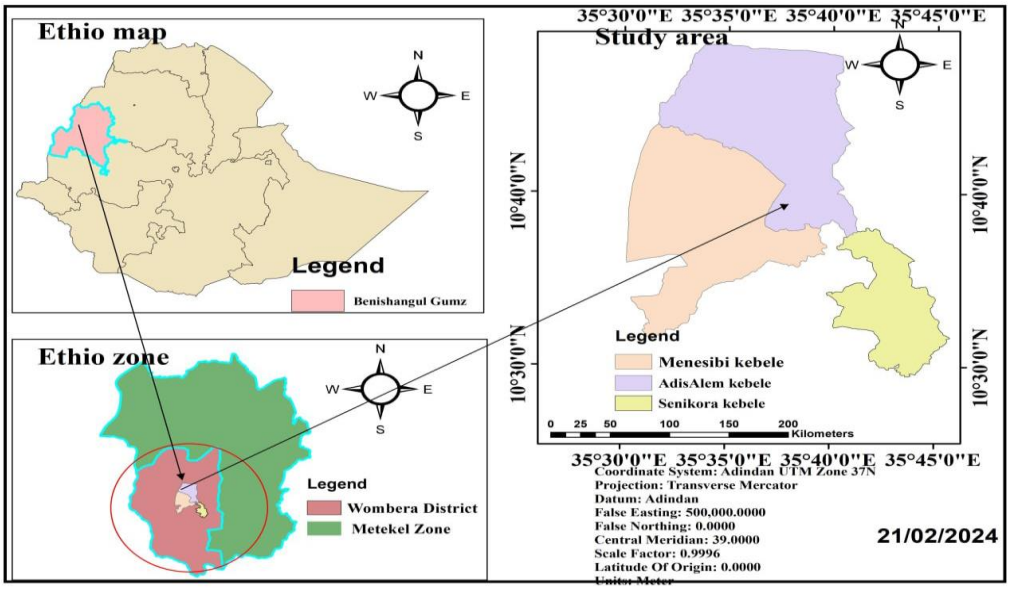

Figure 2: Map of the study area

Source: sketch by own manipulate from Ethiopia map using Ethio- GIS

3.2. Research design

A cross-sectional study design was employed to study wheat value chain actors, supporter, their roles and factors affecting participation decisions of smallholder wheat producers in product upgrading and value addition practice in Wombera district. To achieve the objective of the study data was collected at one time from the sampled respondents.

3.3. Data sources, types, and methods of data collection

3.3.1. Data types and sources

Both quantitative and qualitative types of data were collected from primary and secondary sources. Quantitative data related to demographic, socioeconomic, and institutional characteristics was collected from the sampled respondents.

3.3.2. Methods of data collection

The primary data was collected through structured interviews, group discussions and key informant interviews. A supervisor and three enumerators were used for data collection. The enumerators were trained and the questionnaire was pre-tested on 20 households to assess the design, clarity, relevance and interpretation of the questions by translating the questionnaire into the local language (Amharic). In addition, the time required for a survey was determined and changes were made based on the feedback from the pre-test. To collect qualitative data, focus group discussions were conducted with three groups of eight farmers from each of the three kebeles in the sample. Interviews were also conducted with cooperative staff, district agriculture and natural resources staff, and road and transportation department staff. In addition, secondary data was collected from published and unpublished sources as well as from the District Offices of trade, Roads and Transportation, Agriculture and Natural Resources, and the Cooperative Office.

3.4. Sampling procedures and sample size determination

3.4.1. Sampling producers of household heads

Multi-stage sampling procedures were used to select the sample households in the study area. In the first stage, out of 36 kebeles in Wombera district, 13 kebeles were purposively selected based on their potential for wheat production. In the second stage, three (3) kebeles were selected from the 13 potential kebeles using a simple random method. These kebeles have the same rainfall distribution, soil type and temperature. In the third stage, wheat producers were selected from each kebeles with probability proportional to sample size (Table 1). Then, the predetermined sample sizes of wheat producers were selected from each sample kebeles and interviewed using a simple random sampling technique. The sample size of wheat producers was determined using the following formula by Yamane (1967) to obtain a representative sample for proportions.

$$n = \frac{N}{1+N(e^2)} = \frac{2100}{1+2100(0.07^2)} = \mathbf{187}$$

Where, n = sample size; N = population size of wheat producers in three kebeles; e = desired level of precision. For this study, a 7% precision level was used, the reason behind this

precision level is that if the precision level is less than 7% the sample size may be very high and it needs more time and budget. Therefore, due to time and budget constraints the above-listed precision level was used so by using the above-mentioned formula 187 wheat-producer households were interviewed from the district.

Table 1: Proportional distribution of sample households in each kebeles

Sample of kebeles	Number of wheat producers	Proportion (%)	Sample size (n)
Menesibu	801	38.14	72
Addis Alem	656	31.23	58
Senkora	643	30.63	57
Total	**2100**	**100**	**187**

Source: - (own computation, 2024) based on data from agriculture and natural resource office

3.4.2. Sampling of traders and consumers

According to (Districit and Trade, 2023), in one district, 80 licensed wheat traders were registered in the trading, road and transport offices, but wholesalers and processors were not registered. For this study, a sample of 25 experienced wheat traders (9 collectors and 16 retailers) who have been in wheat trade for a long time because many wheat traders in the district are not registered and have not been in wheat trade for long. In addition, 22 wheat consumers were randomly selected. The randomly selected consumers were replaced by other randomly selected consumers if the selected consumers had not consumed wheat in the last five months.

3.5. Methods of data analysis

To achieve the objectives of this study, the data obtained from the sample respondents were analyzed using two types of data analysis, namely descriptive statistics and econometric models. STATA version 14.0, SPSS version 20.0 and Excel software were used to enter and analyze the data.

3.5.1. Descriptive analysis

Descriptive statistics including mean, max, min, percentage, frequency, and standard deviation were used in the process of examining the demographic, socioeconomic, and institutional characteristics of sampled producers, traders, and consumers. To test the significance of the explanatory variables inferential statistics such as the chi-square test and t-test were employed.

Value chain analysis: is the process of breaking a chain into its component elements to better comprehend its composition and operation. Establish chain governance, or leadership, to aid in the construction and strengthening of the chain. Then, decide which chain activities provide value, and allocate costs and added value to each activity. The analysis entails identifying chain actors at each stage and discerning their roles and relationships (Mohammed, 2018, Lule *et al.*, 2024).

According to Arage (2018), mapping of value chain is understanding the value chain actor's traits and their interactions entails studying all of the actors in the chain, the flow of goods through the chain, employment characteristics, and the locations and amounts of domestic and international sales. Surveys, interviews, participatory workshops, and the gathering of secondary data from diverse sources can all be used to get this information.

3.5.2. Econometric analysis

The introduction or planting of improved wheat varieties with high yields and disease resistance as well as the improvement of existing goods through several techniques like the adoption of improved seed, application of fertilizer, herbicides, and pesticides to improve the

quality of the wheat product are considered as forms of product upgrading for this study. In contrast, increasing value added through a several of steps carried out by wheat farmers that start from harvest value addition techniques were characterized. The post-harvest value addition activities carried out in the study area included wheat cleaning, storing, and transporting to create form, time, and place utility respectively.

Multivariate probit model: This model was used to examine how various explanatory variables affected the various product upgrades and value addition strategies.

Different studies use models to estimate dichotomous mathematical relationships between qualitative response variables and explanatory variables. For qualitative response models aim to find probability of something happening, while quantitative models like OLS are rejected for this study. Logit and probit models are qualitative response regression used when the response variable is one or univariate variable. In case, product upgrading techniques and value addition practices involves more than one dependent variable. For that matter the two models were not used in this study. The tobit model is used when a sample in which information on the regressand is available only for some observations (censored sample) that is why it is not used in this study. The multinomial logit model is used when our dependent variable involves more than two responses variables. It assumes independence or mutually exclusiveness of dependent variables in which the inclusion of one variable precludes the other. This study aimed at assessing only the participation decision of smallholders not level of participation; Hence, Heckman two-stage model was not used. As a result, a multivariate probit model was employed to assess the influence of the explanatory variables on the participation decision of wheat producers in product upgrading techniques and value addition practices. Wheat producers have the decision to participate in multiple upgrading and value addition practices simultaneously.

When a profit is probable, wheat producers take part in techniques such as value addition and product upgrading. Utility can be used to describe this expected profit. Accordingly, the decision to participate in upgrading techniques arises when the utility (UP_i) linked to such participation exceeding the utility (UNP_i) linked to not participating.

i.e. $UP_i - UNP_i > 0$

Lule *et al.* (2024) had revealed that the multivariate probit model was defined in the following way. The probability that the home i take part in j's product upgrading or value addition activities is: $P(y_{ij} = 1) = \int_{-\infty}^{yij} \Phi\ (yij^*/X_i\beta, \sum)\ d\ yij^*$ (1)

With Σ representing the variance matrix-covariance and ϕ representing the probability density functions of the multivariate normal distribution

Based on the distribution function, the probability that a wheat grower was take part in upgrading and value addition operations was as follows:

$$\text{Prob}\ (Y_{ij} = 1)\ =\ F\ (X_i\beta) \quad (2)$$

If and only if $yij^* > 0$, where yij^* is the utility obtained by participating in j product or value addition activity, then household i participates in the product upgrading and value addition activity of j p ($y_{ij} = 1$). This may be expressed in the following way:

$$Y_{ij} = \begin{cases} 1\ if\ \ y_{ij}^* > 0 \\ \ \ 0\ if\ y_{ij}^* \leq 0 \end{cases} \quad (3)$$

yij^* Latent (unobservable) level of utility the household i get from j product upgrading and value addition activity. It may be expressed as a function of observable explanatory variables in this way: $y_{ij} *= X_{\text{ij}}\beta_i + \varepsilon_{ij}$

Xij vector of the explanatory variable, βi is an unknown parameter to be estimated, Ɛij disturbance term of j upgrading activity where:

$E\ (\varepsilon|\ x)\ = 0$, the Sum of the mean of the disturbance term is zero

$\text{Var}\ (\varepsilon|\ x)\ = 1$, variance of disturbance term is constant

$\text{Cov}\ (\varepsilon|\ x)\ = \rho$, unobserved correlation between the stochastic components of the different types of product upgrading and value addition activities

Therefore, the probit model is specified as:

$Y_{ij} = X_i\beta_i + e_{ij}$ (4)

Where, i, j =1, 2, 3……..n

Yij is the probability of i^{th} wheat producers to participate in j product upgrading and value addition activities; βi are parameters and estimated Xi is the vector of an explanatory variable. The regression coefficients of the MVP model cannot be interpreted like other models' regression coefficients. Therefore, the marginal effects of each variable that give the

magnitude of the marginal effects of change in the explanatory variables on the expected value of the dependent variable were computed using a conditional mixed process (cmp).

3.6. Hypothesis and definition of working variables

3.6.1. Dependent variables

Smallholder wheat producers participation in product upgrading techniques were determined by dummy response variables that take a value of 1 if producers participate in respective product upgrading technique and 0 otherwise.

Adoption of improved varieties: according to Lule *et al.* (2024), adoption of improved varieties are one crucial techniques for product upgrading a key strategy for raising quality, quantity, and satisfying producers demands due to their enhanced quality product, increased yields, meeting market demands, and improved profitability. Smallholder farmers that practice in local varieties produced low productivity and quality which influences market prices.

Fertilizer application: it is another crucial factor for product upgrading to enhancing wheat productivity and improving grain quality. It also essential for maintaining plant health, reducing waste, and promoting sustainable agriculture, ensuring quality post-harvest sustainable land management practices, and post-harvest technologies. In Ethiopia fertilizers are used to produce cereals crops including teff, maize, wheat, barley, and sorghum using more chemical and inorganic fertilizers can increase productivity and production, especially in wheat grain yields (Dabessa Iticha *et al.*, 2021).

Herbicide application: application of herbicides is currently the most common method for weed control in agriculture among farmers. Chemicals that kill or suppress unwanted plants (weeds) and they help crops grow better and produce higher yields. It offers an economically feasible to manage weeds and produce crops (Munaweera and Jayasinghe, 2018).

Pesticides application: application of pesticides in the production is crucial to upgrade the product and control a variety of pests from disease that reduce yield, low quality, low markets returns, and reduce damage of crop. Pests and diseases are affecting agricultural products,

affecting quantity and quality. Pesticides application used to control diseases and increase quality and quantity product. Appropriate pesticide application in the right quantities and at the right time is recommended (Radosavac and Knežević, 2017).

Decisions on the wheat producer's participation in value addition techniques: were dummy dependent variables that take a value of 1 if producers participate in respective value addition practice and 0 otherwise.

Form utility (cleaning): it is crucial practice for value addition, cleaning wheat involves removing dust, weed seeds, stones, broken kernels, chaff, and large debris through various methods to change the design of the product and it ensures a higher purity of grains before distributed to the marketed to attract buyers. Develop and apply a maize grain cleaning method that can decrease the amount of physical contaminants and improve the quality of maize grains and produced high quality of products from them as well (Akampwera, 2017).

Time utility (storage): proper wheat storing allows farmers to keep wheat for a period of time through various materials that give farmers the freedom to wait for better market conditions for selling their crop. Grain must be properly stored in order to meet the increasing demand or greater price can be paid for grain that has high quality and requires proper grain storage (Lyda *et al.*, 2019).

Place utility (transportation): transporting wheat in bulk through cooperatives is often more efficient and cost-effective than individual farmers handling their transportation through various transportation means. It reduces overall costs and increases profit margins for farmers because cooperatives connect them with a wider market, offering the right place to sell their wheat for potentially higher prices (Sharma *et al.*, 2023).

3.6.2. Independent variables

The independent variables hypothesized to influence wheat producer participation decisions in product upgrading and value addition practices were defined and hypothesized as follows.

Sex of the household head (Sex): This is a dummy variable that takes a value of 1 for males and 0 for females. Male-headed households have been generally more likely than female-

headed households to adopt new agricultural production technology because female-headed households are more likely to face barriers to resource access and control within specific social groups (Mengesha *et al*., 2019). Similarly, compared to their female counterparts, male HHH are more likely to participate in the increasing function performed. As stated (Gebresilassie, 2018), the sex of household heads had a positive and significant influence on the use of fertilizer by smallholders. Albe and Aman (2022) sex of household heads had a positive effect on adoption of improved wheat varieties. Mumah *et al.* (2024) sex of household heads positively influenced machinery adoption on maize productivity. Therefore, it was hypothesized to have a positive influence on the likelihood of farmer's participation in product and value addition practice.

Age of household head (Age): is a continuous variable measured by years. The HHH becomes older and their probability of participating in product upgrading and value addition activity decreases. Atinafu *et al.* (2022) the adoption of new technologies for wheat production had a negative effect by years of age. Mumah *et al.* (2024) age had a negative influence on machinery adoption on maize productivity. According to Atnafu Delele (2020), the age of the HHH influenced positively and significantly the likelihood of farmers adding value to soybeans. So it was hypothesized to have a negative influence on the participation decision of wheat producers in product upgrade and value addition practice.

Education level of household head (Edu): This is a continuous variable expressed in years relates to a respondent's formal education. The degree of formal education of HHH determines their openness to new concepts and innovations. The probability that producers enhance the production technique and take on new roles along the chain was rise to their level of formal education. According to Atinafu *et al.* (2022), education had positively influence on adoption of improved wheat production technology. A one-year increase in respondents' educational attainment raises the likelihood that improved wheat production technologies. Tamirat *et al.* (2017), (Abera *et al.*, 2022) state that education level's had a positive association with row-planting technique and significance. Usman (2016) states that education has a positive effect on a decision to participate in wheat value addition. So it was hypothesized to positively affect their participation in product upgrade and value addition practice.

Family size (Fsize): This continuous variable is measured as the number of adult-equivalent household members. Because of this, producing wheat requires a lot of labor, improving the product quality and adding value when it's on the farm as well as the activities performed after harvest depending on the size of the family. According to Gebresilassie (2018) unit increase in the family size in adult equivalent increases the probability of use of fertilizer. A positive relationship indicates that household heads with larger families are more likely to adopt row-planting technology than heads of smaller families (Tamirat *et al.*, 2017). According to Usman (2016) and Molla *et al.* (2022), the hypothesized family size of the household positively affects the participation of the household in wheat value additional activities. Therefore, it was hypothesized to have a positive influence on product upgrading and value addition practice.

Distance to nearest market (Mrktdis): It is a continuous variable measured in walking minutes between a household's location and the closest market. The probability that wheat farmers was participate in the upgrading of products and value addition practice decreases when farmers have to travel long distances to obtain agricultural inputs from the market such as improved seed and herbicides, pesticides, fertilizers etc. Market distance had a negative effect on the probability of adoption of wheat production technology (Atinafu *et al.*, 2022). According to Usman (2016) and Molla *et al.* (2022), the likelihood of wheat value addition participation was affected by the distance between the household and market negatively and significantly. Atnafu Delele (2020) reported that distance to the nearest market affects negatively and significantly the likelihood of farmers adding value to soybean products. Kaba and Emana (2024) state that market distance had a negative effect on the probability of adoption of soybean production packages. It was hypothesized to have a negative effect on wheat producer's decisions to participate in the upgrading of the product and value addition practice.

Farming experience (Fexp): This is a continuous variable measured in years of farming activities. As farmers engaged long-term wheat farmers plan to update products by adopting new varieties or improving agronomic practices, focusing on adding value to achieve reasonable market prices. According to Usman (2016), the experience of the farmers in farming activities positively influences the decision to participate in wheat value addition.

Abera *et al.* (2022) found that farming experience had influenced the probability of teff row planting technology adoption positively. Mumah *et al.* (2024) farming experience had influenced the probability of farmer's participation in machinery adoption on maize productivity. Therefore, it was hypothesized to positively impact the probability of farmers taking part in the upgrading of the product and value addition practice.

Access to market information (Acmrkt): it is a dummy variable for access to market information take 1 and 0 otherwise. This is so that farmers have market information and knowledge of the price difference expressed in terms of price per kg between value-added and non-value-added products. According to Usman (2016) and Molla *et al.* (2022), reported that access to market information positively and significantly affects a decision to participate in wheat value addition. According to Siyum *et al.* (2022), access to market information had influence positively the probability of farmers' participation in the adoption of bread wheat technology. Therefore, it was hypothesized to positively impact the probability of farmers taking part in the upgrading of the product and value addition practice.

Access to extension contact (Acexco): This is a dummy variable that takes a value of 1 when a HHH has access to an extension contact and 0 otherwise. It is a crucial component that improves farmers' knowledge and awareness of various farming techniques. Additionally, it broadens the actors' understanding of value contribution. According to Tamirat *et al.* (2017) and Abera *et al.* (2022), found that the probability of adoption of row planting of wheat was positively influenced by access to extension contact. Usman (2016) found that access to extension contact affected the decision to be engaged in wheat value addition positively. Molla *et al.* (2022) state that access to extension services affects the decision to be engaged in wheat value addition negatively. Kaba and Emana (2024) state that access to extension contact had a positive effect on the probability of adoption of a soybean production package. So it was hypothesized that affects positively the participation decision of wheat producers taking part in the upgrading of the product and value addition practice.

Access to training (Actrain): This is a dummy variable that takes a value of 1 when a HHH has access to training and 0 otherwise. Wheat farmers can enhance the quality of their wheat products through the adoption of new seed varieties and by improving their production

techniques through training. Atinafu *et al.* (2022) found that the probability of adoption of improved wheat production technology was positively influenced by access to training. According to Dorsis (2022), the probability of adoption of improved maize varieties was positively influenced by access to training. So it was hypothesized that affects positively the participation decision of wheat producers taking part in the upgrading of the product and value addition practice.

Access to credit (Accred): This is a dummy variable that takes a value of 1 when a HHH had access to credit and 0 otherwise. Certain value chain operations need a significant amount of capital because wheat producers' likelihood of upgrading is increased when they have access to financing. An improvement in market and sales-related upgrading was positively correlated with financing availability (Alwang *et al.*, 2019). According to Usman (2016), access to credit had a positive and significant effect on farmers' likelihood of participating in value addition to wheat production. Atinafu *et al.* (2022) found that the probability of adoption of improved wheat production technology was positively influenced by access to credit. The probability of adoption of teff row planting and inorganic fertilizer was positively influenced by access to training respectively (Abera *et al.*, 2022, Iresso and Abebe, 2024). So it was hypothesized that it affects positively the participation decision of wheat producers taking part in the upgrading of the product and value addition practice.

Tropical Livestock Units (TLU): are a continuous variable used to measure livestock. A significant source of revenue and draft power is livestock. A household that has large numbers of livestock is likely to have more income and this helps smallholder farmers to purchase inputs like improved seed, fertilizer, herbicide, and pesticides and also increase farmer capacity to purchase available material and to prepare suitable conditions for wheat value addition. Tamirat *et al.* (2017) state that TLU had a positive association with the adoption of the row-planting technique of wheat. Molla *et al.* (2022) ownership of livestock affects the participation of smallholders in wheat value addition negatively and significantly. the probability adoption of improved maize varieties and wheat technology positively influenced by TLU respectively (Dorsis, 2022, Siyum *et al.*, 2022). Therefore it was hypothesized to affect positively the participation decision of wheat producers taking part in the upgrading of the product and value addition practice.

Adoption of improved variety (Adopimprov): it is a dummy variable taking a value of 1 if household heads adopted improved variety and 0 otherwise. According to Kumar *et al.* (2023), improved seeds need intensive pre-harvest and post-harvest management. For instance, improved varieties with disease resistance offer longer storage shelf life, reduced spoilage, and efficient cleaning processes. They also have uniform seed size and shape, reducing waste and weed seed contamination to store and transport to cooperative uniformly (consistent supply of high-quality of wheat to cooperative). Therefore it was expected to have a positive association with wheat value addition practice.

Fertilizers application (Ferapp): it is a dummy it takes a value of 1 in the circumstance that the head of the household has applied fertilizer and 0 otherwise. According to Kumar *et al.* (2023), applying a recommended rate of fertilizer in pre-harvest practices can improve wheat quality, potentially impacting the efficiency of the cleaning activities and transporting. It also reducing the risk of excessive moisture and reducing waste in the grain during storage. Proper uses of fertilizer in wheat crops tend to adding nutrients to the soil to improve wheat growth to produce higher yields and higher-quality of grains. This creates a surplus of grain that households may be more motivated to store and to transport to union (Argaw *et al.*, 2023). It was anticipated that the variable has a positive effect on wheat value addition practice.

Herbicide application (Herbapp): it is a dummy variable that takes a value of 1 if wheat producers applied herbicide and 0 otherwise. According to Ayana (2020), wheat weeds can be successfully controlled with herbicides, although this is dependent on how they are applied and the surrounding conditions to support different growth phases or densities they are recommended at different rates. Herbicides control weeds, enhancing wheat plant growth and health leading to higher-quality grains with fewer broken kernels making it easier to separate desired wheat during cleaning, storing and transporting. It was anticipated that the variable had a positive effect on wheat value addition practice.

Pesticide application (Pestapp): it is dummy variable that take 1 if wheat producers applied pesticide and 0 otherwise. According to Horamani and Sarmamy (2022), pesticides control insects damaging wheat kernels resulting in cleaner harvests and improved efficiency in cleaning ,storing, and transporting. They also maintain grain quality, benefiting value-addition activities. It was anticipated that the variable had a positive effect on wheat value addition practice.

Table 2: Summary of hypothesis of independent variables

Independent variable	Type of variables	Measurement of variables	Expected sign		Source
			Dependent variable		
			Product Upgrading	value addition practice	
Sex of the household head	Dummy	1=male 0=female	+	+	Atnafu Delele (2020), Albe and Aman (2022), Mumah *et al.* (2024)
Age of household head	Continuous	Year	-	-	Atinafu *et al.* (2022)
Education of household head	Continuous	Year of schooling	+	+	(Usman, 2016), (Atinafu *et al.*, 2022)
Family size	Continuous	Adult equivalent	+	+	Gebresilassie (2018), (Molla *et al.*, 2022)
Distance to market	Continuous	Walking minute	-	-	(Molla *et al.*, 2022) Kaba and Emana (2024)
farming experience	Continuous	Number of years	+	+	Mumah *et al.* (2024)

Access to market information	Dummy	1= has access 0= otherwise	+	+	Usman (2016), Siyum *et al.* (2022)
Access to extension contact	Dummy	1= has access 0= otherwise	+	+	Kaba and Emana (2024),(Molla *et al.*, 2022)
Access to training	Dummy	1= has access 0= otherwise	+	+	Atinafu *et al.* (2022)
			+	+	
Access to credit	Dummy	1= has access 0=otherwise	+	+	(Iresso and Abebe, 2024)
Livestock	TUL	Continuous	+	+	(Molla *et al.*, 2022),(Dorsis, 2022)
Adoption of improved seed	Dummy	1= has access 0= otherwise		+	Kumar *et al.* (2023)
Fertilizer application	Dummy	1= has access 0= otherwise		+	Kumar *et al.* (2023)
Herbicide application	Dummy	1= has access 0= otherwise		+	(Ayana, 2020)
pesticide application	Dummy	1= has access 0= otherwise		+	Horamani and Sarmamy (2022)

Source: designed by own based on literature review

4. RESULTS AND DISCUSSION

This chapter discusses the results of descriptive and econometric analysis. The sample producers, traders, and consumers of socio-economic, institutional, and demographic characteristics were described using descriptive statistics. A detailed discussion of the roles of each actor in the wheat value chain was focused in this chapter and factors affecting wheat producers' participation in product upgrading practice and value addition practice were presented and discussed using a multivariate probit model. It also explores constraints and opportunities in wheat production and marketing.

4.1. Descriptive analysis

4.1.1. Socioeconomic, demographic, and institutional characteristics of participant and non- participant in product upgrading

In this study, adoption of improved wheat variety, fertilizer application, herbicide application, and pesticide application were considered as a product upgrading strategy. This subsection included descriptive statistics of participant and non-participant in product upgrading and value addition practices as well as inferential statistics techniques like chi-square and t-test were used to test significant differences between participant and non-participant.

Results from the samples of households interviewed in wheat product upgrading techniques table 3 show that 66.84% of households planted improved varieties, 61.50% of households applied fertilizer, 69.52% of household use herbicide, and 67.91% of household use pesticide respectively in the study area. In addition, smallholder producers of wheat in the study area said during interviews that there is limited availability of improved wheat varieties and fertilizer, high prices, and lack of credit. Because of this reason, 33.16% of farmers were did not planted improved varieties gradually lowering yield per unit area and 38.50% of farmers did not apply fertilizer respectively.

Table 3: Participation of households in product upgrading techniques

product upgrading techniques	Items	Frequency	Percentage
Adoption of improved seed	No	62	33.16
	Yes	125	66.84
Fertilizer application	No	72	38.50
	Yes	115	61.50
herbicide application	No	57	30.48
	Yes	130	69.52
Pesticide application	No	60	32.09
	Yes	127	67.91

Source: Own computation from survey result, 2024

The relationship between the continuous variables and the respondent's participation in product upgrading techniques at probability levels were thereby shown in Table 4.

Age: The sample respondent average age was 42.2 years. The average age of improved seed adopters and non-adopters was 41.2 and 44.2 years, fertilizer application participants and non-participants was 41.3 and 43.6 years, herbicide application participants and non-participant was 41.1 and 44.5 years, and pesticide application participant and non-participant were 41.3 and 44.2 years respectively. This finding suggests the age of participants in product upgrading strategies was younger.

Education level: The sample respondents average overall education level was 5.96 grades (schooling years). The improved seed adopters and non-adopters average education level was 6.5 and 4.9 schooling years, fertilizer application participants and non-participants was 6.5 and 5.1 schooling years, herbicide application participants and non-participants was 6.5 and 4.8 schooling years, and pesticide application participants and non-participants was 6.4 and 5 schooling years respectively. The study result suggests that smallholder wheat farmers' education levels improve their ability to participate in product upgrading more intensely and efficiently for product upgrading techniques.

Family size: The conversion factor was used to convert the sample of household total family size to adult equivalent, in accordance with Storck *et al.* (1991). The sample respondents owned 3.9 total average adult equivalent labors in numbers. On average improved seed adopters and non-adopters had 4.14 and 3.32 family sizes, fertilizer application participants and non-participants had 4.14 and 3.43, herbicide application participants and non-participants had 4.11 and 3.32, and pesticide application participants and non-participants had 4.19 and 3.18 family sizes respectively. This finding suggests the average adult equivalent labors of participants in product upgrading strategies were higher.

Market distance: The other main factor influencing farmers' frequent travel to markets to sell their agricultural products and buy farm inputs was market distance. The sample respondents traveled on average 57.2 walking minutes to the nearest market (D/zeyit). On average improved seed adopters and non-adopters traveled 56.7 and 58.1 minutes, fertilizer application participant and non-participant was traveled 56.7 and 57.97 minutes, herbicide application participants compared to non-participants travelled 56.78 and 58.1 minutes, and pesticide application participant and non-participant was travelled 56.8 and 58.03 minutes respectively.

Farming experience: The sample respondents' average farming experience was 15.3 years. While improved seed adopters and non-adopters average farming experience was 16.1 and 13.6 years, farming experience of fertilizer application participants and non-participants was 15.9 and 14.2 years, farming experience of herbicide application participants and non-participants was 15.9 and 13.9 years, and farming experience of pesticide application participants and non-participants was 16 and 13.7 years respectively.

Tropical Livestock Unit: according to Storck *et al.* (1991), the conversion factor was used. The sample respondents' total average of tropical livestock units was 6.7 TLU. On average improved seed adopters and non-adopters had 7.3 and 5.5 TLU ,fertilizer application participants and non-participants had 7.14 and 6, herbicide application participants and non-participants, had 7.16 and 5.65 and, pesticide application participants and non-participants had 7.24 and 5.6 respectively. Finally, Table 4 the t-test indicated a statistically significant difference between participants and non-participants in all product upgrading techniques at 1% significance level.

Table 4: Socioeconomic and demographic characteristics of participants and non-participants in product upgrading (for continuous variables)

variables	Improved wheat variety			Fertilizer application			Herbicide application			Pesticide application		
	Adopter (N=125)	non adopter (N=62)	t-value	User (N=115)	non user (N=72	t-value	User (N=130)	non user (N=57)	t-value	User (N=127)	non user (N=60)	t-value
Age	41.2	44.2	7.7***	41.3	43.6	-8.9***	41.1	44.5	5.6***	41.3	44.2	7.3***
Edu	6.5	4.9	-8.4***	6.5	5.1	-7.1***	6.5	4.8	-8.4***	6.4	5	-7.5***
Fsize	4.1	3.3	-6.2***	4.14	3.43	5.5***	4.11	3.32	-5.85***	4.19	3.18	-8***
Mrkdis	56	58.1	6***	56.7	57.9	6***	56.78	58.1	5.35***	56.8	58	5.5***
Fexp	16.1	13.6	-8.6***	15.9	14.2	-6***	15.9	13.2	-6.5***	16	13.7	-7.8***
TLU	7.3	5.5	-8.9***	7.14	6	-5.4***	7.16	5.65	-7.1***	7.24	5.6	-8.5***

Note: *** indicate statistical significance at 1%.

Source: Own computation from survey result, 2024

Sex of household head: Both male- and female-headed households comprised the sample of respondents in this study. According to Table 5 indicated, 87.2% of sampled households adopted improved wheat seed and 56.45% of non-adopters, 88.7% of fertilizer application participants and 58.33% of non-participants, 86.92% of herbicide application participants and 54.39% of non-participants, and 87.4% of pesticide application participants and 55 % of non-participants were male household headed respectively.

Access to market information: It is another essential institutional service that encourages producers to use techniques to facilitate product upgrading. From sampled households, 89.6% of adopters and 38.71% of non-adopters, 86.96% of fertilizer application participants and 50% of non-participants, 86.92% of herbicide application participants and 40.35% of non-participants, 86.19% of pesticide application participants and 40% of non-participants were obtained market information respectively. In this study the sampled households had access to various types and sources of wheat market information ,the result from interviewed indicated that from Appendix Table 1, market prices (37.4%), input prices (31.4%), product quality(14.4%), buyers (9.1%), and the remaining supply and demand (8%) the sampled households get those types of wheat market information whereas the most significant market information sources are DAs (33.7%), market participants (32.1%), fellow farmers (13.9%), cooperatives (11.8%), and traders (58.1%) in study area.

Access to extension service: it is another key institutional service that encourages producers to adopt techniques that facilitate product upgrading. The result indicated that, from sampled households 77.6% of adopters and 37.1% of non-adopters, 73.91% of fertilizer application participants and 48.61% of non-participants, 76.15% of herbicide application participants and 36.84% of non-participants, and 77.93% of pesticide application participants and 35% of non-participants did get extension service. The sampled households had various types and sources of extension services, the results from interviewed indicated that from Appendix Table 3, input usage (32%), product upgrade activities (30%), value adding activities (25.1%), and the remaining marketing of wheat (12.3) whereas, the most significant extension services source are DAs (46.5%), Office of agriculture (36.4%), Model farmers (9.6%), and cooperatives (7.5%), while mean average of sampled households contact with DA last production season was 3.76 days with min 2 and max 5 days in study area.

Access to training: access to training for wheat production empowers farmers to achieve higher yields, better quality wheat, and more efficient production practices. Additionally, the development and improvement of agricultural farmers' knowledge and proficiency in producing and marketing their produce was mostly dependent on training. The results indicated that, 87.2% of adopters and 35.48% of non-adopters, 89.09% of fertilizer application participants and 44.44% of non-participants, 87.69% of herbicide application participants and 29.82% of non-participants, 87.4% of pesticide application participants and 33.33% of non-participants did get training service. The results of the interviewed indicated that from Appendix Table 2, the sampled households had various types and sources of training services. Crop management (23%),use of credit (7%), post-harvesting value addition activity (24.1%), use input (25.1%), and marketing of agricultural products (20.9%). Various organizations and people provided these kinds of training for sampled households As a result, 19.8% of sampled households received training from DA, Conversely, 18.2%, 36% and 25.7% of sampled households received training services from the cooperatives, district office of agricultural and natural resource and non-governmental organizations (RLLP) respectively.

Access to credit: credit is used to assist producers in upgrading their products by enabling them to buy agricultural inputs and materials for post-harvesting activities. The results indicate that, from sampled households, 82.4% of adopters and 43.55% of non-adopters, 83.48% of fertilizer application participants and 47.22% of non-participants, 82.31% of herbicide application participants and 40.35% of non-participants get credit service.

Finally, Table 5 indicated that the relationship between the dummy variables and respondent participation in product upgrading techniques mentioned above, the chi-square test indicated a statistically significant difference between participants and non-participants in all product upgrading techniques at 1% significance level.

Table 5: Demographic and institutional characteristics of participants and non-participants in product upgrading (dummy variables)

dummy variables	Improved wheat variety						Fertilizer application					Herbicide application					Pesticide application				
	Adopter (N=125)			non adopter (N=62)		X^2-value	User (N=115)		non user (N=72)		X^2-value	User (N=130)		non user (N=57)		X^2-value	User (N=127)		non user (N=60)		X^2-value
	Items	N	%	N	%		N	%	N	%		N	%	N	%		N	%	N	%	
Sex	Male	109	87.2	35	56.45	22.1	102	88.7	42	58.33	23.1	113	86.92	31	54.39	24	111	86.9	31	55	24.2
	female	16	12.8	27	43.55	***	13	11.3	30	41.67	***	17	13.08	29	45.61	***	16	12.6	29	45	***
Acmrkt	Yes	112	89.6	24	38.7	54.11	100	87	36	50	30.5	113	86.92	23	40.35	43	112	86.2	24	40	47.7
	No	13	10.4	38	61.29	***	15	13	36	50	***	17	13.08	34	59.65	***	15	11.8	36	60	***
Acexco	Yes	97	77.6	23	37.1	26.9	85	73.9	35	48.61	12.3	99	76.15	21	36.84	27	99	78	21	35	32.7
	No	28	22.4	39	62.9	***	30	26.1	37	51.39	***	31	23.85	36	63.16	***	28	22	39	65	***
Actrain	Yes	109	87.2	22	35.48	52.8	99	86.1	32	44.44	36.6	114	87.69	17	29.82	63	111	87.4	20	33	56.7
	No	16	12.8	40	64.52	***	16	13.9	44	55.56	***	16	12.31	40	70.18	***	16	12.6	40	67	***
Accred	Yes	103	82.4	27	43.55	29.5	96	83.5	34	47.2	27.5	107	82.31	23	40.35	40	108	83.5	24	40	36.3
	No	22	17.6	35	56.45	***	19	16.5	38	52.8	***	23	17.69	34	59.65	***	21	16.5	36	60	***

Note: *** indicates statistical significance at 1%.

Source: Own computation from survey result, 2024

4.1.2. Socioeconomic, demographic, and institutional characteristics of participant and non- participant in value addition practices

In this study, cleaning, storing, and transporting to cooperative union were considered as a value addition strategy that creates form utility, time utility, and place utility respectively in the study area. This subsection included descriptive statistics of participant and non-participant in value addition practices as well as inferential statistics techniques like chi-square and t-test that were used to test significant differences between participant and non-participant.

Results from the samples of households interviewed in wheat value addition techniques table 6 showed that 56.15% of households participated in wheat cleaning, 73.26% of households participated in wheat storing, and 54.55% of households participated in transporting of wheat to a cooperative union respectively in the study area.

Table 6: Participation of households in value addition techniques

value addition techniques	Items	Frequency	Percentage
Wheat cleaning/form utility	No	82	43.85
	Yes	105	56.15
Wheat storing/time utility	No	50	26.74
	Yes	137	73.26
Wheat transport to a cooperative union/place utility	No	85	45.45
	Yes	102	54.55

Source: Own computation from survey result, 2024

The relationship between the continuous variables and the respondents' participation in value addition practices at probability levels were thereby shown in Table 7.

Age: The sample respondent's average age was 42.2 years. The average age of participant and non-participant in cleaning of wheat was 41.2 and 44.2 years participant and non-

participant in wheat storing was 41.4 and 44.4 years, households who participate in transporting wheat to union and non-participated was 40.8 and 43.9 years respectively. This finding suggests the average age of participants in value addition strategies was younger than non- participant.

Education level: The average education level for the sample respondents was 5.98 years of schooling. The average education level of households who participated and non-participated in wheat cleaning was 6.5 and 5.2 schooling years, households who participated and non-participated in wheat storing was 6.3 and 4.8 schooling years, households who participated and non-participated in transporting of wheat to union was 6.6 and 5.2 schooling years respectively.

Family size: The conversion factor was used to convert the sample of household total family size to adult equivalent, in accordance with Storck *et al.* (1991). The average number of adult equivalent labors owned by the sample respondents was 3.8, households who participated and non-participated in the cleaning of wheat had 4.2 and 3.4 family sizes, households who participated and did not participate in storing of wheat had 4.0 and 3.4 family sizes, households who participated and did not participate in transporting wheat to the union had 4.0 and 3.6 family sizes respectively. These findings suggest that average adult equivalent labors of participants in value addition techniques to be higher.

Market distance: The other main factor influencing farmers' frequent travel to markets to sell their agricultural products and buy farm inputs is market distance. The sample respondents traveled on average 57.2 walking minutes to the nearest market (D/zeyit). On average households who participated and non-participated in wheat cleaning traveled 56 and 57.6 minutes, households who participated and non-participated in wheat storing traveled 56.8 and 58.1 minutes, and household who participated in transporting wheat to union and non-participated was traveled on average 56.76 and 57.6 minutes respectively.

Farming experience: The average farming experience for sample respondents' was 15.3 years. The average farming experience of households who participated and did not participate in wheat cleaning was 16.2 and 14.2 years, who participated and non-participated in wheat

storing was 15.9 and 13.6 years, who participate in transporting wheat to the union and non-participate was 16 and 14.4 years respectively. This finding suggests that average farming experiences of participants in value addition strategies were more than non-participant.

Tropical Livestock Unit: The sample respondents' total average of tropical livestock units was 6.7 TLU. While average TLU of households who participate and non-participate in wheat cleaning had 7.2 and 6.1 respectively, households participants and non- participants in wheat storing had 7.13 and 5.5, households who participated in transporting wheat to the union and non-participants had 7.21 and 6.1 TLU respectively.

Finally, Table 7 indicated that the relationship between the continuous variables and respondent participation in value addition practices mentioned above the t-test indicated a statistically significant difference between participants and non-participants in all value addition practices at 1% significance level.

Table7: Socioeconomic and demographic characteristics of participants and non-participants in value addition (continuous variables)

variables	Cleaning/form utility			Storing/time utility			Transporting /place utility		
	Participant N= 105	non participants N=82	t-value	participants N=137	non participants N=50	t-value	participants N=102	non-participants N=85	t-value
Age	41.2	43.5	6***	41.4	44.4	6.8***	40.8	43.9	8.4***
Edu	6.5	5.2	-6.5***	6.3	4.8	-6.95***	6.6	5.2	-6.8***
Fsize	4.2	3.4	-6.8***	4	3.4	-4.55***	4	3.6	-3.55***
Mrkd	56	57.8	5.1***	56.8	58.1	5.2***	56.76	57.6	3.85***
Fexp	16.1	14.2	-6.9***	15.88	13.56	-7.3***	15.99	14.4	-5.4***
TLU	7.2	6.1	-5.6***	7.13	5.5	-7.35***	7.21	6.1	-5.4***

Note: *** indicates statistical significance at 1%.

Source: Own computation from survey result, 2024

Sex of household head: Both male- and female-headed households comprised the sample of respondents in this study. The findings indicate that 86.67% of wheat cleaning participants and 64.63% of non- participants, 88.86% of wheat storing participants and 50% of non-participants, and 89.22% of sampled households from participants and 37.65 % of non-participants of wheat transporting to the union were male-headed households.

Access to market information: The results indicated that, 88.57% of participants and 52.44% of participants of wheat cleaning, 87.59% of the participants and 32% of non-participants of wheat storing, and 88.24% of the participants and 54.12% of non-participants of wheat transporting to union obtained market information respectively.

Access to extension service: The results showed that, 80% of participants and 43.90% of non- participants in wheat cleaning, 73.73% of participants and 38% of non-participants of wheat storing, 77.45% of participants and 48.24% of non- participants of wheat transporting to union did get extension service respectively.

Access to training: training is the development and improvement of agricultural farmer's knowledge and proficiency in producing and marketing their produce. The results showed that, 87.62% of participants and 47.56% of non- participants in wheat cleaning, 84.67% of participants and 30% of non- participants in wheat storing, 91.18% of participants and 44.71% of non- participants in wheat transporting to union did get training service.

Access to credit: credit is used to assist producers in upgrading their products by enabling them to buy agricultural inputs and materials for post-harvesting activities. According to the study's findings, 82.86% of participants and 52.44% of non- participants in wheat cleaning, 81.75% of participants and 36% of non- participants in wheat storing, 84.31% of participants and 51.76% of non- participants in wheat transporting to the union did get credit service respectively.

Finally, Table 8 indicated that the relationship between the dummy variables and respondent participation in value addition practices mentioned above the chi-square test indicated a statistically significant difference between participants and non-participants in all value addition practices at 1% significance level.

Table 8: Demographic and institutional characteristics of value addition participants and non-participants (dummy variables)

dummy variables	**Cleaning/form utility**						**Storing/time utility**					**Transporting /place utility**				
	Participant (N=105)			non participant (N=82)		X^2-value	participate (N=137)		non participant (N=50)		X^2-value	Participant (N=102)		non-participant (N=85)		X^2-value
	Items	N	%	N	%		N	%	N	%		N	%	N	%	
Sex	Male	91	86.67	53	64.63	12.62***	119	86.86	25	50	28.11***	91	89.22	53	37.65	18.89***
	Female	14	13.33	29	35.37		18	13.14	25	50		11	10.78	32	62.35	
Acmrkt	Yes	93	88.57	43	52.44	30.31***	120	87.59	16	32	57.07***	90	88.24	46	54.12	27.21***
	No	12	11.43	39	47.56		17	12.41	34	68		12	11.76	39	45.88	
Acexco	Yes	84	80	36	43.9	26.09***	101	73.72	19	38	20.33***	79	77.45	41	48.24	17.21***
	No	21	20	46	56.1		36	26.28	31	62		23	22.55	44	51.76	
Actrain	Yes	92	87.62	39	47.56	35.22***	116	84.67	15	30	52.19***	93	91.18	38	44.71	47.73***
	No	13	26.28	43	52.44		21	15.33	35	70		9	8.82	47	52.29	
Accred	Yes	87	82.86	43	52.44	20.10***	112	81.75	18	36	36.19***	86	84.31	44	51.76	23.18***
	No	18	17.14	39	47.56		25	18.25	32	64		16	15.69	41	48.24	
Adimprov	Yes	98	93.33	27	32.93	75.8***	116	84.67	9	18	73.47***	91	89.22	34	40.00	50.67***
	No	7	6.67	55	67.07		21	15.33	41	82		11	10.78	54	60.00	
Fertile app	Yes	86	81.9	29	35.37	42.12***	107	78.10	8	16	59.66***	85	83.33	30	32.29	45.19***
	No	19	18.1	53	64.63		30	21.90	42	84		17	16.67	555	64.71	
Herb app	Yes	96	91.43	34	41.46	54.24***	117	85.40	13	26	60.99***	93	91.18	37	43.53	49.67***
	No	9	8.57	48	58.54		20	14.60	37	74		9	8.82	48	56.47	
Pest app	Yes	96	91.43	33	40.24	56.4***	117	85.40	12	24	64.55***	91	89.22	38	44.71	42.93***
	No	9	8.57	49	59.76		20	14.60	38	76		11	10.78	47	55.29	

4.1.3. Production of wheat in the study area

In the study area, different cereal crops were produced such as teff, wheat, maize, barley, and soybean particularly wheat which was produced for consumption and used as a cash crop using rain-fed techniques and harvested annually. According to Table 9, on average sample households of frequency tillage by using oxen was 3.68 times depending on the kind of soil and weed and pest infestation, its frequency might range from two to four times with a similar standard deviation of 0.45 this implies that tillage was critical to controlling weeds and pests, maintaining soil fertility, and optimizing wheat yield and quality. The sampled wheat-producing respondents allocated an average of 0.46 hectares of land for wheat production with a similar standard deviation of 0.31 hectares respectively. From samples of respondents, 51.9% and 48.1% used row planting and broadcasting sowing seed types respectively, and average seed rates for row and broadcasting planting were 99.57kg and 114.6 kg per hectare, respectively implying that it applied below the recommended rate for row 100kg and 120 kg for broadcasting per hectare in the study area. Access to agricultural inputs facilitates the growing of commodities focused on the market and raises production for wheat farmers by acquiring improved varieties, smallholder wheat producers may increase the standard local variety to satisfy consumer demand and charge more for their produce.

According to Table 9, in the study area, the survey of sampled households on wheat variety production indicates that 49.7% use Dandaa, 17.1% use Alidoro, and 33.2% of households reuse last year's crop's seed. Additionally, the survey results indicated that 62% of households sourced wheat seed from agricultural and natural resource offices. While 24.1%, 2.7%, and 11.2% obtained it from markets, traders, and other farmers, respectively in the study area.

Fertilizer application is another crucial factor in enhancing wheat productivity and improving grain quality. In Ethiopia fertilizers are used to produce cereals crops including teff, maize, wheat, barley, and sorghum, using more chemical and inorganic fertilizers can increase productivity and production, especially in wheat grain yields (Dabessa Iticha *et al.*, 2021). In the study area, the average application of NPS and urea was around 122 kg and 167 kg, respectively. This indicates that fertilizers were applied at a rate lower than the recommended amounts of 200 kg of urea per hectare and 150 kg of NPS per hectare for wheat. Whereas the

most significant sources of fertilizer are cooperatives union (84%) and primary cooperatives (16%), in the study area. Furthermore, according to focused group discussion, smallholder producers reported that 61.5%, 34.8%, and 3.7% of limited availability of fertilizer, the high price of fertilizers, and lack of credit respectively were a challenge to use the recommended amount of fertilizer.

The application of herbicides is currently the most common method for weed control in agriculture among farmers. It offers an economically feasible to manage weeds and produce crops (Munaweera and Jayasinghe, 2018). In this study, all sample respondents (100%) said they used 2.4D types of herbicide for controlling weeds in their wheat production, while 81.8 % and 18.2% of sample respondents got herbicide types from the cooperative union and private trades respectively. The key informant interview with the district office of agriculture and natural resources indicated that most smallholder wheat producers applied herbicides after weeds germinated.

The application of pesticides in the production of wheat is crucial to control a variety of pests from disease and pests that reduce yield, low quality; low market returns, and damage to the crop (Radosavac and Knežević, 2017). From samples of respondents, 81.8 % and 18.2% of sample respondents got pesticides from cooperative unions and private trades respectively. The key informant interview with the district office of agriculture and natural resource office suggests that most wheat producers use pesticides after disease or pest severely damages the produce.

Table 9: Types and sources of agricultural input for wheat Production

Types of seed from adopter	Frequency	Percentage
Dandaa	93	49.7
Alidoro	32	17.1
Source of seed		
Agricultural office	116	62
Cooperative	45	24.1
Private trader and farmers	26	13.9
Source of herbicide and pesticide		
Cooperative union	153	81.8
Private traders	34	18.2
Source of fertilizer		
Cooperative union	157	84
Primary cooperative	30	16
Reason for low rate recom fertilizer		
Limitation of fertilizer	115	61.5
Lack of credit	65	34.8
High price of fertilizer	7	3.7
Sowing types		
Row	97	51.9
Broadcasting	90	48.1

Variables	mean	min	max	SD
Plowing freq	3.68	3	4	.46
Urea	167	150	200	24
NPS	122	100	150	24
Land cover(ha)	1	4	1.92	.82
Seed rate row	99.57	80	100	2.5
Seed rate brod	114.6	100	120	8.2

Source: Own computation from survey result, 2024

4.1.4. Post-harvest practices carried out in the study area

Value addition in wheat production involves transforming wheat into desirable, higher-market value products through various processes throughout the wheat value chain from farm to consumer (Maku *et al.,* 2023, Molla *et al.,* 2022). In addition to cultivating wheat, wheat producers in the study area undertook marketing and value-adding activities. Cleaning, storing, packaging, transporting, and marketing are all crucial steps in the post-harvest process for wheat. For this study cleaning, storing, and transporting were considered as value addition practice separating grain from the stalk was traditionally done by hand as well as using animals for threshing in the study area.

Cleaning improves wheat quality by removing impurities and reducing storage losses, ensuring longer shelf life and higher desirable buyers and can fetch a better price. In this study from the table below, 61.5% of sample respondents participated in cleaning activities by removing dust, weed seeds, broken kernels, light straw, and stems by polishing, and 27.3% of sample respondents participated in cleaning activities by separating the required amount of wheat by picking out the grains such as stones and pebbles, broken kernels, light straw, and stalks, 8% of samples respondent separate light chaff and dust from heavy wheat grains by using wind and the remaining 3.2% by using sieves of different sizes separate large waste such as weed seeds, chaff, stalks, and broken kernels from the required amount of wheat.

Storage is another activity of value addition proper storage of wheat allows producers to hold higher market prices, potentially increasing profits, and reduces spoilage and pest infestation, preventing significant economic losses and maintaining quality and efficiently transporting quantities to reach the market, and contributing to a smooth supply chain and benefiting producers at the union. In the study area, sample responders regularly build storage areas and 68.4%, 28.3% and 3.2% of sample respondents stored their wheat by filling in pics bags, plastic sacks (medaberia), and gotera respectively to create time utilities and distributing to market/cooperative union. On average samples of households storing their wheat at store place were 3.3 months ranging from three to four months with a standard deviation of 0.46 and 62% sample of households use acetelic super(Sitophilus granaries)/tablets to control pest that attacks wheat grain during storage and the remaining 32% did not use. The recommended

dose for storage of grain wheat acetic super was 25 grams per qt. During FGD on average samples of households that use acetic super was 22.5 grams per quintal, this indicates that sample respondent use was lower than the recommended dose in the study area.

Transportation plays a crucial role in adding value to wheat by connecting it to markets utilizing vehicles and animal-pulled carts to create place utilities. To create place utilities, 41.8%, 50.8%, and 6.4% of sample respondents in the study area used donkeys (pack animals), animal-pulled carts, and cars respectively, to move their wheat from storage to market (cooperatives union).

Table 10: Types of material for value addition techniques

Types of cleaning	**Frequency**	**Percentage**	**Transportation means**	**Frequency**	**Percentage**
Sieves	6	3.2	Donkey	80	42.8
Wind	15	8.0	Animal carts	95	50.8
Polishing	115	61.5	Vehicles	12	6.6
Pick out	51	27.3			
Storage material					
Pick bag	128	68.4			
Plastic sack	53	28.3			
Gotera	6	3.2			
Acetic super/tab					
Yes	116	62			
No	71	32			
Storage time	**mean**	**Min**	**Max**	**SD**	
	3.3	3	4	.46	

Source: Own computation from survey result, 2024

4.1.5. Demographic and socio-economic characteristics of wheat traders and consumers

For this study, 25 wheat traders including both men and women were conducted. According to the result, 80% of sampled traders were male and 20% of sampled traders were female. The average age of the sample trader was 39.92 years with a range 32 to 48 years and 4.36 standard deviations. The average education level for the sample traders was 6.02 years of schooling. The average number of adult equivalent labors owned by the sample traders was 3.08 with min, max and standard deviations 2, 4, 0.8 respectively. The average experience for sample traders was 18.2 years. The average initial capital of wheat traders was Birr 13,600, while the average current capital was Birr 93200. From samples of traders 56%, 32%, and 12% source of capital from own, loan, and share.

Table 11: Demographic characteristics of wheat trader

Variables	**Mean**	**Minimum**	**Maximum**	**SD**
Age	39.92	32	48	4.36
Education level	6.2	3	11	2.1
Family size	3.08	2	4	0.8
Experience	18.2	15	23	2.7
Initial capital	13600	5000	25000	6041
Current capital	93200	50000	150000	
Sex	**frequency**	**Percentage**		
Male	20	80.00		
Female	5	20.00		
Capital source	**frequency**	**Percentage**		
Own	14	56		
Load	8	32		
Share	3	12		
Loan source	**frequency**	**Percentage**		
Family	8	32		
Private money lender	5	20		
Saving and credit	12	48		

Source: Own computation from survey result, 2024

According to the result, 68.2% of sampled consumers were male and 31.8% of sampled consumers were female. The average age of the sample consumers was 42.18 years with a range of 36 to 48 years and 2.7 standard deviations. The average education level for the sample consumers was 5.73 years of schooling with a range of 3 to 9 and 1.8 standard deviations .The average family size of the sample consumer was 3.45 with a range of 6 and 1.2 standard deviations. The average consumption experience for sample consumers' was 22 years. From the result, 40.9%, 31.8%, and 27.3% of households were farming, trade, and employment respectively for means of income of consumers in the study area.

Table 12: Demographic characteristics of wheat consumers

Variables	**Mean**	**Minimum**	**Maximum**	**SD**
Age	42.18	36	48	2.7
Education level	5.73	3	9	1.8
Family size	3.45	2	6	1.18
Experience	22	18	28	2.18
Sex	**Frequency**	**Percentage**		
Male	15	68.2		
Female	7	31.8		
Means of income for consumer				
Farming	9	40.9		
Trade	7	31.8		
Employment	6	27.3		

Source: Own computation from survey result, 2024

4.2. Wheat value chain analysis

According to the VCA framework, players in the value chain are individuals or groups who interact with money and a product, the value of which normally increases with each transaction (Workneh, 2023). Value chain analysis was used in the study to describe the linkages between actors in terms of input, product, information, and money flow, maintaining an easy transition. It also identified actors and activities involved in moving wheat from production to consumption in the study area.

The survey reveals primary wheat value chain actors were input suppliers, smallholder farmers, primary cooperatives, unions, local collectors, retailers, and consumers. Those wheat value chains comprise actors who have directly contributed to the production, processing, and delivery of the final product to customers. Wheat value chain supporter provide an enabling environment for the value chain actors, influencing the effectiveness and quality of processes, including those not directly involved in production and distribution, such as financing providers, cooperatives, district agricultural and natural resource offices, and non-government (RLLP).

4.2.1. Wheat value chain actors and their roles

Primary wheat value chain actors are those directly involved in production, processing, and distribution while supporting actors are those not directly involved in production that support the effectiveness and quality of production and distribution. Value chain influencers are those whose actions have the potential to impact the general outcome of the value chain. Six actors in the wheat value chain were identified in the study area. Actors and their roles are generally defined as follows:

Suppliers of agricultural inputs: Wheat farmers in the study area can obtain several inputs from suppliers, including seeds, fertilizer, pesticides, and herbicides. As a result, the district office of agriculture, cooperatives, private seed traders, and district markets were identified as the main sources of input in the study area. By contrast, the majority of producers in the sample obtained their seeds, herbicides, and pesticides from private traders, cooperative unions, and the district market. The supply of chemical fertilizers (NPS and urea) depended

upon a primary cooperative and cooperative union. The survey results indicated that 62% of households sourced wheat seed from agricultural and natural resource offices. As a result, input suppliers are considered key actors in wheat production and marketing.

Wheat producers: smallholder farmers and cooperative members were major parts of the wheat value chain actors that perform tasks on the farm to produce wheat such as preparing inputs, plowing, sowing, fertilizer, and weed, controlling pests and diseases, harvesting, and handling wheat after harvest. To ensure the production coincides with the demands of the market they use donkeys or animal carts to transport their wheat grain to the closest marketplaces and sell their product to cooperatives, consumers, local markets, and retailers in the study area.

Local collectors: are key actors in the wheat value chain who buy wheat from smallholder farmers and then resell it to retailers and district markets. They act as an intermediate between producers and retailers facilitating transactions. They have good phone contacts with customers and operate in essential kebeles such as Senkora, Gessengesa, Gocher, Addis alem, Menesibu, and Wombera town. Sometimes, they buy products from farm gate places at lower prices and sell them to consumers to increase their profits.

Cooperatives: have a crucial role in both production and marketing making them important actors in the wheat value chain. They can easily complete their tasks because they are primarily found in local kebeles nearest to farmers. They purchase agricultural products (wheat) and primarily distribute them to members like sugar, powder, and oil. The study area has eleven primary cooperatives and one cooperative union among those three primary cooperatives from the three sampled kebeles was surveyed. They were the primary supplier of inputs and struggled to improve the quantity of wheat produced and farmer's benefits in the study area. Cooperatives in the study area were well-organized offering additional benefits to their members in the form of allowances or dividend shares, in addition to purchasing wheat and providing input.

Retailers: are actors in the value chain who operate at the end of the market channeling that purchase wheat from local collectors, and smallholder farmers and sell to consumers in the study area. They perform tasks like purchasing, shipping, cleaning, storing, and selling.

However, their low financial resources hinder their participation in larger business activities during the survey.

Consumers: the final actors in the wheat value chain who eat wheat such as kollo, enjera, bread, and wine (tella, areqi). Hence, smallholder farmers, local collectors, and retailers were the direct suppliers of the marketed wheat to consumers in the study area. Before it reaches end users, the produced wheat in the district passes through several intermediates.

4.2.2. Value chain supporters and their roles

Value chain supporters indirectly support wheat value chain main actors by providing financial services, legal laws, production information, training, and advice, including assistance with seedlings, herbicides, pesticides, fertilizer, and crop management. Key service providers were district agriculture and natural resources, cooperatives, microfinance, trade road and transportation offices, developmental agents, and NGOs (RLLP) in the study area. Key informant interviews with district agricultural and natural resource office experts and developmental agents revealed that producers received general agricultural extension services to significantly advance producers technical knowledge and skills, particularly in wheat production. Additionally, wheat farmers could obtain financial services from Wombera credit and saving institution to buy pesticides, fertilizers, seeds, and herbicides.

Value chain influencers: are actors who have the activities to improve or worsen the performance of the entire value chain. These consist of the legal system, security rights related to property tenure, regulatory framework, and security actors. The regulatory framework offers expertise and information on rules and regulations to farmers and traders. Farmers have the right to land through land tenure security wheat traders were licensed by the district trade office, and traders have access to a marketplace provided by the Wombera town municipality.

4.2.3. Wheat value chain map

Value chain mapping visualizes the structure and key actors in a product's value chain, illustrating their order and connections. It aids in understanding the flow of money, information, products, and inputs, as illustrated in Figure 3.

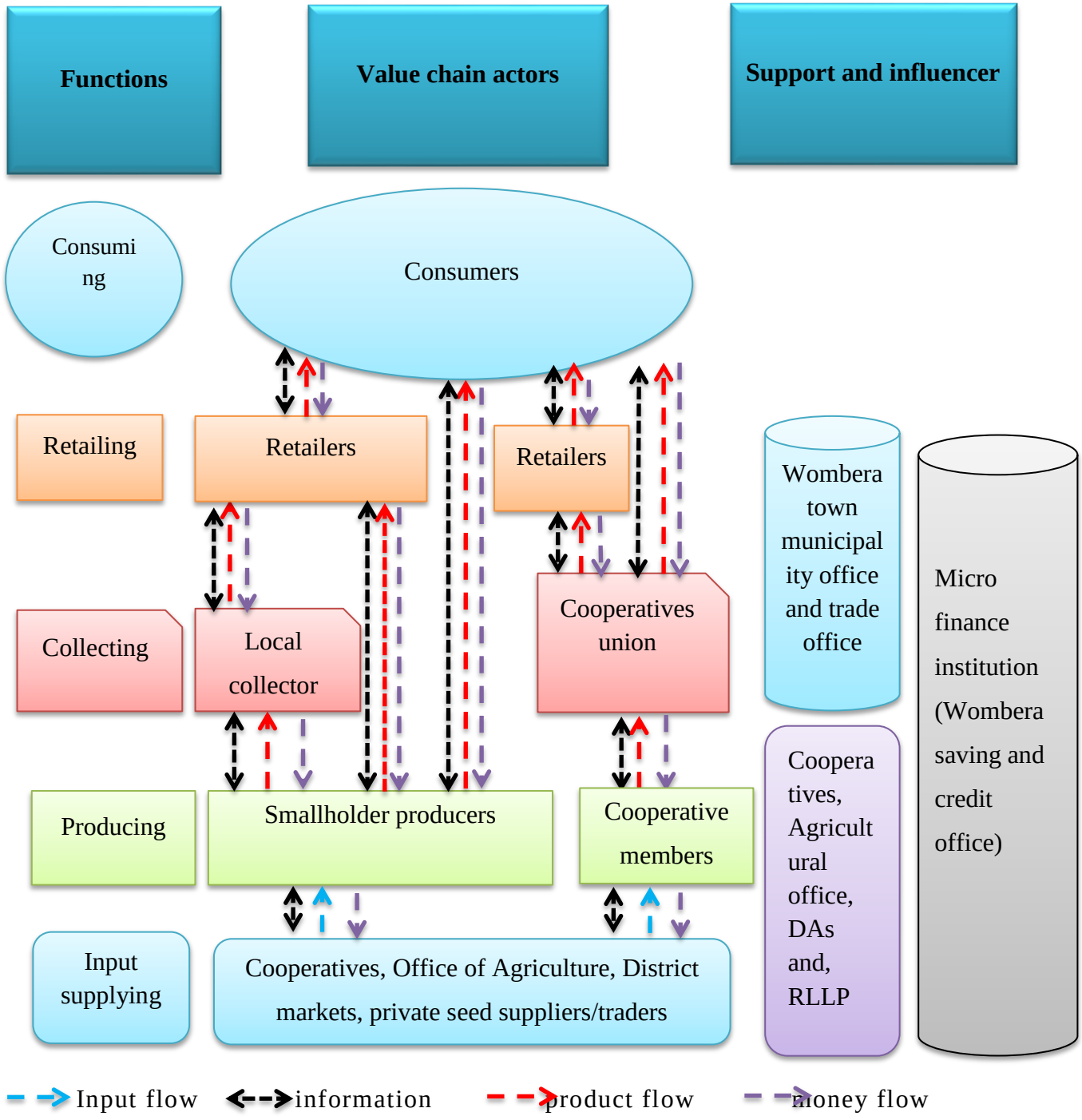

Figure 3: Wheat value chain map of wombera district

Source: Own sketch from survey result, 2024

4.3. Econometric Analysis

4.3.1. Factors influencing the decision of farmers to participate in wheat product upgrade practices

In this study, the methods of product upgrading were adopting improved wheat seed, fertilizer application, herbicide application, and pesticide application were practiced by sampled households in the study area. A multivariate probit model was used to analyze factors influencing farmer's decision to participate in product upgrading techniques.

The overall significance of the variables was tested by using the Wald chi-square statistic. Table 13 shows that the Wald chi2 (44) = 165.27, p= 0.000 is strongly significant at the 1% significance level, suggesting that the model components have adequate explanatory power. The null hypothesis of independence between the product upgrading techniques (rho21 = rho31 = rho41 = rho32 = rho42 = rho43 = 0) was rejected at the 1% significance level according to the simulated maximum likelihood ratio test (LR chi2 (6) = 28.31 (Prob > chi2 = 0.0001). Consequently, the null hypothesis which states that all of the ρ (Rho) values are collectively equal to 0 is rejected demonstrating the goodness-of fit model. The choice of MVP over the individual probit model was supported by the decisions to engage in various product upgrading approaches being interdependent.

MVP indicated the correlation between product upgrading techniques. The correlation between ρ21 (adopting improved wheat variety and fertilizer application) were positively and significantly correlated at 1%. ρ31 (application of herbicide and adoption of improved wheat variety) were positively and significantly correlated at 1%. Likewise, ρ32 (application of herbicide and fertilizer application) were positively and significantly correlated at 1%. ρ41 (application of pesticides and adoption of improved wheat variety) are positively correlated. From this finding, it is possible to conclude that producers who adopted improved variety are more likely to participate in applying of fertilizer, herbicide and pesticides. ρ42 (application of pesticide and fertilizer application) were positive and significantly correlated at 5%. ρ43 (application of pesticide and herbicide application) were positively correlated. Based on the multivariate probit model findings, the probability of households in adopting improved seed, fertilizer application, herbicide application, and pesticide application was 66.8%, 61.7%,

69.8%, and 67.8% respectively in product upgrading practices. The joint probability of any product upgrading strategy indicates households were more likely to participate in product upgrading practice compared with not participating when considering the combined probabilities of success (49 %) and failure (19.8%) of upgrading decisions.

Table 13: Correlation matrix, overall fitness, and probabilities from MVP models

Predicted probabilities	
Adoption improved seed	0.668
Fertilizer application	0.616
Herbicide application	0.698
Pesticide application	0.678
Joint probability and overall fitness	
Joint probability (success)	0.49
Joint probability (failure)	0.198
Number of draws	5
Observation	187
Log-likelihood	-210.37
Wald chi2 (44)	165.27
Prob > chi2	0.0000***

Correlation matrix estimation

	ρ1	**ρ2**	**ρ3**	**ρ4**
ρ1	1.00			
ρ2	0.408***(0.137)	1.00		
ρ3	0.492***(0.143)	0.552***(0.148)	1.00	
ρ4	0.329 (0.278)	0.453 **(0.178)	0.0.260 (0.186)	1.00

Likelihood ratio test of rho21 = rho31 = rho41 = rho32 = rho42 = rho43 = 0: chi2(6) = 28.31 Prob > chi2 = 0.0001***

Note: ***, **,* indicate statistical significance at 1%, 5%, and 10% respectively, Parenthesis in the disturbance term correlation matrix showed the standard error

Source: Own computation from survey result, 2024

Table 14 illustrates that twelve independent variables were incorporated into the multivariate probit model to analyze factors that influence product upgrading practice from those, five variables significantly affected the adoption of improved wheat varieties, four variables significantly affected the application of fertilizer, five variables were significantly affected the application of herbicides and pesticides at different significance level.

Table14: Results of MVP models of factor affecting wheat product upgrading practices.

Variables	**Adoption improved seed**		**Fertilizer application**		**Herbicide application**		**Pesticide application**	
	Coef. (Std.Err)	**(dy/dx)**	**Coef. (Std.Err)**	**(dy/dx)**	**Coef. (Std.Err**	**(dy/dx)**	**Coef. (Std.Err)**	**(dy/dx)**
Sex	0.338	0.047	0.582**	0.135	0.492	0.067	0.590	0.078
	(0.380)		(0.283)		(0.314)		(0.386)	
Age	-0.037	-0.006	-0.009	-0.001	-0.103**	-0.018	-0.033	-0.009
	(0.061)		(0.050)		(0.058)		(0.062)	
Edu	0.303**	0.043	0.192**	0.043	0.219**	0.034	0.050	0.007
	(0.144)		(0.103)		(0.118)		(0.130)	
Fsize	0.198	0.027	0.157	0.045	0.184	0.032	0.859***	0.108
	(0.215)		(0.151)		(0.168)		(0.215)	
Mrktdis	-0.223**	-0.03	-0.20***	-0.048	-0.111	-0.017	-0.087	-0.021
	(0.107)		(0.077)		(0.084)		(0.103)	
Fexp	0.274***	0.038	0.098	0.023	0.077	0.014	0.233***	0.009
	(0.081)		(0.063)		(0.072)		(0.082)	
Acmrkt	0.530	0.065	0.170	0.036	0.096	0.004	0.323	0.014
	(0.392)		(0.306)		(0.351)		(0.417)	
Acexco	0.859**	0.121	0.145	0.035	0.482*	0.081	0.829***	0.079
	(0.354)		(0.256)		(0.281)		(0.319)	
Actrain	0.154	0.004	0.260	0.065	0.558**	0.089	0.436	0.063
	(0.390)		(0.301)		(0.311)		(0.384)	
Acred	0.459	0.070	0.50**	0.12	0.558**	0.090	0.797**	0.087
	(0.329)		(0.254)		(0.281)		(0.336)	
TLU	0.387***	0.056	0.076	0.02	0.121	0.022	0.354***	0.050
	(0.131)		(0.091)		(0.103)		(0.135)	
_cons	3.904		7.476		5.898		-4.503	
	(6.67)		(5.072)		(5.590)		(6.821)	

Note: ***, **, and * indicate statistical significance at 1, 5, and 10%, respectively.

Source: Own computation from survey result, 2024

Sex: The smallholder wheat producer decision to participate in the fertilizer application was positively and significantly affected by sex of the household head at 5% significance level. This finding implied that male-headed households were more likely to adopt fertilizer than female headed households. Male-headed household had better access to information or resources and make decision to adopt a new practice related to fertilizer use. The marginal effect finding showed that when the household head is male, the probability of the household participating in fertilizer application was increases by 13.5% all other variables constant. This result is supported by the findings of (Abebe and Debebe, 2019, Dabessa Iticha *et al*., 2021, Iresso and Abebe, 2024), who found that male-headed households were found to be more likely to use fertilizer.

Age: the age of the household head had a negative and significance effects on the probability of household participate in the application of herbicides at a 5% significance level. This finding suggests that the probability of household participation in herbicide application decreases with the age of the farmer increase because younger farmers more openness to new technology and receptive to adopting new practices than older farmers. The probability of a household participating in application of herbicide decrease by 1.8% as the age household increase by one year keeping all other variables constant. Explanation is that herbicide applications take physical work, which makes it more straightforward for younger farmers to apply herbicide. Younger farmers being more comfortable with technology were likely to be quicker to embrace the benefits of product upgrade initiatives. The result is in line with the findings of Munaweera and Jayasinghe (2018), found that the age of farmers negatively affects herbicide use. The result is contrary with finding of (Argaw *et al.*, 2023, Kaba and Emana, 2024, Massresha *et al.*, 2021), found that the age of farmers positively affects adoption of soybean production technology, inorganic fertilizer, and agricultural technology respectively.

Education level: The probability of adopting an improved wheat variety,fertilizer application, and herbicide application were positively and significantly influenced by the education level of household head at 5% significance level. As years of education of the household head increases their probability of adopting an improved wheat variety and responsibly using fertilizer and herbicide also increases. Because education can lead to a better understanding of

the benefits of improved varieties, such as higher yields, disease resistance etc. As the education level of household head's increase by one year of formal schooling, the likelihood of adopting an improved wheat variety, fertilizer application, and herbicide application increases by 4.3%, 4.3%, and 3.4% respectively. This implied that education empowers farmers to understand new technologies benefit from improved varieties, use fertilizer, use herbicide foster risk tolerance, and enhance communication and negotiation skills, facilitating effective stakeholder interaction. This result is consistent with the study by (Adhikari *et al.*, 2020, Dabessa Iticha *et al.*, 2021, Dorsis, 2022, Argaw *et al.*, 2023, Sime, 2023, Iresso and Abebe, 2024) found that education level positively influenced the adoption of wheat technology, application of fertilizer and herbicide. The result is contrary to the finding of Subedi *et al.* (2019), who found a negative and significant influence of education level on the adoption of improved wheat variety.

Family size: it had a positive and significance influence on the likelihood of a household participating in pesticide application at 1% significance level. Larger families often associated with larger landholdings or higher income are more likely to use pesticides due to their increased labor availability perceived need to protect crops from pests and risk-averse nature than small families in the study area. Marginal effects indicate that the probability of household a using pesticides increases by 10.8%, as the family size increases by adult equivalent. The result is contrary to the finding of Dorsis (2022), who found family size negatively affects the adoption of improved maize variety.

Market distance: The probability of household in adopting an improved wheat variety and fertilizer application as a product upgrading technique was negatively and significantly influenced by distance to the market at significance level of 5%, and 1% respectively. The likelihood of a farmer using fertilizer and adopting an improved wheat variety supposedly decreases by 3%, 4.8% as the distance to market far away by one-minute walk. The result is supported by the findings of (Albe and Aman, 2022, Atinafu *et al.*, 2022, Kaba and Emana, 2024, Sime, 2023), who found market distance negatively affect adoption of wheat variety, adoption of soybean and wheat production technology respectively.

Farming experience: farming experiences had a positive and significance influence on the likelihood of participation of households in the adoption of improved wheat variety and the application of pesticides at 1% significance level. Farmers experience increases household adoption of improved wheat varieties and applying pesticides to upgrade the product suggesting they are more aware of new technologies and confident in implementing them. The marginal effect of farming experience implied that the probability of household participation in the adoption of improved wheat variety and the application of pesticides increases by 3.8% and 0.9% respectively, as farming experience increases by one year. This result is in agreement with (Abera *et al.*, 2022, Argaw *et al.*, 2023, Kaba and Emana, 2024, Mumah *et al.*, 2024), who found farming experience positively affects the adoption teff row planting technology, inorganic fertilizer, soybean production technology, machine adoption for maize productivity respectively. The result is contrary to the finding of Islam and Hossain (2016), who found farming experience negatively affects the adoption decision of dose of chemical fertilizer and pesticides in agricultural technology.

Access to extension contact: The probability of household in adopting an improved wheat variety, herbicide application, and pesticide application positively and significantly influenced by access to extension contact at significance level of 5%, 10%, and 1% respectively. Access to extension contact implies that farmers who frequently contact with extension agents during the wheat cropping season for product upgrades were technically more efficient in adopting improved wheat varieties, applying herbicides, and pesticides. The marginal effect of access to extension contact implied that the probability of household participation in adopting an improved wheat variety, herbicide application, and pesticide application increases by 12.1%, 8.1 %, and 7.9% respectively, as the household head has access to extension contact. The result is supported by the findings of (Abera *et al.*, 2022, Iresso and Abebe, 2024, Kaba and Emana, 2024, Siyum *et al.*, 2022) found extension service contact positively affects the adoption teff row planting technology, inorganic fertilizer, soybean production technology, improved bread wheat technology respectively. The result is contrary to the finding of Islam and Hossain (2016) and Hawas and Degaga (2023), who found extension service contact negatively affects the adoption of agricultural technology, and the adoption of pesticides in agriculture respectively.

Access to training: Access to training was positively and significantly influenced the probability of household in application of herbicides at 5% significance level. This implies that farmers who received training are more likely to integrate herbicide application into their weed control strategies in wheat production. The marginal effect of access to training implied that the probability of household in application of herbicides increases by 8.9%, as the household head has access to training services. The probable explanation for the result is that training develops a more targeted approach to supporting product upgrading practices and knowledge and skills for better practices for farmers, addressing knowledge and skill gaps in agriculture. It builds confidence, fosters a growth mindset, and allows for experimentation and improvement. This result is in agreement with (Albe and Aman, 2022, Dorsis, 2022), who revealed that training positively affects the adoption of wheat variety and maize varieties respectively.

Access to credit: The probability of household in fertilizer application herbicide application, and pesticide application as product upgrading techniques positively and significantly influenced by access to credit at 5% significance level. Having access to credit is essential for wheat farmers to upgrade product strategies to purchase improved seeds, fertilizers, herbicides, pesticides and labor then access to financing is one factor in the study area. The marginal effect implies that, as household has access to credit the probability of household in fertilizer application, herbicide application, and pesticide application increases by 12%, 9%, and 8.7%, respectively as all other variables are constant. The result is supported by the findings of (Abera *et al.*, 2022, Iresso and Abebe, 2024), who found that credit positive influence on teff row planting and inorganic fertilizer technology adoption respectively. The result is contrary with the finding of Subedi *et al.* (2019), credit negatively affects the adoption of improved wheat varieties.

TLU: tropical livestock unit positively and significantly influenced the probability participation of households in adopting an improved wheat variety and pesticide application as product upgrading techniques at 1% significance level. This implies that farmers who have higher tropical livestock units were more likely to adopt improved wheat varieties and apply pesticides possibly due to increased financial resources, access to manure as fertilizers, and better information about purchasing seeds, fertilizers, and labor in the study area. As the TLU

of the household increased by one, the probability of participation in adopting an improved wheat variety and pesticide application increases by 5.6%, and 5%, respectively as all other variables are constant. The result is supported by the findings of (Dorsis, 2022, Sime, 2023, Siyum *et al.*, 2022, Dabessa Iticha *et al.*, 2021), who revealed that tropical livestock units positively affect the adoption of maize variety, wheat technology adoption, adoption of improved bread wheat technology and inorganic fertilizer use in maize production respective.

4.3.2. Factors affecting smallholder farmer participation decision in value addition practice

In this study, the methods of value addition were wheat cleaning (create form utility), storing (create time utility), and transporting wheat to cooperative union (create place utility) were practiced by sampled households in the study area. A multivariate probit model was used to analyze factor affecting farmer's decision to participate in value addition techniques.

The overall significance of the variables was tested by using the Wald chi-square statistic. Table 15 shows that the Wald chi2 (45) = 164.46, p= 0.000 is strongly significant at the 1% significant level, suggesting that the model's components have adequate explanatory power. The null hypothesis of independence between the value addition techniques (rho21 = rho31 = rho32 = 0) was rejected at the 10% significant level according to the simulated maximum likelihood ratio test (LR chi2 (3) = 6.49 (Prob > chi2 = 0.0901). Consequently, the null hypothesis, which states that all of the ρ (Rho) values are collectively equal to 0 is rejected demonstrating the goodness-of-fit of the model. The choice of MVP over the individual probit model was supported by the decisions to engage in various value addition approaches being interdependent.

The results indicated a positively correlation between participation in wheat cleaning and storing (ρ21). ρ31 (participation in wheat cleaning and transporting wheat to cooperative union) were positively and significantly correlated at 1%. This suggests that households participating in cleaning the wheat were more likely to participate in wheat cleaning and might be in transporting wheat to cooperative unions. Likewise, ρ32 (wheat storage and transporting to cooperative union) were positively correlated.

Based on the multivariate probit model's findings, the probability of households participating in wheat cleaning, storing, and transporting to cooperative union were 55.7%, 72.8%, and 54.5%, respectively in value addition practice. Among the value addition practice, more households were most likely to participate in storing wheat compared to other practice. The joint probability of value addition strategy was indicated households were more likely to participate in value addition practice compared with not participate when considering the combined probabilities of success (40.4%) and failure (20.7%) of value addition decisions.

Table 15: Correlation matrix, overall fitness, and probabilities from MVP models in value addition

Predicted probabilities			
Wheat cleaning			0.557
Wheat storing			0.728
Wheat transporting to cooperative union			0.545
Joint probability and overall fitness			
Joint probability (success)			0.404
Joint probability (failure)			0.207
Number of draws			5
Observation			187
Log-likelihood			-198.97
Wald chi2 (45)			164.46
Prob > chi2			0.0000***
Correlation matrix estimation			
	ρ1	**ρ2**	**ρ3**
ρ1	1.00		
ρ2	0.112 (0.203)	1.00	
ρ3	0.368*** (0.140)	0.038(0.171)	1.00
Likelihood ratio test of rho21 = rho31 = rho32 = 0: chi2(3) = 6.49 Prob > chi2 = 0.0901*			

Note: ***,* indicates statistical significance at 1% and 10% respectively and Parenthesis in the disturbance term correlation matrix showed the standard error

Source: Own computation from survey result, 2024

Table 16: Result of MVP models of factors affecting wheat value addition practices.

variables	Cleaning		Storing		Transporting	
	Coef. (Std.Err)	(dy/dx)	Coef. (Std.Err)	(dy/dx)	Coef. (Std.Err)	(dy/dx)
Sex	-0.019	-0.010	0.443	0.071	0.416	0.101
	(0.350)		(0.323)		(0.309)	
Age	-0.029	-0.008	0.010	0.005	-0.151***	-0.036
	(0.051)		(0.062)		(0.050)	
Edu	0.010	0.000	0.033	0.009	0.125	0.031
	(0.108)		(0.129)		(0.106)	
Fsize	0.390**	0.085	-0.193	-0.033	-0.120	-0.026
	(0.177)		(0.193)		(0.160)	
Mrktdis	-0.095	-0.024	-0.050	-0.006	-0.004	-0.000
	(0.085)		(0.097)		(0.083)	
Fexp	0.119*	0.024	0.156**	0.024	0.057	0.012
	(0.068)		(0.083)		(0.063)	
Acmrkt	0.213	0.040	0.582*	0.089	0.012	0.011
	(0.346)		(0.342)		(0.338)	
Acexco	0.513*	0.112	0.095	0.019	0.192	0.041
	(0.271)		(0.316)		(0.275)	
Actrain	0.089	0.024	0.487	0.082	0.572*	0.132
	(0.344)		(0.350)		(0.336)	
Acred	0.209	0.033	0.522*	0.075	0.524**	0.124
	(0.289)		(0.313)		(0.278)	
TLU	0.024	0.002	0.121	0.015	0.040	0.005
	(0.104)		(0.121)		(0.100)	
Adimprov	0.864**	0.191	0.230	0.038	0.124	0.031
	(0.389)		(0.449)		(0.391)	
Fertilapp	0.123	0.030	0.679**	0.101	0.594**	0.129
	(0.307)		(0.348)		(0.292)	
Herbapp	0.257	0.049	0.197	0.032	0.093	0.025
	(0.375)		(0.366)		(0.361)	
Pestapp	0.129	0.029	0.124	0.027	0.120	0.021
	(0.389)		(0.447)		(0.379)	
_cons	1.582		-1.623		5.005	
	(5.727)		(6.220)		(5.325)	

Note: ***, **, and * indicate statistical significance at 1, 5, and 10% respectively.

Source: Own computation from survey result, 2024

Age: The age of the head of the household had a negative and significance influence on the probability of household participation in wheat transporting to a cooperative union at a 1% significance level. This finding suggests that the likelihood of household in wheat transporting to cooperative union decreases with the age of the farmer increase. The probability of a household in wheat transportation to cooperative union decreases by 3.6% as the age of household increase by one year keeping all other variables constant. The explanation for this result is that younger farmers are more comfortable with new technologies and market information leading to increase value add to product that improve efficiency and profitability in agriculture. The finding is supported by Shifera (2020), who found that age negatively affects market participation. The result is contrary to the finding of Atnafu Delele (2020), who found age positively affects soybean value addition.

Family size: family size positive and significance effect on the probability of a household participating in wheat cleaning to create form utility at 5% significance level. This suggests that larger family sizes are more likely to participate in wheat cleaning before delivery to the market than smaller family sizes because adding value to wheat requires a lot of labor to improve the products quality. As the family size household head increases by an adult equivalent, the probability participation in wheat cleaning activities increases by 8.5% keeping other explanatory variables constant. This indicates family labor is the main source of labor for pre and post-harvest agricultural activities in a value addition. The finding is in line with (Molla *et al.*, 2022, Usman, 2016), who found family size had positive and significant effects on household participation in wheat value-addition activities.

Farming experience: farming experiences had a positive and significance effect on the probability of households in wheat cleaning activities and storing to create form and time utility at 10% and 5% significance level respectively. Farmers' experience increases probability household in cleaning activities and storing, suggesting they are more aware of new technologies and confident in adding value to the existing wheat to improve the quality to attract customers and to gain profit in value addition activities. The marginal effect of farming experience implied that the probability of a household's participation in wheat cleaning activities and storing increases by 2.4% and 2.4% respectively, as household head farming

experience increases by one year. The result is supported by the findings of (Maku *et al.*, 2023) found farming experience had positive effect on maize value addition.

Access to market information: access to market information was positively and significantly influences the probability participation of the household in wheat storage activities to create time utility at a 10% significance level. The marginal effect result showed that the likelihood of a household head participating in wheat storing increased by 8.9% when household has access to market information. According to the results, households that receive market information are more likely to become active participants in the prevalent value addition activity potentially increasing their income. Farmers who receive market information, particularly the price premium for value-added wheat can make informed decisions on how to enhance their wheat quality in the market. The finding is in line with (Molla *et al.*, 2022, Usman, 2016, Maku *et al.*, 2023), who found market information positive and significant effects on household participation in wheat and maize value addition activities respectively.

Access to extension contact: The probability participation of households in wheat cleaning activities to create form utility was positively and significantly influenced by access to extension contact at 10% significance level. Access to extension contact implies that farmers who frequently contact extension agents during the wheat post-harvesting season for value addition were technically more efficient in wheat cleaning activities to create form utility. The marginal effect of access to extension contact implied that the probability of the household's participation in wheat cleaning activities increases by 11.2%, as the household head has access to extension contact. This result is consistent with the study by Usman (2016), (Maku *et al.*, 2023), who found that extension service contact positively affects wheat and maize value addition.

Access to training: Access to training a positively and significantly influence on household participation in wheat transporting to cooperative unions to create place utility at 10% significance levels. This implies that Farmers who receive training in production, post-harvest handling for quality, and proper storage techniques are more likely to have a surplus of wheat that justifies transporting to a union for sale. The marginal effect of access to training implied that the probability of household participation in transporting wheat to cooperative union

increases by 13.2%, as the household head has access to training services. Explanation for the result is that training develops a more targeted approach to supporting value addition practices and knowledge and skills for better practices for farmers, addressing knowledge and skill gaps in agriculture. It builds confidence, fosters a growth mindset, and allows for experimentation and improvement to create a place of utility to farmers. The result is supported by the findings of (Maku *et al.*, 2023), who found that training positively influences youth participation in maize value addition.

Access to credit: The probability of households in wheat storing and transporting to a cooperative union to create time utility and place utility was positively and significantly influenced by access to credit at 10% and 5% significance level respectively. Having access to credit is essential for wheat farmers to value addition strategies to purchase pic bags, pesticides to store, and to cover the cost of transportation, loading, and unloading then access to credit is one factor to keep wheat and transport wheat to the union. The marginal effect implies that, when household has access to credit service, the probability of household participation in wheat storing and transporting to cooperative union increases by 7.5% and 12.4%, respectively, while all other variables constant. This result is consistent with the study by Usman (2016), who found that credit service contact positively affects wheat value addition.

Adoption of improved seed: Adoption of improved seed a positive and significantly influence household participation in wheat cleaning activities to create form utility at 5% significance levels. This implies that higher-quality wheat can be produced by using improved seeds that have desired characteristics like disease resistance and increased yields and fewer diseases or damaged kernels need to be removed through cleaning. The marginal effect of the adoption of improved seed implied that the probability of household's participation in wheat cleaning activities increases by 19.1%, as household heads adopt improved seed.

Fertilizer application: it positively and significantly influence household participation in wheat storing activities and transporting to union to create time and place utility at 5% significance levels. The marginal effect of the fertilizer application implied that the probability of household's participation in wheat storing activities and transporting wheat to

union increases by 10.1% and 12.9% respectively as household heads apply fertilizer. Fertilizer application encourages households to participate more in storing their wheat and transporting to the union this implies that proper uses of fertilizer in wheat crops tend to adding nutrients to the soil to improve wheat growth to produce higher yields and higher-quality of grains. This creates a surplus of grain that households may be more motivated to store and to transport. It can lead to healthier and more robust wheat plants, potentially reducing spoilage like disease resistance and increased yields and fewer diseases or damaged kernels during storage.

4.4. Constraints and opportunities of wheat production and marketing

In the wheat value chain from input supply to consumption, value chain analysis aids in the identification of bottlenecks. In the study area production and market stages were classify constraints and opportunities by actors through questionnaires and focused group discussions.

4.4.1. Constraints of wheat production

Farmers in the study area who are involved in the production of wheat the main actors at this stage. The constraints that these farmers faced were ranked according to their significance results from the survey in Table 17 below, and each participant was asked to rank the constraints they faced in that order. Consequently, constraints that farmers faced were a shortage of improved seed, a limited training service, delayed fertilizers supply, high input costs (improved seed, fertilizer, herbicide, and pesticide), inadequate credit services to purchase inputs (improved seed, fertilizer, and chemicals), limited extension services, low soil fertility, crop diseases, and low wheat yield these factors were ranked from first to ninth.

As a result, the shortage of improved wheat variety which was a significant reason for wheat market oriented ranked first (26.7%), followed by the high cost of inputs and lack of funds to buy inputs were ranked second and third by (18.7% and 16%) respectively. While credit is a vital source of funding for farmers to purchase agricultural input required to boost output and sell excess wheat. Limited training services in the production and crop diseases were ranked fourth and fifth at (10.7% and 9.6%) respectively. One of the productivity issues that farmers in the study area faced was the prevalence of disease. Limited extension services, low soil fertility, delayed fertilizers supply, and low wheat yield factors were ranked sixth, seventh,

eighth, and ninth by (7.5%, 5.3%, 3.2%, and 2.1%) respectively. Because of the land degradation caused by constant plowing without shifting crops, low soil fertility was decreasing wheat output and raising expenses for farmers. The FGD results indicate constraints on wheat production, including limited knowledge of handling and storage facilities, inadequate credit service, high input costs, and disease and pest attacks. These findings support the results obtained from the sampled respondents.

Table 17: Constraints of wheat production

Constraints	**Frequency**	**Percentage**	**Rank**
Shortage of improved varieties	50	26.7	1st
High cost of inputs	35	18.7	2nd
Lack of funds to buy inputs	30	16.0	3rd
Limited of training service	20	10.7	4th
Crop diseases	18	9.6	5th
Limited extension services	14	7.5	6th
Delayed fertilizers supply	10	5.3	7th
Low soil fertility	6	3.2	8th
Low wheat yield	4	2.1	9th

Source: Own computation from survey result, 2024

4.4.2. Constraints of wheat marketing

Numerous factors influenced the district's wheat marketing. As a result of the survey table18, factors that influence wheat marketing are unfair pricing and cheating on balance, which was a significant factor for the wheat market was ranked first (34.8%), followed by lack of market information and inadequate capital were ranked second and third by (21.4% and 18.7%) respectively. The existence of an organization that provides information about the market is crucial for boosting the efficacy and efficiency of marketing initiatives. So, wheat marketing was affected by incomplete market information, farmers also sold their produce at a forward price, collecting payment from purchasers, particularly traders, before harvest, which decreased their desired profit margin when they sold at the regular time in the study area.

Lack of storage facility, weak connection with wheat actors, and low quality of wheat were ranked fourth, fifth, and sixth, by (10.7%, 8 %, and 6.4%) respectively. The FGD results indicate constraints on wheat marketing, including lack of timely and sufficient market information, lack of credit, market infrastructure, and transportation costs. These findings support also the results obtained from the sampled respondent.

Table 18: Constraints of wheat marketing in the study area

Constraints	**Frequency**	**Percentage**	**Rank**
Unfair pricing and cheating on balance	65	34.8	1st
Lack of market information	40	21.4	2nd
Inadequate capital	35	18.7	3rd
Lack of storage facility	20	10.7	4th
weak connection with wheat actors	15	8.0	5th
Low quality of wheat	12	6.4	6th

Source: Own computation from survey result, 2024

4.4.3. Opportunities for wheat production and marketing

In the study area, there are lots of opportunities for wheat production and market, despite the significant challenges mentioned previously. High farm-level demand, high productivity potential, favorable land and climate conditions, and interest in improved seed varieties are major opportunities for wheat production. While High market demands for wheat, the Establishment of cooperatives and the building of infrastructure facilities are opportunities for wheat at the marketing stage.

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary and Conclusions

Wheat is one of the cereal crop plays a vital role in both the economic well-being and food security of rural communities. The study analyzes wheat value chain to identify wheat value chain actors, supporters and their roles, assess factors influencing participation decision in product upgrading and value addition techniques and identity constraints and opportunity in wheat production and marketing. Qualitative and quantitative data were collected through structured interviews, focus group discussions, and key informant interviews from primary and secondary sources. Purposive sampling was employed to select 25 wheat traders, while a random sample was used to select 187 wheat smallholder producers and 22 consumers. Data was analyzed using descriptive and econometric models.

As a result, 38.50% of farmers did not apply fertilizer and 33.16% of farmers were did not adopt improved, which gradually decreased yield per unit area, 3.2% farmers stored their wheat by filling in improved bags (pics bags) to create time utilities in value addition in study area.

In study area, primary wheat value chain actors were input suppliers, smallholder producers, local collectors, cooperatives, retailers, and consumers with their roles including input supplying, producing, distributing, marketing, and consuming. While the district office of agriculture and natural resources, DAs, NGOs (RLLP), cooperatives and trade, road and transportation office were value chain supporters.

The study identified several constraints faced by farmers in the wheat production area were shortage of improved seeds, limited training service, delayed fertilizer supply, high input prices, inadequate credit services, limited extension services, low soil fertility, crop diseases, and low wheat yield. Cheating on balance, lack of market information, inadequate capital, weak connection to actor, and low quality of wheat were the main constraints in wheat marketing.

The MVP model showed that variables like sex, education, family size, farming experience, extension contact, training, credit service, TLU positively and significantly influenced the product upgrading techniques, while market distance and age of household head had a negatively and significantly influence. Whereas, households' participation in value addition practices was positively and significantly influenced by variable like family size, farming experience, market information, extension contact, training, credit service, improved seed adoption, and fertilizer application while age of household had a negative effect.

As concluded based this finding, farmers did not apply fertilizer and did not adopt improved due to shortage of fertilizer, improved wheat varieties, and inadequate credit. Wheat producers understanding in wheat production and marketing in general and rate of recommended input usage in particular, infrastructure, crop diseases, market information, training, credit service , and extension services related to both production and marketing were still less in the study area. In order to successfully and robustly strengthen the wheat value chain in the study area, it is crucial that the mentioned factors receive appropriate attention. Finally, concluded that several institutional and socioeconomic factors are crucial for households to participate in value addition practice and product upgrading, thus strengthening their standing as marginalized wheat producers, which requires intervention.

5.2. Recommendation

Based on the findings and conclusions the following recommendations have been forwarded for future interventions aimed at enhancing the wheat value chain in the study area.

As a result, 38.50% of farmers did not apply fertilizer, and 33.16% of farmers were did not adopt improved wheat variety, which gradually decreased yield per unit area. Therefore, to increase the adoption and usage of fertilizers in wheat production and ultimately increase productivity, the district offices of agriculture, cooperative union and saving and credit office should give particular attention to the availability of improved wheat varieties, fertilizer, and credit through government quality assurance.

The following recommendations are forwarded based on findings to improve farmers' decision-making regarding their participation in products upgrading and value addition of wheat:-

This finding showed that the distance to the market had a negative and significant effect on the adoption of improved wheat varieties and use of fertilizers as product upgrading techniques. As a result, in order to improve access to essential inputs (improve seeds, fertilizers, herbicides, pesticides) for wheat production, ultimately boosting overall output, the government (district, zonal, and regional road and transport authorities) should focus more on enhancing the current market centers achieved by constructing road infrastructure and offering reliable transportation for agricultural inputs in the study area.

Improved wheat variety adoption and pesticide application as product upgrading technique and cleaning and storing of wheat as value addition practices were positively and significantly influenced by household farming experience. Consequently, development agents, local authorities, and other stakeholders should create an opportunity for farmers to share their experiences.

The storage of wheat as value addition practice was positively and significantly influenced by market information that highlights the input and output markets price. As a result, it is recommended that policies that spread market knowledge about input and output in various

marketplaces. This can be accomplished by pushing farmers to seek updated market information by using the media and extension agents.

Access to extension contact has a positive and significant influence on adoption of improved wheat varieties, application of pesticides and herbicides as techniques for product upgrading and cleaning of wheat as a value addition practice. Farmers who have regular contact with extension agents are more likely to participate in beneficial product upgrading and value addition practices. Therefore, agricultural and natural resource offices, development agents should focus on creating more development centers and hiring additional extension workers to increase the frequency of contact between farmers, to improve farmers' skills and abilities, facilitating knowledge and improved farming practices.

The application of herbicide as a product upgrading technique and wheat transporting as a value addition practice positively and significantly influenced by access to training in wheat production. Therefore, it is necessary to capacitate farmers on technology utilization through the provision of training and enhancing the existing extension services in order to promote the use of these strategies for product upgrade and value addition practice. A number of wheat producers received comprehensive training from RLLP and DAs on several types of wheat developing techniques and marketing strategies in the study area. Therefore, RLLPs and DAs should increase training programs offered to farmers by providing valuable knowledge on wheat development techniques, marketing and use of herbicide.

The use of fertilizer, pesticides, and herbicides as product upgrading techniques and the storage and transportation of wheat as value addition practices were positively and significantly affected by access to credit service. Limited access to financing identified as a major challenge for most farmers in applying fertilizer, pesticides, and herbicides techniques of product upgrading and value addition practice. So, microfinance institutions in the district/zone should enhance their delivery systems to allow farmers to obtain and apply for credit specifically for purchasing various improved inputs to upgrade their product and to add value.

Adoption of wheat improved varieties and fertilizer application have positive and significance influence on cleaning of wheat, storing and transporting as a value addition technique. The adoption of wheat varieties and application of recommended fertilizer rates can significantly contribute to wheat development and encourage value addition practice. Farmer who adopt improved seed and fertilizer are more likely to participate in value addition practices, it lead to cost savings, improved efficiency, and higher quality grain as well as potentially reducing spoilage , increased yields and fewer diseases or damaged kernels during storage. Therefore, district improved seed and fertilizer supplier institutions (agricultural office and cooperative) should enhance delivery systems, ensure timely distribution of required quantity and quality of agricultural input and provide training on improved varieties and fertilizer application.

The study is limited to only one cereal crop product and three kebeles in the wombera district, and further researcher should focus to explore other district and products, as well as other upgrading and value addition techniques.

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7. APPENDICES

APPENDIX A

Appendix Table 1: Types and source of market information

Types of Market information	**Frequency**	**Percentage**
Market price	70	37.4
Buyers participant	17	9.1
Input price	58	31.4
Product quality	27	14.4
Supply and demand	15	8.0
Source of market information		
DAS	63	33.7
Fellows farmers	26	13.9
Market	60	32.1
Traders	16	8.6
Cooperatives	22	11.8

Source: Own computation from survey result, 2024

Appendix Table 2: Types and source of training offered to sampled households

Types of training	**Frequency**	**Percentage**
Use of input	47	25.1
Wheat management	43	23.0
Use of credit	13	7.0
Post-harvest activity	45	24.1
Marketing of wheat	39	20.9
Source of training		
DAS	37	19.8
Cooperatives	34	18.2
Agricultural office	68	36.4
NGO(RLLP)	48	25.7

Source: Own computation from survey result, 2024

Appendix Table 3: Types and source of extension service offered to sampled households

Types of extension service	**Frequency**	**Percentage**
Input usage	60	32
Product upgrade	57	30
Marketing of wheat	23	12.3
Value adding	47	25.1
Source of extension service		
Agricultural office	68	36.4
Model farmers	18	9.6
Das	87	46.5
Cooperative	14	7.5
Source of credit		
WD saving and credit	109	58.3
Friends	47	25.1
Family	23	12.3
Traders	8	4.3

Source: Own computation from survey result, 2024

Appendix Table 4: Test of multicollinearity for stata output

Variable	VIF	1/VIF
Adimprov	3.21	0.311488
Pestapp	2.85	0.350276
Herbapp	2.58	0.388322
Fertilapp	1.96	0.510489
Actrain	1.91	0.523485
Edu	1.83	0.546417
Age	1.71	0.583448
TLU	1.71	0.584583
Acmrkt	1.68	0.594009
Fexp	1.57	0.638578
Fsize	1.57	0.638863
Acred	1.35	0.741807
Acexco	1.31	0.765726
Mrktdis	1.29	0.776630
Mean VIF	1.89	

Appendix Table 5: Conversion factors used to calculate TLU

Types of animal	**Conversion factor of TLU**
Oxen and cow	1.00
Bull	0.75
Heifer	0.70
Sheep and goat	0.13
Horse and mules	1.10
Donkey	0.70
Poultry	0.013

Source:(Storck *et al.*, 1991)

Appendix Table 6 : Conversion factors used to estimate Adult Equivalent

Categories age of household	**Male**	**Female**
0-14 years	0.4	0.4
15-64 years	1	0.8
>65 years	0.75	0.75

Source:(Storck *et al.*, 1991)

Appendix Table 7 : Mvprobit model and marginal effect stata output for product upgrading techniques

```
Iteration 0:   log likelihood = -224.52554
Iteration 1:   log likelihood = -213.14002
Iteration 2:   log likelihood = -210.60014
Iteration 3:   log likelihood = -210.39097
Iteration 4:   log likelihood = -210.37091
Iteration 5:   log likelihood = -210.37085
Iteration 6:   log likelihood = -210.37085

Multivariate probit (SML, # draws = 5)          Number of obs   =        187
                                                Wald chi2(44)   =     165.27
Log likelihood = -210.37085                     Prob > chi2     =     0.0000
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Adimprov						
Sex	.3380485	.379642	0.89	0.373	-.4060362	1.082133
Age	-.0367993	.0608768	-0.60	0.546	-.1561155	.082517
Edu	.3032605	.1438103	2.11	0.035	.0213975	.5851234
Fsize	.1983247	.2146588	0.92	0.356	-.2223987	.6190482
Mrktdis	-.2225542	.1074772	-2.07	0.038	-.4332056	-.0119027
Fexp	.2742818	.0820851	3.34	0.001	.113398	.4351657
Acmrkt	.5304753	.3921636	1.35	0.176	-.2381513	1.299102
Acexco	.8592984	.3487383	2.46	0.014	.1757839	1.542813
Actrain	.1539512	.3896812	0.40	0.693	-.60981	.9177124
Acred	.4589319	.3293248	1.39	0.163	-.1865329	1.104397
TLU	.3873013	.1306817	2.96	0.003	.1311699	.6434327
_cons	3.904204	6.774442	0.58	0.564	-9.373459	17.18187
Fertilapp						
Sex	.5818222	.2832666	2.05	0.040	.0266298	1.137015
Age	-.0086946	.049621	-0.18	0.861	-.1059499	.0885607
Edu	.1923352	.103042	1.87	0.062	-.0096234	.3942938
Fsize	.1568554	.1506106	1.04	0.298	-.1383359	.4520466
Mrktdis	-.2053865	.0773549	-2.66	0.008	-.3569993	-.0537738
Fexp	.0982509	.0632291	1.55	0.120	-.0256758	.2221776
Acmrkt	.1698813	.3057057	0.56	0.578	-.4292909	.7690535
Acexco	.145295	.2563952	0.57	0.571	-.3572304	.6478205
Actrain	.2603443	.300543	0.87	0.386	-.3287091	.8493977
Acred	.5002289	.2541069	1.97	0.049	.0021885	.9982692
TLU	.0757577	.0913348	0.83	0.407	-.1032551	.2547706
_cons	7.475975	5.07245	1.47	0.141	-2.465845	17.41779
Herbapp						
Sex	.4924723	.3136907	1.57	0.116	-.1223502	1.107295
Age	-.1029569	.0575224	-1.79	0.073	-.2156987	.0097848
Edu	.2188495	.1183392	1.85	0.064	-.0130911	.4507901
Fsize	.1844368	.1683371	1.10	0.273	-.1454978	.5143714
Mrktdis	-.1111904	.0842217	-1.32	0.187	-.2762619	.053881
Fexp	.0772117	.0716159	1.08	0.281	-.0631528	.2175762
Acmrkt	.0959904	.3509982	0.27	0.784	-.5919534	.7839341
Acexco	.4824966	.2806453	1.72	0.086	-.067558	1.032551
Actrain	.5582147	.3107481	1.80	0.072	-.0508404	1.16727
Acred	.5580241	.2807761	1.99	0.047	.007713	1.108335
TLU	.1206578	.1025316	1.18	0.239	-.0803004	.321616
_cons	5.898445	5.590378	1.06	0.291	-5.058494	16.85538
Pestapp						
Sex	.5896685	.3855372	1.53	0.126	-.1659706	1.345308
Age	-.0331852	.0623692	-0.53	0.595	-.1554265	.0890561
Edu	.0504081	.1296442	0.39	0.697	-.2036899	.3045061
Fsize	.8586038	.2152717	3.99	0.000	.4366791	1.280529
Mrktdis	-.0871009	.1026048	-0.85	0.396	-.2882026	.1140009
Fexp	.2326699	.0815976	2.85	0.004	.0727415	.3925983
Acmrkt	.3229097	.4171572	0.77	0.439	-.4947033	1.140523
Acexco	.8287005	.3193826	2.59	0.009	.2027222	1.454679
Actrain	.4363759	.383657	1.14	0.255	-.315578	1.18833
Acred	.7969784	.3359571	2.37	0.018	.1385146	1.455442
TLU	.3542714	.1352693	2.62	0.009	.0891484	.6193943
_cons	-4.503309	6.821005	-0.66	0.509	-17.87223	8.865615
/atrho21	.4327016	.1642642	2.63	0.008	.1107497	.7546535
/atrho31	.5435963	.1891725	2.87	0.004	.172825	.9143676
/atrho41	.3416968	.3121633	1.09	0.274	-.2701322	.9535257
/atrho32	.6215264	.2134639	2.91	0.004	.2031448	1.039908
/atrho42	.4889925	.2245414	2.18	0.029	.0488994	.9290855
/atrho43	.2661139	.1999172	1.33	0.183	-.1257165	.6579443
rho21	.4075766	.1369768	2.98	0.003	.1102991	.637917
rho31	.4957054	.1426883	3.47	0.001	.1711247	.723222
rho41	.3289913	.2783762	1.18	0.237	-.2637478	.741375
rho32	.5521899	.1483758	3.72	0.000	.2003957	.7778517
rho42	.4534164	.1783787	2.54	0.011	.0488604	.7301673
rho43	.2600051	.1864022	1.39	0.163	-.1250584	.5769937

```
Likelihood ratio test of  rho21 = rho31 = rho41 = rho32 = rho42 = rho43 = 0:
              chi2(6) =  28.3094    Prob > chi2 = 0.0001
```

Average marginal effects Number of obs = 187
Model VCE : OIM

Expression : Pr(Adimprov), predict(pr eq(#1))
dy/dx w.r.t. : Sex Age Edu Fsize Mrktdis Fexp Acmrkt Acexco Actrain Acred TLU

	Delta-method dy/dx	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Sex	.0467118	.0505031	0.92	0.355	-.0522725	.1456961
Age	-.0061974	.0082798	-0.75	0.454	-.0224254	.0100307
Edu	.0430538	.0183605	2.34	0.019	.0070678	.0790398
Fsize	.0268434	.0288505	0.93	0.352	-.0297025	.0833894
Mrktdis	-.0304637	.0137782	-2.21	0.027	-.0574686	-.0034589
Fexp	.0376125	.0099236	3.79	0.000	.0181626	.0570624
Acmrkt	.0653855	.0515867	1.27	0.205	-.0357225	.1664936
Acexco	.1208989	.0436572	2.77	0.006	.0353324	.2064653
Actrain	.004111	.0526093	0.08	0.938	-.0990012	.1072233
Acred	.0699346	.0423235	1.65	0.098	-.0130179	.1528871
TLU	.0563282	.0167897	3.35	0.001	.0234211	.0892354

Average marginal effects Number of obs = 187
Model VCE : OIM

Expression : Pr(Fertilapp), predict(pr eq(#2))
dy/dx w.r.t. : Sex Age Edu Fsize Mrktdis Fexp Acmrkt Acexco Actrain Acred TLU

	Delta-method dy/dx	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Sex	.1354177	.0667638	2.03	0.043	.0045631	.2662723
Age	-.0014787	.0118511	-0.12	0.901	-.0247064	.0217489
Edu	.0433398	.0240988	1.80	0.072	-.0038931	.0905726
Fsize	.0449085	.0365416	1.23	0.219	-.0267117	.1165286
Mrktdis	-.0476786	.0178852	-2.67	0.008	-.082733	-.0126242
Fexp	.0233319	.0152359	1.53	0.126	-.0065299	.0531936
Acmrkt	.0355066	.0739897	0.48	0.631	-.1095105	.1805238
Acexco	.0353071	.0611594	0.58	0.564	-.0845631	.1551773
Actrain	.064693	.0720086	0.90	0.369	-.0764413	.2058274
Acred	.1195229	.0590352	2.02	0.043	.003816	.2352298
TLU	.0201828	.0219923	0.92	0.359	-.0229212	.0632869

Average marginal effects Number of obs = 187
Model VCE : OIM

Expression : Pr(Herbapp), predict(pr eq(#3))
dy/dx w.r.t. : Sex Age Edu Fsize Mrktdis Fexp Acmrkt Acexco Actrain Acred TLU

	Delta-method dy/dx	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Sex	.0673071	.0508104	1.32	0.185	-.0322795	.1668936
Age	-.0179542	.0093153	-1.93	0.054	-.0362119	.0003034
Edu	.0337597	.0188865	1.79	0.074	-.0032571	.0707766
Fsize	.032035	.0279523	1.15	0.252	-.0227505	.0868206
Mrktdis	-.0167669	.0137224	-1.22	0.222	-.0436623	.0101285
Fexp	.0140537	.0118862	1.18	0.237	-.0092429	.0373503
Acmrkt	.0041425	.0584353	0.07	0.943	-.1103886	.1186736
Acexco	.0809438	.0451258	1.79	0.073	-.0075012	.1693888
Actrain	.0886652	.0506811	1.75	0.080	-.0106679	.1879984
Acred	.0896751	.0448702	2.00	0.046	.0017311	.1776192
TLU	.022225	.0169078	1.31	0.189	-.0109137	.0553637

Average marginal effects Number of obs = 187
Model VCE : OIM

Expression : Pr(Pestapp), predict(pr eq(#4))
dy/dx w.r.t. : Sex Age Edu Fsize Mrktdis Fexp Acmrkt Acexco Actrain Acred TLU

	Delta-method dy/dx	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Sex	.0778562	.0465324	1.67	0.094	-.0133456	.169058
Age	-.009442	.0077627	-1.22	0.224	-.0246567	.0057727
Edu	.0065541	.016132	0.41	0.685	-.0250641	.0381722
Fsize	.1079049	.024319	4.44	0.000	.0602406	.1555693
Mrktdis	-.0214511	.0131652	-1.63	0.103	-.0472545	.0043522
Fexp	.0094368	.0110143	0.86	0.392	-.0121509	.0310244
Acmrkt	.0140441	.0510478	0.28	0.783	-.0860078	.1140959
Acexco	.0785869	.0402288	1.95	0.051	-.0002602	.157434
Actrain	.0632186	.0480812	1.31	0.189	-.0310189	.157456
Acred	.0868743	.0427972	2.03	0.042	.0029933	.1707554
TLU	.0496387	.016423	3.02	0.003	.0174503	.0818272

Appendix Table 8: Mvprobit model and marginal effect stata output for value addition practice

```
Iteration 0:   log likelihood = -202.21857
Iteration 1:   log likelihood = -199.07876
Iteration 2:   log likelihood = -198.97435
Iteration 3:   log likelihood = -198.97422
Iteration 4:   log likelihood = -198.97422

Multivariate probit (SML, # draws = 5)          Number of obs   =        187
                                                Wald chi2(45)   =     164.46
Log likelihood = -198.97422                     Prob > chi2     =     0.0000
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Cleaning						
Sex	-.0185661	.3499258	-0.05	0.958	-.7044081	.6672759
Age	-.0291222	.0513023	-0.57	0.570	-.1296729	.0714284
Edu	.0097683	.1080264	0.09	0.928	-.2019596	.2214962
Fsize	.3898575	.1770863	2.20	0.028	.0427748	.7369402
Mrktdis	-.0949636	.084775	-1.12	0.263	-.2611197	.0711924
Fexp	.1186043	.0682472	1.74	0.082	-.0151577	.2523663
Acmrkt	.2128203	.3459321	0.62	0.538	-.4651943	.8908348
Acexco	.5134333	.270625	1.90	0.058	-.0169819	1.043849
Actrain	.0893902	.3437925	0.26	0.795	-.5844307	.7632112
Acred	.2086759	.2892289	0.72	0.471	-.3582024	.7755541
TLU	.0235431	.1042489	0.23	0.821	-.1807809	.2278671
Adimprov	.8643275	.3885062	2.22	0.026	.1028692	1.625786
Fertilapp	.123431	.3074458	0.40	0.688	-.4791517	.7260137
Herbapp	.2567656	.3754263	0.68	0.494	-.4790564	.9925877
Pestapp	.1294546	.3893681	0.33	0.740	-.6336928	.892602
_cons	1.581715	5.726546	0.28	0.782	-9.64211	12.80554
Storing						
Sex	.4429115	.3227781	1.37	0.170	-.1897219	1.075545
Age	.0103811	.0619894	0.17	0.867	-.1111159	.131878
Edu	.0332643	.1291308	0.26	0.797	-.2198275	.2863561
Fsize	-.1934894	.1928662	-1.00	0.316	-.5715002	.1845214
Mrktdis	-.049898	.0965581	-0.52	0.605	-.2391484	.1393524
Fexp	.1558052	.0828355	1.88	0.060	-.0065494	.3181598
Acmrkt	.581905	.3416296	1.70	0.089	-.0876766	1.251487
Acexco	.0949992	.3162528	0.30	0.764	-.5248449	.7148433
Actrain	.4873061	.3504653	1.39	0.164	-.1995933	1.174205
Acred	.521858	.3127131	1.67	0.095	-.0910485	1.134764
TLU	.1212809	.1207705	1.00	0.315	-.115425	.3579869
Adimprov	.2296403	.4485409	0.51	0.609	-.6494837	1.108764
Fertilapp	.6789601	.3480339	1.95	0.051	-.0031738	1.361094
Herbapp	.196721	.3660688	0.54	0.591	-.5207606	.9142026
Pestapp	.1241445	.4465782	0.28	0.781	-.7511326	.9994216
_cons	-1.622507	6.220331	-0.26	0.794	-13.81413	10.56912
Transporting						
Sex	.4159085	.3091718	1.35	0.179	-.190057	1.021874
Age	-.1512287	.0500016	-3.02	0.002	-.24923	-.0532274
Edu	.1251917	.1063281	1.18	0.239	-.0832075	.3335909
Fsize	-.1199968	.1602979	-0.75	0.454	-.434175	.1941815
Mrktdis	-.0043462	.0834156	-0.05	0.958	-.1678379	.1591455
Fexp	.0569735	.0634432	0.90	0.369	-.067373	.1813199
Acmrkt	.0119285	.3380915	0.04	0.972	-.6507187	.6745757
Acexco	.1916123	.274981	0.70	0.486	-.3473404	.7305651
Actrain	.5722509	.3357168	1.70	0.088	-.0857418	1.230244
Acred	.5236655	.2780853	1.88	0.060	-.0213716	1.068703
TLU	.0400307	.0997582	0.40	0.688	-.1554917	.235553
Adimprov	.124013	.3912046	0.32	0.751	-.642734	.89076
Fertilapp	.5935295	.2922113	2.03	0.042	.0208058	1.166253
Herbapp	.0930395	.3608984	0.26	0.797	-.6143084	.8003875
Pestapp	.120364	.3790146	0.32	0.751	-.622491	.863219
_cons	3.38753	5.546833	0.61	0.541	-7.484063	14.25912
/atrho21	.1125353	.2050908	0.55	0.583	-.2894353	.5145059
/atrho31	.3858277	.1616978	2.39	0.017	.0689058	.7027496
/atrho32	.0385142	.171434	0.22	0.822	-.2974903	.3745188
rho21	.1120626	.2025153	0.55	0.580	-.281615	.4734485
rho31	.3677578	.1398289	2.63	0.009	.068797	.6061101
rho32	.0384952	.17118	0.22	0.822	-.2890142	.3579379

```
Likelihood ratio test of  rho21 = rho31 = rho32 = 0:
            chi2(3) =   6.4887   Prob > chi2 = 0.0901
```

Average marginal effects Number of obs = 187
Model VCE : OIM

Expression : Pr(Cleaning), predict(pr eq(#1))
dy/dx w.r.t. : Sex Age Edu Fsize Mrktdis Fexp Acmrkt Acexco Actrain Acred TLU Adimprov Fertilapp Herbapp Pestapp

	Delta-method dy/dx	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Sex	-.0104754	.0761315	-0.14	0.891	-.1596903	.1387396
Age	-.0079136	.0108187	-0.73	0.464	-.0291179	.0132908
Edu	.000355	.0231562	0.02	0.988	-.0450302	.0457403
Fsize	.0850241	.0367664	2.31	0.021	.0129633	.157085
Mrktdis	-.0237694	.0178962	-1.33	0.184	-.0588452	.0113064
Fexp	.0238573	.0141221	1.69	0.091	-.0038215	.0515361
Acmrkt	.0395211	.0736834	0.54	0.592	-.1048957	.183938
Acexco	.112007	.0560529	2.00	0.046	.0021454	.2218685
Actrain	.0242644	.0735363	0.33	0.741	-.1198641	.1683929
Acred	.0331306	.0610171	0.54	0.587	-.0864608	.152722
TLU	.00201	.0221014	0.09	0.928	-.0413079	.045328
Adimprov	.1913214	.0783623	2.44	0.015	.0377341	.3449088
Fertilapp	.030365	.0654006	0.46	0.642	-.0978179	.1585478
Herbapp	.049052	.0807105	0.61	0.543	-.1091377	.2072416
Pestapp	.0291304	.0837049	0.35	0.728	-.1349281	.193189

Average marginal effects Number of obs = 187
Model VCE : OIM

Expression : Pr(Storing), predict(pr eq(#2))
dy/dx w.r.t. : Sex Age Edu Fsize Mrktdis Fexp Acmrkt Acexco Actrain Acred TLU Adimprov Fertilapp Herbapp Pestapp

	Delta-method dy/dx	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Sex	.0711054	.0490578	1.45	0.147	-.0250461	.1672568
Age	.0046346	.0098167	0.47	0.637	-.0146058	.0238751
Edu	.0086487	.0201446	0.43	0.668	-.0308339	.0481314
Fsize	-.0325677	.0291284	-1.12	0.264	-.0896584	.0245229
Mrktdis	-.0060652	.0149023	-0.41	0.684	-.0352732	.0231428
Fexp	.0240446	.012378	1.94	0.052	-.0002158	.048305
Acmrkt	.0887415	.0520502	1.70	0.088	-.013275	.1907579
Acexco	.0191715	.0481299	0.40	0.690	-.0751614	.1135044
Actrain	.0820451	.0523116	1.57	0.117	-.0204838	.1845739
Acred	.0751135	.0479233	1.57	0.117	-.0188143	.1690414
TLU	.0153506	.0184047	0.83	0.404	-.020722	.0514232
Adimprov	.0376752	.0691104	0.55	0.586	-.0977787	.1731291
Fertilapp	.1012292	.0536847	1.89	0.059	-.0039909	.2064493
Herbapp	.0322453	.0560502	0.58	0.565	-.0776111	.1421017
Pestapp	.0268361	.069109	0.39	0.698	-.108615	.1622872

Average marginal effects Number of obs = 187
Model VCE : OIM

Expression : Pr(Transporting), predict(pr eq(#3))
dy/dx w.r.t. : Sex Age Edu Fsize Mrktdis Fexp Acmrkt Acexco Actrain Acred TLU Adimprov Fertilapp Herbapp Pestapp

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
Sex	.1007381	.0693311	1.45	0.146	-.0351484	.2366245
Age	-.03625	.0106957	-3.39	0.001	-.0572133	-.0152867
Edu	.0312317	.0237922	1.31	0.189	-.0154001	.0778635
Fsize	-.0259299	.0367912	-0.70	0.481	-.0980394	.0461796
Mrktdis	-.0002748	.0191378	-0.01	0.989	-.0377842	.0372346
Fexp	.0124991	.0144193	0.87	0.386	-.0157622	.0407603
Acmrkt	.0111671	.0767356	0.15	0.884	-.139232	.1615661
Acexco	.0410048	.0626965	0.65	0.513	-.0818781	.1638878
Actrain	.1317425	.0745016	1.77	0.077	-.0142779	.2777629
Acred	.1236085	.0607861	2.03	0.042	.0044699	.2427471
TLU	.00502	.0229405	0.22	0.827	-.0399426	.0499826
Adimprov	.0308823	.0905699	0.34	0.733	-.1466315	.2083961
Fertilapp	.129278	.0650223	1.99	0.047	.0018365	.2567194
Herbapp	.0247586	.0822288	0.30	0.763	-.1364069	.1859241
Pestapp	.0205277	.0866068	0.24	0.813	-.1492185	.1902739

APPENDIX B, SURVEY QUESTIONARIES

JIMMA UNIVERSTY

College of agriculture and veterinary medicine

Department of Agricultural economics and Agribusiness and value chain management

Questionnaires and interview guides for different stakeholders to conduct a study on value chain analysis of wheat in Wombera district of Metekel zone 2024

By: Ureji Aregeta Jirata

Instruction for enumerator

- Make a brief introduction before starting any question, introduce yourself to the farmers, greet them locally, and clarify the objective of the study.
- Please fill in the interview schedule according to the farmers' replies (do not express your feelings).
- Please ask each question clearly and patiently until the farmer receives your points.
- Please do not use technical terms and forget local units.
- Place the answer in the space provided.
- Prove that all questions are asked and the interview schedule format is properly completed.

A. producers/ farmers survey Questionaries'

I. General information

Questionnaire number_____

Name of district _____

Name of kebele _____

Name of Enumerator _____ phone no_____

Date _____/_____/_____E.c

II. Demographic characteristics of producers

1. Name of household head _____ phone no_____
2. Sex of household head 1=male 0 =female
3. Age of household head in years _____
4. Educational level of the household head (in the years of schooling) _____grade
5. Total family size of household _____

Sex category	0- 14 years	15- 64 years	> 65 years
Male			
Female			
Total			

6. Distance of your resident from the nearest market center _____walking time (minutes)

III. Land holding size, and labor source for wheat production

1. Total land size operated in ha _____ (Note : 1 ha = 4 timad or 1 timad =0.25 ha)

Description	Size(area) timad or hactare
Owned land	
Rented in land	
Land cultivated for wheat	

2. What methods do you use to cultivate your land for wheat production? 1= Hand tool 2= Oxen 3= Tractor 4= others specify_____
3. What is the source of labor for wheat production and their numbers? 1=family labor 2=hired labor 3=labor exchange 4= cooperation 5= others
4. Do you have livestock? 1=Yes 0= No and specify livestock holdings of your household

Types of livestock	Oxen	cow	Sheep	Goat	Donkey	Mule	Horse	Poultry
Owned								
sold during year								
Income from sale								

IV. Crop production and input used

1. Farming experience in years _____
2. How long (experience) have you in wheat production _____years
3. Did you plant improved wheat in produced wheat? 1= Yes 0= no
4. If yes, for **Q.3** what types of adoption level of improved seeds did you use? 1= Danidaa 2=Ali doro 3=Tesfaye 4=Shorma 4=Hidase 5=Anigolcha 6= others (specifiy) _____

5. What types of planting of seeds did you use? 1=broadcasting 2= row planting
6. Do you get benefit from planting improved wheat variety? 1=Yes 0= No
7. If no, for **Q. 3,** what are the possible reasons? 1= high price 2= No credit facilities 3= limited supply 4= quality problem 5= lack of awareness 6 =others (specify) _____
8. Why do you produce wheat? 1=Sale 2=Consumption 3= Both
9. Input used for wheat production

Types of input		Did you used 1= Yes 0= No	Source of input **(Code A)**	Do you have access 1= Yes 0= No	How do you get **(code B)**	Used per hectare
Improved seed						
Organic fertilizer						
In Organic fertilizer	DAP /NPS					
	UREA					
Chemical	Herbicide					
	pesticide					
Other specify						

Code A	**Code B**
1. Own 2. Local market	1. Purchase on cash 2. On credit
3. Private seed enterprise 4.Cooperatives (specify)	3. Gift 4. Exchange on kind
5. NGO (specify) 6. Research center (specify)	5. Own 6 other (specify)
7. Fellow farmers 8. WDAGO	

10. If no for **Q.11** ,why?(multiple response is possible) 1 =Not available 2 =Too expensive 3 =Not available on time 4= cash shortage 5= others (specify) _____

V. Production service

Access to Credit

1. Do you have access to credit? 1= Yes 0= No
2. Did you borrow money for wheat production? 1= Yes 0= No
3. If yes, for **Q.2**, for what purpose did you receive? 1=purchase of fertilizes 2=purchase of improved seed 3= purchase of chemicals 4 =payment to hired labor 5=other (specify)
4. If yes, for **Q.2**, from where did you collect your credit? (Multiples response is possible)

1= micro finance (specify) ___ 2= cooperatives/union (specify) ____ 3=NGOs (specify) ___ 4=bank (specify) ___5 = Traders 6=relatives 7= Iquib/Idir 8= others (specify) ___

5. If no, for **Q.2**, what was the reason? 1= Not available 2= high interest rates 3 = lack of collateral security 4= a lot of bureaucracy 5= Not need credit 6= fear of in ability to repay 7= others (specify) ___

Access to extension and information services contact

1. Did you receive any extension services contact? 1 = Yes 0 = No
2. If yes, for **Q.1,** how many times (days) did you contact with DA last production season?
3. If yes, for **Q.1**, who provided the extension services? 1 = Office of agriculture 2 = NGOs 3 = Model farmers 4 = Research centers 5 = Cooperative 6 = Others (please specify)____
4. If no, for **Q.1** what was the reason for not receiving these services? 1 = Not available nearby 2 = Contact farmers not available 3 = Lack of time to get the services 4 = Others (please specify)_____
5. What types of extension services did you receive? 1 = Input use 2 = Product storage 3 = Credit use 4 = Marketing of wheat 5 = Fertilizer application 6 = Value adding activities 7 = Harvesting 8 = Others (please specify)_____
6. How do you receive advisory services? (Multiple responses are possible) 1 = Farm-to-farm visit by the development agent 2 = Experience sharing tour 3 = Visit to demonstration/model farmers' site 4 = Training 5 = Others (please specify)_____

Access to training service

1. Have you got training related to wheat value chain? 1= Yes 0= No
2. If **Q.1**, No why? 1= no service provider 2= low quality of training 3= have no time to participate 4= others (specify)
3. Was the training you get easily understandable and practicable? 1= Yes 0=No
4. If your answer for **Q.1** yes , on which aspects, by whom and for how long you have got the training ?(fill in the below table) (Multiple responses are possible)

No	**Types of training**		**1 =Yes 0= No**	**By whom (code A)**	**How many times (code B)**	**Code A**
1	Crop management					1.Research center(specify)
2	Use input	Improved varieties				2. NGO
		Fertilization application				3. Cooperatives/union (specify)

		Herbicide application				4. Development agents 5. Agriculture office 6. Others **Code B** 1. Daily 2. Weekly 3. Monthly 4. Rarely
3	Use of credit					
4	Harvesting					
5	Post -harvesting function upgrading activity	cleaning				
		storage				
		transportation				
		Packing				
		others				
6	Marketing of agricultural Product					

Access to Market information

1. Did you get access marketing information? 1= Yes 0= No
2. If yes for **Q.1,** from whom did you get the market information? 1=DAs 2=Fellow farmers 3= District expert 4= Radio 5= brokers 6= market 7= others (specify)_____
3. What types of information did you get? 1= price information 2= market price information 3= buyers information 4= input market and price 5= other (specify)_____
4. At what time interval do you get the information? 1 = Daily 2= weekly 3= monthly 4= other (specify)_____
5. Do you get market information before value adding your product to market in last year? 1= Yes 0= No
6. If **Q.5** yes, from whom did you get the value add market information? 1=DAs 2=Fellow farmers 3= district expert 4= Radio 5= brokers 6= market 7= others (specify)_____
7. Did you know the market price of wheat products before you sold? 1= Yes 0= No

Distance from the nearest market

1. How far you from the market center?
   - From village market _____ walking on foot _____minute/hr.
   - From farm gate to market _____ walking on foot _____minute/hr.

1. What area limitations with input providers (accessibility, quality, and price of inputs)?

2. What are Challenges concerning the production of wheat (losses incurred after harvest, illness, availability of extension services, loans, transportation infrastructure, and market accessibility)?

VI. Wheat marketing

1. Amount of wheat produced and sold to different markets in 2022/23 (Multiple responses are possible)

Amount wheat produced (Qt)	Amount wheat sold(Qt)	To whom **(code A)**	Where to sold **(code B)**	Marketing cost	Selling price	Terms of sell **(code C)**

Code A	**code B**	**Code C**
1.Local collector	1.On the farm	1.Cash
2.Wholesalers	2.Vilage market	2.Credit
3.Retilers	3.District market	3.Advace payment
4. Cooperatives	4.Zonal market	4. Others (specify)_____
5. Processors	5. Others (specify)_____	
6.Brokers		
7.Consumers		
8. Others (specify)_____		

2. What is the reason for selling to the selected actors? 1= price difference from others 2= closeness in distance 3= transport availability 4= others (specify)
3. Why did you sell immediately after harvest? 1= better price 2= storage problem 3= fear of price fall 4= bulk of production 5= others (specify)
4. Is there a difference in market price due to the difference in place of sale and types of buyers? 1= Yes 0= No
5. What is main constraint to targeting the preferred channel? 1= cost 2= quantity 3= quality 4= low price 5= lack of information 6=unreliable market 7=other(specify)_____
6. Who sets your selling price? 1= myself 2= buyers 3= set by negotiations 4= set by demand and supply 5= other(specify)_____
7. What requirements the current channel(s) use to purchase? 1= quality 2= size 3= transport 4= group member 5= variety 6= other(specify)_____
8. Do you wheat products have preferred qualities by buyers? 1= Yes 0= No

9. For which purpose do you use income generated from sales of wheat? 1= purchase of food 2= purchase of input 3= purchase of grain 4= purchase of dairy animals 5= other (specify)_____
10. Do you get any support from any organization or government department during marketing? 1= Yes 0 =No
11. If your answer for **Q.10** is yes, who and what types of support?
12. What are the main issues facing wheat marketing?
13. What element influences the quality of your products?

VII. Value addition techniques

1. Do you harvest wheat at the right time? 1= Yes 0= No
2. If no, for **Q.1**, why? 1= lack of awareness 2= carelessness 3= market distance 4= labor constraint 5= lack of market information 6=others (specify)_____
3. Do you have any value addition on your wheat produce before you deliver to market? 1= Yes 0= No
4. What value adding activities you perform?(fill the below tables) (Multiple responses are possible)

Actor	Value adding activities by actors **(code A)**	1=Yes 0=No	**Code A** 1.cleaning 2. packaging 3.storing 4.transporting 5.processing 6.others(specify)
Producer			

5. What was your reason for adding value? 1= improve sale volume 2= get higher price 3= increase buyers demand 4= others (specify) _____
6. What packaging material do you use? 1=plastic sack (Madaberiya) 2=pic bag 3 =others (specify)_____
7. Do you clean product before delivery to market 1=yes 0= no
8. If yes for **Q.7** what kind of wheat cleaning do you use?

1=Clean produce by using large sieves to remove chaff, stalks and other large debris before marketing

2= Sieves of different sizes separate large waste such as weed seeds and broken kernels from the required amount of wheat.

3= separate light chaff and dust from heavy wheat grains by using wind

4= remove dust, weed seeds, broken kernels, light straw, stems by polishing

5= separate the required amount of wheat by picking out the grains such as stones and pebbles, broken kernels, light straw, and stalks.

9. Do you store product before delivery to market 1=yes 0= no
10. Do you use improved storage facilities? 1= Yes 0= No
11. If yes, for **Q.10**, which types of materials do you use? 1=pics bag 2= Metal silo hermatic 3= plastic sack (Madaberiya) 4= others (specify)_____
12. Did you use Acetelic Super to control pest that attacks wheat (Sitophilus granaries) during storing 1=yes 2=No
13. How long did you store before delivering to market? _____
14. What is your motive for wheat storage? 1= Expecting high price 2= for saving 3= lack of demand 4= for consumption 5= for extends shelf life 6= for reduced product loss
15. Do you transport your product to cooperatives union? 1=Yes 0= No
16. If yes for **Q.15**, what is your means of transportation? 1 =Head carrying 2= Own pack animal 3= Animal cart 4= public transport (vehicles) 5=others (specify)_____
17. If no for **Q.15** why? 1= unavailability of transportation service 2= Better price at farm gate 3= have no time to take to market 4= farm from market 5=no road infrastructure 6=other (specify) _____
18. What are limitations with input providers (accessibility, quality, and price of inputs) in last production season?
19. Challenges production of wheat (losses incurred after harvest, illness, availability of extension services, loans, transportation infrastructure, and market accessibility)?
20. What obstacles exist for both functional and product upgrading in the wheat value chain?
21. What are the main issues facing wheat marketing?
22. What are the opportunities of wheat production and marketing?

B. Traders Survey Questionnaires

I . General information

1. Name of enumerator _____signature _____
2. Date _____/_____/_____

II. Demographic Characteristics

1. Name of trader _____phone_____
2. Age in years _____
3. Sex 1=male 0= female
4. Educational level (in the years of schooling) _____grade
5. Total family size _____

Sex category	0-14 years	15-64 years	> 65 years
Male			
Female			
Total			

6. Distance from the nearest market center _____walking time (minutes)
7. Types of trader 1= wholesaler 2= retailers 3 = local collector 4= cooperatives 5 =union 6=other (specify)_____
8. Trade system 1=Alone 2= partnership 3=others (specify)_____
9. How long have you been operating the business? _____ Years.
10. Source of capital 1= own 2= loan 3= Gift 4= share 5= others (specify)_____
11. If your answer is **2** for **Q.10,** what is the source? 1=Relative/family 2= private money landers 3=NGO(specify)___ 4= micro finance institution(specify)_____5= bank (specify)_____ 6= other(specify)_____
12. How your linkage is characterized? 1= flow of product 2= flow of finance 3= flow information 4= flow of knowledge 5= others(specify)_____
13. If your answer is **3**, in **Q.12** what is the direction of flow of information? 1= one way 2= two way

III .Purchasing

1. From which market and supplier did you buy wheat? (multiple market area is possible and multiple answers are possible)

Wheat	Amount wheat	From whom to purchase	Where to purchase	Terms of purchase **(code C)**

	purchase (Qt)	**(code A)**	**(code B)**	

Code A

1. Producer
2. Local collector
3. Wholesalers
4. .Retailers
5. Cooperatives
6. Processors
7. Brokers
8. Consumers

code B

1. On the farm
2. village market
3. district market
4. Zonal market
5. others (specify)_____

Code C

1.Cash
2.Credit
3.Advace payment
4. others (specify)_____

2. Why do you prefer this market? 1= better quality 2= high supply 3= shortest distance 4=other (specify) _____
3. How do you measure your purchase? 1= by sack 2=by weighing 3= others (specify)
4. Who sets the purchase price?1=myself 2=by demand and supply 3= sellers 4= others___
5. Average buying prices for products per 100 kg in 2023/24 production season _____birr
6. Do you consider quality requirement of your customers in purchasing activities? 1=Yes 0= No

IV . Selling

1. Where and to whom did you sell wheat (multiple market area is possible and multiple answers are possible)

Amount wheat sold(Qt)	To whom **(code A)**	Where to sold **(code B)**	Marketing cost	Selling price	Terms of sell **(code C)**

Code A

1.Local collector
2.Wholesalers
3. Retailers
4. Cooperatives
5. Processors
6.Brokers
7.Consumers
8. Others (specify)_____

Code B

1.On the farm
2.Vilage market
3.District market
4.Zonal market
5. Others (specify)_____

Code C

1.Cash
2.Credit
3.Advace payment
4. Others (specify)__

1. How did you sale your product 1=direct to the purchaser 2= through broker 3= others_____
2. Do you know the market price in different markets in (code B) before you sold your product? 1= Yes 0= No
3. Who sets the selling price? 1= myself 2= by demand and supply 3= sellers 4= others(specify)_____

V. Marketing service

1. Did you have wheat trade license? 1= Yes 0= No
2. If yes, for **Q.1** where did you get? _____
3. Are there restricted imposed on unlicensed wheat traders 1= Yes 0= No
4. Did you store wheat before you sold? 1= Yes 0= No
5. If yes, for **Q.4,** for how long did you store wheat in the store? _____
6. If yes, for **Q.4**, capacity of your storage? _____quintal at time

VI. Value addition practice

1. Do you have any value addition on your wheat? 1= Yes 0= No
2. If yes, for **Q.1** what are those value adding activities?(multiple response is possible) 1= cleaning 2= storing 3=packing 4= processing 5=transporting 6=grading 7=others __
3. How much did you sell 100 kg of product of value added? _____
4. What was your reason for adding value? 1=improved sale volume 2= get higher price 3=buyers demands 4= others(specify)_____
5. Would you adopt a technology in adding value in wheat? 1= yes 0= no
6. If yes, for **Q.5** what are those value adding technologies? _____
7. What are the constraint of you faced in wheat trading?1=price setting problem 2=price fluctuation 3= shortage of truck 4=regulatory framework 5= unlicensed traders 6= storage problem 7=others(specify)_____
8. What are the opportunities of wheat of marketing? 1= wheat trading experience 2=growing numbers of buyer 3= proxy to main road 4= other(specify)_____

C. Consumers interview schedule

I . General in formation

1. Name of respondent _____phone number_____

2. District _____Kebele_____
3. Sex 1= male 0= female
4. Age in years _____
5. Total family size _____

Sex category	0-14 years	15-64 years	> 65 years
Male			
Female			
Total			

6. Educational level (in the years of schooling) _____grade
7. Means of income 1= farming 2= trade 3=employment 4=other(specify)_____
8. Experience in wheat products consumption _____years
9. Distance to nearest market _____ (minutes' walk)

II. Wheat demand, purchase and consumption

1. Is wheat consumed in your family? 1= Yes 0= No
2. Source of wheat you consumed? 1=own produce 2= purchase 3= others (specify)_____
3. If your answer is 2, for **Q.2**, how much income you spent on wheat purchasing per years /month/week/day? _____
4. Frequency of wheat purchase per month/week? _____
5. If no for **Q.1** for what time did not consume wheat _____months
6. Purchase prices of wheat and related information (multiple answers are possible)

Wheat	Amount wheat purchase per month (Qt)	From whom to purchase (code A)	Where to purchase (code B)	Terms of purchase (code C)

Code A	code B	Code C
1. producer		
2. .Local collector	1.On the farm	1.Cash
3.Wholesalers	2.Vilage market	2.Credit
4 .Retailers	3.District market	3.Advace payment
5. Cooperatives	4.Zonal market	4. Other (specify)____
6. Others (specify) _____	5. Others (specify)_____	

7. Do you consider any quality attributes to purchase wheat? 1= Yes 0= No
8. Have you ever paid premium for the value added product? 1= Yes 0= No
9. As buyer do you have difficulty in obtains sufficient supplies? 1= Yes 0= No
10. What is/are the constraint hindering consumption of wheat? 1=supply shortage 2= lack of market information 3= income shortage 4= poor product handling 5= lack of storage 6= high price 7 =others(specify) _____
11. Linkage with commercial wheat value chain actors (multiple response is possible) 1= local collectors 2= farmers 3= retailers 4= wholesalers 5= cooperatives 6= others (specify)_____
12. Do you think wheat market chain is complex and many intermediaries? 1= Yes 2= No
13. Do you think traders of wheat marketing are efficient and competitive? 1= Yes 2= No
14. If no for **Q.13**, what is the problem of traders? 1= high competition with unlicensed trades 2= supply poor quality 3= cheat scaling weighting 4= price setting problem 5= government policy problem 6 =others(specify) _____
15. Do you think that the price of wheat reduced if the value chain actor's linkage is improved? 1= Yes 2= No

D. Checklist for focus group discussion

Participant's producers of wheat in selected kebeles

District _____kebeles _____

1. Limitations with input providers (accessibility, quality, and price of inputs)?

2. Challenges concerning the production of wheat (losses incurred after harvest, illness, availability of extension services, loans, transportation infrastructure, and market accessibility)?

4. What are the main issues facing wheat marketing? How to resolve

5. What element influences the quality of your products? And how can one resolve?

6. How much dose did you used during storage per quintal?

E. Checklist for key informant's interview

District _____ kebeles _____

Date _____Name of interviewee _____ Name of the organization_____

1. What threats exist to the availability of inputs and the wheat extension service?

2. Which infrastructure limitations have the biggest effects on wheat production?

3. What part does the Farmers Training Centre play in the production of wheat? How?

4. How does your company fit into the wheat value chain?

5. What opportunities and challenges did you encounter in carrying out the responsibilities given to you by your organization?

6. Do you believe that the participants in the wheat value chain are efficient and competitive?

7. In what part of the wheat value chain does inefficiencies occur and intentions are required?

THANK YOU FOR YOUR PATIENCE AND TIME ALLOCATION TO RESPOND!