



JIMMA UNIVERSITY

**COLLEGE OF AGRICULTURE AND VETERINARY MEDICINE,
DEPARTMENT OF AGRICULTURAL ECONOMICS AND
AGRIBUSINESS MANAGEMENT**

**SEED POTATO VALUE CHAIN ANALYSIS: THE CASE OF
SMALLHOLDER FARMERS IN WELMERA DISTRICT, WEST SHEWA
ZONE, OROMIA, ETHIOPIA.**

M.Sc THESIS

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**Seed Potato Value Chain Analysis: The Case of Smallholder Farmers in
Welmera District, West Shewa Zone, Oromia, Ethiopia.**

By

Tesfu Nega Bedada

A Thesis

**Submitted to the School of Graduate Studies, College of Agriculture and
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Requirements for the Award of the Degree of Master of Science in
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DEDICATION

I dedicated this Thesis to my Mother ABERU GURMU and my Father NEGA BEDADA for their encouragement, support and partnership in the success of my academic career.

STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this Thesis is my own work. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and completion of this Thesis. Any scholarly matter that is included in the Thesis has been given recognition through citation.

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ABBREVIATIONS AND ACRONYMS

BoA	Bureau of Agriculture Office
BLUE	Best Linear Unbiased Estimator
CLR	Classical Linear Regression
CSA	Central Statistical Authority
DWH	Durbin -Wu-Hausman
ENSP	Ethiopia-Netherlands Seed Partnership
GDP	Gross Domestic Product
GMMC	Gross Marketing Margin of Cooperative
GMMP	Gross Market Margin of Producers
GMMR	Gross Marketing Margin of Retailer
GMMRC	Gross Marketing Margin of Rural Collectors
GMMW	Gross Marketing Margin of Wholesalers
GVC	Global Value Chain
HRC	Holeta Agricultural Research Center
MVN	Multivariate Normal Distribution
MVP	Multivariate Probit
NGOs	Non-governmental Organizations
NMM	Net Marketing Margin
OLS	Ordinary Least Square
TGMM	Total Gross Marketing Margin
TLU	Tropical Livestock Unit
SNNP	Southern Nations Nationalities and Peoples' Region
SSA	Sub-Saharan Africa
2SLS	Two Stages Least Squares
UNIDO	United Nations Industrial Development Organization
USD	United State Dollar
VC	Value Chain
VIF	Variance Inflation Factor

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ABSTRACT

In Ethiopia, potato has great potential to improve the livelihood and food security status of many farmers in most highland areas and offers a pathway out of poverty due to its high yield potential, short maturity period and adaptability to diverse agro-ecologies. Majority of seed potato growers grow local potato varieties that are low yielding, susceptible to diseases and pests, and use poor quality seed saved from the previous harvest or obtained from the local market. This research attempted to analyze seed potato value chain in Welmera district, with specific objectives of identifying the determinants of seed potato marketed supply and market outlet choices of smallholder farmers in the study area. Primary data were collected from randomly selected 153 seed potato producers and 14 traders and analyzed using STATA software. Both descriptive, multiple linear regression and multivariate probit models were used to analyze data. Seed potato value chain actors were identified in the study area as input suppliers, producers, rural collectors, retailers, wholesalers, and cooperatives. Five seed potato market channels were identified where, the highest total gross margin (39.96%) was found in channel II (Producer → Rural Collector → Wholesaler → Retailer → Other seed potato producer).

Market performance analysis shows that highest gross marketing margin of producers in seed potato markets channels are 81.87%. Multiple linear regression model results show that five variables including, family size, yield of seed potato, farming experience, distance to nearest market, and area of land allocated for seed potato production significantly affected the quantity of seed potato supplied to the market. The multivariate probit model results indicated that eight explanatory variables including, quantity of seed potato sold, age of household head, educational level of the farm household, access to credit, ownership of transport facilities, land allocated for seed potato production, and access to market information significantly influenced seed potato producers' choices of alternative market outlets for their produce. Based on the findings government and other concerned stakeholders need to focus on improving farmers' knowledge and experience, encouraging adult education, expanding accessibility of market information and infrastructure, strengthening credit service to improve the income of the farmers through selecting the best outlet and improving land management practices and yield and volume sales of seed potato through strengthening extension service in order to accelerate market chain development.

Key words: Input supply system; Marketing margin; Seed potato; Value chain analysis; Ethiopia.

1. INTRODUCTION

1.1. Background and Justification

Potato is the world's third-most important food crop, cultivated in more than 150 countries on over 20 million hectares around the world, generating income for small- and medium-sized producers, and being consumed by more than one million people globally (Mickiewicz *et al.*, 2022). The production of vegetables is very important to Ethiopia's economy. Both commercial and small-scale farmers in Ethiopia cultivate a wide variety of vegetable crops, which are produced in different agro-ecological zones and used it as food and a source of income (Serbessa *et al.*, 2023). Vegetable production in Ethiopia can range from small-scale production for domestic markets to large-scale production for personal consumption (Hunde, 2017).

Ethiopia has been recognized as one of Africa's most important regions with the greatest potential for potato production, which contributes significantly to food security, increased agricultural revenues, poverty reduction, and cash income generation for smallholder farmers (Wubet *et al.*, 2022). However, the productivity of potato (13.3 t ha^{-1}) is very low compared to the world average (20.11 t ha^{-1}) as well as other African countries like South Africa (37.3 t ha^{-1}), Algeria (31.2 t ha^{-1}) and Egypt (29.2 t ha^{-1}) (Asnake *et al.*, 2023). Many diverse and complex biotic and abiotic factors are contributing for low productivity of potato including inappropriate agronomic practices, prevalence of disease and insect pests, poor soil fertility management, high cost of seed tubers, inadequate storage and marketing facilities (Menza *et al.*, 2014).

Potato is grown in most parts of Ethiopia, with the major ones including the central, eastern, northwestern and southern areas which cover approximately 83% of the potato farmers. Welmera district is one of the potential high land areas for potato production (Fikadu and Mulatu, 2023). Despite its immense potential, the average productivity of potato production on farmers' field is about (7 t ha^{-1}) in the study area and (13 t ha^{-1}) in overall potato growing areas in the country (Fikadu and Mulatu, 2023). This is very low as compared to an attainable level (25 t ha^{-1}) on farmers field and about (35 t ha^{-1}) on research fields (Tiruneh *et al.*, 2017). This low yields have largely been attributed to increasing incidences of pests and diseases, particularly late blight, bacterial wilt, nematodes, and viruses, most of which are seed-borne. In Ethiopia, use of low-quality seed potatoes by the majority of potato growers is associated with underdevelopment of the seed potato value chain (Hirpa Tufa *et al.*, 2016). One of the key challenges that emerge from

different analyses of the Ethiopian seed potato system is the limited availability and affordability of high-quality potato seeds at a local level (Tafesse *et al.*, 2020).

In the country, particularly in the study area, seed potato value chains are underdeveloped and participants along the chain are not well-coordinated (Abebe *et al.*, 2012). To suggest improvement options, knowledge on the performance of the seed potato value chains is important. However, currently there is a lack of knowledge on the seed potato value chains in the study area. To the best of author's knowledge there is no similar study conducted in the study area. The objective of this study is, therefore to examine the breadth and approach gap on seed potato value chain analysis in Welmera district.

1.2. Statement of the Problem

Ethiopia has a diverse climate and altitude conditions which are conducive to the production of different vegetable crops (Emana *et al.*, 2015a). Vegetable production is becoming an increasingly important activity in the agricultural sector of Ethiopia following the development of irrigation and increased emphases given by the government policy with respect to commercialization of agriculture focuses on those commodities that have export potential and high growth impact (Asfaw, 2021). Despite the increasing importance of vegetables in Ethiopia, there is inadequate knowledge on improved production practices and challenges by smallholder farmers in the country. According to Tadele *et al.* (2014), the results of the study shows that potato yields of small-scale farmers fall far below their potential due to a potent combination of inadequate supplies of high-quality seed or lack of well-organized seed production and supply system. According to Gebeyehu *et al.* (2024), the market and price of seed potato is mainly influenced by its abundance, prices of ware potato in the current or previous season, local legislation, and the activities of other actors such as brokers.

A study by Wubet *et al.* (2022), the main potato production constraints include shortage of land, traditional production systems, shortage of improved seed, high cost of inorganic fertilizer, and absence of modern production technology, low irrigation facility, and lack of adequate pesticide/herbicide. The major potato marketing constraints include the low price of the product during high supply, price fluctuation, lack of modern packaging services, lack of working capital, poor road condition, deficiency of market information, absence of standardized packing and weighing scales, and lack of policy framework in price-setting strategy.

According to Faris *et al.* (2018) study conducted on value chain analysis of potato in Dedo district, the results of the study revealed that constraints preventing potato value chain development, including shortages and high prices of improved seed, poor infrastructure and low storage facilities, poor linkages with other actors in the chain, the prevalence of disease and pests, and the perishability of the product. Degebasa (2019), the results of the study indicates that the main challenges to potato production in Ethiopia are due to limited knowledge on seed and ware potato production techniques, a lack of improved varieties and germplasm for diverse agro-ecologies, a shortage of quality and healthy seed tubers and planting material, diseases and pests, poor agronomic practices and irrigation practices, limited capacity, and a lack of formal seed systems (dominated by informal seed systems). Getnet *et al.* (2023) challenges in the seed potato systems in Ethiopia have been identified, including a lack of public-private partnerships for the seed potato value chain. This means that the public sector (which is responsible for providing basic seed and quality assurance, certification, and regulation) and the private sector (which is involved in the multiplication, distribution, and marketing of seed potatoes) do not work together effectively to ensure the availability and accessibility of quality seed potatoes for farmers.

In the study area, farmers grow two types of potato varieties: local and improved. The majority of potato growers grow local potato varieties that are low yielding, infested with diseases and pests. Improved potato varieties are high yielding, relatively clean, and disease tolerant. However, seed of improved potato varieties is not available to the majority of the farmers. The majority of seed potato growers use poor quality seed saved from the previous harvest or obtained from the market. The seed potato growers are associated with the underdevelopment of the entire seed potato value chain that results in low production and productivity of seed potato in the study area. Understanding the existing inputs supply systems, production and marketing systems of seed potato is important for developing/upgrading value chain in the study area.

In order to maximize the benefits that they may earn, farmers have to make appropriate decisions as to where and when they should sell their product. However, there are various factors that affect households' market outlet choice decision and supply their products to the market. Identifying these factors is very important in terms of investigating possible areas of interventions that may help farmers to maximize their benefits and to increase their income in potato production and marketing activities (Emana et al., 2015b). Mersha *et al.* (2017) studied

shows that education level of household head, household size, potato cultivated land size, quantity of potato produced, input cost, livestock ownership and access to market that affect households' potato market supply in the study area. Even though some related studies were carried out in different parts of the country, such study that provides empirical evidence for improving the production and marketing of seed potato has not been undertaken in the study area. Therefore, there is a strong need to make value chain analysis to analyze factors affecting quantity of seed potato supplied to the market and examine the determinants of market outlet choice decisions of seed potato producers in the study area.

1.3. Objectives of the Study

1.3.1. General objective

The general objective of this study is to analyze value chain of seed potato in Welmera district, West Shewa Zone, Oromia, Ethiopia.

1.3.2. Specific Objectives

1. To identify seed potato value chain actors, their roles and benefit shares in the study area.
2. To analyze factors affecting quantity of seed potato supplied to the market and
3. To examine the determinants of market outlet choice decisions of seed potato producers.

1.4. Research Questions

1. Who are the major actors' of seed potato value chain and who gets more benefits in the study area?
2. What are the factors affecting quantity of seed potato supplied to the market in the study area?
3. What are the determinants of market outlet choice decisions of seed potato producers?

1. 5. Significance of the Study

This study provides information on the seed potato value chain actors, marketing margin, benefit share of actors, factors affecting quantity of seed potato supplied to the market, and determinants of market outlet choice decisions of seed potato producers in the study area. Market-oriented production is intended to strengthen producers and traders to increase their competitiveness to domestic, regional and export markets. But when different bodies involved producing a product there could be problems that reduce efficiency and effectiveness of the value chain as a whole. The information generated could help a number of organizations for research and development

organizations, traders, producers, policy makers, extension service providers, government and non-governmental organizations to assess their activities and redesign their mode of operations and ultimately influence the design and implementation of policies and strategies. It could help different actors to identify and analyze new ways of stimulating innovation. It could also be used by students and researchers as a reference for further study.

1.6. Scope and Limitations of the study

The study is based on one-year data and is limited to one district and to one most economically important seed root tuber (seed potato) crop. Hence, the study is limited spatially as well as temporally to make the study more representative in terms of wider range of area and time horizon. Despite these limitations, the findings of the research provide important basis for relevant interventions for the study area.

1.7. Organization of the Thesis

The thesis has been organized under five chapters. Chapter one pinpoints background, statement of the problem, research questions, objectives, significance of the study, scope and limitations of the study and organization of the thesis. Chapter two presents review of empirical evidences to the study. Chapter three discusses research methodology (description of the study area, data types and sources, methods of data collection, sampling techniques and methods of data analysis) of the study. Chapter four presents result and discussions (descriptive, value chain analysis and econometric results) are presented and discussed in detail. Chapter five draws conclusion and appropriate recommendations.

2. REVIEW OF LITERATURE

In this part of the study the History of value chain, Basic definitions and concepts of value chain, Agricultural value chain analysis, Methodology for value chain analysis, Importance of value chain in agricultural sector, Purpose of the value chain analysis, Dimensions of value chain analysis, Value chain approach, Seed potato production and marketing in Ethiopia and empirical reviews would be discussed.

2.1. Basic Definitions and Concepts of Value Chain

Production: It is the process of converting inputs into outputs through the physical transformation of ideas and designs into reality on the ground in the form of physical products or services provided to customers, and in industrial economic units, production activities take the largest share of costs because they include the cost of raw materials and molding cost (Horngren *et al.*, 2009).

Value chain: is the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use (Kaplinsky and Morris, 2000).

Supply chain: refers to the entire vertical chain of activities from production on the farm, through processing, distribution and retailing to the consumer (Hobbs *et al.*, 2000).

Supply chain management is about making the chain as efficient as possible through better flow scheduling and resource use, improving quality control throughout the chain, reducing the risk associated with food safety and contamination, and decreasing the agricultural industry's response to changes in consumer demand for food attributes (Dunne, 2001) .

Value chain analysis: is seeks to characterize how chain activities are performed and to understand how value is created and shared among chain participants (Kaplinsky and Morris, 2000).

Marketing: It is the contact with individuals and groups in order to introduce them to the products and services of the current and new economic unit, as well as to familiarize them with the features and characteristics of these products and services. The marketing activity includes a collection of sub activities represented in advertising activities, packaging activities, printing and publication activities and etc (Elbert *et al.*, 2016).

Market chain: It is the term used to describe the various links that connect all the actors and transactions involved in the movement of agricultural goods from the producer to the consumer (Lundy *et al.*, 2004).

Marketed surplus: It shows quantity actually sold after accounting for losses and retention by farmers, if any and adding previous stock left out for sales. Thus, marketed surplus may be equal to marketable surplus, it may be less if the entire marketable surplus is not sold out and farmers retain some stock and if losses are incurred at the farm or during transit (Thakur *et al.*, 1997).

Marketable surplus: It is the quantity of produce left out after meeting farmers' consumption and utilization requirements for kind payments and other obligations (gifts, donation, charity, etc) (Thakur *et al.*, 1997).

Market channel: is a business structure of interdependent organizations that reach from the point of product or origin to the consumer with the purpose of moving products to their final consumption or destination (Armstrong and Kotler, 2003).

Marketing performance: can be evaluated by analyzing costs and margins of actors in different channels. A commonly used measure of system performance is the marketing margin or price spread. Margin or spread can be useful descriptive statistics if it used to show how the consumer's price is divided among participants at different levels of marketing system (Mendoza, 1995).

Marketing costs: are the embodiments of barriers to access to market participation by resource poor smallholders. It refers to those costs, which are incurred to perform various processes along different channels. Further, marketing costs like handling cost (labor, loading and unloading, costs of damage, transportation and etc.) to reach an agreement, transferring the product, monitoring the agreement to see that its conditions are fulfilled, and enforcing the exchange agreement (Holloway and Ehui, 2002).

Marketing margins: is the percentage of the final weighted average selling price taken by each stage of the marketing chain. The total marketing margin is the difference between what the consumer pays and what the producer/farmer receives for his product. In other words it is the difference between retail price and farm price (Cramer, 1982). Marketing margin is a commonly used measure of the performance of a marketing system (Abbott and Makeham, 1979).

Market structure: refers to the number and relative size of distribution of buyers/sellers in the market. It is generally believed that higher market concentration implies a noncompetitive

behavior and thus inefficiency. But, studies also warn against the interpretation of such relationships in isolation (Scott, 1995). The organizational features of a market should be evaluated in terms of the degree of seller concentration, entry barriers (licensing procedure, lack of capital, know-how, and policy barriers), degree of transparency and degree of product differentiation that condition or influence the conduct and strategies of competitors (Amha, 1994).

Market conduct: refers to the strategies that firms pursue with regard to price, product and promotions, and the linkages/relationships between and among firms. The market behavior of firms will determine whether or not they compete and whether they are acting innovatively to improve market efficiency. Informal association between even a small numbers of firms (collusion) can cause price distortions, and seemingly independent firms can have joint ownership (subsidiaries) (Urgessa, 2011). Market conduct deals with the behavior of firms that are price-searchers are expected to act differently than those in a price-taker type of industry (Cramer, 1982).

2.2. Agricultural Value Chain Analysis

An agricultural value chain is defined as the people and activities that bring a basic agricultural product like vegetables from obtaining inputs and production in the field to the consumer, through stages such as processing, packaging, and distribution.

Value chain analysis seeks to investigate how producers engage in activity steps to deliver values to consumers. According to Westlake (2005) ‘value chain’ in agriculture identifies the set of actors and activities that bring a basic agricultural product from production in the field to final consumption, where at each stage value is added to the product.

A value chain can be a vertical linking or a network between various independent business organizations and can involve processing, packaging, storage, transport and distribution. The terms “value chain” and “supply chain” are often used interchangeably.

Traditional agricultural value chains are generally governed through spot market transactions involving a large number of small retailers and producers.

Modern value chains are characterized by vertical coordination, consolidation of the supply base, agro-industrial processing and use of standards throughout the chain.

2.4. Methodology for Value Chain Analysis

2.4.1. Value chain mapping

According to Herr and Muzira (2009) creating a visual representation of the linkages between firms in value chains as well as other market stakeholders is what mapping a value chain entails. It's a graphic representation of a value chain's primary product transactions. A value chain map is useful for comprehending the process, identifying and categorizing key players, depicting supporting institutions and enabling settings, and displaying various market chains and channels.

2.4.2. Identification of value chain actors

Identification of primary actors, supporting actors, commodity movement, information flow, gross output values, job prospects, and product destination should all be included in a value chain analysis (Emana and Nigussie, 2011). According to Kaplinsky and Morris (2001) value chain mapping of inputs, commodities, and services assists each industry in identifying the essential role actor for corporate success. Profitability analysis, physical flow of commodities, flow of services, job opportunities provided along the value chain players, sales destination (concentration of sales among the major actors and number of buyers), and commodity imports and exports should all be included in this stage.

According to Emana and Nigussie (2011) there are three types of value chain actors:

Value chain core actors: the fundamental actors in the value chain are those who engage directly with the products and are involved in their production, processing, trading, and ownership. Input providers, producers, itinerant collectors, assembly traders, wholesalers, retailers, and processors all fall within this category.

Value chain supporters: value chain supports are actors in the value chain who do not directly interact with the product but whose services provide value to it. They help by providing market data, market intelligence, technical and business training, facilitating producer-buyer connections, and organizing and supporting collective marketing. Credit and savings services, banking services, risk insurance services, and futures markets are all examples of financial support services.

Value chain influencers (enabling environment) the regulatory framework, laws, trade agreements, and public infrastructures at the local, national, and international levels.

2.4.3. Value chain upgrading

Upgrading the chain enhances the production process, product quality, chain functions, and relationships with other chains. It was accomplished by employing innovations in the form of new information and technologies (UNIDO, 2011). According to Kaplinsky and Morris (2001) upgrading in firms can take place in the form of:

Process upgrading: increasing the efficiency of internal processes such that these are significantly better than those of rivals, both within individual links in the chain, and between the links in the chain.

Product upgrading: introducing new products or improving old products faster than rivals. This involves changing new product development processes both within individual links in the value chain and in the relationship between different chain links.

Functional upgrading: increasing value added by changing the mix of activities conducted within the firm or moving the locus of activities to different links in the value chain.

2.5. Importance of Value Chain Analysis

Kinney and Raiborn (2011) Value chain analysis means the testing each of its activities and determining whether it add value or not, and an indication of whether these activities represent a competitive advantage or not. According to Sweeney (2009) the focus will be on activities that add value to both the economic unit and the customer and work to strengthen them, and on the other hand, the non-value added activities will be reduced or completely eliminated, which results in a reduction in the unjustified costs associated with these activities.

2.6. Purpose of the Value Chain Analysis

According to Al-Sfan *et al.* (2022) the primary purpose of value chain analysis is to achieve the strategic objectives of the economic unit represented by reducing the costs associated with non-value added activities in addition to improving quality and reducing response time for the customer and thus improving the processes performance of this unit, therefore, the value chain analysis focuses on identifying the most important sources available to the economic unit that enable it to achieve and maintain competitive advantage, and this is done by gathering activities different activities and identifying their strengths and weaknesses as well as working on reinforcing the strengths and addressing weaknesses in a way that helps improve the performance of the economic unit in general.

2.7. Dimensions of Value Chain Analysis

2.7.1. Boundary of analysis

Most studies of value chains focus on the intra-firm standpoint, consistent with Porter's original value chain concept (Fearne et al., 2012). However, value chains are now being viewed more and more as systems of multiple firms, where each firm recognizes the need for harmonized strategies along the length of the chain.

2.7.2. Scope of value considered

In the analysis of value chains, it is important to look into the sources and beneficiaries of the value created by the chain. While it is essential to focus on customer value, there is need for value chain analysis to be more dynamic and explore how activities and attributes affect consumer behavior, since individual customers evaluate a product's attributes differently, considering among many other factors, their gender, culture and socio-economic status, which influence their ability and willingness to buy and pay for their purchases (Fearne *et al.*, 2012). It is therefore appropriate for value chain analysis to identify and work within specific market segments, instead of regarding customers as a single homogenous group.

2.7.3. Governance

According to Gereffi (1994) defines governance as “authority and power relationships that determine how financial, material, and human resources are allocated and flow within a chain.” According to Fearne *et al.* (2012) observed that some earlier studies that applied value chain analysis limited their investigation to identifying the flow of materials and information.

2.8. Value Chain Approach

According to Humphrey and Navas-Alemán (2010), two approaches to the promotion of value chains can be distinguished:

2.8.1. Structure-oriented approach

The business relationships between the actors participating in a value chain are the central focus of the promotion. The structure-oriented approach is geared towards finding points of contact for cooperation with the private sector. At the same time, supporting organizations on the meso level (state and private advisory organizations, financial services providers) are included in the promotion in order to improve the access of value-chain actors to innovations and services and to ensure the sustainability of the promotion.

2.8.2. Firm-centric approach

In contrast, places the primary emphasis on supporting business relationships of local firms and producers with selected, mainly transnational firms. These firms shape the value chain – they determine what is produced and how; they specify the product and the production method and thereby influence the barriers to entry. At the same time, these firms are able to shape business relationships with local firms in such a way as to improve the competitiveness and market access of producers, by such means as farmers' organizations or contract farming.

2.9. Value Chain Actors for Seed Potato

In the value chain for seed potato (Figure. 1), linked actors produce seed potato of different generations, starting with pathogen-free seed from a laboratory and ending with use by ware producers. Seed moves from actor to actor across the chain, as the output of each generation of seed provides the input to the next, and money to purchase the seed moves in the opposite direction.

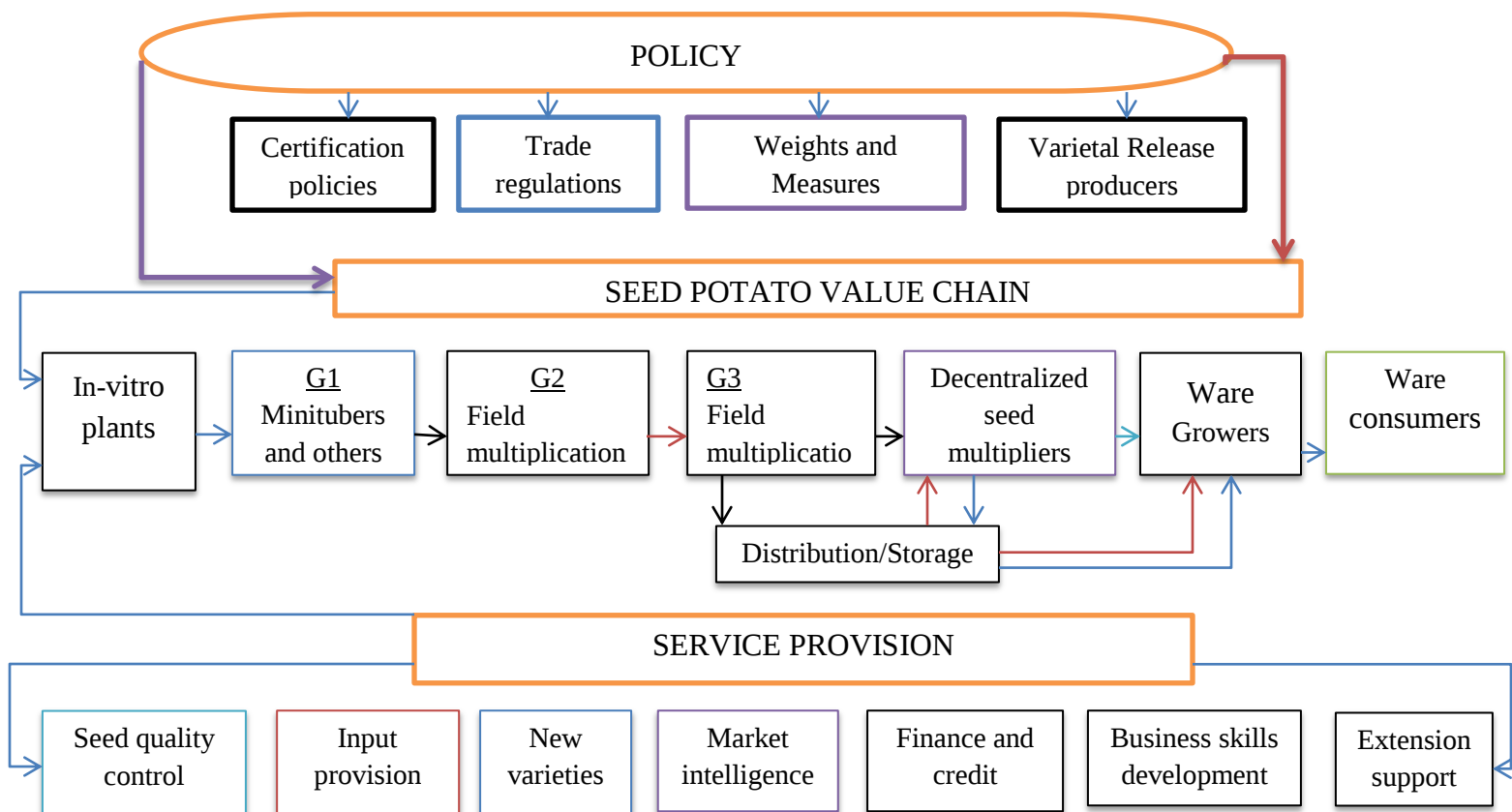


Figure1: Seed potato value chain.
Source: Thiele et al. (2011)

2. 10. Seed Potato Production and Marketing in Ethiopia

2.10.1. Seed potato production in Ethiopia

Potato was top ranking among root and tuber crops contributing 81.7% and 83.7% for area coverage and production tonnage, respectively (Tessema *et al.*, 2023). Potato is the first among root and tuber crops in terms of area allocated for food production and tonnage and one of the major staples consumed across the country. There are about 5 million smallholder potato producers in Ethiopia; however, ~3.7 million (77.3%) potato producers are found in three of the nine regions; Oromia, Amhara, and Southern Nations Nationalities and Peoples' Region (SNNP). The average yield of potato in Ethiopia in 2020 was estimated to be 13.3 ton ha⁻¹ (Tessema *et al.*, 2023), which is lower than the world and African averages. This yield can be easily doubled with improved quality seed potato production and delivery coupled with better crop management practices.

Generally, in all areas of Ethiopia, there is no separate plot and management for ware and seed potato production. Mostly, potato tubers are sorted into ware and seed immediately after harvest. For most potato producers seed potato is usually considered as the by-product of ware potato. In the central and northwestern areas, some farmers practice positive selection and some grow seed potatoes on a separate piece of good quality land (Kaguongo *et al.*, 2007).

2.10.2. Seed potato storage methods in Ethiopia

The methods and conditions of storing seed potato affect the sprouting and quality and eventual field performances. Seed potato storage conditions must preclude all manner of insect infestation and damage, especially potato tuber moth and aphid (Gebeyehu *et al.*, 2024). Seed potato storage is a common practice in all potato producing areas of Ethiopia. Many farmers are commonly store seed as a source of future income. Farmers store seed potato by leaving the tubers in the soil un-harvested (postponed harvesting); by other traditional storage methods like in a local granary, on bed-like structures or the floor in their house; or by diffused-light storage. Because of storage and other postharvest problems Ethiopia loses 30–50% of its potato production (Endale *et al.*, 2008). In the central and northwestern areas of Ethiopia only 5% of potato farmers were found to use diffused-light storage (Gildemacher *et al.*, 2009) but the use of diffused light storage for seed tubers of improved varieties is becoming common in the central area of Ethiopia.

About 87% of the farmers in the central area and 25% in the northwestern area were found to use diffused light storage for storage of seed potatoes of improved varieties (Tesfaye *et al.*, 2008).

2.10.3. Seed potato systems in Ethiopia

Seed systems can be defined as the ways in which farmers produce, select, save and acquire seeds (Sthapit *et al.*, 2008). There are two broad categories of seed systems operating currently in Ethiopia: formal and informal. The formal seed system involves a legal and regulated process of seed certification and serves as a source of improved crop varieties. However, more than 90 percent of the seed requirement in Ethiopia is met through the informal system in which seeds to be used for planting are produced and distributed by farmers without regulation (Atlaw and Korbu, 2011, Alemu, 2011, Emanu and Nigussie, 2011, Sisay *et al.*, 2017, Fentie, 2021, Mulesa *et al.*, 2021).

The informal seed potato system is a seed potato system in which tubers to be used for planting are produced and distributed by farmers without any regulation. This seed system exists in all potato growing areas of Ethiopia (Hirpa *et al.*, 2010). The alternative seed potato system is a seed potato system that supplies seed tubers produced by local farmers under financial and technical support from NGOs and breeding centers.

2.10.4. Seed potato marketing in Ethiopia

The price of seed is usually two to three times that of ware potato. If ware potato was expensive in the previous season, it is likely to drive the price of ware potato upwards in the subsequent season. When farmers sell ware potato at competitive prices, they are likely to invest part of the earnings in quality seed or other improved farm inputs to maintain high and quality yield of ware potato. In stable markets, the price of seed is about two to three times that of ware potato and seed contributes 40–60% of the cost of ware potato production (Demo *et al.*, 2015).

2.11. Review of Empirical Studies

According to Devaux *et al.* (2014) potato is the third most important consumed crop in the world, playing a vital role in food and nutrition security in many countries. Particularly, in the face of the rising global population, the role of this crop is significant in enhancing food supply. However, due to biotic and abiotic conditions, the actual yield of potato is much lower than its potential yield. According to Haverkort and Struik (2015) a recent studied there is a gap of 10% to 75% between the actual and potential yield of potato due to various socio-ecological

problems. In East Africa, where the livelihood of millions of smallholder farmers depends on potato, poor quality seed and bacterial wilt have been identified as main yield gap drivers (Harahagazwe et al., 2018). Reducing the yield gap due to complex socio-ecological problems such as bacterial wilt can therefore improve the livelihood of millions of smallholder farmers.

According to Tolessa (2019) among African countries, Ethiopia has the most potential of potato production because of the highlands comprises 70% of the country and home to higher percent of the population. According to Sharma *et al.* (2018) annual potato crop production is currently valued at more than USD 1.16 billion, and over 3.7 million smallholder farmers are growing the crop in the country. To enhance quality seed potato availability in the country, hundreds of seed potato cooperatives have been established during the last decade (Sisay et al., 2017). The seed potato cooperatives have been able to enhance seed availability in the country (Ayana *et al.*, 2013).

According to Sisay *et al.* (2017) more than 20% of the national seed potato demand was supplied by seed potato cooperatives in Ethiopia. Despite the improvement in the availability of seed potato, poor seed quality has remained a major constraint. The use of poor quality seed spreads various potato diseases from one area to the other. According to Abdurahman *et al.* (2017) the recent studies showed that bacterial wilt has spread nationwide and is embedded in the country's seed potato system due to the uncontrolled movement of latently infected seed. According to Wondim and Desselgn (2018) study conducted value chain analysis of potato in South West Gojam Zone, the actors involved in potato value chain were producers, traders (input suppliers, collectors, wholesalers, retailers, and processors), and end consumers.

Fentie *et al.* (2020) study conducted value chain analysis of potato he identified two potato value chain actors were, direct actors those are input suppliers, producers, traders, consumers and indirect actors were those that provide financial or non-financial support services, such as government offices, research institutions, credit agencies, business service providers, NGOs and cooperatives. According to Tadesse and Bakala (2018) conducted value chain analysis of potato in Sheka Zone, Southwest Ethiopia, major actors in potato value chain were seed and other input suppliers, farmers, traders and consumers but in potato value chain in the study area there were no processors.

2.11.1. Factors affecting quantity of seed potato supplied to the market

According to Geremewe *et al.* (2019b) estimates of the parameters of the variables expected to determine the marketable supply of potato by using ordinary least square model. Among the hypothesized twelve explanatory variables in his result five variables were found to significantly affecting marketed surplus of potato. Among this only distance to nearest market affect negatively while use of improved seed, frequency of extension contact, land allocated for potato production and yield affect significantly and positively.

According to Abduselam *et al.* (2018) conducted value chain analysis of potato in Dedo district of Jimma zone, Ethiopia. In his study he examined determinants of potato marketed surplus using Maximum likelihood estimates of Tobit model for potato marketed surplus. The result of the model indicated that out of thirteen important explanatory variables included in the Tobit model, about seven variables were found to statistically significant. Among this two variables age of house hold head and non-farm income, were negatively influenced and five variables active family labor, land allocated for potato , access to improved seed, access to credit and number of extension contact, were positively influenced potato marketed surplus by producers.

According to Fentie *et al.* (2017) studied explanatory variables were hypothesized as factors affecting household level marketed surplus of potato. Among this hypothesized variables, six variables are found to significantly affecting marketed surplus of potato by using multiple linear regression estimation result indicated that only distance to all-weather road is significantly and negatively influence potato marketed surplus while total livestock unit, land size allocated for potato production, irrigation access, other farm income and lagged price as significantly and positively influence potato marketed surplus. According to Bazie (2016) studied from the hypothesized variables the result of the multiple linear regression models indicates marketed surplus of potato was significantly affected by distance to all weather roads, number of livestock, potato land size, irrigation access, cash income from other farm activities and lagged price. All of these variables affect marketed surplus positively except distance to all-weather road. According to Woldesenbet (2013b) using multiple regression model indicated that marketable supply is significantly affected by access to extension service, access to market information, vegetable farming experience and quantity of potato produced. The result shows that quantity of potato production significantly affected by access to extension service, access to market information,

vegetable farming experience, sex of the household head, age of the household head and quantity of fertilizer application.

2.11.2. Determinants of market outlet choice decisions of seed potato producers

According to Emanu et al. (2015b) study conducted factors affecting market outlet choice of potato producers, the result of multinomial logit model indicated that farming experience, farmers' bargaining power, quantity of potato sold, access to market information, and distance to the nearest market are among the significant variables in affecting choice selections. Chalwe (2011) studies similar findings explained the direct or positive relation between market channel choice decisions of different products with quantity sold, access to market information, and distance to the nearest market.

According to Edossa *et al.* (2019) the study conducted factors affecting potato market outlet choices of smallholder potato producers the result of multivariate probit model indicated that only distance from the market were significantly and positively influenced collectors outlets while education level of the household heads, family size, current market price of potato and post-harvest value addition activities were significantly and negatively influenced collectors outlets. Education level of the household head, family size, current market price of potato and farm size were significantly and positively affected wholesalers outlets. Out of 11 hypothesized variables only distance from the market was significantly and negatively influenced the retailer's outlets. According to Geremewe et al. (2019b) using multivariate probit model result indicated that experience in potato production, distance to nearest market, land allocated for potato production, quantity of potato supplied to market, frequency of extension contact and amount of credit taken significantly influenced market outlet choice for potato producers.

2.12. Conceptual Framework of the Study

The conceptual framework is essential as a guideline in identifying important variables and for effective and efficient data collection. Based on the evidence through theoretical concepts and empirical studies, a framework is presented in multi-dimensional content in nature (socio-economic factors, production factors, institutional factors, and marketing factors) which is an influence on seed potato market supply and market outlet choices. Augmentation in the quantity of seed potato supplied to the market leads producers to select alternative market outlets to sell their supply that maximize profit, which in turn results household income increase. With this

ground, the value chain of seed potato conceptual framework was constructed, as illustrated in figure 2.

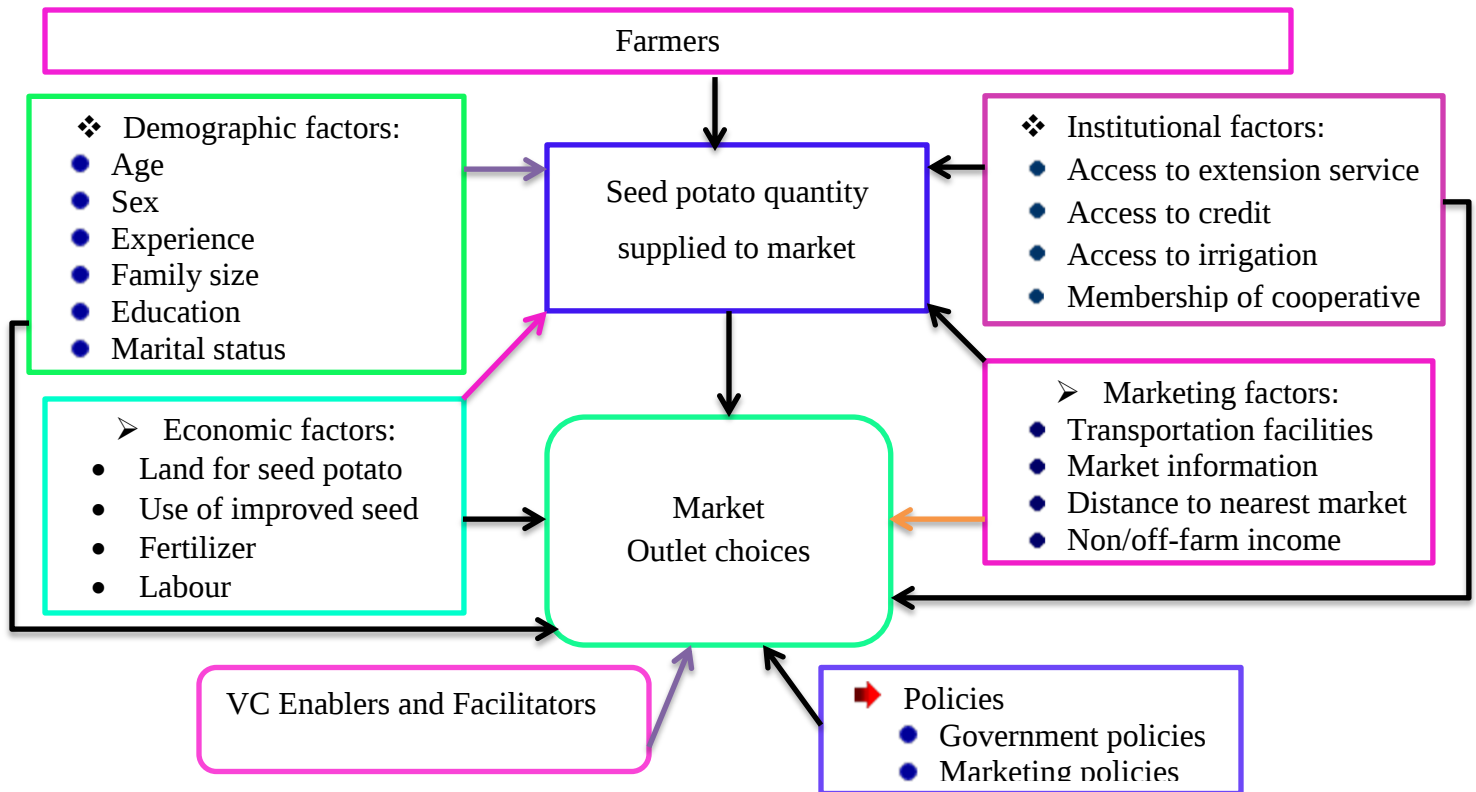


Figure 2: Conceptual framework of the study area

Source: Own sketch from survey results, 2023

3. METHODOLOGY

In this chapter, description about the study area, research design and approach, data types and sources, sampling procedure, methods of data collection and data analysis, and explanation on hypothesized variables are discussed.

3.1. Description of the Study Area

The study was conducted in Welmera district, which is located in Oromia Regional State, Central Ethiopia (Figure 3). Welmera district is one of 25 districts found in West Shewa Zone, Oromia, Ethiopia. The district is located 30 km west of Addis Ababa, the capital city of the country along Ambo road. Holeta town is the seat of the district. The area is bordered by Sebeta Hawas district on the south, Ejerie district on the west, Mulo district on the north, Sululta on the northeast and Sheger city (Burayu) administration on the east. The district has 18 peasant associations. The total land area is about 80,927 hectares, of which 37411 hectares are farmlands or under cultivation. The altitude of the district ranges from 2060 m a.s.l. to 3380 m a.s.l (Gudina and Alemu, 2023).

Geographically, the district is located at 09° 02' 34"N to 09° 06' 46"N and 43° 02' 02"E to 43° 05' 38"E. The total population is estimated to be 104,143, with 52,403 men and 51,740 women. Welmera district is classified into two agro-ecological zones: namely, Highland (Dega) and Midland (Woynadega). Highland (Dega) accounts for 61% of the total, while the midland (Woynadega) account for approximately 39% (Bureau of Agriculture, 2023). The area is characterized by bimodal rainfall pattern with mean annual rainfall of 970 mm. The main rainy season spans from June to September and accounts for 70% of the rainfall, while the remaining 30% is received during short rainy season (Belg), which spans from February to April (Bureau of Agriculture, 2023). The mean maximum, minimum and mean annual temperatures of the study area were 22.8, 6.2, and 14.5°C, respectively. Agriculture is the main livelihood of the study area. The major farming system in the area is mixed crop-livestock production where crop production and livestock rearing take place simultaneously. The major vegetables grown in the district include potato, beet root, lettuce, carrot, tomato, head cabbage, and onion. The major crops grown in the district include teff, wheat, barley and faba bean, while the livestock rearing include cattle, sheep, and goats, equines and poultry production. The majority of the land of the district (65.83%) is under cultivation. Natural vegetation covers about 19.64% of the land area of

the district, while the remaining 4.49% and 10.01% are grassland and other land uses, respectively (Bureau of Agriculture, 2023).

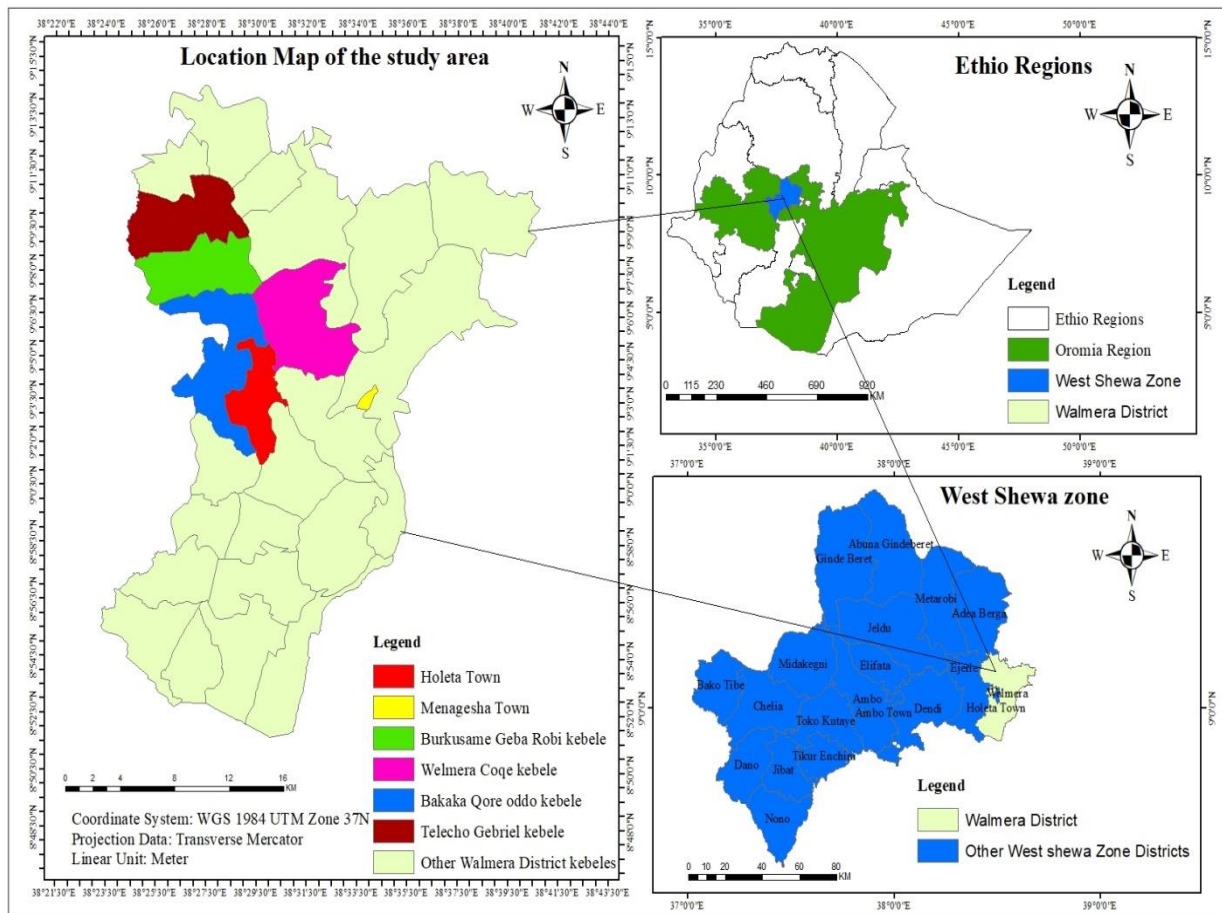


Figure3: Map of the study area
Source: Own sketch

3.2. Research Design and Approach

3.2.1. Research design

This study was taken on cross sectional survey research design since the main aim is to analyze and make deductions on the concerns that exist in seed potato value chain. The study focuses on Welmera district because this district is the key production area of seed potato. The target population for this study was made up of those farmers who practice seed potato production. At the level of the district selected, the choice of kebeles for the survey conducted on the basis of the importance of their total seed potato production in the district. This selection was carried out in collaboration with expertise of agriculture office in the Welmera district.

3.2.2. Research approach

Both quantitative and qualitative approach was used. The quantitative approach was applied to conduct quantifiable and empirical data with respect to the study area, through questionnaires was distributed to sample respondents and traders. The qualitative approach was applied to conduct in depth analysis of data collected through semi-structured interview and nonparticipant observation in qualitative way.

3.3. Types and Sources of Data

In this study, both qualitative and quantitative data types were collected. A both primary and secondary data sources were used. Secondary data sources were collected from Welmera District Bureaus of Agriculture, Welmera District Office of Irrigation and Development Authority, District Trade and Market Development Office and its associated primary cooperatives and Central Statistical Authority (CSA), published and unpublished reports, bulletins, and websites. Primary data was collected from 2022/23 cropping season using personally administered structured questionnaires and through observation method. Primary data sources were collected from smallholder farmers from four randomly selected seed potato producer kebeles and seed potato traders (collectors, retailers, and wholesalers).

3.4. Sampling Procedure and Sample Size Determination

Three stages random sampling procedure was used for the selection of sample household heads. In the first stage, Welmera district was selected purposively based on the potential of seed potato production. In the second stage, out of 18 kebeles in the district, 4 potential seed potato producers' kebeles namely, Rob-Gabeya, Bakaka Qore Oddo, Welmera Coqe and Talecho were randomly selected.

In the last stage, from 7790 seed potato producers in Welmera district about 153 samples of household heads were randomly selected, using probability proportional size following a simplified formula provided by Yamane (1967). Therefore, the required sample size at 95% confidence level with degree of variability of 5% and level of precision equal to 8% are used to obtain a sample size required which represent a true population (Table 1)..

$$n = \frac{N}{1 + N(e)^2} = \frac{7790}{1 + 7790(0.08)^2} = \frac{7790}{50.856} = 153 \text{ --- (1)}$$

Where, N = Population size,

n = sample size and

e = level of precision considered 8%.

Table 1: Sample distribution of seed potato producers in selected kebeles

No.	Kebeles	Total number of seed potato producers	Proportionality	Number of sampled households
1	Rob-Gabeya	172	0.236	153*0.236 =36
2	Bakkaka Kore Oddo	180	0.247	153*0.247 =38
3	Welmera Coqe	186	0.255	153*0.255 =39
4	Talecho	189	0.259	153*0.259 =40
Total		727		153

Source: Welmera District Agriculture Office, 2023.

For this study, primary data was collected from traders. The sites for the trader surveys were market towns in which a good sample of seed potato traders existed. On the basis of flow of seed potato, four markets (Holeta, Ejere, Menagesha and Finfinne) were selected as, the main seed potato marketing sites for the study area. Here traders sampling was very difficult task due to absence of recorded list of population of traders and the opportunistic behavior of the traders. Hence a purposive sampling method was used to select wholesalers, rural collectors and retailers from specified markets. Union/cooperatives were selected based on flow of seed potato selling to

farmers and any institution. Finally, 14 seed potato traders were selected for the purpose of the study.

3.5. Methods of Data Collection

They are the tools for data collection. Primary data were collected through both participatory research approach (key informant interview, focus group discussion and field observation) and formal survey. A preliminary assessment was conducted to collect basic information about the study area and select four representative kebeles. They include questionnaire, interview, focus group discussion; and observation was designed in such a way that they could generate as much information as possible in order to address the research questions and objectives of the study. The questionnaire was designed both for producers and traders (rural collectors, retailers and wholesalers).

Before the actual field survey, a prepared structured questionnaire was pre-tested on five seed potato producers in rural area and three seed potato traders in urban area to evaluate the appropriateness of the design, clarity and interpretation of the questions, relevance of the questions and to estimate time required for an interview. The questionnaire covered different topics in order to capture relevant information related to the study objectives. After some modifications, the questionnaire for seed potato producers and traders were finalized.

The formal survey was conducted through formal interviews with randomly selected farmers and purposively selected traders and required information was collected. Focus group discussions were held at the study site with some farmers to understand the problems they had faced in the production and marketing of seed potato. Focus groups allow for interactions between the researcher and the participants and among the participants themselves. A total of eight key informants were interviewed with an unstructured questionnaire and both quantitative and qualitative information were gathered regarding the situation of production and marketing of seed potato, availability of different facilities, organization roles, challenges and opportunities, and the relationship between the actors. Enumerators who have degree certificate were recruited and trained for data collection. Structured interviews was conducted with four extension agents one from each kebele.

3.6. Methods of Data Analysis

Methods of data analysis, namely descriptive statistics, value chain performance and econometric analysis were used for analyzing the data collected from seed potato producers and traders.

3.6.1. Descriptive analysis

Descriptive statistics such as frequency, mean, percentage, and standard deviation was used.

3.6.2. Analysis of seed potato value chain performance

Market performance of seed potato: Estimating marketing margin and cost components is the best tool to analyze the seed potato value chain performance. Marketing margin measures the share of the final consumer price that is taken by a particular agent in seed potato value chain. In analyzing market margin, first the total gross marketing margin (TGMM) was calculated.

The formula to calculate TGMM is given as:

$$\text{TGMM} = \frac{\text{Final Consumers' Price} - \text{Producers' Price}}{\text{Final Consumers' Price}} \times 100 \text{ --- (2)}$$

Where, TGMM = Total gross marketing margin.

Producer's gross marketing margin" (GMM) which is the portion of the price paid by the end consumer that belongs to the farmer as a producer. It should be emphasized that growers that as middlemen also receive an additional marketing margin.

The producer's margin is calculated as:

$$\text{GMMp} = \frac{\text{Consumers Price} - \text{Marketing Gross Margin}}{\text{Consumers Price}} \times 100 \text{ --- (3)}$$

$$\text{or GMMp} = 1 - \text{TGMM}$$

Where, GMMp is = the producer's share in consumer price

The net marketing margin (NMM) is the percentage of the final price earned by the intermediaries as their net income after their marketing costs are deducted. Thus, the net marketing margin is calculated as:

$$\text{NMM} = \frac{\text{Gross Marketin Margin} - \text{Marketing Costs}}{\text{Consumer Price}} \times 100 \text{ --- (4)}$$

The higher NMM or profit of intermediary will decrease the profit share of the smallholder farmers.

3.7. Econometric Model

An econometric analysis deals with the analysis of determinants of seed potato supplied to the market and decisions of farmers' choice in market outlet. For managing this, appropriate model were used to multiple linear regression model for the first and Multivariate probit (MVP) model for the second.

3.7.1. Determinants of seed potato market supply

The econometric analysis used to estimate the causal relationship between the dependent variable and the explanatory variables. Multiple linear regressions were used to analyze the determinants of seed potato supplied to the market as all sample households supply these seed potato to the market. However, when some of the assumptions of the Classical Linear Regression (CLR) model are violated, the parameter estimates of the above model may not be Best Linear Unbiased Estimator (BLUE). Thus, it is important to check the presence of heteroscedasticity, multicollinearity and endogeneity problem before fitting important variables into the regression models for analysis.

The problem of endogeneity occurs when an explanatory variable is correlated with the error term in the population data generating process, which causes, the ordinary least squares (OLS) estimators of the relevant model parameters to be biased and inconsistent. The source of endogeneity could be omitted variables, measurement error and simultaneity (Maddala and Lahiri, 1992). Both Hausman test and Durbin-Wu-Hausman (DWH) test were applied to check the presence of endogeneity.

Econometric model specification of supply function in matrix notation is as follows:-

$$Y = X'\beta + U \text{ — — — — — (5)}$$

Where: Y = a vector of quantity of seed potato supplied to market, X' = a vector of explanatory variables, β = a vector of parameters to be estimated, U = disturbance term.

Multicollinearity problem arises due to a linear relationship among independent variables; and becomes difficult to identify the separate effect of independent variables on the dependent variable because of the existence of strong relationship among them (Tay, 2017). Multicollinearity problem among explanatory variables had been checked using the Variance Inflation Factor (VIF). As a rule of thumb, if the VIF is greater than 10 (this will happen if R^2 is

greater than 0.90), the variable is said to be highly collinear. A measure of multicollinearity associated with the variance inflation factors is computed as:

$$VIF (X_j) = \frac{1}{1 - R_j^2} \quad (6)$$

Where; R_j^2 represents a coefficient for determining the subsidiary or auxiliary regression of each independent continuous variable X .

Heteroscedasticity is a situation in which variance of the disturbance term is not constant. If there is heteroscedasticity problem in the data set, the parameter estimates of the coefficients of the independent variables cannot be BLUE. Breusch-Pagan test of heteroscedasticity was employed for detecting heteroscedasticity.

3.7.2. Variables selection, definition and working hypothesis

In the case of identifying factors influencing seed potato supplied to the market and market outlet choice decision, the main task was exploring which factors potentially influence and how these factors are related with the dependent variables.

3.7.2.1. Variables used for seed potato market supply

Dependent variable:

Quantity of seed potato supplied to market (QSOLD): It is a continuous dependent variable used in the multiple linear regression model equation. It determines the actual supply of seed potato in 2022/23 production season by individual household to the market, which is measured in quintal (100kg).

Independent Variables:

Yield (YILDSPOT): It is an economic factor and continuous variable that can affect the household level volume sales and measured in quintals per hectare during survey year. Productivity is assumed to affect the volume supply positively, because a farmer that obtains high yield can supply more to the market than a producer who had fewer yields. Geremewe et al. (2019a) studied result shows that potato yield was positively and significantly related with quantity of potato supplied to market.

Sex of the Household Head (SHH): This is a dummy variable (takes a value of 1 if the household head is male and 0 otherwise). Habtamu (2015) who found that the gender of the

farmer had a positive and significant effect on the quantity of potato supplied in to the market. Therefore, it is expected to have either a positive relation with volume of seed potato marketed.

Age of household head (AGEHH): It is a continuous variable measured in years. Oljira and Goshu (2017), age of household heads positively affected the amount of onion sold. Aged households are believed to be wise in resource use; on the other hand, young households are active for labor work. Therefore, this variable was expected either to have a negative or positive effect on the quantity of seed potato supply.

Educational level (EDUC): It is a continuous variable and refers to years of schooling a household head attended. Educated farmers tend to be more innovative and more likely to adopt improved agricultural technologies and its marketing systems. Formal education enhances the information acquisition and adjustment abilities of the farmer, thereby improving the quality of decision making Education enables farmers to have better skills and better access to information to supply more amounts of vegetable (Hailu, 2016). Therefore, this variable was hypothesized to influence market supply of seed potato positively.

Family size (FAMSIZE): This variable is a continuous explanatory variable measured in Adult equivalent. Since production is the function of labor, availability of labor is assumed to have positive relation with volume of supply. However, family size is expected to have positive impact on volume of sales of seed potato, but large family size was expected to negative influence on seed potato supply to indicated that the higher the number of household members, the more they were consumed their production. A study conducted by Senbeta (2022) showed that household size had significant negative effect on quantity of potato market supply. Therefore, family size is expected to influence market supply of seed potato either negatively or positively.

Farming experience (FARMEXPER): This is a continuous variable measured in the number of years a household has been engaged in seed potato production and marketing. Hailu (2016) and Woldeesenbet (2013a) revealed that vegetable farming experience of the household has a significant and positive effect on the quantity of onion and potato supplied respectively. Therefore, this variable was hypothesized to positively affect seed potato market supply.

Land allocated for seed potato production (FAMSIZE): This variable is a continuous variable measured in terms of number of hectare allocated to seed potato production and expected to affect the household level of seed potato market supply positively. In agriculture, land is one of

the major factors of production; because producers who allocate a large area of land for seed potato production than producers who allocate less area of land and under the same input utilization condition can produce more and supply more to market. Hailu (2016) and Fentie et al. (2017) revealed that land allocated for potato has positively and significantly affected on volume of sales of potato to the market. Therefore, land holding and market supply have expected to have direct relationship.

Ownership of transport facility (OWNTRANSPF): It is a dummy variable which took a value of 1 if the households owned transportation facilities, and zero otherwise. The availability of transportation facilities helps farmers to supply their product from long distance and remote area to the available market easily. Jagwe *et al.* (2009) found that the household who have access to transportation facilities can supply the product at longer distance. This variable is hypothesized to have positive effect on market supply of potato.

Access to improved seed potato (IMPSEEDP): This is a dummy variable that takes a value of 1 if a farmer uses improved seed and 0 otherwise. Access to improved seed improves the yield and quality of output. Farmers using improved seeds often capture higher potato yields and thus are more likely to increase outputs and market surplus and producers would benefit from planting them (Geremewe et al., 2019a). Kumilachew Alamerie Melesse (2016) confirmed that as the producer use improved seed, the sale of potato to the market increases. Therefore, use of improved seed is expected to have positive effect on market supply of seed potato.

Quantity of fertilizer applied (QFAPPLD): It is a continuous variable measured in quintals. It represents the quantity of chemical fertilizer both (UREA and NPS) applied to seed potato production per hectare of land. Obviously, fertilizer increases the productivity of land. Hence, this variable is hypothesized to affect the quantity of seed potato supplied to the market positively.

Number of livestock owned (NLOWNED): This variable is a continuous one and refers to the total number of livestock the household own in terms of tropical livestock unit (TLU). It is assumed that the household with larger TLU can have a better economic strength and financial position to purchase agricultural input such as fertilizer and hire labor during peak season. The member also transports their product using pack animals to the cooperative or elsewhere. So, this variable was hypothesized to influence the quantity of seed potato supplied to the market positively.

Frequency of extension contact (FREEXTCONT): It is a continuous variable, which refers to the frequency of contacts that producers have with an extension agent per month. Frequent of extension contact provides important information that helps to increase seed potato market supply. Tadesse (2011) found access to extension increase fruits supplied to the market. Therefore, this variable was hypothesized to influence the quantity of seed potato supplied to the market positively.

Access to credit (CREDITACC): This is a dummy variable that takes 1 if a farmer takes loan for seed potato production or 0 otherwise. Access to credit would enhance the financial capacity of the farmer to purchase the necessary inputs for potato production. Mahlet *et al.* (2015) explained that those households with better access to loan have better chance to increase their potato market supply. Therefore, it was hypothesized that access to credit would influence seed potato market supply of households positively.

Access to irrigation (ACCIRRIG): This is a dummy variable that takes a value 1 if a farmer has an access to irrigation for seed potato production and 0 other wise. As farmer uses irrigation the more products it produces may market oriented. Alemu (2012) studied result indicated that farmers who have access to irrigation can sale vegetable at least twice a year which increases their market supply. Therefore, irrigation was expected to have positive effect on market supply of seed potato.

Non/off-farm income (NOffarm): It is a dummy variable measured in terms of whether the household obtained income from off and non-farming activities. It is 1 if the household is involved in non/off-farm activities and 0 otherwise. Woldesenbet (2013a) and Hailu (2016) showed that non-farm income has a significant and positive influence on the volume of cabbage and potato supplied respectively. The participation of producers in off and non-farm income expected to expand and intensify the production and supply of seed potato to the market positively.

Distance to nearest market (DNMKT): It is a continuous variable measured in walking minute which the farmers are required to travel in order to sell their product to the market. If the farmer is located in a village that is far from the market, the farmer is poorly accessible to the market. Alemu (2012) and Woldesenbet (2013a) studied result showed that distance from the nearest market was found to be negatively and significant influenced on the volume of cabbage and

potato supplied to market respectively. Hence, this variable is hypothesized to have an inverse relationship with the quantity of seed potato supplied to the market.

Table 2: Description of dependent and independent variables used in (OLS) model

Variables	Types	Measurement	Hypotheses
Dependent variable			
Quantity supply	Continuous	Quintal	
Independent variables			
Sex of households head	Dummy	1 if Male, 0 if Female	+/-ve
Use of improved seed	Dummy	1 Yes, 0 Otherwise	+ve
Access to credit service	Dummy	1 Yes, 0 Otherwise	+ve
Access to irrigation	Dummy	1 Yes, 0 Otherwise	+ve
Ownership of transport facility	Dummy	1 Yes, 0 Otherwise	+ve
Access to off/non- farm income	Dummy	1 Yes, 0 Otherwise	-ve
Age	Continuous	Number	+/-ve
Family size	Continuous	Adult equivalent	+/-ve
Frequency of extension contact	Continuous	Number	+ve
Farming experience	Continuous	Years	+ve
Yield	Continuous	Qt/ha	+ve
Quantity of fertilizer applied	Continuous	Qt/ha	+ve
Educational level	Continuous	Years	+ve
Distance to nearest market	Continuous	Walking minutes	-ve
Livestock owned	Continuous	TLU	+ve
Land allocated for seed potato	Continuous	Hectare	+ve

3.7.3. Determinants of market outlet choice

Multinomial models are appropriate when individuals can choose only one outcome from among set of mutually exclusive, collectively exhaustive alternatives. However, in this study producers' market outlet choice are not mutually exclusive; considering the possibility of simultaneous choices of outlet and the potential correlations among these market outlet choice decisions. Since, seed potato is cash crops in the study area and the overall market contexts may compel producers to choose more than two outlets simultaneously. The multivariate probit model takes into account such potential interdependence in market outlet choices and the possible correlation in the choice of alternative outlets. The multivariate probit model is regression model that simultaneously estimates the influence of independent variables on one or more than one dependent variables, and allows for the error terms to be freely correlated. The dependent variable represents 1 (if chosen) or 0 (if not chosen) responses to the question regarding the importance of each factor on outlet choice. Multivariate probit approach simultaneously models the influence of the set of explanatory variables on choice of markets outlet, while allowing for

the potential correlations between unobserved disturbances, as well as the relationships between the choices of different market outlet (Belderbos *et al.*, 2004).

The observed outcome of market outlet choice can be modeled following random utility formulation. Consider the i^{th} farm household ($i=1, \dots, N$), facing a decision on whether or not choice available market outlet. Let U_0 represent the benefits to the farmer choice wholesalers, and let U_k represent the benefit of farmer to choice the K^{th} seed potato market outlets: where K denotes choice of wholesalers (Y_1), retailer (Y_2) and rural collectors (Y_3). The farmer decides to choice the K^{th} market outlet if $Y_{ik}^* = U_k^* - U_0 > 0$. The net benefit (Y_{ik}^*) that the farmer derives from choice of K^{th} market outlet is a latent variable determined by observed explanatory variable (X_i) and the error term (ε_i):

$$Y_{ik}^* = X_i' \beta_k + \varepsilon_i \quad (K=Y_1, Y_2, Y_3) \dots \dots \dots (7)$$

Using the indicator function, the unobserved preferences in equation (7) translate into the observed binary outcome equation for each choice as follows:

$$Y_{ik} = \begin{cases} 1 & \text{if } Y_{ik}^* > 0 \\ 0 & \text{Otherwise} \end{cases} \quad (K=Y_1, Y_2, Y_3) \dots \dots \dots (8)$$

In multivariate model, where the choice of several market outlets is possible, the error terms jointly follow a multivariate normal distribution (MVN) with zero conditional mean and variance normalized to unity (for identification of the parameters) where $(\mu_{y1}, \mu_{y2}, \mu_{y3}) MVN \sim (0, \Omega)$ and the symmetric covariance matrix Ω is given by:

$$\Omega = \begin{bmatrix} 1 & \rho_{y1y2} & \rho_{y1y3} \\ \rho_{y2y1} & 1 & \rho_{y2y3} \\ \rho_{y3y1} & \rho_{y3y2} & 1 \end{bmatrix} \dots \dots \dots (9)$$

Particular interests are off-diagonal elements in the covariance matrix, which represents the unobserved correlation between the stochastic components of the different type of outlets.

This assumption means that equation (8) generates a multivariate probit model that jointly represents decision to choice particular market outlet. This specification with non-zero off-

diagonal elements allows for correlation across error terms of several latent equations, which represents unobserved characteristics that affect the choice of alternative outlets

Following the form used by (Cappellari and Jenkins, 2003), the log-likelihood function associated with a sample outcome is then given by;

$$\ln L = \sum_{i=1}^N \omega_i \ln \Phi_i(\mu, \Omega) \dots \dots \dots (10)$$

Where ω is an optional weight for observation i , and Φ_i is the multivariate standard normal distribution with arguments μ_i and Ω , where μ_i can be denoted as:

$$\mu_i = (K_{i1}\beta_1 X_{i1}, K_{i2}\beta_2 X_{i2}, K_{i3}\beta_3 X_{i3}, \dots, K_{in}\beta_n X_{in} \dots \dots \dots (11)$$

While, $\Omega_{i1} = 1$ for $j = k$ and

$$\Omega_{jk} = \Omega_{kj} = K_{ij}K_{ik}\rho_{jk} \text{ for } j \neq K, K = 1, 2, 3, \dots \text{with } K_{ik} = 2x_{ik} - 1 \dots \dots \dots (12)$$

3.7.3.1. Variables used for seed potato market outlet choice

Dependent variable:

Market Outlets (MKTO): It is a qualitative categorical dependent variable used in multivariate probit model. In this regard, producers are expected to choose the best outlets through which they sell their products depending up on various criteria on which to maximize his/her profit. The outlet choices might be along farmers decision involving in four alternative markets. It is represented in the model as Y_1 for household who choose to sell seed potato mainly to wholesalers, Y_2 for producers that mainly sell their seed potato to retailers and Y_3 for producers that mainly sell their seed potato to rural collectors.

Independent variables:

In order to examine the determinants of seed potato market outlet choice the following explanatory variables that are hypothesized and expected to influence the dependent variable(s):-

Sex of the household head (SHH): This is a dummy variable (takes a value of 1 if the household head is male and 0 otherwise). This is support by findings of (Hailu, 2016) confirmed that male-headed producers are more likely to deliver potato to collector outlet than female-headed households. Male household heads have more chance to choose appropriate market

outlets than female household heads. It is hypothesized that sex of households would have influence on market outlet choice decisions.

Age of household head (AGEHH): It is a continuous variable and measured in years. Aged households are believed to be wise in resource use. Age of household are believed to be wise in searching better price offering market outlet, whereas young household heads are active in obtaining information which enables them to choose the right outlet. The findings of (Endris *et al.*, 2020) showed that age of the household head positively related to more likely to sell onion produce to collector outlet than other market alternatives. The finding (Xaba and Masuku, 2013) found that age of the farmers was significant determinant of the choice to use non-wholesale market channel over other-wholesale market channel. Therefore, this variable was hypothesized either positively or negatively influence wholesaler outlet choice.

Educational level of the household head (EDUHH): It is continues variable and measured in years of schooling of the household. It is believed that if the education level of the producers becomes increase, there would be a possibility to choose the best outlets that provide a benefit for him/her. Therefore, education is believed to improve the knowledge of the alternate market outlet choice, because as people learn more and more they become well-designed in choice of best outlet through better use of their time. Study conducted by (Edossa *et al.*, 2019) who found that education is positively and significantly influences the related to potato producers selling to wholesalers' market outlets choice then other market outlet. So, education is hypothesized to influence seed potato market outlet choice.

Family size (FSIZE): It is a continuous variable measured in terms of adult equivalent. Since seed potato is bulky in nature, it needs more labor for marketing activity. Households who have more household member tend to have more labor which in turn increases the choice of better market outlet. Hailu (2016) found that households who have more family size was expected to influence positively and significantly the choice of wholesalers. The findings of (Tolassa and Bedada, 2023) found that households who have more family size were expected to influence positively and significantly the choice of wholesalers. Hence, family size is hypothesized to affect outlet choices.

Seed potato production experience (SPPEXPER): This is a continuous variable measured in number of years. A household with better farming experience are more likely to change and/or seed potato marketing and differences in profitability in the different marketing outlets. This is supported by (Tolassa and Bedada, 2023) showed that more experienced households in head cabbage production were less likely to choose retailer outlets. Those farmers who have many years for head cabbage production can adjust and deliver their product to alternative marketing outlets in order to get better price and to maximize profit than retailer' outlet. Therefore, it is expected that farm experience affects seed potato market outlet choice decisions.

Land allocated for seed potato production (FARMSIZE): This variable is a continuous variable measured in terms of number of hectares allocated to seed potato production. As the land size of a household allocated to seed potato increases, the production proportionally may increase, so that the amount of seed potato sold increases and can increase the probability of the household choosing the best outlet. Hailu (2016) found that farmers who allocated relatively more size of land for potato production was positively and significantly affected collectors. In this study, land allocated to seed potato production is expected to influence seed potato market outlet choice.

Distance from nearest market (DNMKT): This is a continuous variable measured in walking minutes from the household residence to the nearest market. The closer the market, the lesser would be the transportation charges, reduced walking time, and reduced other marketing costs, better access to market information and facilities. Magogo *et al.* (2015) confirmed that distance from the nearest rural market is negatively related with the potato producers likelihood of choosing retailer outlet. Therefore, it is hypothesized to influence the decision of farmers to choose the better market outlets.

Non/off-farm income (NON-OFFARM): It is a dummy variable measured in terms of whether the household obtained income from off and non-farming activities. It is one if the household is involved in non/off-farm activities and zero otherwise. The farmers who gain more income from non/off farm income want to supply their seed potato to any nearest market outlet with low price than to go far. Tolassa and Bedada (2023) confirmed that farmers who have access to off/non-farm income choose retailer channels over others. This is due to farmers who have non-farm income wanting to sell head cabbage smaller quantities and want to practice retail business by

using their income from other businesses. Hence, off/non-farm income is hypothesized to influence market outlet choice decision of seed potato producers.

Frequency of extension contact (FREXTCONT): This is continuous variable which is the number of days that farmer had contact with extension agent for agricultural work supervision in a year. Hailu (2016) found that the number of extension contact has positive and significant influence with wholesaler outlet choice decision. Households who were visited more by extension agent were more likely to deliver onion through wholesaler outlets than households less visited by extension agent. So that extension contact is assumed to have direct relation with market outlet choice of seed potato producers.

Access to credit (CREDITACC): This is a dummy variable taking the value one if the household takes loan and zero otherwise, which indicates credit taken for seed potato production. The study conducted by (Geremewe et al., 2019a) who found that access to credit has positively related to the choice of retailer outlet compared to other outlet in marketing of seed potato. Therefore, It is hypothesized that access to credit would have influence on market outlet choice decisions.

Access to transport facility (ATRANSPF): It is a dummy variable which took a value of 1 if the households owned transportation facilities, and zero otherwise. The availability of transport facility helps to reduce long market distance constraints and offering greater depth in marketing choices. The study conducted by (Tolassa and Bedada, 2023) confirmed that access to transport services has positively related to the choice of wholesaler outlet compared to other outlet in marketing of seed potato. Transport facilities increase the likelihood of farmers to select wholesaler channels than other market channels. Therefore this variable is expected to have influence on the market outlet choices.

Access to market information (MKTINFO): It is a dummy variable assuming 1 for a household that has access to market information and 0 otherwise. Amaya Urquieta (2009) found that the better information that the farmers have about the product market, the better would be the choice he/she makes on the channel selection. Therefore, it is hypothesized that market outlet choice decision affected by seed potato producers.

Average current market price of seed potato (SPPRICE): This is a continuous variable measured as average price of seed potato in the current market price in birr per quintal. When the price of the product is promising, farmers are motivated to sell their product to a particular

market outlet. This line with (Hailu, 2016) who confirmed that current market price of potato is negatively and significantly influences the likelihood selling potato producers to collectors and consumers outlet. Therefore, this variable has hypothesized to have relationships with market outlet choice decision of seed potato producers.

Membership to any cooperative (MCOOP): It is binary variable and takes the value of one if the household is membership of any cooperatives engaged in any business, otherwise zero. Thus, cooperatives improve understanding of members about market and strengthen the relationship among the members. Kuma *et al.* (2013) the result indicated that the relationship between members of cooperative and channel choice. Therefore, it is expected to be associated with market outlet choice decision of seed potato producers.

Ownership of motor pump (OWNMOTOR): It is a dummy variable which takes a value of 1 if the farmers had own motor pump for irrigation 0 otherwise. A household with owned motor pump for irrigation in seed potato production is assumed to produce more amounts of seed potato and, hence have hypothesized to influence on seed potato production. The study conducted by (Hailu, 2016) who found that farmers who had own motor pump are less likely to choose collector outlet compared to those who had not owned motor pump. This may be because ownership of motor pump enables farmers to produce more potato which induce them to choice large buying outlet (wholesaler). Therefore, in this study, ownership of motor pump is hypothesized to have relation with market outlet choice to sell their seed potato product.

Table 3: Description of dependent and independent variables used in MVP model

Variables	Types	Measurement	Expected effect on outcome		
			Wholesaler	Retailer	Collector
Market outlet (choice)	Categorical				
Sex	Dummy	1 if Male, 0 if Female	+ve	+ve	-ve
Non/Off- farm income	Dummy	1 Yes, 0 Otherwise	-ve	-ve	+ve
Access to market information	Dummy	1 Yes, 0 Otherwise	+ve	+ve	+ve
Ownership of motor pump	Dummy	1 Yes, 0 Otherwise	+ve	+ve	-ve
Cooperative membership	Dummy	1 Yes, 0 Otherwise	+ve	-ve	-ve
Access to credit	Dummy	1 Yes, 0 Otherwise	+ve	+ve	-ve
Access to transport facility	Dummy	1 Yes, 0 Otherwise	+ve	-ve	-ve
Age	Continuous	Years	-ve	+ve	+ve
Quantity sold	Continuous	Quintal	+ve	+ve	-ve
Family size	Continuous	Adult equivalent	+ve	+ve	+ve
Frequency of extension contact	Continuous	Number	+ve	-ve	-ve
Educational level	Continuous	Years	+ve	-ve	+ve
Farming experience	Continuous	Years	+ve	-ve	+ve
Land allocated for seed potato	Continuous	Hectares	+ve	+ve	+ve
Distance to nearest market	Continuous	Walking in minutes	-ve	-ve	-ve
Current price of seed potato	Continuous	Birr	+ve	-ve	-ve

4. RESULTS AND DISCUSSION

This chapter presents the results of the study. Descriptive analysis is employed to describe the demographic and socio-economic characteristics of sampled respondents and traders. Value chain analysis presents value chain analysis of seed potato which includes the actors' costs and profit margin in seed potato value chain, What does seed potato value chain map look like in the study area?, seed potato value chain actors and their roles, challenges and opportunities along the value chain, marketing channels, and benefit shares of actors in the value chain discussed. Econometric analysis was employed to identify factors affect market supply of seed potato at farmers' level in the district and the alternative seed potato market channels and the factors affecting farmers' seed potato market channel choice decisions.

4.1. Demographic and Socio-economic Characteristics of Sample Respondents

This sub-section explains the profile of sampled respondents with regard to their age, sex, family size, and farming experience, education level, marital status, access to extension services, access to credit, access to irrigation, ownership of motor pump, access to markets information, and distance from nearest market.

Sex of household respondents

Gender was analyzed by checking the number of male and female headed households. The sample population of seed potato producer respondents considered during the survey was 153. As shown in Table 4, Out of total households head interviewed 76.47% were male headed households while 23.53% were female headed households.

Marital status of household respondents

Most of the sample respondents 94.77% were married. The percentage of respondents who were single was 2.61%. The percentage of respondents who were Divorced and Widowed was 1.31% and 1.31% respectively.

Table 4: Demographic and socioeconomic characteristics of samples (Categorical variables)

Total (N=153)			
Variables	Indicators	Freq	%
Sex	Male	117	76.47
	Female	36	23.53
	Single	4	2.61
Marital Status	Married	145	94.77
	Divorced	2	1.31
	Widowed	2	1.31

Age of the household heads: Age is one of the demographic factors that are useful to describe sample respondents' experience and networking. The study result indicated that the mean age of the sample household heads was 39.76 years ranged from 27 to 62 with a standard deviation of 7.86 years.

Age distribution and dependency ratio of sample respondents

Age distribution reflect the productivity of the population as it has a bearing on employment pattern, quality of work done, and overall health situation within the community. In the study area, the sampled population was categorized into three categories viz. less than 14 years, 15-64 years (economically active population groups), and above 65 years. The study result reveals that 59.6% of the population is economically active and 40.4% of the population is below 15 years and there is no sampled population is above 65 years. The calculation showed that the dependency ratio in the study area is 67.80%; it implying that every 100 person within the economically active population groups supported not only themselves but also additional 67.80% economically dependent persons with all necessities (Table 5). The livelihood of farm households mainly depends on agriculture which requires more labor for various activities like land preparation, planting, weeding, harvesting, marketing, and so on.

Table5: Age category and Dependency Ratio (DR)

Age category	Frequency	Percent	Dependency Ratio(DR)
Dependent population	318	40.40	67.80%
Active population	469	59.60	
Total	787	100	

Source: Own survey result, 2023.

Education level of household heads: The education level of the household head can influence how he/she views innovations, techniques, and new ways of doing business. It affects the decision-making process. In the study result shows that mean of schooling years of seed potato producers were 5.10 years /grades and with maximum of 12 grades complete (Table 6).

Family size of the household heads (Adult equivalent): The mean family size of the total sample respondents was 5.12 persons ranging from 1 to 10 and this might assist them for a better participation of households in the seed potato markets (Table 6). According to (Emana and Gebremedhin, 2007) the horticulture production system is often intensive and requires more labor for cultivation than the cereal production does. The labor available for work per household is directly proportional to the family size.

Seed potato production experience: The survey result shows that sample respondents have a mean of 8.43 years of farming experience in seed potato production with a standard deviation of 4.536 years.

Size of land allocated for seed potato production: One of the most important factors that influence seed potato production is resource endowment, availability of land for seed potato production. Land is the basic asset of the farmers. Based on the survey results indicated that the total land used for seed potato production is an average per household allocation of 1.53 in ha during survey year in 2023.

Frequency of extension contact: Having access to agricultural extension service and frequent contact initiate farmers to produce and supply their product. In the study result revealed that average number of sample farmers' frequent contact with extension workers at their farm or get advice throughout the production process of seed potato was 2.19 times per year.

Amount of seed potato produced: The mean seed potato production in the study area was 34.97 quintals per sample households which range 8 to 120 quintals.

Number of livestock owned (TLU): The survey result showed that the average number of livestock in tropical livestock unit for sample respondent was 6.28; often the number of livestock owned by a household is considered as a measure of wealth in rural area. The study conducted by (Fikadu and Mulatu, 2023) found that livestock is the very basic asset of the rural farming community of Welmera district in particular and in the country in general. Livestock are important livelihoods and means and sources of income for the rural community.

Distance to nearest market: The average distance that most of the households used to travel to sell their seed potato product to the market was about 23.52 walking in minutes.

Table 6: Demographic and socioeconomic characteristics of samples (Continues variables)

Variables	Total (N=153)	
	Mean	SD
Age of household head (Years)	39.76	7.865
Education level of household head (Years)	5.10	3.420
Family size of household head (Adult equivalent)	5.12	1.784
Seed potato production experience (Years)	8.43	4.536
Frequency of extension contact(Numbers)	2.19	0.626
Land allocated for seed potato production (ha)	1.53	0.068
Amount of seed potato produced (Quintals)	34.97	21.818
Number of livestock (TLU)	6.28	2.969
Distance to nearest market (Walking in minutes)	23.52	18.795

Source: Own survey result, 2023.

4.2. Access to Institutional Service of Sample Respondents

Access to agricultural extension services

The survey result (Table 7), shows that out of the total respondents of seed potato producing sample households, about 62.7% of the farmers reported that they had access to extension service in 2023 during production season, whereas 37.3% of the farmers reported that they had no access to extension service. The extension services providers were District office of agriculture experts, Development agents, Holeta agricultural research center (HARC), relative friends. The extension service advice especially on during seed potato production, planting and spacing, disease and pest control, fertilizer application and land preparation, respectively.

Use to improved seed potato

Access to improved seed help to increase productivity and thereby increase production, about 38.6% of sample producers has access to improved seed potato, whereas about 61.4% of sample producers had no access to improved seed potato.

Access to training

According to Ahmad *et al.* (2007) training service in agriculture is indispensable which assists the farmers in the improvement of production and productivity. It enables the flow of information and the transfer of knowledge and scientific findings to practice. It helps in disseminating innovations and ideas which emerge from research findings and improves the farmer's production and productivity. The survey results (Table 7), shows that 66% of sample respondents got training in the different topics on seed potato production from different government organizations in the last two years in Welmera district, while 34% of sample

respondents reported that they had no access to training service. The trainings were not given on marketing of seed potato, harvesting and post-harvest handling.

Ownership of motor pump

A household with owned motor pump for irrigation in seed potato production is assumed to produce more amounts of seed potato. The survey result indicated that about 92.8% of sample respondents do not have been own motor pump for seed potato production whereas only about 7.2% of sample respondents they had no own motor pump for seed potato production.

Access to own transport facility

The availability of well-functioning transport network is very important because it creates place utilities of the product. The survey result in the (Table 7) shows that about 79.74% of sample respondents have their own transport facility and about 20.26% have no transport facility. Moreover, the results revealed that the main means of transportation used to sell seed potato to the market were transport by vehicles, carts, on donkey or horseback load and manpower, respectively.

Access to credit

Finance is the crucial element starting from land preparation up to the marketing of the product. Access to credit is one of the factors that can facilitate and hinder good marketing and price in seed potato production. As depicted in (Table 7), only 7.84% of sample respondents had used to credit in Welmera district. While majority of sample respondents were 92.16% no access to credit service regarding to seed potato production and marketing. Credit was accessible and available for poor farmers to build asset and food secured by purchasing the different packages designed by the regional government, there is lack of attention to access and avail credit for seed potato producers in Welmera district.

Access to irrigation

Access to irrigation leads to an increase in yield per unit area and subsequent increases in income, consumption and food security. Irrigation enables smallholders to diversify cropping patterns, and to switch from low-value subsistence production to high value market oriented production. Irrigation can benefit the poor specifically through higher yields per unit of lands, lower risks of crop failure, and higher and year round farm employment. The result of the study revealed that about 88.2% of seed potato producers haven't access to irrigation while about 11.8% of seed potato producers have access to irrigation.

Membership to any cooperatives

Agricultural cooperatives membership helps their members to increase their yield and incomes by pooling their resource to support collective service provisions and economic empowerment. The survey result showed that about 62.75% of sample respondents have not been a membership of any agricultural cooperatives while 37.25% of sample households were membership of agricultural cooperatives/organization. Those sample households memberships of agricultural cooperatives are better informed compared with non- membership of agricultural cooperatives, which may serve as important source of information on agricultural technologies.

Access to market information

Market information is among important components for the timely supply to available channels to satisfy the demand. The sample respondents have different access to market where the benefits and the choices of channels also differ. The survey result in (Table 7) indicated that about 68.63% of sampled farmers had access to market information from different sources and only 31.37% had no access to market information. The type of market information provided were 67.62% of about seed potato price information, 23.81% of buyer's information and 8.57% of market place information. The sample respondents revealed that the major source of seed potato marketing information about 50.94% of gets from brokers, 45.28% of gets from other farmers, 1.89% of gets from radio/television and 1.89% of gets from development agents.

Non/ off -farm income activities

The survey result shows that sample households about 88.24% were not participating on off/non-farm income activities and only 11.76% were participating on off/non-farm income activities.

Table 7: Sample respondents' access to service in relation to seed potato (Dummy variables)

Variables	Total (N=153)		
	Items	Frequency	Percent
Access to extension service	Yes	96	62.7
	No	57	37.3
Received training	Yes	101	66.01
	No	52	33.99
Ownership of motor pump	Yes	11	7.2
	No	142	92.8
Access to irrigation	Yes	18	11.8
	No	135	88.2
Use of improved seed potato	Yes	59	38.6
	No	94	61.4

Own transportation facility	Yes	122	79.74
	No	31	20.26
Access to credit	Yes	12	7.84
	No	141	92.16
Membership of any cooperative	Yes	57	37.25
	No	96	62.75
Access to market information	Yes	105	68.63
	No	48	31.37
Access to non/off-farm income	Yes	18	11.76
	No	135	88.24

Source: Own survey results, 2023

4.3. Demographic Characteristics of Sampled Traders

Table 8 summarizes the demographic characteristics of trader's respondent in terms of age, family size, experience, sex, marital status and education level. The survey result showed that 57.1% of the sample traders were females while 42.9% of them were males. This implies that women's are more participating seed potato trading than males. The survey result revealed that about 92.9% of sample traders were married, whereas about 7.1% of sample traders are single or unmarried. About to the education level of traders; the survey result indicated that about 14.3% of the sample traders are non-educated, However, about 21.4% and 50% of the trader sample respondents attended primary and secondary school respectively, whereas, 7.1 % and 7.1% are diploma certificate holders and degree and above respectively.

The average family size of the sample traders is 4.21 persons and ranges from 1 to 6. The average age of the traders was 37.57 years and range from 28 to 46 years. The traders have an average of 5.9 years of experience in seed potato trading (ranging from 2 to 12 years trade experience).

Table 8: Demographic and socio-economic characteristics of sampled traders

Variable	Item	Holeta (N=7)		Ejere (N=3)		Menagesha (N=2)		Finfinne (N=2)		Total (N=14)	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Sex	Male	4	28.6					2	14.3	6	42.9
	Female	3	21.4	3	21.4	2	14.3			8	57.1
Marital status	Single			1	7.1					1	7.1
	Married	7	50.0	2	14.3	2	14.3	2	14.3	13	92.9
	Illiterate			1	7.1	1	7.1			2	14.3
Education level	Primary	2	14.3					1	7.1	3	21.4
	Secondary	4	28.6	2	14.3	1	7.1			7	50.0
	Diploma							1	7.1	1	7.1

certificate Degree and above	1	7.1								1	7.1
Continues variables	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Age	36.71	2.87	37.67	9.07	39.50	4.94	38.50	2.12	37.57	4.45	
Family size	4.28	0.97	3.67	1.52	4.50	0.70	3.50	0.70	4.21	1.05	
Experience	7.08	2.44	5.00	1.00	3.50	2.12	5.50	2.12	5.9	2.37	

Source: Own survey results, 2023.

4.4. Major Seed Potato Production and Marketing Constraints in the study area

The seed potato value chain in the study area faces numerous challenges. Descriptive statistics (frequency and percentages) were employed for analyzing smallholder farmers' responses. A number of frequent field surveys using questionnaires were conducted, and the following seed potato production and marketing problems were identified (Table 9).

Table 9: Major constraints to seed potato production raised by producers

Production constraints	Frequency	Percent
Lack of improved varieties	128	83.7
Prevalence of disease and Pests	31	20.3
Shortage of irrigation water	84	54.9
Lack of credit availability	106	69.3
Shortage of fertilizer	59	38.6
Marketing constraints		
Poor linkage with value chain actors	118	77.1
Lack of adequate storage facilities	55	35.9
Low quality of seed potato	85	55.6
Lack of market information	44	28.8
Product perishability	31	20.3
Low price for seed potato	58	37.9
Lack of organized market	94	61.4
Far market distance	41	26.8

Source: Own computed from survey data, 2023.

As depicted in Table 9, there were constraints raised by sample seed potato producers. About 83.7% of producers reported an inadequate supply of improved seed potato varieties, while 69.3% reported a lack of credit availability. About 54.9%, 38.6%, and 20.3% of sample producers raised a shortage of irrigation water, a shortage of fertilizer, and a prevalence of disease and pests, respectively. Regarding marketing constraints, about 77.1% and 61.4% of sample producers raised poor linkage with value chain actors and a lack of organized markets,

respectively. About 55.6%, 37.9%, and 35.9% of sample producers raised low quality of seed potato, low price for seed potato, and lack of adequate storage facilities, respectively.

4.5. Constraints and opportunities of actors along seed potato value chain

The major constraints that hinder the development of the seed potato value chain, as well as opportunities along the seed potato value chain, were identified through focus group discussions, and key informant interviews are summarized below.

Table 10: Summary of constraints and opportunities of seed potato value chain

Stages of value chain	Constraints	Opportunities
Input supply	• Limited access to improved seed potato • High cost of inputs • Shortage of input supply (fertilizer)	• High demand for buying quality seed • High demand for input • Being neighbors with HARC
Production	• Prevalence of disease and Pests • Shortage of irrigation water • Inadequate agronomic practices by farmers • Lack of adequate storage facilities • Lack of credit availability	• Favorable climatic conditions • Availability of underground water • Availability of daily labor work • Support from GOs and NGOs
Marketing/ Trading	• Low quality of seed potato • Poor linkage with value chain actors • Lack of organized market • Low price for seed potato • Product perishability • Far from main market • Limited credit service	• Establishment of cooperative markets • High market demand for seed potato • Credit provider establishments • Closeness to district town • Government promotes research institutes. • Infrastructure development

Source: Own summary from Focus group discussion and Key informant interview, 2023.

4.6. Average Cost of Seed Potato Production

Based on the survey data, the costs of production and returns at the prevailing prices were used to estimate the benefits. This section aims at identifying and quantifying different costs, which are incurred by the farmers in seed potato production process. The cost involved in seed potato cultivation can be variable cost and fixed cost.

Table 11: Average cost of seed potato production (Birr/Qt)

Cost Items	Birr/Qt
Seed	85.70
Fertilizer (NPS)	80.08
Fertilizer (UREA)	59.29
Labor for plowing	6.62
Oxen for plowing	9.44
Labor for weeding	7.70
Pesticide/herbicide	23.09
Labor for harvesting	7.36

Total variable cost	279.28
Rental value of land (Birr/year)	97.82
Total fixed cost (Birr)	97.82
Total production cost (Birr/Qt)	377.1

Source: Own from survey results, 2023.

4.7. Seed Potato Value Chain Actors and Their Roles

The main actors participated in seed potato value chain in the study area were input suppliers, producers, rural collectors, wholesalers, retailers, cooperatives, supporters and enablers.

Inputs suppliers

Agriculture value chain analysis begins from the input supply level. The availability of input at the right time and at the right place is crucial for farmers to increase production and market supply. The seed potato is the main input of potato cultivation and good quality seed potato is required for better production both in terms of quantity and quality. The main source of input suppliers to farmer in the study area were district agriculture office, traders and informally from farmer to farmer exchange. They provide seeds, fertilizers, pesticides and farm implements. Majority of sample respondents used seed potato from own save and local markets. Traders (wholesalers) buy seed potato from other traders from the Welmera district and sell to district producers. Regarding fertilizers, seed potato growers obtained either from market or development agent. Due to lack of input (fertilizer, improved seed potato and pesticide) majority of the sample producers obtained the inputs through purchase even if the amount is small. Since the annual income of the producer depend mainly on seed potato production, the purchasing power was reported as lower even if there is willingness of using inputs if supplied at right time.

Table 12: Sources of seed potato for sampled respondents

Name of variety	Source of varieties	N	Percent	Com.
Gudanne	District agriculture office (BoA)	2	1.31	1.31
Gudanne and Burqitu	Research center (HARC)	29	18.95	45.10
	Union/cooperative (Robi Berga)	4	2.61	26.14
Gudanne and Jallanne	Local markets	34	22.22	23.53
	Fellow farmers	84	54.90	100.00
Total		153	100.00	

Source: Own field survey results, 2023.

Producers

Producers are the primary and most valued actor in the seed potato value chain. Farmers decide, what input to use, when to seed and harvest, how much to consume, and how much to sell, considering the available resource. They perform most of the value chain functions right from

farm inputs preparation on their farms to post harvest handling and marketing. The major value chain functions that seed potato producers perform include land preparation, planting, fertilization, irrigating, protecting from weed, pest/disease, harvesting and post-harvest handling and marketing. In Welmera district seed potato are produced based on rainfed and small number of farmers used to produce irrigation system.

As it is depicted in the Table 14, about 98.69% of sampled respondents were producing seed potato by sole cropping and small proportion 1.31% were producing by intercropping with others short cycled products. Most farmers sell the majority of their seed potato products at harvest time, keeping only small amount stored for own seed used. Farmers are producing seed potato for market oriented and they sell to wholesalers at farm gate and district market, sell to cooperative at farm get, sell to retailer at district market (Holeta town) and sell to rural collector at farm gate and village markets and sell to other seed potato producers at village markets.

Table 13: Sample respondent's seed potato production system adopts

Growing system	N	Percent
Sole cropping	151	98.69
Intercropping	2	1.31

Source: Own from survey results, 2023.

Collectors

Rural collectors are independent operators at primary markets who assemble and transport seed potato from smallholder farmers, using back animals and vehicles for sale to larger markets. The local traders play the key role as in the seed potato value chain in the study area; their trading activities include buying and assembling, repacking, sorting, and selling to wholesalers typically transport on vehicle, horse or cart to district market town. Their major sales outlets are relatively wholesalers. Local traders collect seed potato for wholesalers, retailer and wholesalers purchase from rural collectors by covering all cost and additional fee for their services.

Wholesalers

Wholesalers are traders that buy seed potato from rural collectors and directly from seed potato producers, usually those in surplus areas for resale in deficit, to larger market centers and retailers with better financial and information capacity. Wholesalers are the major buyers of seed potato as they buy at least a truck load of seed potato at a time from producers. They mostly purchase from farmers and local collectors. There are no wholesalers who have the license to do wholesale in Welmera district. Wholesalers buy seed potato from farmers through brokers who

represent them in seed potato buying activities. They have better storage, transport and communication access than other traders.

Retailers

Retailers are key actors in seed potato value chain within and outside the study district. They are the last link between producers and other seed potato producers. In the study area, retailers are buying seed potato either directly from producer or wholesaler traders. During the market visit, it was observed that retailers keep small amount of seed potato. Producers usually buy seed potato from retailers as they offer according to requirement and purchasing power of the buyers.

Cooperatives

During the time of survey, there are some seed potato producers 'cooperatives. Producers have taken an action of organizing themselves in cooperatives to tackle the existing poor market access and price for seed potato. Some of the farmers who were primary producers 'cooperative members were working with Robi-Berga Union/Cooperative, Holeta Agricultural Research Center and District Agriculture Office for many years.

Enablers and facilitators

In a value chain, enablers include all chain-specific actors providing regular support services or representing the common interest of the value chain actors. The supporting function players for the seed potato value chain are those who are not directly related to the seed potato value chain but provide different supports to the value chain actors. In the study area, there are many institutions supporting seed potato value chain the most common support providers are district agriculture office, district irrigation and development authority, district trade and market development office, union/cooperatives (Robi Berga cooperative), cooperative bank of Oromia(CBO), Sinqee bank, and Holeta Agricultural Research Center(HARC).

4.8. Seed Potato Value Chain Map

Mapping a value chain facilitates a clear understanding of the sequence of activities and the key actors and relationships involved in the value chain. Mapping of value chain functions is considered to show the relationships and integrations of the processes and activities performed along the value chain. The major seed potato value chain actors identified in the study area during survey conducted were the important players found in the channel of input supply to end user for planting. Value chain map of seed potato in the study area during the study time can be illustrated in Figure 4.

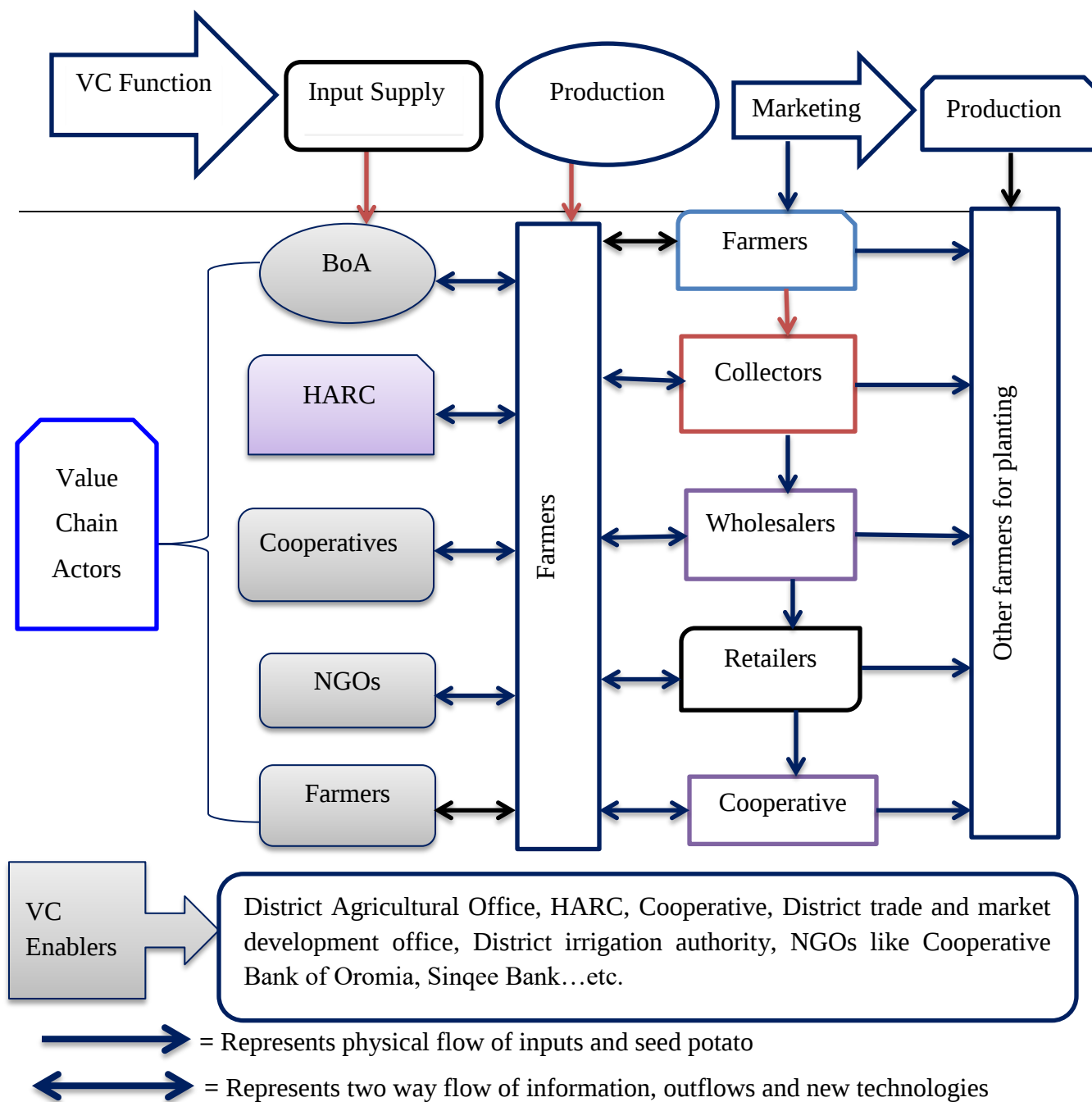


Figure 4: Value chain map of seed potato in the study area

Source: Own sketch from survey result, 2023.

4.9. Seed Potato Marketing Cost, Marketing Channels and Marketing Margin

4.9.1. Marketing cost analysis

Marketing costs are estimated to compute the share of profit captured by key actors in the marketing chain. The survey result indicated that the average marketing costs incurred by every actor during transaction. The highest marketing cost was incurred by the wholesalers (271.84 birr/qt) followed by rural collectors (214.17 birr/qt). This is because wholesalers transport costs is higher to reach far market and specialized labor for the packing, store rent, brokerage, loading and unloading is relatively expensive in the terminal market. Average cost of retailers was (201.13 birr/qt) when the retailer incurred cost for transporting seed potato to reach the market. Average marketing cost of producers was (162.11 birr/qt) and average marketing cost of cooperative was (185 birr/qt).

Table 14: Average marketing costs for different marketing channels (Birr/Qt)

Costs of Marketing	Actors				
	Producers	Collectors	Retailers	Wholesalers	Cooperatives
Packing material cost	26.54	52.50	29.38	30	35
Loading/unloading cost	22.72	40	41.25	40	30
Transport cost	56.06	66.67	45.63	51.67	40
Brokerage cost	46.79			41.67	
Sorting and grading cost		35	28	26	25
Store rent cost			30.62	35	40
Telephone cost		10	11.25	32.5	15
Tax cost	10	10	15	15	
Total marketing cost	162.11	214.17	201.13	271.84	185

Source: Own computation from survey results, 2023.

4.9.2. Marketing channels

In the study area, sample respondents were sell seed potato through different channels. Five main alternative channels were identified for seed potato marketing.

It was estimated that 3596 quintals of seed potato were supplied to the market by sampled respondents in 2023 year. Wholesalers and retailers were the main receivers of seed potato with percentage shares of 36.95% and 28.83%, respectively (Figure 5). The market channels identified during the survey time in the study area were:

Channel I: Producer → other seed potato producer: This channel is the shortest channel at which producers directly sell to other seed potato producers at local market area. It represented

6.09% of the total seed potato supplied to market which amounted to 219 quintals of seed potato during the survey period.

Channel II: Producer → Rural collector → Wholesaler → Retailer → Producer: Rural collectors are buying seed potato from producers at local market and farm gate area and they sell to wholesalers at district market. It accounted for 14.76% of total seed potato marketed 531 quintals during the survey year.

Channel III: Producer → Retailer → Producer: Retailers in the study area seed potato buy without the involvement of brokers and resale to producer. It represented 28.83% of total seed potato marketed 1037 quintals during the survey period.

Channel IV: Producer → Wholesaler → Retailer → Producer: This is the largest and most important channel; it represented 36.95% of total seed potato marketed by volume of 1329 quintals during survey time. Wholesalers buy seed potato at the farm gate through brokers facilitated directly from producers and sell it to retailers in Holeta town, Ejere, Menagesha, central and other market area.

Channel V: Producer → Cooperative → Producer: Cooperative is support farmers for seed potato production than buying seed potato from producers and they sell to producers for planting. It accounted for 13.34% of total seed potato marketed 480 quintals during the survey year.

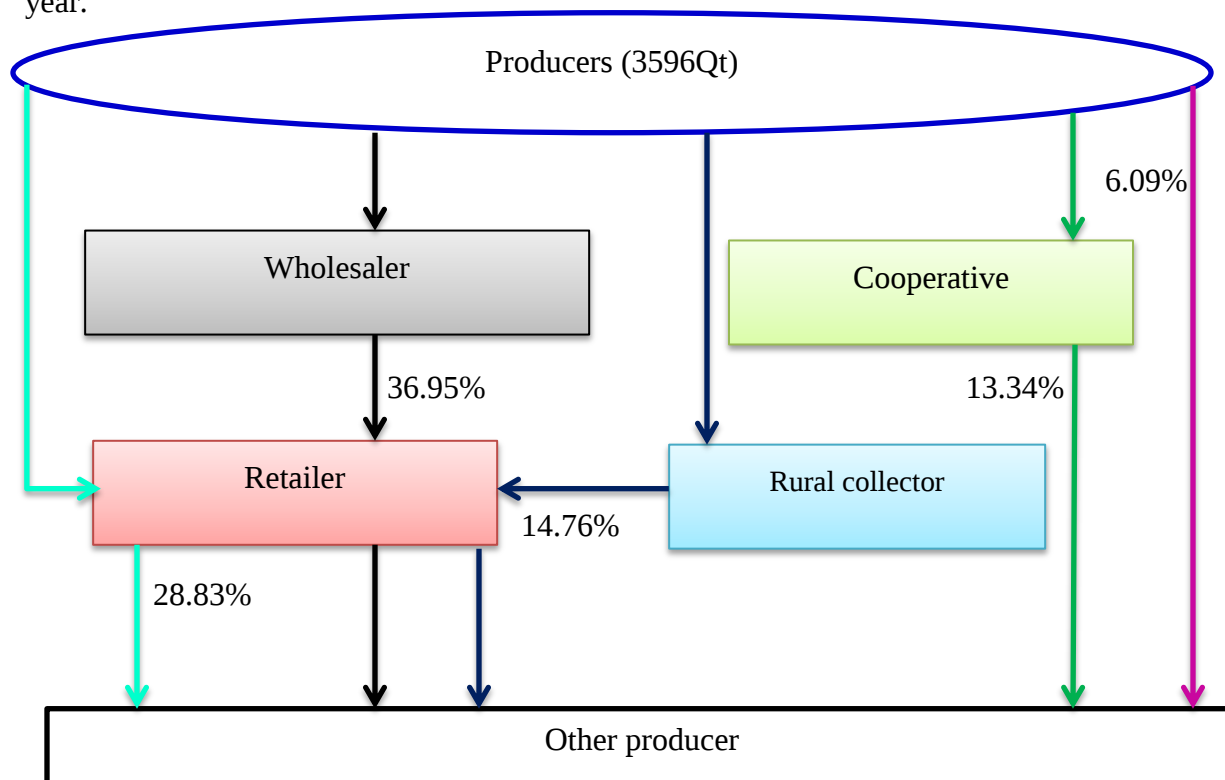


Figure 5: Seed potato marketing channel

Source: Own sketch from survey result, 2023.

4.9.3. Marketing margin analysis

The survey result in Table 15 depicted that the differences between the total income from seed potato trade and the costs incurred in the process of seed potato trading which gives the marketing profit of each actor namely producers, rural collectors, retailers, wholesalers and cooperatives. The results showed that seed potato producers market profit was highest when they sell wholesalers in channel IV which is 998.14 birr/qt, sell cooperatives in channel V which is 958.14 birr/qt and direct sell other producers in channel I which is 945.17 while take lowest market profit when they sell to retailers and rural collectors which accounts, 922.79 birr/qt and 941.64 birr/qt, respectively. This indicates producers are more profitable if they sold to wholesalers, cooperatives and other producers. From traders retailers shared the highest profit 122.58birr/qt when they made direct purchase from producers in channel III they sold to producers and 104.28birr/qt when they made purchase from wholesalers in channel II and IV they sold to producers. Cooperative gained the profit 91.19 birr/qt on channel V, if they bought from producers and they sold to other producers. Seed potato rural collectors made a profit of 90.29 birr/qt on channel II and wholesalers made a profit of 85.31birr/qt on channel II and 82.21birr/qt on IV. This implies that retailers, cooperative and rural collectors were received the highest fee from seed potato marketed in the study area while wholesalers took the smallest profits shares from seed potato value chain (Table 15).

As revealed in Table 15, total gross marketing margin (TGMM) is highest in channel II and IV which was 39.96% followed by channel IV which was 27.25%, and lowest in channel V which was 15.37%. Producer's share (GMMp) was highest in channel III which account 81.87% from the total consumers' price and lowest in channel-II which is 60.03%. This difference might support the theory that as the number of marketing agents increases the producers share decreases. The reason being, the higher number of middlemen in the commodity market, the more profit they retain for their services whether they add value to the item or not. The results shows that the maximum gross marketing margin from traders was taken by retailers, which accounts 18.12% of the consumers' price in channel III followed by cooperative which was

15.54% in channel V. The minimum gross margin is taken by rural collector which was 12.58% in channel II.

Table 15: Seed potato marketing margin for different marketing channels (Birr/Qt)

Actors		Seed potato marketing channels				
		I	II	III	IV	V
Producers	Purchase price					
	Production cost	377.1	377.1	377.1	377.1	377.1
	Marketing cost	162.11	133.94	162.11	145	185
	Selling price	1484.38	1452.68	1462	1520.24	1520.24
	Market profit	945.17	941.64	922.79	998.14	958.14
	GMM _P (%)	100	60.03	81.87	62.83	62.83
Rural Collectors	Purchase price		1452.68			
	Production cost					
	Marketing cost		214.17			
	Selling price		1757.14			
	Market profit		90.29			
	GMMP _{RC} (%)		12.58			
Wholesalers	Purchase price		1757.14		1520.24	
	Production cost					
	Marketing cost		271.84		271.84	
	Selling price		2114.29		1874.29	
	Market profit		85.31		82.21	
	GMMP _W (%)		14.76		14.63	
Retailers	Purchase price		2114.29	1462	2114.29	
	Production cost					
	Marketing cost		201.13	201.13	201.13	
	Selling price		2419.70	1785.71	2419.70	
	Market profit		104.28	122.58	104.28	
	GMMP _R (%)		12.62	18.12	12.62	
Cooperative	Purchase price					1520.24
	Production cost					
	Marketing cost					185
	Selling price					1796.43
	Market profit					91.19
	GMMP _C (%)					15.54
TGMM (%)		0	39.96	18.12	27.25	15.37

Source: Own computation from survey results, 2023.

4.10. Results of Econometric Model

In this section, the selected explanatory variables were used to understand the factors affecting quantity of seed potato supplied to the market and determinants of market outlet choice decisions of seed potato producers.

4.10.1. Factors affecting quantity of seed potato supplied to the market

Analysis of factors affecting farm level volume supply of seed potato was found to be important to identify factors constraining seed potato supply to market. Prior to fitting multiple linear regressions, some diagnostic tests were done to check for existence of multicollinearity, heteroscedasticity and endogeneity problems. This was meant to assess if the independent variables were suitable for inclusion in the model. The variance inflation factor (VIF) was used to test for multicollinearity and the results showed that the mean value of VIF was 1.99 and it ranged between 1.14 and 4.24 (Appendix Table 20). If there is presence of multicollinearity between independent variables, it is impossible to separate the effect of each parameter estimate in the dependent variables. It is thus, important to test multicollinearity between explanatory variables.

Test of heteroscedasticity: Since there is heteroscedasticity problem in the data set, the parameter estimates of the coefficients of the independent variables cannot be BLUE. Breusch-Pagan test of heteroscedasticity was employed for detecting heteroscedasticity.

Multiple regression model method was used to analyze factors affecting the volume of seed potato sold to the market by seed potato producers in the study area. According to the result of this study, all sample households are good suppliers of seed potato to the market. Multiple linear regression models were used to run and analyzed sixteen explanatory variables. As depicted in the Table 16, the model was statistically significant at 1% probability level indicating the goodness of fit of the model to explain the relationships of the hypothesized variables. Coefficient of multiple determinations (R^2) was used to check goodness of fit for the regression model. Hence, R^2 indicates that 79.89 percent of the variation in the quantity of seed potato supplied to market was explained by the variables included in the model.

Table 16: Determinants of farm level volume sales of seed potato (OLS Estimates)

Variable	Coef.	SE	P> t
Constant	1.058	8.118	0.896
Sex	-0.794	1.686	0.638
Age	-0.286	0.175	0.105
Educational level	0.187	0.334	0.576
Family size (Adult equivalent)	-1.415***	0.488	0.004
Tropical livestock unit (TLU)	0.272	0.337	0.421
Land allocated for seed potato	10.248***	1.224	0.000
Own transportation facilities	-2.978	2.059	0.150
Fertilizer (UREA and NPS)	0.020	0.016	0.211
Yield	0.346***	0.042	0.000
Access to improved seed potato	0.928	1.821	0.611
Frequency of extension contact	-0.160	0.671	0.812
Seed potato farming experience	0.675***	0.251	0.008
Access to credit service	-0.626	2.771	0.821
Access to irrigation	-0.009	2.484	0.997
Off/non-farm income	-1.742	2.279	0.446
Distance to nearest market	-0.592***	0.179	0.001
Number of observation		153	
F(16, 136)		33.77	
Prob > F		0.0000***	
R-squared		0.7989	
Durbin test (X^2)		0.990 (p = 0.3197)	
Wu-Hausman F(1,137)		0.892 (p = 0.3465)	

Note: Dependent variable is quantity of seed potato supplied to market in quintal in 2023.

*** is significant at 1% level of probability.

Source: Own computation from survey result, 2023.

The explanation on the effect of the significant explanatory variables is discussed below.

Family size: Family size affects the seed potato market supply negatively and significantly at less than a 10% significant level. It was prior expectations. The survey result indicates that as family size in adult equivalent increases by one unit the seed potato marketed surplus decrease by 1.415Qt, making other things constant. The implication is that households' participation decision in quantity of seed potato supplied market could depend on family size or the per capita consumption requirement that could be satisfied from own production. Thus, the likelihood of being a seller in seed potato market decreases for households with larger family size. The result is consistent with the result of (Beyu, 2022) who found that household with large family sizes

need to feed their family first and take the remaining small portion surplus to the market, especially if the crop is consumed at home.

Size of land allocated for seed potato production: The result shows that land allocated for seed potato has significant effect on volume sales of seed potato at 1% significant level with expected positive sign. The positive sign of the coefficient implies that the larger the land size allocated for seed potato production the larger the quantity produce and thereby increasing the quantity of produce available for sale. Increase in the size of one hectare of land allocated for seed potato is increase volume sales of seed potato by 10.248 quintals, keeping other factors constant. The reason could be access to more arable land that encourages farmers to produce more seed potatoes. In support of the finding here, (Hailu, 2016, Hegena and Teshome, 2022) indicated that the area of land allocated for vegetable production affected the amount of sold significantly and positively.

Seed Potato Farming Experience: The result shows that seed potato farming experience of households has positive and significant effect at 1% level on the seed potato quantity sold with expected positive sign. Thus, the result implied that as farmer's experience increase by one year, the probability of market supply increases by 0.675, keeping other factors constant. This means that farmers with more experience in seed potato production and marketing have higher ability to produce more and participate in the market than less experience because they have more marketing network and information. This is in line with conducted by Hailu (2016) who illustrated as farmers experience increased the volume of onion supplied to the market has increased.

Yield of Seed Potato: The result indicated that seed potato yield was positively and significantly related with quantity of seed potato supplied to market at 1% significance level. The positive and significant relationships between the two variables indicate that seed potato yield (output per unit of land) is very important variable affecting the volume of seed potato market supply. The coefficient for yield implies that an increase in yield of seed potato by one quintal per hectare resulted in an increase in farm level market supply of seed potato by 0.346 quintal, keeping other factors constant. This is in line with study conducted by Hailu (2016) showed that the yield of potato produced by households significantly and positively affected the market supply.

Distance to the Nearest Market

Distance to nearest market affected the quantity of seed potato supplied to market negatively and significantly at 1% significance level. The model result shows that other explanatory variables being constant, as the distance of the producers' residence from the nearest market increase by one walking minute, the quantity of seed potato supplied to market the decrease by 0.592 quintals. This is may be due to the reason that as the distance to the nearest market increases transportation cost increases; since seed potato is highly perishable and bulky product its loss and other marketing costs increased. This is in line with study conducted by Woldesenbet (2013a) who indicated that distance to market caused market surplus of cabbage to decline.

4.10.2. Determinants of market outlet choice decisions of seed potato producer

The multivariate probit model fits the data reasonably well. The Wald test (Wald (X^2 (48) = 90.32, $p = 0.0002$) is significant at 1%, which indicates that the subset of coefficients of the model is jointly significant and that the explanatory power of the factors included in the model is satisfactory. The results of likelihood ratio test in the model (LR (X^2 (3) = 51.0269, $p > \chi^2 = 0.0000$) is statistically significant at 1% level, indicating that the independence of the market outlets choice is rejected and there are significant joint correlations for two estimated coefficients across the equations in the model (Table 17). The likelihood ratio test of the null hypothesis of independence between the market outlets decision ($\rho_{21}=\rho_{31}=\rho_{32}=0$) is significant at 1%. Thus, the null hypothesis that all the ρ (Rho) values are jointly equal to 0 is rejected, indicating the goodness-of-fit of the model. Hence, there are differences in market outlet selection behavior among seed potato producers, which are reflected in the likelihood ratio statistics. Separately considered, the ρ value (ρ_{ij}) indicate the degree of correlation between each pair of dependent variables. The ρ_{21} (correlation between the choice for wholesalers and retailers) and ρ_{31} (correlation between the choice for wholesalers and collectors) and ρ_{32} (correlation between the choice for retailers and collectors) all are negatively interdependent and significant at the 1, 5, and 1% probability levels respectively (Table 17).

The simulated maximum-likelihood (SML) estimation of marginal success probability for each outlet's result shows that the probability of seed potato producers' market outlets chooses wholesaler, retailer, and collector, which was 47%, 59%, and 48%, respectively.

The joint probability of (success) to select all outlets were 3.63% and the joint probability of (failure) to select all outlets were 3.78%. The result in Table 18 shows that out of sixteen explanatory variables included in the multivariate probit model that can affect the market channel choice of seed potato in the district, eight variables had a significant effect on market channel choice. They were the age of household head, educational level of household head, land size allocated for seed potato, access to credit, quantity supplied to the market, own transport facility, own motor pump, and access to market information, which were found to significantly affect the market outlet choice behavior of seed potato producers.

Age of household head: The age of the farm household head affected choosing retailer market outlets positively and significantly at a 5% significant level. The result shows that, as age of household head increases the probability of choosing retailer market outlet increase. One year increase in age of the household head was associated with 2 % increase in the probability of choosing retailers as marketing channels related to other market outlet. This implies that, older farmers may take their decision to choose better market outlet which gives higher price more easily than the young farmers, because older people might have marketing experience, accumulated capital or a long term relationship with their clients or might have preferential access to credit due to their age, availability of land, or family size. This finding is related to Melese *et al.* (2018) who found that age of household head significant and positively influenced choice of retailer market outlet by smallholder farmers.

Educational level of the farm household: Education level of household head had a positive and significant effect on market channel choice of a retailer outlet at a 5% significant level. An additional year in school was associated with 5% increase in the probability of selling to retailer market outlet. This result shows that educated farmers would more likely to sell to retailers than other market outlet. The possible reason might be that as the education level increases farmer's productivity increases and strengthen the linkage with retailers. Education increases the knowledge of farmers that can be used to collect information, interpret the information received, and make knowledgeable and marketing decisions. This result is in line with the finding of Mohammed Kassaw *et al.* (2019) that education level is positively and significantly related to the retailers' market outlet.

Land allocated for seed potato: Contrary to what was expected, land size allocated for seed potato have a negative and significant effect on wholesalers and retailers market outlets at 5% and 10% probability level, respectively. The result indicates that, an increase in one hectare of farm land allocation for seed potato production decreases the probability of selling to wholesalers and retailers outlet by 14.5% and 11.5% relative to other market outlet, respectively. The finding result shows that those household seed potato producers who allocated less hectares of land for seed potato production would produce less output and they likely to sell to other market outlet that purchase less amount than wholesaler and retailer outlet. Therefore, they choose other market outlets because they can absorb their less volume. This result is similar with the finding by Hailu (2016) who found that an increase in land allocation for the production of potato decreases producers' likelihood of choosing retailer outlet.

Access to credit: The likelihood of choosing collector outlet was positively and significantly affected by access to credit at 5% levels of significance. As the farmers have access to credit, seed potato producer are more likely to sell to collector outlet as compared to producers who not access to credit. In addition as the farmers have access to credit, the probability of participating in wholesaler and retailer market channels will decreases. The possible reason that farmers who choose collector market outlet have better access to formal credit than wholesalers' and retailers market outlets. The result is consistent with the findings by Melese *et al.* (2018) who found that probability of choosing assembler was positively affected by access to credit at significance levels.

Ownership of transport facilities: As hypothesized, ownership of a transport facility was positively associated with the choice of wholesaler outlet. Having an own transport facility increased farmer's probability of selling to wholesalers by 19% compared to others market outlet. Ownership of transport facilities by farmers increased the likelihood of choosing wholesalers outlet. This might be due to the reason that farmers who have transport facilities could supply their product to urban centers and sale to wholesalers directly by getting better prices which might go to the collectors. This shows that the availability of transportation facilities helps reduce long market distance constrain and offering greater depth in marketing choices. This result is in line with finding by Mohammed Kassaw *et al.* (2019) who found that owning transport facilities influenced the choice of wholesalers' outlet positively and significantly.

Quantity supplied to market. The likelihood of choosing wholesaler market outlet positively affected by the quantity of seed potato supplied to the market at a 1% level of significance but the likelihood of choosing retailer market outlet negatively by the quantity of seed potato supplied to the market at a 10% level of significance. The result indicates households that supply large output of seed potato accessed wholesaler market outlet compared with households who supply less because of wholesaler capacity to purchase large amounts of seed potato products. This is because if the quantity of seed potato offered to the market is high, producers might fear taking it back to their house if it is not sold because they choose wholesalers' outlets. On the contrary, if the amount of product that offered to the market is small, farm household might be interested to sell for retailers. This study is in line with Demisse *et al.* (2022) finding shows that the household that chooses a wholesaler is positively and significantly affected by volume supply to the market but likelihood of choosing retailers negatively and significantly by the quantity of seed potato supplied to the market.

Ownership of motor pump: Ownership of the motor pump had a negative and significant influence on the choice of collector outlet at 5% probability level. The negative sign shows that farmers who had own motor pump are less likely to choose collector outlet compared to those farmers who had not owned motor pump. This might implies that farmers who had own motor pump for irrigation produce more seed potato and thus deliver their product to any of the available outlets compared to those farmers who had not. This result is consistent with the findings of Hailu (2016) ownership of motor pump had a negative and significant influence on the choice of retailer outlet.

Access to market information: Contrary to what was expected, access to market information is associated negatively and significantly at 10% level of probability with the likelihood of choosing collector outlets. The negative relationship may be attributed to other outlets' preference for higher-priced products. Seed potato growers no longer prefer to sell their produce to local collectors; instead, they transport it to the nearest market centers. This result is in line with Wosene and Gobie (2021) who found that farmers who earn more money choose to sell their tomato at a reasonable price to the nearest market outlet rather than travel long distances. Farmers' access to information increases their bargaining power to get a reasonable price.

Table 17: Marginal effect after multivariate probit model estimation for determinants of seed potato supplied to market outlets choice

Variables	Wholesaler			Retailer			Collector		
	Coef.	Std.Err	dy/dx	Coef.	Std.E rr	dy/dx	Coef.	Std.Err	dy/dx
Sex	0.358	0.279	0.116	0.023	0.260	0.001	-0.703	0.347	-0.152
Age	-0.010	0.028	-0.003	0.070	0.032	0.020**	-0.017	0.025	-0.011
Educational level	-0.085	0.061	-0.028	0.165	0.065	0.050**	-0.025	0.068	-0.009
Adult equivalent	-0.122	0.086	-0.034	0.058	0.077	0.011	-0.026	0.074	0.003
Land allocated	-0.468	0.253	-0.145**	-0.411	0.221	-0.115*	-0.170	0.290	-0.030
Farming experience	-0.046	0.038	-0.015	-0.009	0.036	-0.001	0.042	0.036	0.012
Cooperative membership	0.128	0.269	0.028	-0.233	0.239	-0.065	-0.247	0.297	-0.031
Own motor pump	0.461	0.453	0.149	0.833	0.492	0.252	-1.156	0.517	-0.331**
Freq extension contact	0.111	0.135	0.045	-0.108	0.129	-0.032	-0.003	0.124	-0.007
Access to credit	0.007	0.255	0.0081	0.019	0.279	0.006	0.605	0.265	0.196**
Own transport facilities	0.559	0.283	0.190**	-0.210	0.284	-0.059	0.277	0.243	0.045
Non/off- farm income	0.050	0.290	0.017	-0.419	0.318	-0.098	0.139	0.433	0.030
Market information	0.245	0.243	0.089	0.371	0.238	0.109	-0.368	0.294	-0.139*
Quantity sold	0.036	0.012	0.010***	-0.010	0.008	-0.004*	0.013	0.010	0.004
Current price of seed	0.000	0.000	0.000	0.000	0.000	0.0002	0.000	0.000	0.000
Distance nearest market	-0.003	0.030	-0.0002	0.014	0.031	0.005	-0.065	0.036	-0.017
Number of observation =				153					
Wald $X^2(48)$ =				90.32					
Prob > X^2 =				0.0002***					
Likelihood ratio test of rho21 = rho31 = rho32 = 0									
Log likelihood = -249.90 $X^2(3)$ = 51.0269 Prob > X^2 = 0.0000									

Note. * **, and * show significance at 1, 5, and 10%, respectively.

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary and Conclusion

The study was undertaken in the Welmera district, West Shewa Zone. The specific objectives of the study were identify seed potato value chain actors, their roles and benefit shares, analyze factors affecting quantity of seed potato supplied to the market and examine the determinants of market outlet choice decisions of seed potato producers. To address the objectives of the study, both quantitative and qualitative data was used. The data were gathered from both primary and secondary sources. The primary data were collected through personal interviews from 153 randomly selected households and 14 traders were selected purposively using pre-tested semi-structured questionnaire and checklist. Qualitative data were collected through focus group discussions, key informants interviews and field observations. Analysis was made using descriptive statistics, gross margin and econometric model using (STATA Software Package). All the sampled households were seed potato producers. Determinants of seed potato supply to market and market outlet choice decision are found to be important elements in the study of seed potato value chain. Therefore, in identifying determinants that affect the quantity of seed potato supplied to market, a multiple linear regression model was used and multivariate probit model (MVP) was applied to analyze factors affecting market outlet choice of farmers for selling seed potato in the study area. The findings of this study are summarized as follows.

The analysis of descriptive statistics revealed that, out of 153 total sampled seed potato producer 76.47% were male headed and the rest 23.53% were female headed households. The average ages of the sampled respondents were 39.76. The average family size was 5.12 in the study area. Seed potato value chain analysis in the study areas revealed that the main value chain actors are input suppliers, producers, rural collectors, wholesalers, retailers and cooperative. The main supporters of the seed potato value chain in the study area were District Agricultural Office, Holeta Agricultural Research Center, Robi-Berga Cooperative, District trade and market development office, District irrigation authority, NGOs like Cooperative Bank of Oromia and Sinqee Bank. Different actors involved in seed potato value chain in study area, however there is a weak link among actors in the value chain.

Five alternative channels were identified in seed potato marketing with each channels having different marketing margin and about 3596 quintals of seed potato were marketed by sample

producers. The result indicates that seed potato producers market profit was highest when they sell to wholesalers in channel IV which is about 998.14birr/qt while took lowest market profit when they sell to retailers in channel III which is about 922.79 birr/qt. The result of margin analysis for actors involved in seed potato value chain indicates that total gross marketing margin (TGMM) was highest in channel- II and lowest in channel –V which was about (39.96%) and (15.37%), respectively. Producer's share (GMMp) was highest in channel III which account 81.87% from the total consumers' price and lowest in channel-II which is about 60.03%. Production costs incurred by seed potato producer were rental value of land, seed/tuber, fertilizer (UREA and NPS), labor for plowing, labor for weeding, labor for harvesting, oxen for plowing and chemicals, the highest cost items incurred by producers was the cost of land rental and seed purchase with an average cost of birr 97.82 and 85.7 for producing a quintal of seed potato.

The overall seed potato value chains are constrained by a number of factors which hinder the development of seed potato value chain. At farm level, the major production constraints are lack of improved varieties, pest and diseases, shortage or absence of irrigation and lack of credit availability in the study area. At marketing stage, poor linkage with value chain actors, lack of adequate storage facilities, low quality of seed potato, lack of market information, product perishability, low price for seed potato and lack of organized market.

Econometric result of multiple linear regression model indicated that family size, productivity, seed potato farming experience, distance to nearest market and area of land allocated for seed potato production are significantly determining the quantity of seed potato supplied to the market. The multivariate probit model was run to identify factors determining farmers' market outlet choice decision. The model results indicated that the probability to choose wholesalers marketing outlet for seed potato was significantly affected by the land allocated for seed potato, access to own transport facility and quantity sold to market. The probability of choosing retailers marketing outlet was affected by age of household head, educational level of household head, quantity supplied to market, and land allocated for seed potato production. The probability to choose collectors market outlets was significantly affected by the access to credit, access to own motor pump, and access to market information. Therefore, these variables require special attention if farmers margin from seed potato production is to be increased. These problems can be addressed by providing improving land management practices, providing adult education,

credit access, providing motor pump, market information and rural-urban infrastructure were very important.

5.2. Recommendations

The findings of this study enabled us to make the following recommendations for policy makers, developments actors and researchers who have strong interest in promoting seed potato production and marketing for equal benefits among value chain actors.

1. Strengthen the input supply system especially improved varieties and fertilizers timely delivery with reasonable price. Therefore, district agriculture office and irrigation authority office should provide farmers with improved seed and closely work with agricultural research organizations that releases improved seed potato varieties.
2. Strengthening the linkage/interaction among value chain actors helps for better performance of seed potato value chain in the study area. Therefore, the government and other concerned bodies should enhance the linkage between actors involved in seed potato value chain.
3. Provide training on seed potato disease and pest control and seed potato management helps to solve seed problem, therefore district agriculture office and irrigation authority office, research institute, university and different non-profit institutions should give due attention to improve storage facility.
4. In order to overcome irrigation water shortage government should give attention to scaled up underground water and other water sources to expand seed potato production and productivity.
5. Encouraging legal seed potato traders and create awareness for illegal traders to collect them into formal seed potato trade system. Hence, the district trade and market development should provide market information and take corrective measures on unlicensed traders and brokers.
6. Strengthen the financial capability of seed potato producers by providing sufficient loan. Therefore, banks and micro finance institutions should provide adequate credit service for seed potato producers according to their need.
7. Market supply is significantly and negatively affected by distance to nearest market, improving infrastructures (road and telecommunications) of rural village by constructing all

weather roads and enlarges network coverage to enhance market access of producers. Therefore, the district administration office, road authority and other concerning body should work to improve road and telecommunications service of the area.

8. Being ownership of motor pump had a significant influence on collector's outlet negatively. Therefore, government and other concerned body should support seed potato producers to have their own motor pump via team forming.

9. Wholesaler and retailer outlet choice is negatively and significantly affected by land allocated for seed potato. Therefore, government should enhance farmers land allocation for seed potato and increase productivity through better land management practice and increase choice of appropriate outlets.

10. Encouraging adult education for farmers is recommended by the government body and non-governmental institutions.

11. Market information is an important component for improving production and marketing of seed potato. The availability of timely and precise market information increases producers bargaining power to negotiate with buyers of their produce. This should be further strengthening by marketing organizations such as irrigation cooperatives so that farmers can sell their produce at reasonable prices with having better purchasing power.

12. Finally, further studies on the value chain are recommended to identify best upgrading practices agreed by different chain actors so that a well-organized regional and national seed potato production and marketing can be implemented.

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7. APPENDICES

Appendix Tables

Appendix Table 18: Conversion factors used to compute tropical livestock units (TLU)

Livestock categories	Conversion factor
Oxen	1.00
Cows	1.00
Calf	0.25
Bull	0.75
Heifer	0.75
Sheep	0.13
Goats	0.13
Donkey (adult)	0.70
Donkey (young)	0.35
Mules	1.10
Horse	1.10
Chicken	0.013

Source: Storck *et al.*, 1991

Appendix Table 19: Conversion factor used to compute adult equivalent

Age Category in year	Sex	
	Male	Female
<10	0.6	0.6
10–13	0.9	0.8
14–16	1	0.75
17–50	1	0.75
>50	1	0.75

Source: (Storck et al., 1991)

Appendix Table20: The result of multicollinearity test of explanatory variables

Variable	VIF	1/VIF
Age	4.24	0.236
Educational level	3.46	0.289
Experience	2.87	0.348
Yield	2.41	0.415
TLU	2.22	0.451
Land allocated for seed potato	2.18	0.457
Quantity of fertilizer in quintal	1.79	0.559
Use to improved seed potato	1.75	0.573
Family size	1.63	0.613
Own transport facility	1.57	0.637
Frequency of extension contact	1.49	0.670
Access to irrigation	1.42	0.7032

Distance to nearest market	1.36	0.737
Access to credit	1.23	0.811
Non/off-farm income	1.14	0.878
Sex	1.14	0.880
Mean VIF	1.99	

Source: Own computation from survey result, 2023.

Appendix Table 21: Means of transport used by sampled respondents

Means of transport	Frequency	Percent	Cumulative percent
On donkey or horseback load	14	9.2	9.2
Head loading	1	0.7	9.8
By vehicle	73	47.7	57.5
Carts	65	42.5	100.0
Total	153	100	

Source: Own computation from survey result, 2023.

Appendix Table 22: Type of information sampled households provided during survey year

Type of information provided	Frequency	Percent	Cumulative percent
Price information	72	47.1	67.9
Market place information	9	5.9	76.4
Buyers information	25	16.3	100.0
Total	106	69.3	

Source: Own survey result, 2023.

Appendix Table23: Sources of labor for seed potato production

Source of labor	Frequency	Percent	Cumulative percent
Family labor only	47	32.0	32.0
Hired labor only	7	4.6	36.6
Family labor + Hired labor	72	47.1	83.7
Family labor + Labor exchange	17	11.1	94.8
Family labor + Hired labor + Labor exchange	8	5.2	100.0
Total	153	100.0	

Source: Own survey result, 2023.

Producers' Survey Questionnaires

Section 1: General Information

1. Date of interview: Date _____ Month _____ Year _____
2. Region _____ District _____ Kebele _____ Village _____
3. Name of enumerator _____ Signature _____
4. Telephone: _____
5. Name of the respondent _____
6. Questionnaire number: _____

Section 2: Household Composition and Characteristics

1. Sex of the respondent [✓]: 1. ☐ Male 2. ☐ Female
2. Age of the respondent _____ years
3. Marital status: 1. ☐ Married 2. ☐ Unmarried 3. ☐ Divorced 4. ☐ Widowed 5. ☐ Others (specify) _
4. Educational level of household head (in year of schooling) _____
5. Family size in age and sex group:

Total family members	Children (<10)	Children (10–13years)	M (14–16 years)	F (14–16years)	M (17–50 years)	F (17–50 years)	M (>50 years)	F (>50 years)
1								

Section 3: Resource Ownership and Land Tenure Status

1. Is your family labor adequate for farm activities? [✓] 1. ☐ Yes 2. ☐ No
2. Do you possess your own land for cultivation? [✓]: 1. ☐ Yes 2. ☐ No
3. How much lands do you used for seed potato production _____ ha in 2022/23?
4. Do you have your own transportation facilities? (✓) 1. ☐ Yes 2. ☐ No
5. If your answer for Q. 4 is yes, what type? (✓) 1. ☐ Vehicle 2. ☐ Transport animals 3. ☐ Cart
4. Others (specify)

Livestock Ownership

1. Do you have a livestock? (✓) 1. ☐ Yes 2. ☐ No

2. If yes, please tell us a bit detail of your livestock ownership? Fill the following table.

No.	Type of animal at the moment	Local breed owned	Estimated average price of each (ETB)	Cross breed/modern owned	Estimated average price of each (ETB)
1	Oxen				
2	Cows				
3	Calf				
4	Bull				
5	Heifer				
6	Sheep				
7	Goats				
8	Donkey(adult)				
9	Donkey (young)				
10	Mule				
11	Horse				
12	Chicken				
13	Others (specify)				
Total value					

Section 4: Seed Potato Production and Inputs Used

1. Have you used improved seed potato varieties in your plot last cropping season (2022/23)?

1. ☐ Yes 2. ☐ No

2. If your answer for Q. 1 is yes, how did you first learn about the improved seed potato variety?

1. ☐ Government extension 2. ☐ Research center (specify) ____ 3. ☐ University (specify) _

4. ☐ Another farmer 5. ☐ Radio/TV 6. ☐ Others (specify) _____

3. Seed potato variety types and annual production during 2022/23 (2014/15 E.C) cropping season:

No	Seed potato variety types	Area under rainfed (timad)	Production rainfed (qt)	Area under irrigated (timad)	Production irrigated (qt)
1	Local Variety				
2	Improved Variety				

4. How long have you practiced production of seed potato? _____ Years.

5. How many times do you produce seed potato in 2022/23 production season? _____

6. What type of seed potato production system do you adopt? (✓) 1. ☐ Sole cropping 2. ☐ Intercropping

3. ☐ Mixing with other crops 4. Others (specify) _____

7. Fill the following table considering inputs used for seed potato production and cost of inputs during 2022/23 production season?

Inputs type	Item		Amount of inputs used for seed potato production	Cost of each inputs (Birr/timad)
Land	Land rented (timad)			
Seed		Name of variety		
	Local variety(Qt/timad)			
	Improved variety(Qt/timad)			
Fertilizers	NPS (Qt/timad)			
	Urea (Qt/timad)			
	Compost (local unit /timad)			
Pesticides/Herbicides	Pesticides(Ltr/timad)			
	Herbicides (Ltr/timad)			
Fuel	Fuel (Litr/timad)			
Others	(Specify)			

8. Did you hire labour and oxen during seed potato production activities in 2022/23?

1. ☐ Yes 2. ☐ No

9. If yes, please fill the following cost incurred related to different operation category?

- ✓ Total cost of hired labor for plowing_____ETB
- ✓ Total cost of hired oxen for plowing_____ETB
- ✓ Total cost of hired labor for planting_____ETB
- ✓ Total cost of hired oxen for planting_____ETB
- ✓ Total cost of hired labor for weeding_____ETB
- ✓ Total cost of hired labor for chemical spraying_____ETB
- ✓ Total cost of hired labor for harvesting_____ETB

10. What type of inputs and from which source did you get such agricultural inputs in the seed potato production process? (Multiple responses are expected)

Crop	Types of inputs	Code1	Sources (code1)	Code2	How (code2)
Seed potato	1. Improved seed		1. Woreda agriculture office		1.Through purchase
	2. Fertilizers		2. Local market		2.On credit bases
	3.Pesticides/herbicides		3. Union(specify)		3. As gift
	4.Farm implements		4. Cooperatives		4.Through
	5. Others (specify)		5. NGOs (specify)		

			6. Research center (specify) 7. University (specify) 8. Fellow farmers		exchange 5.Others (specify)
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11. Do you always get inputs in the quantities that you need at the right time? (✓)

1. ☐ Yes 2. ☐ No

12. If your answer for Q.11 is No, what are the reasons? (✓) (Multiple responses are possible)

1. ☐ I am not sure of the benefit 2. ☐ Too expensive 3. ☐ Not available on time 4. ☐ Cash shortage 5. ☐ Low quality 6. ☐ Far distance 7. Others (specify) ____

13. Did you experience problems in accessing these inputs? (✓) 1. ☐ Yes 2. ☐ No

14. If your answer for Q.13 is yes, what was the most difficult input to access? (Rank them)

No.	Types of inputs used	Problems (write codes1)	Code 1
1	Improved seed		1. Unavailability
2	Fertilizer		2. Shortage of supply
3	Pesticides/herbicides		3. Costly
4	Farm implements		4. Remoteness of input selling site
5	Others (specify)		5. Others (specify)

15. If you have ever encountered problems with the use of improved seed potato, what type? (✓)(Rank them)

1. ☐ Seed not available 2. ☐ Seed too expensive 3. ☐ Not adaptable 4. ☐ Susceptible to diseases 5. ☐ Poor quality of seed 6. ☐ There is germination problem 7. Other (specify) _____

16. What is the labor source for seed potato productions? (✓) (Multiple responses are possible)

1. ☐ Family labor 2. ☐ Hired labor 3. ☐ Labor exchange 4. ☐ Cooperation 5. Others (specify) _

17. What type of farm implements do you use for seed potato production?

Farm Implements	Number	Years of purchase	Price bought in (ETB)	Current value each (ETB) if they can sell
Plough				
Hoe				
Harrow				
Motor pump				
Tractor				
Others (specify)				

18. Would you like to expand seed potato production? (✓) 1. ☐ Yes 2. ☐ No

19. If your answer for Q.18 is yes, why? _____

20. If your answer for Q.18 is No, why? _____

Section 5: Production Service

Extension Contact

1. Did you have extension contact in relation to seed potato production in the 2022/23 cropping season?

1. ☐ Yes 2. ☐ No

2. If your answer for Q.1 is no, why? (✓) (Multiple responses are possible)

1. ☐ No service provider nearby 2. ☐ Possessed the required information 3. ☐ Availability of contact farmers 4. ☐ Do not have time to get the service 5. Others (specify) _____

3. If your answer for Q.1 is yes, how often the extension agent contacted you in 2022/23? _____ in year?

4. What was the extension advice specifically on seed potato production? (✓) (Multiple responses are possible)

1. ☐ Seed bed preparation 2. ☐ Planting and spacing 3. ☐ Fertilizer (compost) applications 4. ☐ Disease and pest control 5. ☐ Harvesting 6. ☐ Transplanting 7. ☐ Marketing of seed potato 8. ☐ Post-harvest handling 9. Others (specify) _____

Training

1. Have you ever received any training related to seed potato production? 1. ☐ Yes 2. ☐ No

2. If your answer for Q.1 is yes, who provided the training? (Rank them)

1. ☐ Development agents 2. ☐ Woreda office of agriculture experts 3. ☐ NGOs (specify) _____

4. ☐ Research centers (specify) _____ 5. ☐ Neighbors and friends 6. ☐ Others (specify) _____

3. How many times have you been trained in the last 12 months? _____

4. On which main area are you trained? 1. ☐ Land preparation 2. ☐ Planting and spacing 3. ☐ Fertilizer (compost) applications 4. ☐ Disease and pest control 5. ☐ Harvesting 6. ☐ Transplanting 7. ☐ Marketing of seed potato 8. ☐ Post-harvest handling 9. Others (specify) _____

Access to Credit

1. Have you received any form of credit for seed potato production in 2022/23 cropping season?

1. ☐ Yes 2. ☐ No

2. If your answer for Q.1 is No, why? (Allow more than one answer and rank them).

1. ☐ No credit association/no access 2. ☐ No need/own financial capacities 3. ☐ No collateral 4. ☐ Not available on time 5. ☐ Borrowing is risky 6. ☐ High interest rate 7. Others, (specify) _____

3. If your answer for Q.1 is yes, from whom did you get credit for seed potato production?

Source(s) of credit	1=Yes 2=No	Amount received (ETB)	Monthly interest rate charged (%)	Payback period	Interest rate (ETB)
Local money lenders					
Farmer group/cooperative					
Rotating savings and credit association /Equb/					
Micro-finance institution					
Relative and friends					
Bank (specify)					
Others (specify)					

4. For what purpose did you take the credit in relation to seed potato production?

1. ☐ To purchase fertilizer for seed potato 2. ☐ To rent in land to extend seed potato production
3. ☐ To purchase seed/seedlings 4. ☐ To purchase transporting animals 5. ☐ To purchase motor
pump/irrigation equipment 6. Others (specify) _____

5. Did you receive the amount you requested? 1. ☐ Yes 2. ☐ No

6. If your answer for Q.5 is No, explain the reasons _____

Access to Irrigation

7. Do you have access to use irrigation facilities for seed potato production? (✓)

1. ☐ Yes 2. ☐ No

8. Do you have your own motor pump? 1. ☐ Yes 2. ☐ No

Membership of Cooperative

1. Did you belong to any farmers' association/organization/cooperative in 2022/23?

1. ☐ Yes 2. ☐ No

2. If your answer for Q.1 is yes, what is the name of the cooperative? _____

3. If your answer for Q.1 is yes, what was the main reason for joining the association?

1. ☐ To easily obtain supervision by extension worker (s) 2. ☐ To easily obtain inputs 3. ☐ To
learn and share experiences with fellow farmers 4. ☐ To sell produce as a group/to easily obtain
market 5. Others (specify) _____

4. If your answer for Q.1 is No, what was the main reason for not joining any association?

1. ☐ Absence/Inexistence of association 2. ☐ Lack of organization in the association 3. ☐ No
incentive/ benefit 4. Other (specify) _____

Section 6: Non-Farm or Off-Farm Activities

1. Did you earn off-farm income last cropping season in 2022/23? 1. ☐ Yes 2. ☐ No
2. If your answer for Q.1 is yes, what is the reason to be engaged in off-farm activities? (Rank them)
 1. ☐ No other occupation during the dry season
 2. ☐ Shortage of farm land
 3. ☐ Attractive income from off-farm activities
 4. ☐ Excess family labor
 5. Others (specify) _____

Section 7: Seed Potato Marketing Practices

1. From the harvested seed potato production, have you sold in the market? 1. ☐ Yes 2. ☐ No
2. If your answer for Q.1 is No, why you did not sell? _____
3. If your answer for Q.1 is yes, please provide the following information in 2022/23:

No	Name of variety	Total quantity produced (qt)	Quantity gifted or donated (qt)	Left for seed (qt)	Quantity sold (qt)	Average selling price(Birr/qt)	Month sold Code 1
1							
2							

Code 1: 1. January; 2. February; 3. March; 4. April; 5. May; 6. June; 7. July; 8. August; 9. September; 10. October; 11. November; 12. December

4. How much and to whom do you sell primarily your seed potato in 2022//23? (Write the codes)

Amount sold (qt)	<u>Price per (qt)</u>	<u>To whom sell</u> 1. Rural collectors 5. Brokers 2. Consumers 6. Union (specify) 3. Retailers 7. Cooperatives (specify) 4. Wholesalers 8. Others (specify)	<u>Terms of sell</u> 1=Cash 2=Credit 3=Advance payment	<u>Where (place of sale)</u> 1. Farm gate 2. Local market 3.Woreda market 4.Zonal(major) market 5. Addis Ababa 6. Others (specify)

5. In deciding to whom to sell, what factors do you consider? (Multiple responses are possible)
 1. ☐ Transport availability
 2. ☐ Price
 3. ☐ Fairness of scaling (Weighing)
 3. ☐ Closeness in distance
 5. Others (specify) _____
6. Means of transportation used? (✓) (Multiple responses is possible)
 1. ☐ On donkey/horseback load
 2. ☐ Manpower
 3. ☐ By Vehicles
 4. ☐ Carts
 5. Others (specify)
7. Do you have storage facility for your seed potato products? (✓) 1. ☐ Yes 2. ☐ No
8. Do you have access to media in 2022/23? (✓) 1. ☐ Yes 2. ☐ No
9. Do you have marketing information in 2022/23? (✓) 1. ☐ Yes 2. ☐ No

- 10.** If your answer for Q.9 is yes, from whom did you get the market information? (✓)
1. ☐ DAs 2. ☐ Kebele administration 3. ☐ District experts 4. ☐ Radio/Television 5. ☐ Brokers
6. ☐ Cooperatives (specify) _____ 7. ☐ Others (specify) _____
- 11.** What type of information did you get? (✓) 1. ☐ Price information 2. ☐ Market place information 3. ☐ Buyers' information 4. ☐ Others (specify) _____
- 12.** At what time interval do you get the information? (✓)
1. ☐ Daily 2. ☐ Weekly 3. ☐ Monthly 4. Others (specify) _____
- 13.** Was the information you want valuable? (✓) 1. ☐ Yes 2. ☐ No
- 14.** Did you face difficulty in finding buyers when you wanted to sell seed potato? (✓)
1. ☐ Yes 2. ☐ No
- 15.** If your answer for Q.14 is yes, due to: (✓) 1. ☐ Inaccessibility of market 2. ☐ Lack of market information 3. ☐ Low price offered 4. ☐ Others (specify) _____
- 16.** Distance of your residence from the nearest village market (km) _____ transport cost per person using car _____
- 17.** Distance of your residence to the nearest main market/urban center (km) _____ transport cost per person using car _____
- 18.** Distance to all weather roads (km) _____ minutes of walking time _____
- 19.** What do you do if you did not get the expected price for your seed potato supply? (✓)
1. ☐ Took back home 2. ☐ Sold at lower price 3. ☐ Took to another market on the same day
4. ☐ Sold on other market day 5. ☐ Others (specify) _____
- 20.** Who sets your selling price for seed potato in last season? (✓)
1. ☐ Yourself 2. ☐ Buyers 3. ☐ Set by demand and supply 4. ☐ Negotiations 5. ☐ Others (specify) _____
- 21.** When did you get the money after your sale? (✓)
1. ☐ As soon as you sold 2. ☐ After some hours 3. ☐ Other days after sale 4. Other (specify) _____

22. Average return of seed potato selling

Seed Potato	Selling price (Birr/qt)	Total cost (Birr/qt)						
		Packing material	Loading/unloading	Transport	Broker	Store rent	Tax	Others(specify)

23. Please mark (✓) for the questions specified here under and indicates seed potato production activity in your area.

Main activity	Months											
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Planting time												
Harvesting time												
Weeding												
Marketing time												

Section 8: Constraints and Opportunities

1. What are the major constraints of seed potato production in your area? (Rank major problems 1-6 and otherwise tick (✓) if the problem is relevant)

No	Production constraints					Rank them
1	Lack of improved varieties			7	Oxen Shortage	
2	Weeds			8	Lack of pesticides	
3	Insect			9	High/Low rain fall	
4	Disease			10	Fertilizer shortage	
5	Shortage/ absence of irrigation			11	Flood	
6	Lack of credit availability			12	Others (Specify)	

2. What are the major constraints of seed potato marketing in your area? (Rank major problems 1-6 and otherwise tick (✓) if the problem is relevant).

No	Marketing Constraints					Rank them
1	Lack of organized market			7	Lack of market information	
2	Low price for seed potato			8	Low quality of seed potato	
3	Absence of proper transportation facility			9	Low consumer demand	
4	Individual marketing (no cooperative marketing)			10	Far market distance	
5	Various intermediaries			11	Poor linkage with value chain actors	
6	Lack of adequate storage facilities			12	Product perishability	

3. Did you solve these problems by your own? If so how?

4. What opportunities did you get by involving in seed potato production?

5. What is the general overview of the value chain activities of seed potato in your area?

6. Dear, respondent can you provide suggestions/recommendations for value chain supporter which will be most helpful for you to realize your wish? _____

Trader's Interview Questionnaire

I. General information

1. Name of enumerator: _____ Signature: _____
2. Date of interview dd/mm/yy: _____ / _____ / _____
3. Address: _____ Region _____ Zone _____ Woreda _____ Town _____

II. Demographic Characteristics of Traders

1. Name of respondent: _____ Sex: _____ Age: _____
2. Name trade: _____
3. Owner name: _____
4. Address: Region _____ Zone _____ Woreda _____ Town _____ kebele _____
5. Name of market (work place) _____
6. Type of trade (✓) 1. ☐ Retailer 2. ☐ Wholesalers 3. ☐ Collectors 4. ☐ Others (specify) _____
7. Marital status of trade owner (✓) 1. ☐ Single 2. ☐ Married 3. ☐ Divorced 4. ☐ Widowed
8. Family size of owner: 1. Male _____ 2. Female _____ Total _____
9. Educational level of the business owner (✓)
 1. ☐ No formal education (illiterate) 2. ☐ Adult education 3. ☐ Primary school (1-8)
 4. ☐ Secondary school (9-12) 5. ☐ Diploma 6. ☐ Degree and above

III. Marketing Aspects

1. Do you trading seed potato before? 1. ☐ Yes 2. ☐ No
2. If your answer for Q1 is yes, how long have you been in seed potato trading? _____ Years
3. Type of your business (✓) 1. ☐ Wholesalers 2. ☐ Retailers 3. ☐ Rural collectors
4. ☐ Brokers 5. ☐ Cooperatives 6. ☐ Others (specify) _____
4. Position of respondent in the trade (✓) 1. ☐ Owner- manager 2. ☐ Spouse of owner
3. ☐ Employed manager 4. ☐ Daughter of the owner 5. ☐ Son of the owner 6. ☐ Relative to the owner 7. ☐ Other (specify) _____
5. Did you trade alone or in partnership?
 1. ☐ Private individual 2. ☐ Private partnership / share company 3. ☐ Other (specify) _____
6. If partnership, how many are you in the joint venture? Share holders _____
7. What is your source of working capital for seed potato trading?
 1. Own (_____ %) 2. Loan (_____ %) 3. Gift (_____ %) 4. Share (_____ %) 5. Others (specify) _____
8. If loan, from whom did you borrow?

1. ☐ Bank (specify) ____ 2. ☐ Microfinance institutions (specify) ____ 3. ☐ Relative/family
4. ☐ Friend 5. ☐ Other traders 7. ☐ Others (specify) _____
9. Amount of loan? _____ Birr. Loan repayment period? _____
10. How much was the rate of interest? _____% for formal, _____% for informal.
11. Do you have any value addition activity on your seed potato products? 1. ☐ Yes 2. ☐ No
12. If your answer for Q 11 is yes, what are those value adding activities?
 1. ☐ Cleaning 2. ☐ Storage 3. ☐ Sorting and/or grading 4. ☐ Transporting to other locations
 5. Others (specify) _____
13. Do you involve in seed potato trading year round? 1. ☐ Yes 2. ☐ No
14. If no, at what period of the year do you involve? 1. ☐ During my free time 2. ☐ When purchase price becomes low 3. ☐ During high supply (when the product is available on the market) 4. ☐ During high demand 5. Other (specify) _____
15. How many seed potato regular suppliers do you have?
Producers _____, Collectors _____, Wholesalers __, Retailers __, others (specify) _____

Purchasing Activities

1. How did you bought seed potato?
 1. ☐ Direct from seller 2. ☐ Through broker 3. ☐ Through commission agent 4. ☐ Other (specify) _____
2. How many seed potato regular buyers do you have?
Wholesalers_____, Collectors_____, Retailers_____Others (specify) _____
3. How did you sell seed potato? 1. ☐ Direct to the purchaser 2. ☐ Through broker
3. ☐ By commission agent 4. Other (specify) _____
4. How do you attract your seed potato suppliers? (✓) 1. ☐ By giving credit to purchase inputs
2. ☐ By giving better price relative to others 3. ☐ By visiting them 5. Other (specify) _____
5. How do you attract your seed potato buyers? 1. ☐ Giving better price 2. ☐ By visiting those
3. ☐ Sell on credit 4. ☐ By giving bonus 5. Other (specify) _____
6. Is there any fluctuation of volume in seed potato brought to the market? 1. ☐ Yes 2. ☐ No
7. If your answer to Q6 is yes, the reason is _____
 1. ☐ Due to price fluctuation 2. ☐ The existence of supply variations 4. Seasonal production
 5. ☐ Due to climatic change 6. Others (specify) _____

8. Where and from whom did you purchase seed potato in 2022/2023?

Purchased from market (use code) 1.At farm gate 2.Village market 3.Woreda market 4. Zonal market 5. Regional market 6.Other (specify)	Purchased from sellers(use code) 1.Farmers 2.Retailers 3.Wholesalers 4.Rural Collectors 5. Cooperatives 6.Other (specify)	Total quantity purchased in a year (qt)	Average price/qt	Terms of payment 1. Cash 2. Credit 3.Advance payment

9. Do you pack your purchase? (✓) 1. ☐ Yes 2. ☐ No

10. If your answer for Q.9 yes, what were your packing materials? (✓) 1. ☐ Sisal sack teka
2. ☐ Plastic sack (Madaberya) 3. ☐ Sisal sack jonia 4. ☐ Basket 5. ☐ Others____

11. Who sets the purchase price? 1. ☐ Myself 2. ☐ Sellers 3. ☐ Set by demand and supply
4. ☐ Set by negotiation 4. Other (specify) _____

12. Who sets selling price in? 1. ☐ Myself 2. ☐ Buyers 3. ☐ Set by demand and supply
4. ☐ Set by negotiation 4. Other (specify) _____

13. How do you evaluate the 2022/23 market price of seed potato in comparison with last year?
1. ☐ Decreased 2. ☐ Constant 3. ☐ Increased 4. ☐ Fluctuated throughout the time

13. Did you store seed potato before you sold? (✓) 1. ☐ Yes 2. ☐ No

14. If your answer for Q13 is yes, for how long did you store seed potato in the store?
_____hrs/days/months

15. What is the most frequently used mode of transport to seed potato from purchasing sites to storage? (✓)1. ☐ Head loading 2.[☐ Pack animals 3. ☐ Animal cart 4. ☐ Cars 5. Others (specify)

16. Indicate your average cost incurred per quintal in the trading process of seed potato

Cost components	Cost incurred in Birr/Qt
Purchase price	
Labor for packing	
Loading/unloading	
Transportation fee	
Sorting	
Storage cost	
Telephone cost	
License and taxes	
Other cost (specify)	
Total Cost	

Selling practice

17. Where and to whom did you sell seed potato?

Where did you sale (market)	To whom do you sell (buyers)	1. Wholesalers 2. Retailers 3. Cooperatives 4. Farmers/producers 5. Unknowns 6. Brokers 7. Others (specify)	Quantities of sold in (qt)	Average price/qt

18. Do you know the market prices in different markets (on farm, village market and other areas) before you sold your seed potato? (✓) 1. ☐ Yes 2. ☐ No

19. Did you have seed potato trade license? (✓) 1. ☐ Yes 2. ☐ No

20. Do you want to expand seed potato trading? (✓) 1. ☐ Yes 2. ☐ No

21. If your answer for Q.20 is yes, why? _____

22. If your answer to Q.20 is No, why? _____

23. Are there problems on seed potato marketing in your area? (✓) 1. ☐ Yes 2. ☐ No

24. If your answer to Q.23 is yes, what are the problems?

Problems	Rank and Tick (✓) them
Lack of credit availability	
Price setting	
Supply shortages	
Storage problems	
Lack of demands	
Inadequate information	
Quality problems	
Government policy	
Absence of government supports	
Capital	
Problems of infrastructures	
High competitions with unlicensed traders	
Others (specify)_____	

Checklist for Key Informants Interview Questionnaire

Location and contact information:

Region: _____, Zone: _____, District: _____, Kebele: _____,

P.O.Box: _____, Telephone: _____, Date of interviewee: _____

Name of the organization: _____

Type of the organization: public/private/NGO: _____

Name of interviewee: _____

Role of the interviewee in the organization: _____

1. What is the role of your organization in seed potato value chain in the study area? _____
2. What are the challenges and opportunities you faced in undertaking those roles assigned to your organization? _____
3. Linkage /interaction/ partnership/ coordination between seed potato value actors _____
4. Do you think value chain actors of seed potato are competitive and efficient? _____
5. Where does intervention needed in value chain of seed potato? _____
6. What are the major constraints that hindered seed potato production and marketing in your area? _____
7. What are the possible solutions to correct these problems? _____
8. What is the role of FTCs on seed potato production? How? _____
9. What did you experience farmers problems in accessing inputs on timely and price as well as amount of inputs they required? _____

Checklist for Focus Group Discussion Questionnaire

Participants: Seed potato producers in selected kebeles

1. District: _____ Kebele _____
2. Is seed potato your main source of on farm income? _____
3. How many times do you grow seed potato per year? _____
4. Was productivity reduced now compared to years ago in your area? If yes, what are the main causes of this reduction? _____
5. What are problems do you face in seed potato production and marketing? _____
6. What would be the solutions to those problems? _____
7. Do farmers know the amount of input use? (Fertilizer, seed, chemical etc) applied per ha? _____
8. How do traders influence farmer's participation in seed potato value chain? _____

9. What are the main channels through which you sell seed potato? _____
10. What are the advantages from each channel? _____
11. What are the constraints faced from each channel? _____
12. What is the price per quintal in each channel? _____
13. How all seed potato value chain actors benefited from this business equally? Your opinion _____
14. What are the other main sources of on farm income? _____

Union/Cooperative information (Robi Berga Farmers' Union/ Cooperative)

1. May you produce seed potato on behave of your organization or bought from other?

If you may produce seed potato on behave of your organization,

1. Land allocated for seed potato _____ hectare
2. Total quantity produced (Qt)/ha _____
3. Total quantity sold (Qt) _____
2. From whom you have collected seed potato?
 1. _____
 2. _____
3. What type of seed potato variety you collected?

A. If local variety, list the name of those varieties

 1. Local variety total _____ Qt
 2. Local variety total _____ Qt

B. If improved variety, list the name of those varieties

 1. Improved variety total collected _____ Qt
 2. Improved variety total collected _____ Qt
4. At what price you bought per Qt?
 1. Local variety _____ Birr/Qt
 2. Improved variety _____ Birr/Qt
5. Have you mostly buy seed potato in contractual agreement or not?
6. After you collect seed potato what value adding activities you have done on it?
7. To whom you sell the seed potato? At what price per Qt?
 1. Farmers _____ Birr/Qt
 2. Retailers _____ Birr/Qt
 3. Wholesalers _____ Birr/Qt
 4. University _____ Birr/Qt
 5. Other institution specify _____ Birr/Qt