

Wubet, Gedefaw Kindu

Article

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*Corresponding author: Gedefaw Kindu Wubet Department of Agricultural Economics, Debre Tabor University, Ethiopia
E-mail: gedefawkindu2013@gmail.com

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MARKETING | RESEARCH ARTICLE

Value chain analysis of Garlic in LiboKemkem District: In the era of COVID-19, South Gondar Zone Amhara Region, Ethiopia

Gedefaw Kindu Wubet^{1*}

Abstract: Garlic is the main bulb crop produced in Libokemkem District, but this crop's value chain status and particular actors were not studied. Thus, the study aimed to assess the Garlic value chain in Libokemkem District, Ethiopia. Four hundred Garlic producers are selected through multistage random sampling techniques. Descriptive, inferential statistics were employed. Feasible General Least Square Model was used to analyze factors for Garlic market supply. According to survey results, three groups of actors are identified. 92.4% of Garlic value chain activities are undertaken by main actors, who constitute 89.6% of the total actors in the entire value chain. Wholesalers governed the chain; they have a 31.2% share of the complete Garlic supplied to the market. During COVID 19 Pandemic, the demand for Garlic products rose; surprisingly, its price also increased because it was considered to treat COVID 19. Quantity of Garlic produced; land allocated, lagged price, market information, experience, and oxen were the significant covariates affecting Garlic market supply positively. Amount of credit and gender were significant covariates that negatively affected Garlic's market supply. Among the many constraints that negatively affect the Garlic value chain are the absence of improved seed confirmed by 95.4% of farmers, high cost of input by 78% of farmers, diseases and pests



Gedefaw Kindu Wubet

ABOUT THE AUTHOR

Gedefaw Kindu Wubet is a Lecturer in the Department of Agricultural Economics at the College of Agriculture and Environmental Science, Debre Tabor University, Ethiopia. He obtained his bachelor's degree in Agribusiness and Value Chain Management from Jimma University and his master's degree in the same specialization in Agribusiness and Value Chain Management at Haramaya University, Ethiopia. His current research interests comprised; value chain analysis, assessment and evaluation of total quality management in different industries like agro-processing, marketing, agricultural marketing, commercialization, impact assessment and evaluation, resource economics, and related socio-economic and governance discipline. He has published with good publishers such as Elsevier.

PUBLIC INTEREST STATEMENT

The main aim of studying value chain research is to create a strong linkage among producers and final consumers to improve the nation's economic well-being of the country. This study aimed to discover the relations among various actors and map activities undertaken in the entire Garlic value chain. Second is the economic benefit of Garlic, especially in the era of the COVID-19 pandemic. Finally, identify significant opportunities and constraints that impede Garlic value chain development. Conducting a value chain study plays a significant role in identifying the main actors, linkages, and substantial opportunities and constraints. This study successfully adds to the body of information; it is the first study conducted on the value chain analysis of Garlic in the study area and its significant impact, especially during the COVID-19 pandemic. Emphasizing value chain study is expected for all commodities that path the entire value chain process.

approved by 81.5% of farmers, and lack of price setting policy framework. The policymakers and practitioners should pay attention to improved Garlic seed conditions, problems, and competitive marketing strategy to ensure sustainable value chain development and balance the demand and supply.

Subjects: Sustainable Development; Rural Development; Economics and Development; Economics; Political Economy; Environmental Economics; History of Economic Thought; Finance; Business, Management and Accounting

Keywords: Libokemkem District; Garlic; value chain analysis; value chain map; actors; FGLS model

1. Introduction

From the beginning, the main contribution of value chain research is to identify the main actors, their roles in the entire value chain, the main opportunities and constraints, and the total economic benefit for producers and consumers. Garlic is an important marketable crop; as a result, the integration of producers with consumers has a highly significant contribution for both producers and consumers. Value chain analysis study has a unique contribution by minimizing the number of intermediaries between producers and final consumers who capture a large amount of profit; as a result, breaking the gap between farmers and producers. Various value-added Garlic products are currently demanded by many consumers and can be consumed with different food items across the globe; these activities can be possible by performing a value chain study. Conducting Garlic value chain research in the study area has excellent opportunities for various stakeholders directly or indirectly involved in the Garlic value chain. Because the study area locations are very suitable for Garlic production, consumption, and marketing, the contribution of conducting Garlic value chain was fundamental for linking local, domestic, and national consumers with potential producers. Since farmers are high producers of Garlic, it is clear that a suitable market and better return were questionable by Garlic producers. After conducting the Garlic value chain research, the right markets were suggested, from linkages with different actors, from local traders to town retailers to consumers. As far as the Researcher's field observation, more than 90% of Garlic producers used local seed varieties. To minimize this constraint, improved seed provider institutions have cooperated. Smooth relations and better communications were created among farmers with actors, and even with final consumers, then coordination was developed, and finally, the farmers' incomes were improved. In addition, previous studies focused on groups of vegetables, but this study primarily focused on the Garlic value chain, making it a novel discovery for further research. Furthermore, the study provides key strategic recommendations for vegetable crops in general and Garlic products in particular in the study area and all consumer countries. This work adds to the value chain literature for current and future researchers. It supplies for regulators and policymakers with valuable information.

Garlic has a history of human use of over 7000 years, and it is the essential bulb crop. Garlic has been used throughout recorded history for both medicinal and culinary purposes. It is widely used to flavor dishes, pickles, and sauces. Garlic has become an increasingly popular vegetable among producers, marketers, and consumers. Especially in the era of COVID 19, Garlic was the most demandable bulb crop because it has high medicinal value to fight disease. Its long acclaimed nutritional and medicinal values are proving to be valid. Different branches of traditional medicine and scientific studies have pointed to Garlic as an antibiotic agent, immunity booster, and blood pressure regulator. More people have discovered its culinary splendor, and producers have found Garlic a potentially highly profitable crop (ITC, (International TradeCenter), 2017). Ethiopia produced 138,764 tons of Garlic in 2017 (FAOSTAT, (Food and Agriculture. Organization. Statistical database), 2017). Ethiopia's Garlic (*Allium sativum* L.) thrives in the country's northwestern areas. The nation grows many unique varieties, including Kuriftu and Tseda. There are also the Bishoftu Mech and "Local" cultivars. A single hectare in the country produces around 16 tons per harvest in

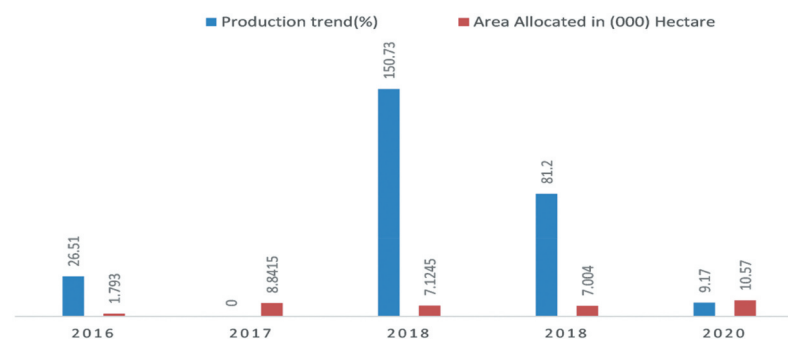
the excellent season. The harvesting period takes place on average from 90 to 123 days of planting (AGPF, 2014). Libokemkem District is now one of the most Garlic producer areas in the country. The total production in this area in 2019/2020 is 311,352 quintal, and the productivity is 94qt/hr (LDARO, 2020). Based on the District crop production and status report, the trend of Garlic production for the last five years was indicated in the Figure 1.

Garlic is the most widely used crop among cultivated *Allium* species in Ethiopia, and it has a wide range of climatic and soil adaptations. Production of this crop is confronted with several problems, and the total production and productivity in the country fluctuate. Among many contributing factors are the lack of improved varieties and Garlic diseases, mainly root rot (*sir abesibis*) and rust that causes yellow spots on the leave and stems, which is a common Garlic dangerous disease in the District (Yebirzaf et al., 2018). Garlic is a high-value crop that can be marketed as fresh, dehydrated, or certified seed. Recently, there have been more developments in the human medical field for Garlic in which there is a compound that has been identified as lowering cholesterol. If these developments come to the commercial phase, it could mean a massive increase in Garlic production and marketing. These present an opportunity for farmers to increase domestic production and marketing of their produce. However, Garlic is a high-risk, labor-intensive crop to produce successfully. Each Garlic producer must strive to obtain maximum yield and quality to survive. Marketing Garlic can also be quite tricky for the smaller producer. The market demands large, clean, unblemished bulbs that are well graded but not still meeting those demands (ITC, (International TradeCenter), 2017).

Garlic is a crop widely grown for fresh market by many producers on a small scale for local and regional markets (FAOSTAT, (Food and Agriculture. Organization. Statistical database), 2013). Almost all farmers in the study area produced and sold raw Garlic, somewhat processed or valued added product in addition to drying. The study area's marketing and transportation are significant problems, especially during lockdown due to the COVID-19 pandemic. Farmers are not well trained with the assistance of ground staff about the postharvest techniques of this particular crop, and they do not obtain fair prices in the market; the price of Garlic remarkably fluctuates, but during the COVID-19 pandemic, the price of Garlic constantly rose. Farmers are yet to reach their full potential and benefit from their farming as a business before the COVID-19 pandemic (LDARO, 2020). To conclude, no studies were conducted on the value chain of vegetables in the study area mainly; the Garlic value chain is not studied yet. Some researchers conducted on the market chain of grain and cereals in the different years, but these previous research findings did not identify the number and types of actors they did not touch on the linkage between producers and consumers and the possible opportunities and constraints. Due to little to no research conducted on the value chain of Garlic, policymakers did not get sufficient information from the literature concerning the subject area. The current study is so designed to address the above-listed concerns by critically analyzing all actors, their linkages, functions, opportunities, and constraints for the Garlic value

Figure 1. Trends of Garlic production in the study area; for the last five years from 2016–2020 G.C.

Source: LiboKemkem District Agricultural Office Yearly Report 2020



chain, and the possible solutions suggested that the previous researchers did not touch on at all. Therefore, this study aimed to map the Garlic value chain and identify the actors' functions. Linkages in the chain analyze determinants of Garlic market supply in the study area and identify significant opportunities and constraints in the value chain. This research work contains five major sections to the best of the presentation arrangement. In the beginning, the introduction of the study with research problems and objectives are presented. In the second section, the literature review contains concepts and definitions of terms, factors, and approaches to study the selected crop; in the third section, the research methodology and model specification are presented, in the fourth section main findings and discussion are reported and finally, policy implication, and conclusion are reported.

2. Literature review

This section contains the concept of value, value chain, value chain analysis, value chain map, value chain governance, value chain actors, actors' linkage, the impact of Garlic on treating COVID-19 Pandemic, Value Chain Modeling, and finally, Empirical kinds of literature on Determinant of Market Supply Analysis.

2.1. Value

It is referred to as the perception of consumers or the price that the customer is willing to pay for a particular offering in return. Value refers to value added to the product by activities at each step in the chain and the value created by the product and activities and then captured by each actor involved.

2.1.1. Value chain

Has recently emerged as a widely held business notion. Different authors forward many definitions at different times for the term value chain. The value chain is a collection of activities to design, produce, and market, deliver and support its product. An organization's competitive advantage is based on its product's value chain. The company's objective is to deliver maximum value to the end-user for the least possible total cost to the company, thus maximizing profit (Porter, 1985). The value chain describes the full range of activities that 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 & Morris, 2000). The value chain activities include design, production, marketing, logistics, and distribution to support the final customer. They may be performed by the same firm or shared among several firms; as they have spread, value chains have become global (Backer & Miroudot, 2014). Production of an agricultural commodity and its transformation into one or more products delivered to final markets involves a sequence of activities. Recent arguments point out that the value chain system should also consider managing end products after consumption because inadequate management can affect the system (Westlake, 2014).

2.1.2. Value chain analysis

Is the process of breaking a chain into its constituent parts to understand its structure and functioning better. The analysis consists of identifying chain actors at each stage and discerning their functions and relationships; determining the chain governance, or leadership, to facilitate chain formation and strengthening; identifying value-adding activities in the chain and assigning costs and added value to each of those activities. The flows of goods, information, and finance through the various stages of the chain are evaluated to detect problems or identify opportunities to improve the contribution of specific actors and the chain's overall performance. Beyond the traditional narrow focus on production, value chain analysis scrutinizes interactions and synergies between actors and the business and policy environment (UNIDO, 2009). Value chain analysis initially emerged as a tool for increasing competitiveness by pinpointing where and how participants could introduce efficiencies, reduce costs and maximize value. Indeed, value chain analysis provides valuable information on structure linkages, actors, and dynamics. It helps identify where, how, why, and by whom value is added and created along the chain and how changes could improve performance (Hawkes & Ruel, 2020).

2.1.3. Value chain mapping

Refers to describing value chains in detail and carrying out the economic analysis and benchmarking. The mappings follow market research and includes presenting in the visual format the chain functions, operators, and linkages. Quantifying adds numbers to the basic map numbers of actors (measuring the quantity of value and express in terms of numbers then adding to the map of actors or this involves adding detail to the basic maps drawn initially, structure and flow), volume of produce or the market share of particular segments in the chain. According to McCormick and Schmitz (2001), value chain mapping enables to visualization of the flow of the product from conception to end consumer through various actors. It also helps identify the different actors involved in the Garlic value chain and understand their roles and linkages. The aim of value chain mapping is also to visualize networks to understand connections between actors in a value chain in a better way, demonstrate interdependency between actors and processes in the value chain, and create awareness of stakeholders to look beyond their involvement in the value chain.

2.1.4. Value chain governance

Governance within value chains reflects the distribution of power and information among various actors (Gereffi et al., 2005). Value chain governance refers to the relationships among the buyers, sellers, service providers, and regulatory institutions that operate within or influence the range of activities required to bring a product or service from inception to its end-use. Governance is about power and the ability to exert control along the chain; some firm (or organization or institution) sets and enforces parameters under which others operate (Schmit, 2004); Humphrey & Schmitz, 2008).

2.1.5. Value chain actors and their linkage

A group of people directly or indirectly involved in value chain activities are called value chain actors. Value chain actors' linkage: different value chain actors create horizontal or vertical linkages forward and backward in the value chain.

2.2. Definition of COVID 19

Coronavirus diseases (COVID-19) is an infectious diseases caused by SARS-CoV-2 virus. The current biggest health problem in the world is Coronavirus Disease 2019 (COVID-19). The major structural protease of SARS-CoV-2 speeds up the viral replication process (Khubber et al., 2020).

2.2.1. The impact of Garlic on treating COVID –19 pandemic

Garlic is a powerful natural antibiotic that can kill many viruses and bacteria. In the active site areas of this serine-type protease, hydrogen bonds develop between the Garlic bioactive and prevent the COVID-19 epidemic. Garlic has the potential to reduce the incidence of COVID-19 in specific communities (Khubber et al., 2020). Garlic organosulfur volatile components, such as thiol-reactive allicin (diallyl thiosulfinate), have potent antibacterial properties against various respiratory infections. (Fritsch et al., 2021). The in vivo inhibitory impact of 0.1 mL Garlic clove extract on SARS-CoV-1 growth was strong, most likely due to structural proteins and genetic materials (Shojai et al., 2016). According to Chakraborty and Majumder (2020), Garlic has previously been shown to have antiviral properties against influenza B, HIV-1, vesicular stomatitis virus, herpes simplex virus (types 1 and 2), coxsackievirus species, and gamma retrovirus. Garlic has been used to cure many human ailments and metabolic issues for millennia. It may also be helpful as an inhalation medication to treat COVID-19-related lung infections and secondary bacterial infections, the leading causes of death in hospitalized patients. During a COVID-19 pandemic, there is a complete or partial lockdown, and people are not allowed to leave. People were more focused at the time on meeting their basic needs. Even after seeing the companies' tempting offers, they were not interested in purchasing anything new (Chauhan et al., 2021). It implies people needs were focused on medicinal crop and basic food items.

2.3. Value chain modeling

There are predicted value chain impacts when different value chain operations are conducted. The life cycle assessment framework (LCA) examined a value chain's environmental impact, particularly for hazardous items or unsustainable production techniques. It is an accounting paradigm for evaluating environmental consequences associated with a product's value chain. It examines the connections between natural inputs (resources) and related environmental outputs such as emissions and waste across the entire value chain, including agriculture, production, processing, transportation, consumption, and final disposal after use (Faße et al., 2009). Various energy approaches are used to evaluate the different crop value chains, including agricultural production, processing, and trade, to assess sustainability of the crop value chain. Policymakers are torn between promoting greater economic diversification and encouraging nature to rejuvenate and absorb the wastes caused by human activities (Dagar, Kamran, et al., 2021). The increasing interconnection of the world's economy and investment flows is called globalization. Due to globalization, the scope and complexity of actors dealing with internal and external risks have grown dramatically. Risk assessment is another strategy for reducing environmental risks and costs associated with production and marketing activities in the value chain. Incorporating bargaining prototypes into the value chain approach significantly impacts profit distribution and information flows between various value chain actors. Value chain equilibrium models, which incorporate risk assessment and game theory techniques, are a valuable tool for evaluating complicated relationships between agents and the environment (Faße et al., 2009). As a result, production and consumption processes in different countries are unsustainable, contributing to the country's environmental quality (Murshed, Md. Aminur et al., 2021). In the medium and long run, the empirical data demonstrated a favorable influence of economic development and a negative impact of square economic growth on environmental deterioration. Furthermore, financial development, energy consumption, globalization, the inflow of remittances, and urbanization degrade environmental quality (M. K. Khan et al., 2021). Urbanization, economic globalization, and political globalization all impact the environment, but energy use, social globalization, foreign direct investment, and economic growth have contributed to increased carbon dioxide emissions (Muhammad & Khan, 2021). Long-term relationships were observed between renewable energy production, economic globalization, economic growth, urbanization, and energy production (Murshed, Rashid, et al., 2021). A well-developed economic system benefits every individual and business. Businesses can be funded by institutions, such as banks, if there is long-term financial development (Zakari et al., 2022). With positive urbanization shocks, the negative effect of the shift in urbanization brings more positive effects (Md. Monirul et al., 2021). Energy consumption and production are linked to environmental issues, as they produce hazardous pollutants that contribute to air pollution, climate change, water, and solid waste disposal (I. Khan et al., 2022). Sustainability, green innovation, and investments in zero-waste and green initiatives have all enhanced long-term economic growth and prosperity. Another positive effect of globalization is increased rivalry between enterprises, which benefits customers by allowing them to buy items at increasingly cheaper prices (Rehman, Ma et al., 2021). Economic development has a considerable impact on environmental pollution (Dagar et al., 2021). Economic growth, non-renewable energy consumption, and foreign direct investment inflows are expected to have adverse environmental consequences, whereas renewable energy use is expected to have positive consequences (Murshed, Md. Aminur et al., 2021).

2.4. Empirical kinds of literature on determinant of market supply analysis

Several empirical studies conducted on factors affecting the marketed surplus of agricultural commodities. (Melese et al., 2018) analyzed determinants of commercialization by small-holder onion farmers in Fogera District; Second-stage Heckman selection estimation indicated that livestock holding, literacy status, land allotted to onion, non/off-farm income, onion yield, ownership of communication device, contract marketing, agroecology, and marketing group significantly determined volume of onion supply. Tadesse (2011) identified factors affecting the marketed surplus of fruits by using OLS regressions at Gomma Woreda. She found that the household head's education level affected the fruit market, the quantity of

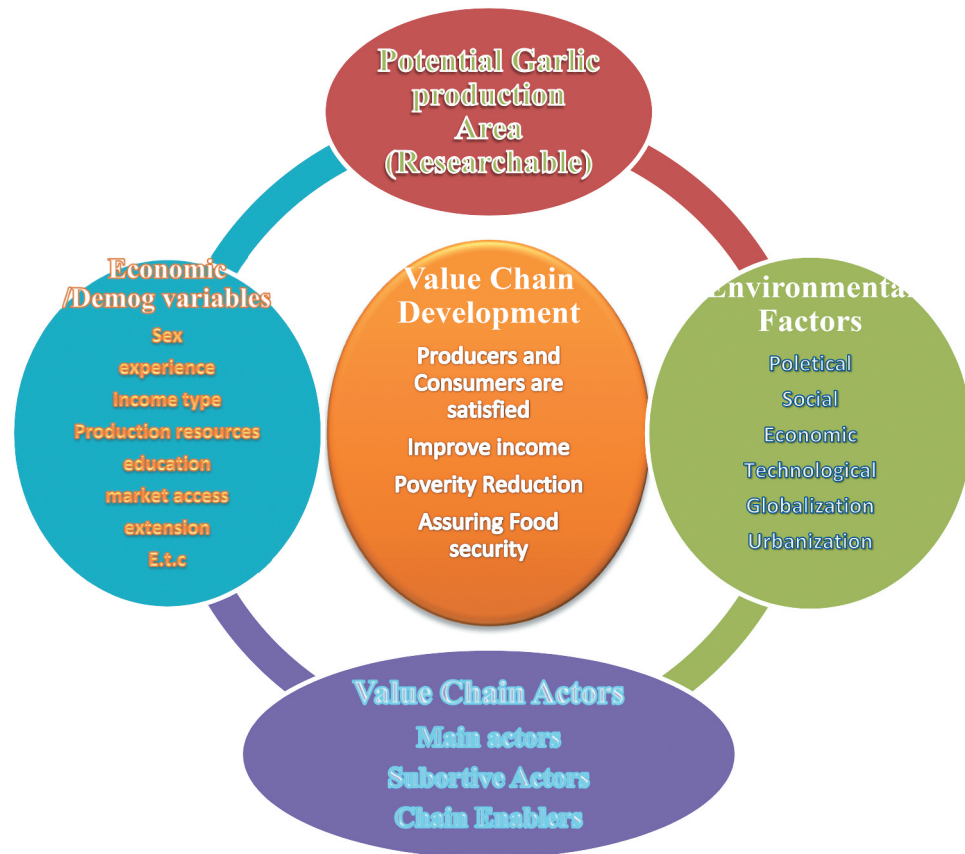
fruit produced, fruit production experience, extension contact, lagged price, and distance to market. Tegegne (2013) adopted multiple regression analysis to identify the relationship between the market supply of vegetables and the hypothesized independent variables at Harbor and Kombolcha Woredas. The result shows that the number of potatoes supplied to the market was significantly affected by access to extension service, market information, vegetable farming experience, sex of the household head, age of the household head, and quantity of fertilizer application. Worku (2019) adopted Heckman's two-step model to identify significant factors affecting market participation and the supply of potatoes in Hadiya Zone. The result shows that sex, education, annual total potato harvest, extension service, access to credit, owning livestock, the district where a farmer is living, and owing oxen also influenced participation and the volume of potatoes supplied to the market. Belete and Haji (2018) estimated determinants of market supply of coffee using multiple linear regression model analysis at Dale District. The result of the OLS regression model analysis pointed out; the sex of the household head, education, the quantity of coffee produced, access to extension service, lagged price of coffee, distance to the nearest market, household non-farm income, and access to market information found to be significantly affecting the market supply of coffee at the household level. Bekele (2017) conducted a study on econometric analysis of the determinants of quantity of potatoes supplied to the market: In the case of Jeldu District, the two-stage list squares econometric model result indicated that education level, the quantity of potato produced, membership to cooperatives and area allocated to potato production affected the quantity of potato supplied to the market significantly and positively. Contrary to these, livestock holding affected the number of potatoes supplied to the market significantly and negatively. Abay (2010) used a multiple linear regression model to analyze factors affecting red pepper market supply at Bure Woreda; the result found that experience in agricultural practices, access to credit, total yield, land size, current year, and lagged prices influenced the marketable supply of pepper. Kelemework (2016) used Ordinary least square regression analysis (OLS) to analyze factors affecting the yield of white haricot bean in Adamitulu District, the age of household heads affected negatively, and livestock, household head education, use of fertilizer, and extension contact affected market supply positively. According to ITC, (International TradeCenter), (2017), Garlic market supply to the market is affected by lagged market prices and seasonal price fluctuation. According to (Thornto, 2016), cooperative members in the production area; influence Garlic production and marketing. Melesse (2016) used the two limit-Tobit regression model to assess the commercial behavior of smallholder potato producers: In the case of kombolcha woreda, the results indicated that non/off-farm income, access to improved seed, and access to irrigation affect the proportion of the value of potato sold positively and significantly while the number of plots affects it negatively.

2.5. Conceptual framework

Value chain analysis provides a framework to understand better the links among producers, traders, exporters, and global markets. The framework also allows for evaluating chain performance by distinguishing the strengths and weaknesses associated with different activities and linkages and identifying barriers to chain development. This information can be used to prioritize interventions that can be made along the chain to improve performance (FAO, 2019).

The value chain of Garlic is explained by its network of activities, including main actors, economic and environmental factors. Hence, the main actors and their roles, the economic factors and their impact, and the environmental factors and their impacts on Garlic value chain are analyzed. The value chain development increased households' income and welfare. Based on theoretical concepts and empirical studies review, a conceptual framework of the Garlic value chain was constructed as depicted in Figure 2.

Figure 2. Conceptual framework of Garlic value chain.
 Source: Own sketch/conceptualization 2021.



3. Materials and methods

3.1. Description of the study area

The study was conducted at LiboKemkem District in the South Gondar Zone of Amhara Region, Ethiopia. This District is situated between 12°39'66" and 12°42'45"N latitudes and 37°26'99" and 37° 28'42"E longitudes (Figure 3). The District is located 645 km away from Addis Abeba (the capital city of Ethiopia) and 70 km away from the Regional City of Bahar Dar.

It covers an area of 1,292.72 km² and comprises 33 rural and 2 urban Kebeles. The following figure is a Map of LiboKemkem District/Study area/.

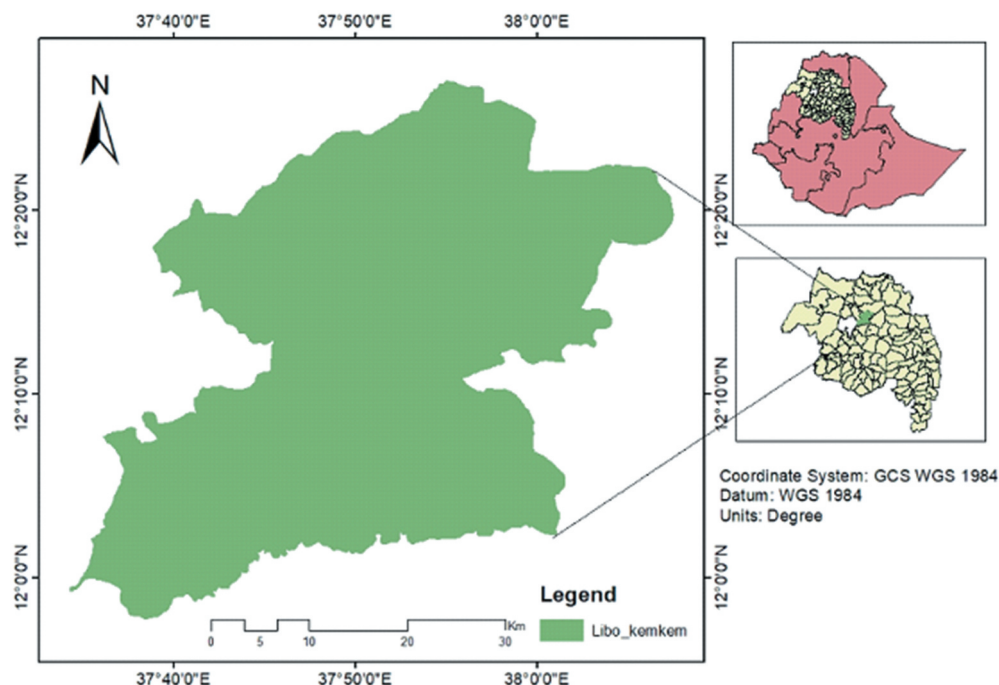
3.1.1. Topography

The elevation of the District ranges between 1025 and 2960 m.a.s.l. The study area is characterized by a rugged topography of mountains, undulating, plain, and valley. In the District, only 42.12% of the total area is plain, with the slope ranging from 0% to 15%. The remaining 33.23%, 17.7%, and 6.95% of this District's area were described to have a gradient of 15–30%, 30–50%, and more than 50%, respectively.

3.1.2. Climatic conditions

Due to altitudinal variations, there are three agro-climatic zones in Libokemkem District, namely Dega, Weyna Dega, and Kolla. The area coverage of the agro-climatic zone of the District is Dega (18%), Weyna Dega (43%), and Kolla (39%). The annual rainfall ranges between 980 and 1700 mm, with the average annual rainfall 1100 with a mono-modal pattern from July to September.

Figure 3. Locations maps of LiboKemKem District.
 Source: LKAACO GIS analysis, 2021



The maximum annual average temperature is 35°C and 16°C, respectively (LKAACO, 2020). The total production farmland in the District is 27,679.65 hectare, Garlic production farm landholding by farmers is 10,570 hectare, and the total land holding by farmers are 53,993.65 hectare.

3.2. Data type, sources, and collection method

3.2.1. Primary data

Smallholder farmers were randomly selected from rural kebeles and traders at different levels, from farmers to wholesales supply to the regional level. Using McCormick and Schmitz (2001) using manual who released a guidebook that provides a practical orientation to data collecting for value chain analysis by recommending how to design questionnaires and conduct interviews.

3.2.2. Primary data collection

Primary data were collected through a household questionnaire survey using structured questionnaires with both open-ended and closed-ended questions. The questionnaire was pre-tested by households selected in each kebele at the preliminary survey, and after feedback, it was modified. Enumerators were trained on data collection, interviewing techniques, and how to approach respondents. Focus group discussion was undertaken with the key actors and checklists used to identify the significant opportunities and constraints. Personal observations and group discussions with community members were also held. Secondary data: was collected by reviewing secondary documents/sources.

3.3. Sampling technique and sample size determination

A multistage random sampling technique was used to collect primary data from respondents. First, LiboKemkem District was selected purposively based on its Garlic production potential. Second, five Garlic-producing kebeles were selected through a random sampling approach. Third, 400 Garlic producer farmers were selected randomly based on the probability proportional to the population size of the sampled kebeles. The (Yamane, 1965) sample size determination formula determined

the overall sample size by considering 95% confidence level, with the degree of variability 5% and level of precision 5% were used to obtain the sample size required. The formula used to calculate and determine the sample size is:

$$n = \frac{N}{1 + N(e)^2}, n = \frac{56,654}{1 + 56,654(0.05)^2} = 397 \text{ But we 400 Samples} \quad (1)$$

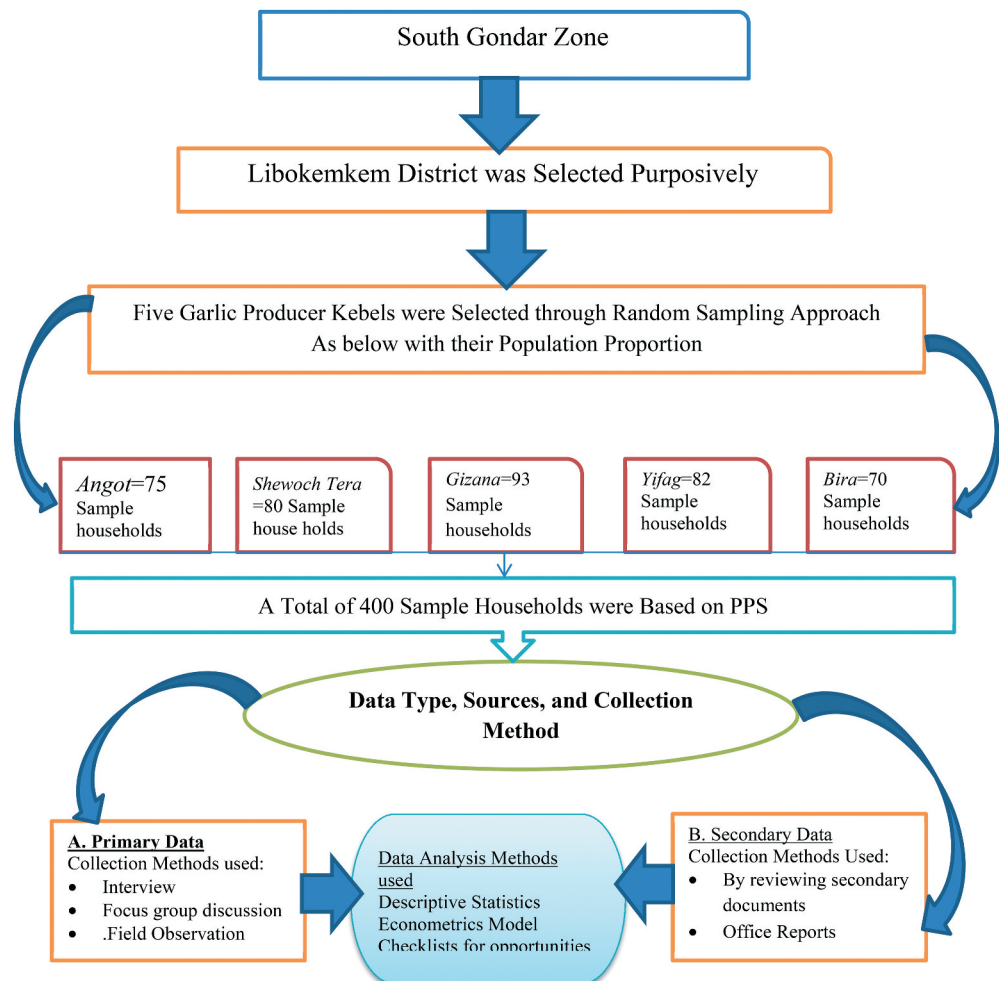
Where: n is the sample size, N is the population size of Garlic producer kebeles, and e is the level of precision considered. The sample size was also determined for traders randomly based on the number of traders found in the District.

3.4. Methods of data analysis

3.4.1. Descriptive statistics

Ratios, frequency, percentages, means, graphs, and standard deviations and inferential statistics, such as t-test and χ^2 -test, were applied to identify or compare socioeconomic variables of respondents, the main actors, and opportunities and constraints throughout the Garlic value chain. [Figure 4](#) Research Design and Sampling Frame.

Figure 4. Research design and sampling frame.
 Source: Own Sketch, 2020.



3.4.2. Econometric model

3.4.2.1. *Determinants of market supply.* Feasible General Least Square Model was employed to identify the driving factors of Garlic supply to the market. The Feasible General Least Square Regressions Model can be specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + \beta_{14} X_{14} + U_i \quad (2)$$

Where, Y = Garlic supplied to market; β_0 = Constant term; X_1 = Quantity of Garlic produced; X_2 = Frequency of extension contact; X_3 = Land allocation for Garlic production; X_4 = Amount of credit; X_5 = Lagged market price; X_6 = Access to market information; X_7 = Distance to the nearest market; X_8 = Garlic production experience; X_9 = Education level of the respondents; X_{10} = Number of families of the household; X_{11} = Number of oxen owned; X_{12} = Gender, X_{13} = Non/off-farm income; X_{14} = Garlic seed type and U_i = disturbance or Error term.

After completing the data collection, the responses were coded and entered into SPSS version 20 software programs and exported to STATA version 15 for analysis and interpretation.

Due to the existence of heteroscedasticity problem, we follow the following procedures for Feasible General Least Square Model estimation, regress Ordinary Least Square model, predict e, residual generate logesq = $\ln(e^*e)$, regress logesq independent var. predict esqhat, generate omega = $\exp(esqhat)$ then generate weight gen w = $1/(\omega)^{0.5}$. Then generate weighted variables gen w_qtygs = qtygs*w, gen w_qtygp = qtygp*w, gen w_fextc = fextc*w, gen w_landag = landag*w, gen w_acredit = acredit*w, gen w_lapric = lapric*w, gen w_acmarkt = acmarkt*w, gen w_mdistr = mdistr*w, gen w_expr = expr*w, gen w_edu = edu*w, gen w_famsz = famsz*w, gen w_oxen = oxen*w, gen w_sex = sex*w, gen w_nincome = nincome*w, gen w_seedt = seedt*w, gen w_age = age*w, and gen w_age2 = age2*w then run FGLS model estimation reg w_qtygs w_qtygp w_fextc w_landag w_acredit w_lapric w_acmarkt w_mdistr w_expr w_edu w_famsz w_oxen w_sex w_nincome w_seedt. validate the researchers remedial mechanism through hettest. Decision: the heteroscedasticity problem was resolved. Hence, the p-value was equal to 0.7676. Value chains create opportunities for economic growth in developing countries. It is a current path that creates a chain between producers and consumers that give the two bodies better off. Value chain analysis research helps to facilitate market access for a particular product by creating permanent networks between local, regional, national, and global markets. It can become sources of capital, knowledge, and technology, integration in existing value chain actors, providing the first step to economic development and a path that is often easier to travel than building a complete value chain (OECD, 2013). Conducting Garlic value chain research in the study area could create opportunities for faster economic growth for all Garlic producers, actors, and consumers through the exchange of goods, services, and information. The current study identified significant production and marketing opportunities and constraints, such as lack of credit and institutional, technical support that make these competitive chains unfavorable and provides possible suggestions to overcome the identified constraints. Due to the value chain is a new form of globalization that allows producers' to link with local, regional, national, and even international marketing networks by employing various quality improvement and value addition techniques. The benefits obtained from the present study are continuous and uninterrupted information flows produced across all Garlic value chain actors in the entire value chain. Some studies analyzed the role of value chains in socio-economic upgrading and observed that some works often focused on the economic aspect rather than social dimensions of upgrading, which means improved working conditions, and higher-skilled and better-paid jobs. However, the current studies consider the social aspects of Garlic producer households. This research made forward and backward linkage between each actor, and it has substantial benefit to the local economy aligned with the fast-growing market by adding value to the raw Garlic product. Most research findings revealed that a value chain is most advanced in the agricultural and food sectors to achieve higher levels of value-added. As a result, it improves the quality of products and creates a business

connection with the urban market, improving farmers' farm income. The current research study establishes transnational relations and suitable linkage structures between actors. It is also necessary to develop mechanisms to protect unfavorable smallholder farmers, empower them, and create conditions to entirely reduce transaction costs through technical and financial support to participate in more globalized and competitive markets fully. The present study looks at how agricultural producers might improve their long-term performance using social and environmental quantitative methods (Ambec et al., 2013). A comprehensive value chain analysis that considers social and environmental factors enables the value chain to gain a competitive edge in earnings for all value chain actors (Zamora, 2016). Value chain analysis findings are used as a practical approach for policymaking that allows us to do a quick value chain analysis while also conducting a quantitative analysis of the impact of policy options based on value chain situations (Bellù, 2012).

4. Result and discussion

To the best of the Researcher's knowledge, the Libokemekem District is endowed in vegetable and fruit production, mainly Garlic is the most and the first vegetable (bulb) crop produced in the district. Even though the district has sufficient potential in Garlic production and consumption, any related study has not been conducted yet. The following information not documented before the Garlic value chain study was conducted in the study area. How much quantity of Garlic was produced in the district was unknown. The types of input/Garlic seed type/ and the possible remedy did not identify and suggested, respectively. The total market demand and the price status for Garlic products did not identify and analyzed. The types and number of actors, functions, linkages, and activities undertaken in the entire value chain are not identified. From most people's viewpoint, Garlic might not consider a medicinal crop to treat many diseases like COVID 19 pandemic. The critical determinants for Garlic production, marketing, market participation, and quantity supply were not estimated. The possible opportunities and constraints that impede Garlic production, marketing, and the total value chain were not analyzed. The income of Garlic producers did not determine, and customers' satisfaction was not checked. The types and numbers of value-added Garlic products were not listed and examined. All the above-concerned issues initiated the researcher to propose and conduct a Garlic value chain study in the selected study district to find solutions for the issues mentioned above. After conducting this study: the following solutions were analyzed and documented. The amount of Garlic production and marketed supply are determined. Seed types identified, possible solutions suggested, and the actors' types and numbers, functions, and linkages identified. Garlic's ability to treat more than 32 infectious diseases, including COVID 19, has been revealed and confirmed, and different contents or substances found in the Garlic crop were identified. The main determinants of Garlic production and marketing were analyzed and interpreted. Possible opportunities and constraints that block Garlic production and the entire value chain development are identified, and the potential solution is suggested for the identified constraints. Garlic producers' incomes increased, and consumers were satisfied with establishing a direct linkage between producers and consumers. The types of Garlic value-added products are identified and acknowledged. After all, the findings of this study can be used as secondary literature for future researchers, policymakers, and other interested individuals. This research finding bridged the gap in information about the Garlic value chain and its medicinal and economic growth. Academicians and scholars will find it helpful in their future studies. The work adds to the existing literature since this is the first study conducted in the study area to look at the Garlic value chain to the best of the researcher's knowledge. It also presents an empirical method for determining the economic benefit of Garlic to individual farmers and the entire population. Finally, the findings of this work have significant policy implications for the central Government's attempt to commercialize the agriculture sector and strengthen the overall food value chain.

4.1. Descriptive statistics result of the data

The mean age of the respondents was 46.44, with the minimum and maximum ages of 24 and 80 years, respectively [Figure 5](#).

Figure 5. Age of sample households.

Source: Own sketch 2021

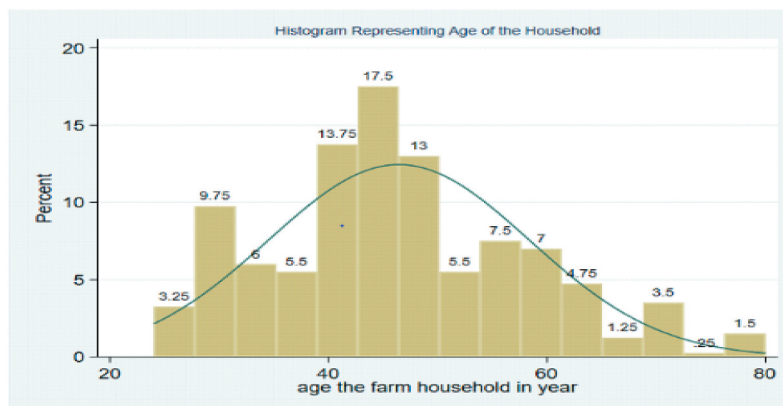
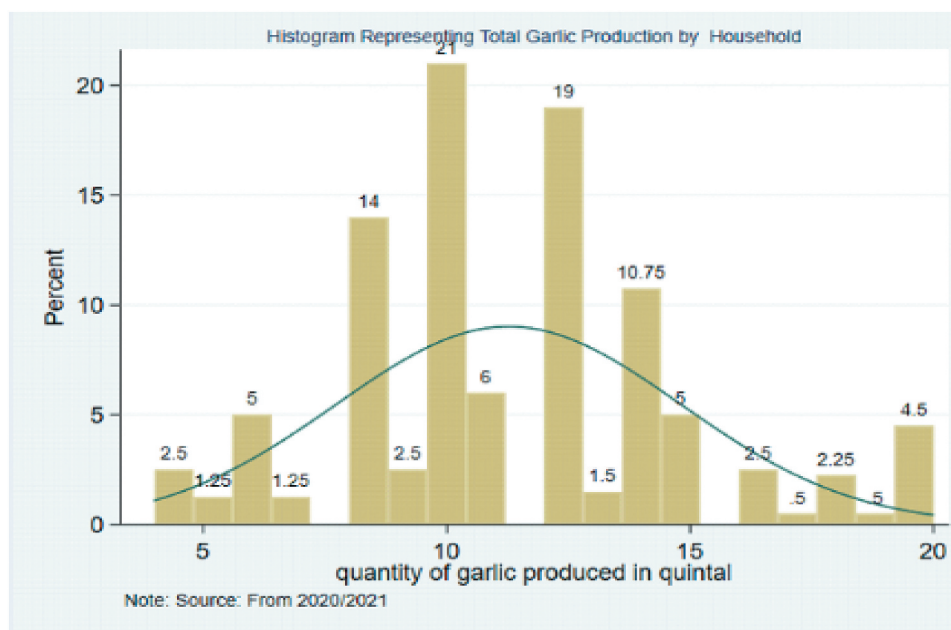


Figure 6. Total Garlic production of the households.



Regarding the number of families, the mean family number was 5.17, and it ranged from 1 to 8 family members; concerning mean Garlic farming experience, of all samples household, 23.48 years of experience in Garlic production. It shows that sample respondents have better experience in Garlic production and marketing activities. The minimum and maximum land allocation for Garlic production were 1 and 6 *timad*, with the mean land allocation being 3.58, and the total mean land holding of all sample households was 5.99 with a minimum of 2 and a maximum of 12 *timad* with a standard deviation of 1.55. The mean irrigable land of the sample farm household was 1.35 *timad* and maximum of 4 *timad*, and a minimum of 0.5 *timad* with a standard deviation of 0.68 [Table 1](#). The average annual Garlic produced by farmers was 11.27 quintals with a standard deviation of 3.54 ranging from 4 to 20 quintals, respectively [Figure 6](#).

The average quantity of chemical fertilizer used for the production of Garlic was 0.9 quintals with a standard deviation of 0.29, and the minimum and the maximum fertilizer quantity were used 0.5

Table 1. Demographic and socioeconomics characteristics of the sampled households (C.Var)

Variables	Mean	Minimum	Maximum	S.D
Number of Families in the Household	5.17	1	8	1.39
Experience of the Household Head	23.48	2	52	11.47
Total Land Size Holding of the Household	5.9875	2	12	1.55
Total Land Allocation for Garlic Production	3.5765	1	6	1.32
Total Irrigable Land Owned by Households	1.34905	0.5	4	0.68
Chemical Fertilizer Used by Households	1.889375	0.5	4	0.49
Number of Oxen Owned by the Households	2.2925	1	4	0.64
Number of Livestock Holding	15.6425	6	26	4.28
Distance to the District Market	9.4475	2	18	3.76
Distance to All Weather Road	3.4525	1	12	1.5
Distance to the Development Centre	4.56375	1	15	2.07

Source: Own Analysis 2021. S.D = Standard Deviation. C.Var = Continues Variables

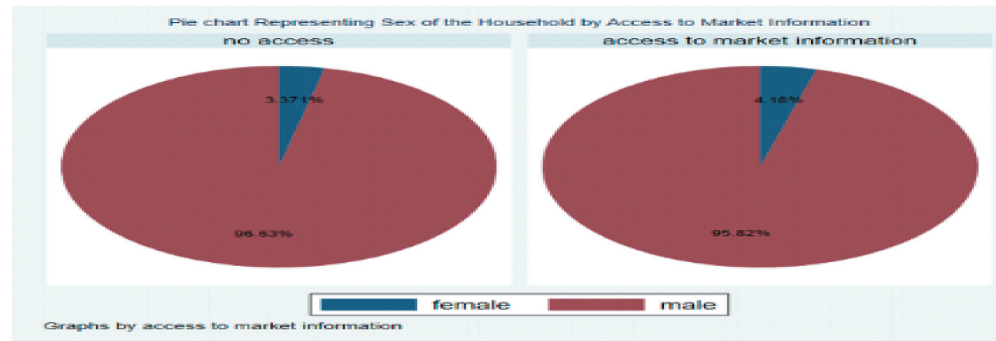
to 2 quintals, respectively. The average oxen owned by Garlic producer farmers was 2.3 with a standard deviation of 0.64, with the minimum and the maximum owned of 1 and 4 oxen, respectively. The average distance of sample households from the district market was about 9.45 kilometers with a minimum distance of 2 km and the maximum distance of 18 km with a standard deviation of 3.76, and the average distance of the sample farmers from all the development centers was 3.45 km with the minimum and maximum distance of 1 and 12 km respectively with a standard deviation of 1.5. The mean lagged price by sample farmers was 9328.5 8Birr/quintal, and the current market price for Garlic is 12,924.41 Birr/quintal; due to the COVID-19 pandemic, the price of Garlic was rose. The mean amount of credit obtained by farmers was 11,154.79 Birr from the lender organization [Table 1](#).

Of the respondents, 4% of sample households were female households, and 96% were male households [Figure 7](#).

Of the total sample respondents, 90% were irrigation users the rest 10% were non-irrigation users. More than 50% of farmers depend on farm income in the study area. Of the total respondents, 44.75% have non/off-farm income, and 55.25% of farmers did not have other income besides farm income. Of the total sample respondents, 96% had access to market information; the rest, 4% had no access to market information, those farmers who have not mobile and are less communicable farmers. The primary market information source for sample farmers was family, friends, and different traders through self-visiting and mobile and other information sources. Of the total respondents, 65.25% had their mobile phones. The survey indicated that about 32.4% of farmers obtained market information from family members who live near town, 27.65% from friends, and 39.5% obtained self-investigation. Out of the total respondents in the study area, 89% had access to credit, and the rest, 11%, had no access to credit [Table 2](#).

Figure 7. Sex of the household heads with access to market information.

Source: Own sketch 2021.



Of the total respondents, 2.5% were single, 94.25% married, 2% divorced, and 1.25% widowed [Figure 8](#).

The education level of sample households was 20.50% illiterate, 41.75% read and write, 17.75% primary school (1–6), 12.75% secondary school (7–12), and 7.25% certificate and above [Figure 9](#).

Sample farmers evidence the trend of Garlic production for the last four years; 97% of farmers said production increased, 1.75% said production was decreased, and 1.25% of farmers said production has fluctuated. The sources of credit for sample households, 96% of farmers obtained from ACSI, 0.75% from cooperatives, 2.75% from Governmental Bank, and 0.5% of farmers obtained from private Banks. Out of the total respondents, 71.5% of farmers had contact with those extension workers weekly, 17.5% of farmers had contact with the extension workers monthly, and 11% had contact once in two weeks [Figure 10](#).

Based on sample respondents, the Garlic price trend for the consecutive four years had increased and sometimes decreased among the total respondents; 96.25% said Garlic price increased through time, the rest 3.75% said it decreased over time, and 0.25% said both increased and decreased. With the extraordinary way, the price of Garlic during COVID 19 pandemic increased demand for Garlic product also increased by violating the law of demand [Figure 11](#).

Qty_{gp} = Quantity of Garlic production

In the case of means of transportation to transport Garlic by Garlic producer farmers, 3.5% of farmers transport Garlic product by the workforce, 43% with back animals, 2% of farmers with the vehicle, and 51.5% of farmers transport with all means of transportation. The market place was accessible for sample farmers; 48.5% of farmers sold at Addis Zemen town market, 39.75% of farmers sold at Yifag, and the rest of the farmers sold at Woreda [Table 3](#).

4.2. Value chain analysis

In this Garlic value chain, the most significant aspects of value chain mapping are used. [Figure 12](#) depicts the interconnectedness and coordination of core, supporter, and influencer actors and their functions. Money and information flow in the opposite direction of product between actors

4.2.1. Actors and their roles in Garlic value chain

Based on their roles, the identified Garlic value chain actors in the study area can be grouped under three levels. The main actors in a Garlic value chain included input suppliers, producers, collectors, wholesalers, retailers, processors, and consumers. The survey result indicated that input suppliers for Garlic producer farmers in the District are; Research Centers and Universities and mainly RUSACO/KO/farmers' association. As indicated in [Figure 13](#), out of all sample Garlic producers,

Table 2. Demographic and socioeconomic characteristics of the sampled households (D.V.s)

Variables	List of Kebeles in the Selected District											
	Shewchtera		Gina		Angote		Yifag		Birra		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Access to Market Information												
access to market information	61	76.25	46	57.5	77	96.25	66	82.5	61	76.25	311	77.75
Not access	19	23.75	34	42.5	3	3.75	14	17.5	19	23.75	89	22.25
Access to Irrigation												
Access to irrigation	75	93.75	79	98.75	75	93.75	77	96.25	74	92.5	380	95
No access	5	6.25	1	1.25	5	6.25	3	3.75	6	7.5	20	5
Access to Non/Off-Farm Income												
Access to	46		42	52.5	37	46.25	18	22.5	36	45	179	44.75
not access	34		38	47.5	43	53.75	62	77.5	44	55	221	55.25
Access to Mobile Phone												
Access to mobile	45		36	45	16	20	14	17.5	28	35	139	47.75
Not access to mobile	35		44	55	64	80	66	82.5	52	65	261	65.25
Access to Credit												
Access to credit	56	70	52	65	45	56.25	54	67.5	60	75	267	66.75
Not access to credit	24	30	28	35	35	43.75	26	32.5	20	25	133	33.25

χ^2 = Chi square test, D.V = Dummy variables

Source: Own Analysis 2021

Figure 8. Quantity supply with martial status.

Source: Qwn sketch 2021.

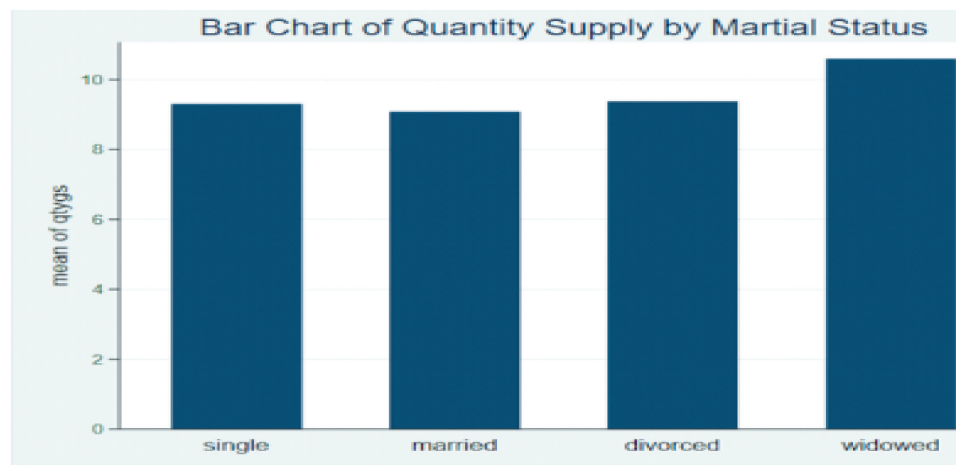
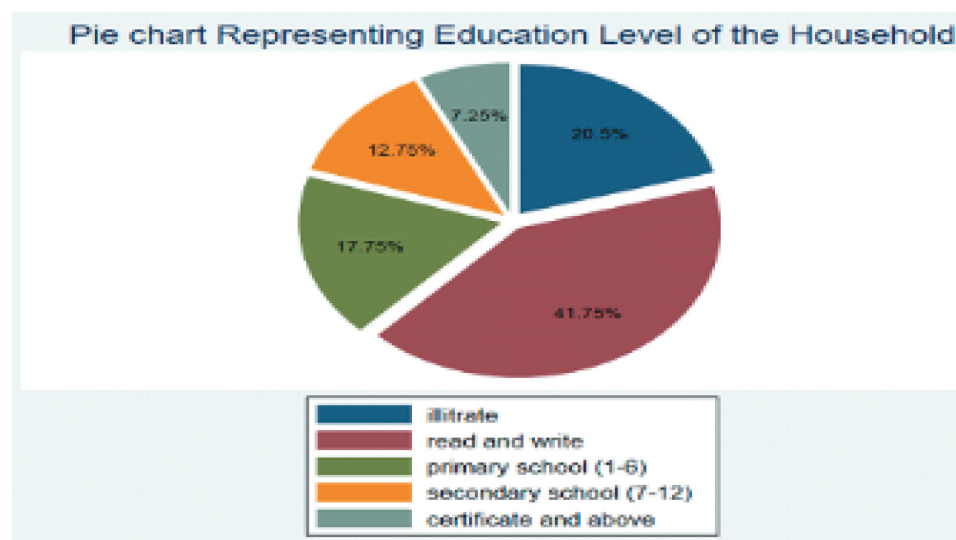


Figure 9. Education level of sample household.

Source: Own sketch 2021.



91.5% used local seed, 0.5% of farmers used improved seed, and 8% used both local and improved seed types for Garlic production.

For producing Garlic by sample farmers, different labor sources were used. From the total sample of farmers in the study area, 37% used family labor, 0.5% produced with labor exchange, 0.75% used family labor and cooperation, and 61.75% of farmers produced with family labor, hired labor, and cooperation [Figure 14](#).

Irrigation Technology Used: Now, Garlic production with irrigation has become a vital farming business in the study area. From the total sample respondents, 95.25% of respondents were used both irrigation and rain-fed farming for Garlic production, and 4.75% of farmers did not use irrigation for the production of Garlic and other crops; instead, they only used rain-fed [Table 4](#).

Figure 10. Frequency of extension contact.

Source: Own sketch 2021.

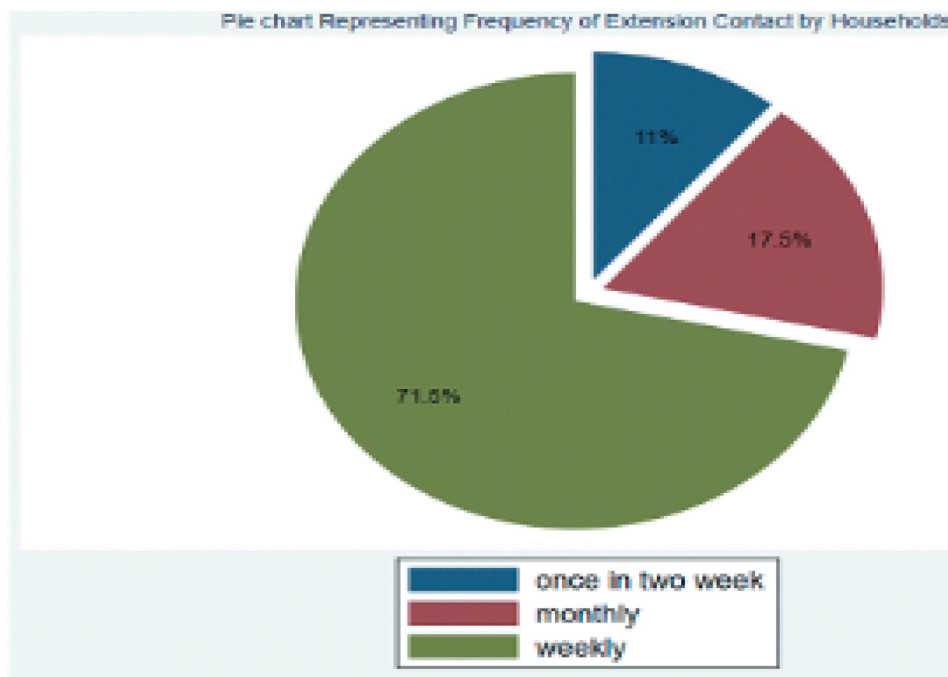
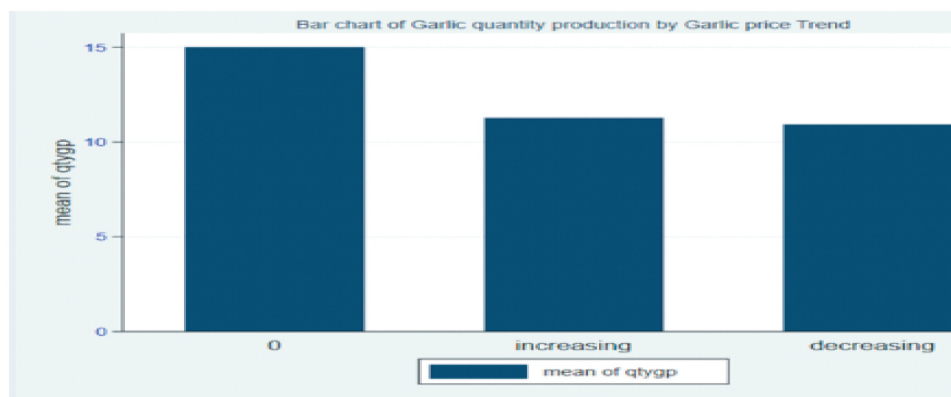


Figure 11. Garlic production with its price trend.

Source: Own sketch 2021.



Producers: These are primary actors next to input suppliers who produce Garlic, mainly for consumption and marketing purposes, and perform most of the value chain functions, starting farmland preparation to purchasing inputs from other sources, and they continue to the post-harvest handling and marketing stage. **Local collectors:** Farmers and another actor who collect Garlic from producers in village markets and resell it at a better price to the following actors. **Wholesalers:** These are well known for purchasing bulky Garlic products with better financial and information capacity. They purchase Garlic either directly from producers or local collector's larger volume than that done by other value chain actors and supply to other big traders/to other towns/cities. **Processors:** In the study area, Garlic is consumed in a boiled and cooked meal with various traditional food items like wot even it can be consumed as raw because it has medicinal value especially during COVID 19 pandemic. There was no standing Garlic processor in the study area.

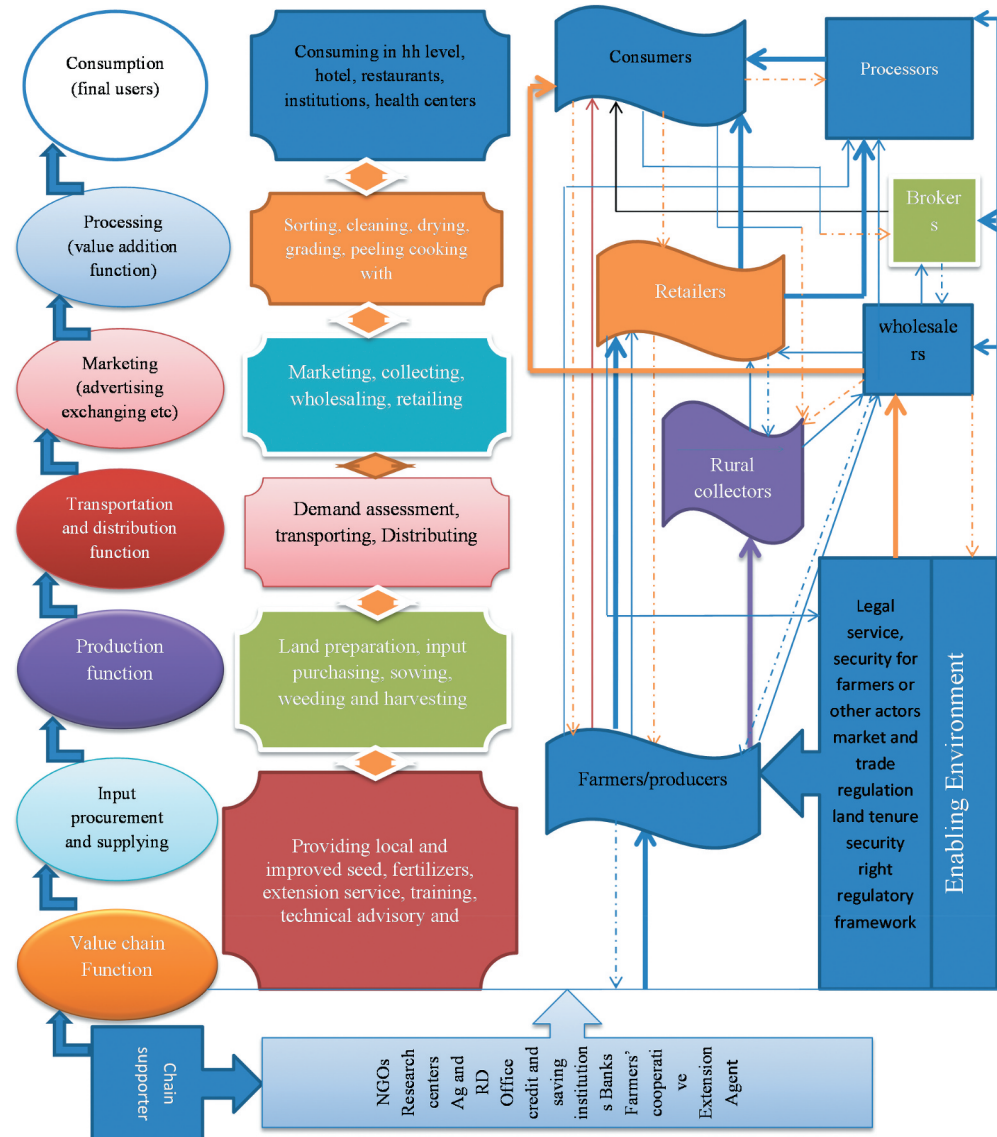
List of Kebelesin the Selected District

Variables		Shewchtera		Gina		Angote		Yifag		Birra				Total		X2
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%		
Means of Transportation															25.61*	
	7	8.75	7	8.75	0	0	0	0	0	0	0	0	14	3.5		
	32		35	43.75	35	43.75	36	45	34	42.5	172	43				
	2	2.5	1	1.25	0	0	3	3.75	2	2.5	8	2				
All Means of Transportation Used	39	48.75	37	46.25	45	56.25	41	51.25	44	55	206	51.5				
The trend of Garlic Production															11.18	
	77		78	97.5	77	96.25	77	96.25	79	98.75	388	97				
	2		2	2.5	0	0	3	3.75	0	0	7	1.75				
	1		0	0	3	3.75	0	0	1	1.25	5	1.25				
Sources of Credit															17.88	
Asci	75		76	95	78	97.5	80	100	75	93.75	384	96				
Cooperative	1		1	1.25	0	0	0	0	1	1.25	3	0.75				
Governmental Banks	4		3	3.75	0	0	0	0	4	5	11	2.75				
Private Banks	0		0	0	2	2.5	0	0	0	0	2	0.5				
Market Place Accessibility															197.1****	
Addis Zemen	63		80	100	8	10	18	22.5	25	31.25	194	48.5				
Yifag	13		0	0	58	72.5	50	62.5	38	47.5	159	39.75				
Woreta	4		0	0	14	17.5	12	15	17	21.25	47	11.75				

χ^2 = Chi-Square Test, C.Vs = categorical Variables.

Source: Own Analysis 2021.

Figure 12. Value chain map of Garlic in Libokemekem District.
 Source: Own Sketch 2021.



Retailers: They are known for their limited ability to buy and handle products with low financial and information capability. Retailers are crucial actors in the Garlic value chain in the area. **Consumers:** Consumers are the end actors in the Garlic value chain and those purchasing the products for consumption. There are many consumers for Garlic products, such as; individual households, cafés/ restaurants, and institutions (higher education institutions like colleges, universities, hospitals, etc.) **Chain supporters:** These are service providers of various types who never directly deal with the product but whose services are concerned with adding value to the product. The main supporting actors significantly contribute to the Garlic value chain in the study area. Farmers' association cooperatives (RuSAco), extension/DA, office of agriculture and rural development, NGOs (SNV), World Vision, Ameld, Orthodox, MEdA (*Emerita*), Agiro BIG, RED Plus, Amhara credit and saving institution (ACSI), research centers and Debre Tabor University, Bahir Dar University and University of Gondar. **Chain influencers (Enabling environment):** These are the value chain environment and

Table 4. Status of sample households by irrigation approach														
Variables		List of Kebele in the Selected Districts												
Irrigation user of the respondent		shewochtera		Gina		Angote		Yifag		Birra		Total		χ ²
		freq	%	freq	%	freq	%	freq	%	freq	%	freq	%	
none user		5	6.25	1	1.25	7	8.75	2	2.5	4	5	19	4.75	6.3
User		75	93.75	79	98.75	73	91.25	78	97.5	76	95	381	95.25	
Total		80	100	80	100	80	100	80	100	80	100	400	100	
Freq. = frequency of farm households; χ ² = Chi square test; Source: Own Analysis from survey result, 2021. As the above table shows, there is no significant mean difference between irrigation users and non-user across each selected sample kebele in Libokemekem District.														

Figure 13. Types of seed used by sample respondents.
 Source: Own Sketch, 2021

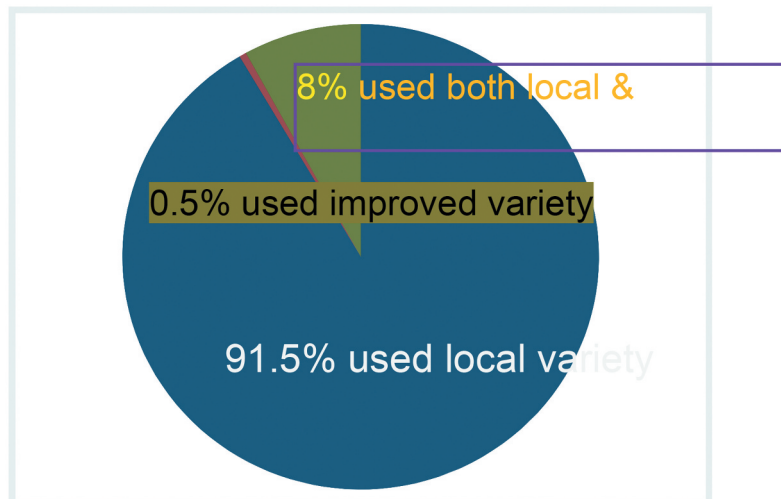
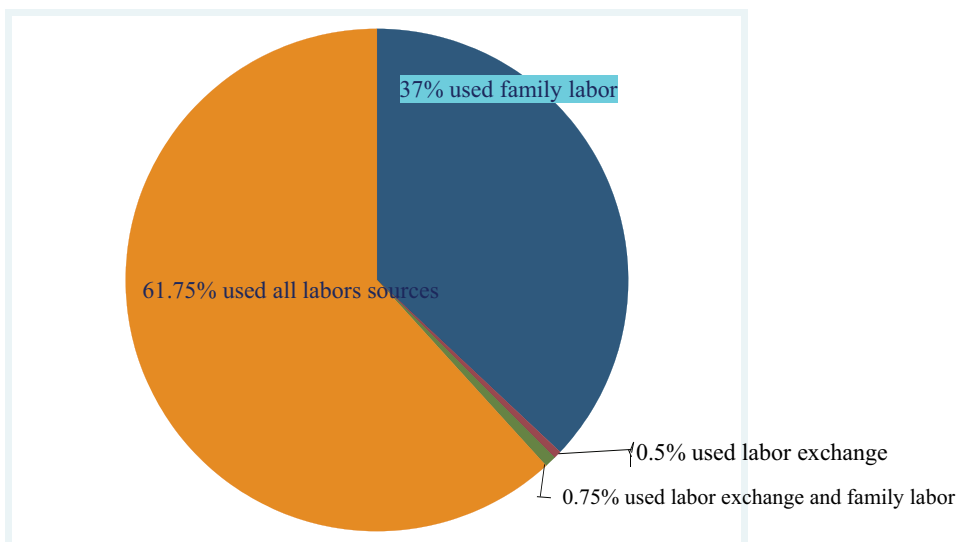


Figure 14. Sources of labor used for Garlic production.
 Source: Own Sketch, 2021.



systems for Garlic value chain performance in the study area. These include; regulatory framework, land tenure security rights, legal service, security for farmers/actors.

4.2.2. Value chains actors linkage

Different actors in the Garlic value chain in the selected study area were linked vertically and horizontally, backward and forward, as shown in Figure 15.

4.2.3. Value chain governance

According to (Kaplinsky & Morris, 2000), Value chain governance gives information about the position of value chain actors and linkages between sellers and buyers. Following this, the Garlic

Figure 15. Actors' linkage in Garlic value chain.
 Source: Own Sketch 2021.

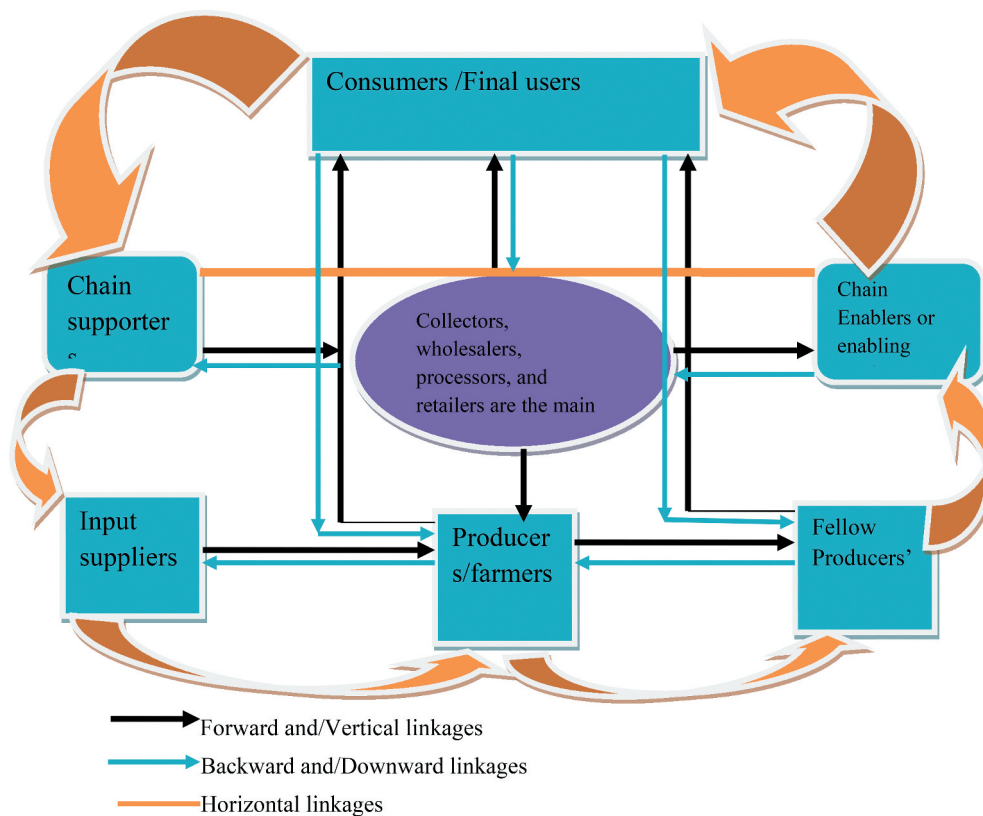


Figure 16. Marketing channel of Garlic in the study area.
 Source: Own Sketch 2021.

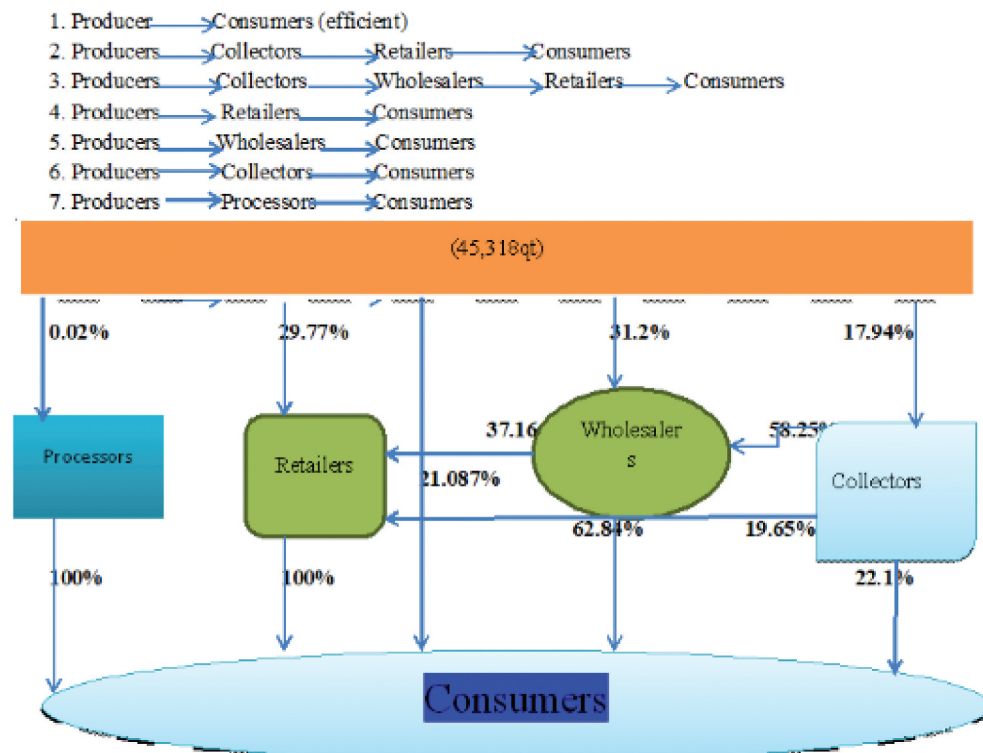


Table 5. Estimations of Garlic market supply by FGLS model

Covariates	Coeff.	Std. Err.	Z-value
w_ Quantity of Garlic production	.618***	0.0405	15.27
w_ Land allocation for Garlic production	.172*	0.103	1.67
w_ Amount of credit earned by sample producers	-.004***	0.002	-3.10
w_ Lagged market price for Garlic product	.003***	0.006	3.53
w_ Access to market information	.544*	0.297	1.84
w_ Experience of the HH for Garlic production	.019**	0.009	2.10
w_ Number of oxen owned by sample households	.305**	0.149	2.04
w_ Sex of the households	-.820*	0.437	-1.88
_cons	2.098*	1.103	1.90
Number of Observation			400
F(14, 385)			216.79
Prob>			0.0000***
R-Squared			0.8874

***, **, and * indicates significant level at 1%, 5% and 10%.; Std. Err = Standard Error.

Source: Own Analysis 2021.

market in the District was influenced by the wholesale market because they have a 31.2% share from the total Garlic supplied to the market related with other value chain actors.

4.2.4. Marketing channel of Garlic

The transactions of Garlic from producers to final consumers were conducted through different marketing channels. Accordingly, seven alternative marketing channels were identified for the Garlic market in the study area, as shown in [Figure 16](#).

It shows that farmers sold more Garlic products to wholesalers and retailers. As indicated in the above [Figure 16](#), farmers sold 31.2% to wholesalers, 17.94% to collectors, 21.087% to consumers, 29.77% to retailers, and 0.02% to processors. Wholesalers and retailers accounted for the larger share of the channel, which may give them the ability to govern the market and play the dominant role in price determination and having the power to control the market.

4.3. Econometrics model analysis result

4.3.1. Determinants of market supply of Garlic

4.3.1.1. Test specification. Multiple tests have been made before proceeding to Feasible General Least Square (FGLS) model estimation. First, the variance inflation factor (VIF) for continuous independent variables was made for multicollinearity problems. Hence, the value of VIF for all variables used in model estimation and their mean were below 10, which indicates that there was no severe problem of multicollinearity. Second, a correlation matrix for dummy and categorical independent variables has been tested, showing no severe correlation between variables. Third, the Breusch-Pagan test has been employed to check the heteroscedasticity problem, which shows a big problem in the dataset. As a result, we employed the Feasible General Least Square (FGLS) model. As depicted in [Table 5](#) below, eight covariates were statistically significant among the 14 estimated covariates that influenced the quantity of Garlic supply to the market. Thus, the quantity of Garlic produced and lagged market price of Garlic (Garlic price in 2020) was positively and statistically significant at a 1% level of significance, while Garlic production experience of the

household head and the number of oxen owned were positively and statistically significant at 5% level of significance. Unexpectedly, the amount of farm credit and gender of the household head were negatively and statistically significant at 1% and 10% levels of significance, respectively. Furthermore, land allocation for Garlic production and access to the market was positively and statistically significant at a 10% significance level. However, surprisingly, the variable extension contact, non/off-farm income, market distance to the farmer's dwelling, family size, frequency of extension contact, and Garlic seed type were not significant in the model. The variable Garlic seed type was insignificant because almost all Garlic producer farmers were used local variety this implies that the productivities of Garlic might not be improved as the expected amount. Distance from the nearest market was not a matter for the farmers while supplying their Garlic product to the market either positively or negatively. Even though three Development Agents are employed per kebele, the variable frequency of extension contact was insignificant in the study area. It implies that their contribution to Garlic production and market supply was not substantial [Table 5](#).

Quantity of Garlic Production: Quantity of Garlic supply has a positive influence to the quantity of Garlic market supply at 1% significant level. Hence, this finding is in line with the theory of production; when the quantity of Garlic produced will increase by one quintal, then the farmer's level of market supply might be increased by 0.62 quintals per unit.

Land allocation for Garlic production: Has a positive association with the quantity of Garlic supply to the market. But, when farmers increase the land allocation by one¹ *Timad* for Garlic production, the quantity of Garlic supply to the market may increase by 0.17 quintal.

Amounts of credit obtained by farm households: This variable has an inverse relationship with quantities of Garlic market supply. Meaning that amount of credit has negatively influence the quantity of Garlic supply to the market. If the amount of credit receiving increases by one Birr, the quantity of Garlic production and supply to the market decreases by 0.004 quintal.

Lagged market price: This variable was positively and significantly influenced the quantity of Garlic supply to the market. If the price of Garlic were increased by one Birr last year, the quantity of Garlic supply to the market would increase by 0.003 quintal for the coming year. **Access to market information:** This variable positively affects the quantity of Garlic market supply. As the Garlic producer farmers are well informed and seeking market information, the quantity of Garlic market supply would increase by 54.5% compared with the existing supply to the market.

Farm experience of the household: This variable positively influences the quantity of Garlic market supply. When the households' farming experience increases by the year, the quantity of Garlic market supply will increase by 0.02 quintal per year.

The number of oxen owned by farm households: This variable statistically and positively influences the quantity of Garlic production and market supply. Oxen are one of the imperative farm inputs, especially in Ethiopia; thus, Garlic production and market supply would increase by 0.3 quintals per hectare and season when the household heads have one additional ox.

Sex of the household head: The sex of the household head has a statistical and negative influence on the quantity of Garlic market supply. Hence, by being female Garlic producers would increase the quantity of Garlic market supply by 82%.

4.4. Opportunities and constraints for Garlic value chain in the study area

Area suitability, farmers' motivation to produce Garlic crop, high market demand crop, availability of different NGOs in the district are some of the opportunities for Garlic value chain. Absence of improved seed (95.4%), high cost of inputs (78%), diseases and pests (81.5%), traditional production system (94.75%), absence of processing plant (95.5%), limited support from Government (89%) and, low income of the consumers, the high price of Garlic, especially during COVID 19.

Table 6. Constraints, opportunities and possible interventions in Garlic value chain

Stages of Garlic V.C.	Constraints	Opportunities	Possible interventions needed
Input supply	Absence of improved Garlic seed, High cost of chemical/inorganic fertilizers Limited role of farmers' cooperative for input supply	research centers and universities try to bring improved Garlic seed to the study area, Highly motivated by farmers for preparing organic fertilizer	Government bodies support research centers and universities for adapting improved seeds Promoting private input multiplier strengthening farmers in preparing compost, by supporting with materials for preparation
Production	Absence of modern production technology, Low irrigation service/ facilities periodic rainfall (drought), poor disease, pest management Influence of natural factors (flood, frost), Weak postharvest management	District suitable condition for Garlic production, fertile arable land and irrigation water, availability continuous demand for Garlic products by the market, medicinal crop,	Increasing production by improving quality seed & limited available resources is needed by farmers and other agents, Transfer farmers from the traditional production system to the modern production system Care should be taken in controlling diseases/pests starting from input selection,
Transporting/ Marketing	price fluctuation, lack of transportation service, poor road condition, lack of market integration among traders, and perishable nature of the product	Product market demand throughout the year, High experience of traders in Garlic production and trading,	Creating market integration among traders Promote value to the product through various production, marketing, transportation, processing, and packaging methods and the product from its production till it reaches to final consumption.
Processing	Absence of processing facility/ plant& value addition, Culturally lack awareness for the processed product by local consumer	Availability of Garlic product throughout the year, individual interest in engaging for the sector Suitable production area	Introduce and follow up a processing plant, Strengthening individuals to enter into the processing business activity Create awareness for processed product type to consumers
Retailing	Lack of marketing facilities, trading capital, low support from concerned bodies for small traders.	Availability of Garlic throughout the year, Consumer demand in small amount	government and other concerned bodies need to access marketing facilities at the local level and give support for small scale traders in the local production area
Consumption	Consumption of this product is not cheap, low income of consumers, and the product's high price, especially during pandemic disease like COVID 19 and during the offseason.	High nutritional and medicinal value of Garlic High demand for consumer preference, suitable food item	Creation of awareness to increasing consumption because the product has nutritional and medicinal value and Garlic raw and processed product should be part of one item in the daily food menu of consumers.

Source: Own Analysis 2021; VC = Value Chain

(89.4% consumers confirmed) are the main value chain constraints explained by the number of respondents [Table 6](#).

5. Discussion and managerial implication

5.1. Discussion

Discussion for Descriptive statistics; Age is one of the most life learning processes that gives the best experience for any activities undertaken by the given household. The research output shows that sample households belong to the most favorable age group. It implies that when the age of the household increases, the likelihood of Garlic production and marketing supply would be

improved since age is informal education; it gives various knowledge to elders. Agricultural output is significantly influenced by changes in working-age households (Guo et al., 2015). Garlic farming is a relatively widespread practice among older farmers. It could be because most young people are involved in activities and services other than farming or prefer to work in cities rather than rural areas (Mina et al., 2021). Farmers in the study area allotted enough proportion of land size for Garlic production. The amount of land allotted to a particular crop substantially impacts sales volume. The more area allocated for particular crop production, the more products are produced, and consequently, the number of products sold to the market would increase. As a result of the economies of scale, per unit production costs would be discounted (Hailu, 2016). The land allotted for this study is greater than the land allotted for the study (Mina et al., 2021). Lower the yield gap for agricultural output in different agro-climatic zones by using varied sizes of land holdings in cultivating techniques. It is shown that farmers with different sizes of land holdings and different sorts of labor have obtained greater yields. Farmers with substantial landholdings are more willing to use the second-best alternative crops for agricultural production (Dagar et al., 2021). Since irrigation technology is an essential agricultural practice, 38% was irrigable land for Garlic production from the total land allotted. Abundant of the increase in production comes from area extension and an increase in small-scale irrigation activities, allowing two or more production rounds per year (Reddy & Kanna, 2016). The Researcher's field observation and the research finding indicated that the amount of production and productivity at the smallholders' farmers' level is meager compared to production gained at state farms and research centers with irrigation.

Increasing agricultural production is the main driving factor in the amount of marketed supply. If the number of production increases, the likelihood of marketed supply will also increase; as a result, the amount of supply and the amount of demand will be balanced. From the findings of this study, the current total Garlic production is better than the average Garlic production in the country during the same production year. The amount of production found in this study is more significant than the result of (Mina et al., 2021). Increasing horticultural production contributes to the rural economy's commercialization and creates many off-farm jobs (Reddy & Kanna, 2016). Increased economic growth means more goods and services are produced, requiring less energy to achieve high productivity (Zakari et al., 2021).

Distance is a matter which can determine the frequency of market participation and the number of sales. In reality, while the distance increases from the marketplace, the probability of market participation and sale intensity would decrease. As distance decrease by a kilometer, the severity of production and marketing constraints would be decreased (Giziew et al., 2014). Therefore, transportation hurts the country's long-term economic growth (Rehman, Radulescu, et al., 2021). From the total sample household participation in Garlic production and marketing, 96% of households were male-headed households. It implies that being male can produce a large amount of Garlic, and proportionally, the marketed supply of Garlic to the market would increase. Male-headed households directly affect the production and market supply of Garlic in the study area. Male-headed households had higher produced capacity per hectare of land than female-headed households.

In other words, production on female farms is slightly lesser than that of male-headed households (Giziew et al., 2014). Therefore, being a male household substantially increases the number of products sold to the market (Hailu, 2016). Market information is an excellent factor in encouraging production and market participation, and sales volume. There was a significant mean difference between each kebele by obtaining market information at the right time at a 1% significant level. Tolera (2008) confirmed that access to timely market information on prices and quantities plays a crucial role in reducing the risk of losing money on a market transaction. Market information included price information, demand for the product, quantity supply, marketplace, and producers and consumers collaboration. Producers have been forced to be oppressed and offended by brokers and other intermediaries because of a lack of accurate and timely market information (Negasi, 2016). The financial resource is a crucial asset for agricultural production. Therefore, the availability of financial institutions in the target area significantly improves total agricultural

production. As a result, access to credit is one of the driving factors for increasing production by purchasing input and improving marketed supply. However, due to the lack of loan provider institutions and inaccessibility of credit services, productivity is low, and product quality is pitiful (Gessese, 2009). Therefore, information and communication technology and financial developments are positively connected with economic growth and development for a given Country (Zhang et al., 2022). In the study area, the average farm households belong to married status, which positively affects agricultural production. By being married, the probability of productivity and market supply would be increased. Education is the sole motivating element that helps producers obtains different information from various sources. Confidently, the findings of this study showed that more than 42% of farmers could read and write, which implies that who placed at equitable educational status. Education level plays a massive role in confirming household access to basic requirements, such as food, shelter, and clothing. Skills and education strengthen operational effectiveness, improving income and assuring food security. Education is essential for commercial management and used as a tool for the decision-making process (Kadigi, 2013). Household education affects the capacity and skills of farmers to accept new technologies and advances to increase production and productivity and subsequently supply more products to the market (Tadesse et al., 2021). With information communication services, the level of education has good coefficient values. It entails boosting educational levels, increasing productivity, and increasing marketed supply while minimizing environmental degradation or pollution caused by production and marketing operations (Zhang et al., 2022). Every season, there is an increase in the need for marketable and medicinal crops. Garlic is demandable by consumers in everyday consumption. In addition, it has high medicinal value since it is considered to treat COVID 19 by many people, even globally. The trends of Garlic production increase every time in Ethiopia, especially in the era of COVID 19. In terms of Garlic production, the overall output of Garlic has been steadily increasing in many nations, the Garlic planting area has remained relatively stable, and the planting area is very concentrated. Changes in supply and demand and capital speculation influence the price of Garlic on the market (Tekeste & N, 2020).

5.1.1. Value chain map, actors, their functions, and their linkages

Value chains encompass all the activities from production to consumption and waste utilization of a particular product. Typical examples of activities along an agricultural value chain include specific inputs, production, collection, transformation, trade, export, wholesale and retail marketing, and consumption (Faße et al., 2009). Value chain analysis is an effective way to examine the interaction among different actors in a given business (Zamora, 2016). The agricultural value chain has been increasingly internationalized (Kuroiwa, 2021). Value Chain analysis is currently the primary concern of every individual and the Government worldwide; keeping this research interest can be expanded and be an endless journey. A value chain map is ideal for describing the structure and actors involved in bringing the product or service from its primary raw materials through final consumption. It can be a valuable tool to guide the research and set out the map. Value chain mapping enables the visualization of the product flow from production to end consumer through various actors (McCormick & Schmitz, 2001). The current Garlic value chain map indicates the physical movement of Garlic from its production to the final consumers with the involvement of various actors either directly or indirectly by undertaking different value chain activities. This Garlic value chain map helps the researcher identify different actors involved in the entire value chain and those activities being undertaken and quickly understand the actors' roles and linkages. This pictorial representation could form a sturdy relationship of actors in getting the product or service from its raw materials purchase and supply through final consumption. Value chain mapping is an analytical and visual tool that helps understand how a particular improvement network is organized spatially in size and direction. It should improve understanding of value flows and aggregation in the economic and innovation system in a systematized and integrated manner. The mapping exercise generates a series of analyses, graphs, and maps that represent various static characteristics of the Garlic value chain on a high level that, taken together, support further reproduction of possible cooperative actions across the entire value chain (Reid et al., 2020). Once the core Garlic value chain is established, the mapping can map the nature of contributors

in the value chain, including identifying the specific market group of actors. The focus should be primarily on the core Garlic value chain, where actors take ownership of the Garlic product and add value to it before selling it. Other actors that provide supporting functions, products, and services that contribute to the value-adding process but are not involved in the core Garlic value chain or marketing transactions, should be considered as part of the related and supporting structures also, including government institutions and service providers on the broader Garlic value chain environment. Information on these Garlic value chain actors should be captured but separated from that core to the value chain. This map should identify the specific names of key actors in the chain and estimate the total number of each type of actor at each stage of the Garlic value chain. A value chain map can also support distinguishing the actors' interaction at the same level and different levels in the chain, as well as observe the critical information on costs of production, marketing, prices of output, and value-added flows across the value chain (Fernandez-stark et al., 2011).

Value chain actors: Actors are all the individuals or organizations, enterprises, and public agencies related to a value chain and, therefore, are crucial for understanding the functioning and performance of the value chain. They are often but not necessarily associated with particular value chain activities. It often makes sense to differentiate between chain and supporting actors for analytical purposes. They are those who are directly involved in value chain activities. Typically in researcher illustrations, they are input suppliers, producers, local collectors, wholesalers, processors, retailers, and consumers. They have in common that they become owners of the raw, semi-processed, or finished product at one stage in the value chain. Supporting actors or service providers can play an important role, but they are not directly involved in value chain activities. A typical case would be an extension service provider or an NGO convoluted in capacity building and another purpose. **Value chain influencers:** The regulatory framework, policies, and infrastructure (Bammann, 2007). In a similar situation in the current research area, value chains of Garlic are those individuals or organizations who take devices during the operation process of moving Garlic product from its origin to final consumption. Numerous Garlic value chain actors were involved in the entire value chain from its creation to final use through performing several activities. Input suppliers, producers, collectors, wholesalers, retailers, processors, consumers, and chain enablers and supporters were the main Garlic value chain actors. These findings were similar to the findings of (Wondim, 2021; Tolera, 2008; Bekele, 2017; Tadesse & Bakala, 2018). Input suppliers perform the central role in supplying agricultural production inputs, improved seeds, and new varieties of Garlic seed. In the study area, more than 90% of Garlic producer farmers used local seed; as a result, the amount of production is detrimental in turn, it affects the amount of marketed supply either directly or indirectly. The contribution of various input suppliers' in the area is still slight to no attention regarding improved Garlic seed varieties. Even though every Garlic value chain actor performs different value chain activities, producers perform most of the value chain functions, starting farmland preparation to final distribution, compared with other actors in the entire Garlic value chain. Due to Garlic, production is highly labor-intensive; more than 60% of Garlic producers used all the labor sources and increased their farm return proportionally. Irrigation is a significant agricultural technology that helps to assure uninterrupted production throughout the year. In the study area, as a common practice, vegetables and fruits are mainly produced with irrigation. Consequently, more than 95% of Garlic producers produced Garlic with irrigation. As far as the researcher's field observation, the price of Garlic products thoroughly increases, particularly in the era of COVID 19; as a result, the demand of Garlic producers in producing Garlic with irrigation is constantly rising in line with this value addition activities also practiced. The value chain concept has been integrated into this work stream to varying degrees and from several perspectives. The activities that encompass a value chain can be delimited within a single actor or divided among different actors through different topographies and can be limited within a single geographical location or spread over more expansive areas (Brennan & Rakhmatullin, 2015). However, conventional value chain analysis concerns

the actors' business functions, such as input supply, production, marketing, distribution, and provision to the end-user (Kuroiwa, 2021).

Value chain Actors' linkages: are the channels or relationships that connect the different value chain activities and through which a product passes from the production to the consumption stages, including vertical, horizontal backward, and forward linkages. Vertical linkages connect actors involved in different value chain activities, from input suppliers to producers, collectors, wholesalers, processors, distributors, retailers, exporters, and so on, all the way to the consumer. Vertical linkages are the commercial relationships involved in bringing the product up through the value chain (Dunn, 2014). In this study value chain, actors like producers were linked vertically with wholesalers, local collectors, retailers, and consumers for giving products and services and made linkage downward for receiving money and other information. In the same way, traders made linkage for different functions in the complete Garlic value chain. Producers made backward linkage with input suppliers, and input suppliers linked with producers for information and financial matters. Horizontal linkages join actors performing the same activity within the value chain. A pattern of horizontal linkages would be producer groups or other actors groups. Essential functions of horizontal linkages include more cost-effective access to inputs, services, and information and the empowerment of farmers to advocate for change (Barron & Stein, 2017). Garlic producers made horizontal linkage with other corresponding producers for the market matter, exchanged different seeds, and shared production experiences. However, their relationship looked to be weak. In the same way, traders also made horizontal linkage in the same function in the complete Garlic value chain. Chain influencers and chain supporters were linked horizontally in their similar functional activities. Generally, actors' linkage in the Garlic value chain was weak compared to other commodity actors' linkage in the study area. In supporting this finding, in vegetable marketing, small holders in rural areas are often poorly linked to markets and do not adequately access useful market information (Wondim, 2021). In the most advanced economies, the number of production processes and forward and backward linkages would reduce environmental quality (Tillaguango et al., 2021). Value chain Governance: In the research area Garlic market was influenced by the wholesale market since wholesalers had an excellent capital position compared with other value chain actors. Hence, the wholesalers are the conspicuous value chain governors in the Garlic value chain (Hasan & Khalequzzaman, 2017).

5.1.2. Determinants of market supply of Garlic

Different factors that affect the Garlic product sales volume were included in the econometrics model. From those factors included and fitted in the econometrics model, the most significant factors discussed hereunder:

Quantity of Garlic produced: Based on the theory of production and marketing, the quantity produced and supply to the market has directly proportional. The more significant the amount of Garlic production; the more considerable amount of product would be available in the market. In line with this finding, (Bekele, 2017) and (Melese et al., 2018) confirmed that the quantity of potato and onion produced was positively and statistically significant, influencing the market supply of the respective study product.

Land allocation for Garlic production has a positive relationship with the quantity of Garlic supplied to the market. It implies that Garlic producers tend to allocate more land for Garlic production than other grains and cereals. Furthermore, since the farmers in Ethiopia engage in a subsistence farming system; thus, they allocate a more significant portion of their farmland for food crops rather than commercial crops. In line with this finding, (Hailu, 2016) and (Bekele, 2017) concluded that land allocation for different crop production was positively and statistically significant to the market supply of the selected commodity in their study areas. In addition, (Melese et al., 2018) confirmed that land allocation significantly determined the volume of onion supply to the market.

Amounts of credit obtained by farm households: This variable negatively relates to quantities of Garlic market supply. The reason can be that farmers might not use the amount of credit as their plan to purchase production input and farm implements. Instead, after receiving the credit from different financial institutions/sources, they might use it for trading, home construction, and other ceremonies. This finding contrasts with (Diriba-Shiferaw, 2016) findings, who argued that credit service providers minimize the financial constraints of Garlic producer farmers when enabling them to obtain modern agricultural inputs. In addition, (Worku, 2019b) found that the participation and amount of supply initiated access to credit to the market in the study area.

Lagged market prices positively and significantly influence the quantity of Garlic supply to the market. The reason would be that when the lagged market price of Garlic was attractive, those Garlic producer farmers were highly motivated to produce more Garlic products and supply that to the market in the next year. Therefore, it implies that when the commodity price increases, the quantity of market supply also increases proportionally. Supporting this finding, (Belete & Haji, 2018) and (Ayalew, 2018) confirmed that lagged market price significantly affected the market supply of the selected commodity at the household level in their study area. Furthermore, ITC, (International TradeCenter), (2017) found that the lagged market price affected the Garlic market supply to the market.

Access to market information positively and significantly affects the quantity of Garlic market supply. It implies that market information is one of the driving factors for Garlic producers in increasing production and marketing capacity, and it helps break price and other information gaps. In line with this finding, (Ayalew, 2018) in his study, found that access to market information for the tomato market significantly affected the market supply of the selected commodity. In addition to this, (Tegegne, 2013) in his finding, found that access to market information significantly influenced vegetable market supply in his study area. The key to value chain sustainability and development is environmental-related technology, research, and development (M. K. Khan et al., 2021).

Farm experience of the household positively and significantly influences the quantity of Garlic market supply. It implies that when farmers become experienced in Garlic production and marketing activities, they would have a strong motivation for Garlic production and marketed supply. As a result, they are possibly supplying Garlic to the market. In line with this finding, (Hailu, 2016) and (Ayalew, 2018) found that the household head's experience statistically and significantly affects the market supply of their target agricultural commodities.

The number of oxen owned by farm households statistically and positively influences the quantity of Garlic production and market supply. Agricultural production is highly input-intensive if it performs without modern farm technology. Therefore, it implies that if the number of oxen in the household increases per production unit, the probability of Garlic market supply would increase. In line with this finding, (Worku, 2019b) found that the number of oxen owned by households influenced volume of potato supply to the market in his study area.

The sex of the household head has a statistical and negative effect on the quantity of Garlic market supply. It shows that female farmers have more market suppliers than male farmers in the case of Garlic production and marketing. Being male farmers, the quantity of Garlic supplied to the market would reduce by 82%, implying that male farmers were interested in producing other cereals and grain crops rather than producing vegetables and fruits compared to female farmers. In contrast with this finding, (Belete & Haji, 2018) found that the sex of the household significantly affected the market supply of coffee at the household level in his study area.

5.1.3. Opportunities and constraints

Almost all Garlic producers in the research area are faced with the absence of improved seed, high cost of input, or shortage of production input (fertilizer), the prevalence of Garlic disease and pests, traditional production system, lack of postharvest handling technology, absence of processing plant, limited support from the Government, and weak extension system. The massive effect of the constraints mentioned above becomes the leading cause for Garlic production and marketed supply below the expected range. The lack of improved seeds becomes a bottleneck for increasing production and market supply of local seeds subject to diseases and pests. Even though the price of Garlic was on the rise, producers faced a lack of access to market information, and transportation constraints, to move Garlic from its production to the market. During COVID 19 pandemic, the amount of Garlic production was reduced related to movement restrictions, particularly for purchasing production inputs. It is considered as a negative impact of COVID 19 on Garlic value chain.

5.2. Managerial implication

This research aims to analyze the Garlic value chain, increase farmers' productivity, and improve their Garlic farm income by directly connecting consumers and other customers. The research finding advised that value chain analysis is a widespread concept it needs a systematic approach to deal with a single crop. Value chain processes could not be accomplished at the individual level, so activities or processes in the value chain should be undertaken by various interconnected actors either in the same function or in different value chain stages. There are three main categories of Garlic value chain actors practically engaged in the entire Garlic value chain. For the successful development of the Garlic value chain over the countries at the expected level, a strong network must be formed between each actor based on their role. Due to rampant population increment, urbanization, globalization, and periodic customer preference, the demand for processing products always rises. Nevertheless, Garlic value addition activities and the value-added product have been observed in a limited position in the study area. In filling the observed gaps, attention is needed to increase processing plants starting from small unit processing at the household level to the large-scale processing plants. Based on the researcher's observation, different efforts have not been made to bring improved Garlic seed varieties to the research area. Immediate alternative actions should be expected from concerned institutions, particularly agricultural office experts, research centers, and Universities.

6. Policy suggestion

Value chain analysis research is the most current approach used to identify and describe different value chain actors, activities, linkages, and opportunities and constraints that impede the value chain development and its sustainability. The current Garlic value chain research was intended to examine the abovementioned components. Based on the findings of this research, the following policy suggestions were made.

Libokemkem District is endowed in Garlic production. Farmers, extension workers, horticulturalists, and other concerned institutions need to motivate to increase its productivities and marketed supply. Various value chain actors are engaged in the Garlic value chain. The linkage that appeared between Garlic value chain actors are unexpectedly to be weak. It is suggested that firm interconnection with value chain actors is paramount for the mutual benefit gained from its performance outcome. The contribution of value chain supporters and enablers is valuable to help the primary value chain actors in the entire Garlic value chain. Hence, sustainable relationship is indispensable as well practitioners and policymakers adjust the working environment for its everyday achievement. The finding of this study revealed that direct linkage from producers to final consumers is the profitable path in which farmers generate sufficient profit from their farm business. To estimate the exact cost incurred by every value chain actor and the profit generated by them, every activity, cost, and profit should

be mapped in a sequential order then it can be visualized. Minimizing the number of actors between farmers and final consumers and controlling unfair profit captured by such actors should be the first focus of trade and marketing office/experts. The improved Garlic seed varieties' are neglected; consequently, Garlic production is going at a perpetual rate. The Researcher suggested that improved Garlic seed varieties, ways of production and postharvest handling practices specifically for Garlic products are required special care to ensure sustainable Garlic value chain development. In addition to many kinds of literature narrating about Garlic, the current study confirmed that Garlic has a highly marketable, medicinal, and daily consumable crop mainly in the study area; however, it has not been given particular focus by the local, regional, and country Government. This findings suggested that, periodic reports, and practical observation papers should be published and be available for readers/public. Many demographic, socio-economic, and environmental factors could affect the development of the Garlic value chain in the study area. To minimize the negative impact of those factors; holistic, hands-on training and alternative strategies need to be given to all value chain actors. In addition to these, several constraints that impede the Garlic value chain have been observed during the survey period: diseases, pests, postharvest losses, and drought, lack of improved seed, shortage of production inputs, and policy framework for price-setting are listed, among others. Since possible measures should be taken from each concerned individual and institution, this research is recent regarding the Garlic value chain, particularly in the study area; thus, the findings are contributed to extension workers, researchers, and policymakers. It has been used as a baseline for further research and policymaking decisions.

7. Conclusions

This study was mainly conducted on Value Chain Analysis of Garlic. There are many actors involved in the entire value chain. Some of them were input suppliers, producers, collectors, wholesalers, retailers, in a few numbers, local processors, chain enablers, and chain influencers. Along the value chain, various functions were undertaken by those actors, such as supply production inputs, production, collecting, storing, transporting, distributing, and marketing. Even though numerous value chain actors are involved in the Garlic value chain, it lacks integration between the actors. To share goods, information, and money, horizontal, vertical, backward, and forward linkage were made by Garlic value chain actors. Due to wholesalers having a sound capital position, they were the prominent governors of the Garlic market compared with other value chain actors. The Feasible General Least Square model result indicated that quantity of Garlic produced, land allocated for Garlic production, lagged market price, access to market information, Garlic production and marketing experience, the number of oxen owned significantly affected the market supply of Garlic positively. The amount of credit and gender of the household head significantly negatively affect the market supply of Garlic. The District's geographical location (naturally gifted), environmental condition, fertile arable land, irrigation water availability, and constant market demand for Garlic products, positive value chain environmental effect (there is no sever globalization and urbanization effects on Garlic value chain activities) identified as a significant opportunities for the Garlic value chain. The survey result showed that 96.4% of the respondents were interested in continuing Garlic production due to its valuable opportunities. Farmers in the study area were produced only local varieties, which made Garlic production detrimental. Research Centers, Universities, and NGOs still did not work well on introducing improved seed varieties into the Region in general and LiboKemkem District in particular. The significant Garlic value chain constraints were the traditional production approach, high production and marketing costs, diseases, inappropriate postharvest handling methods, and the absence of a processing plant. Introducing improved varieties can stimulate Garlic production. They strengthened local cooperatives that engaged in improved seed multiplication and supplied different production inputs to the Garlic producers. Allocating more land for Garlic production, access to market, and access to credit services help to enhance smallholders' Garlic producers' capacity to produce Garlic in the study area. It is

also essential efficient use of resources, promoting local cooperatives, and farmers' experience to assist farmers' production.

8. Limitations, remedies measure and future research

This research is subject to several limitations. The primary limitation of this research;

During data collection, most Garlic producers are not familiar with different words, even the concept of the value chain, value addition, and direct linkage to the farmers; as a result, researcher/data collectors had to repeat to the respondents several times. Focus group discussions look like a simple technique for gathering and triangulating the data, but the implementation can be complicated and time-consuming. Data about socio-economic position possibly would have been complex, especially for the actors, because they are afraid of the taxation system. Since socio-economic status is likely to be an essential determinant, this lack of information constitutes inadequacy of the study; it needed another indirect investigation. In the prior sample size determination phase, the researcher proposed 200 sample respondents. The sample size might not be small but inefficient; the numerical tests would not be able to identify significant relationships within the collected data set. Hence, the researcher determined and collected additional data from 200 sample respondents. After that, the sample size became sufficient. It could have generated more accurate results and valid conclusions were made.

Previously conducted literature (published) related to the current study area is relevant to confirming the current research findings and understanding the research problems, but no similar study was conducted in the area currently investigated. Due to this, the current research work initially lacks theoretical and empirical support. The researcher was forced to develop an entirely new research typology using an experimental research design intended to lay the groundwork using periodic reports and unpublished documents. However, they have accurate information, direct personal interviews, and physical observation in the field during Garlic production and the marketing process (exchange of Garlic between producers and actors, and consumers). It created a significant opportunity for the researcher to identify new gaps in the available documents and describe the need for further research.

Finding the respondents as a group was much more challenging during the survey. People lockdown and stayed in their homes because the period was during the expansion of the COVID-19 pandemic. Once COVID-19 outbreaks, the Government promptly enacted large-scale social distancing or lockdown policies (Thi et al., 2022). As a result, the research work has not been completed within a predetermined period (More time needed). The researcher employed one interviewer-one respondent door-to-door approach keeping distancing between two persons. One interviewer interviewed 10 people per day, which was a unique approach to gather quiet information and focus group discussion, which could be held after the COVID 19 pandemic reduced and people were stabled. Some studies were conducted in the study area for fruit and vegetables as a group, but no study was conducted for a single Garlic crop, even though Garlic has its own characteristics and many medicinal and economical values crop. Therefore, it hurts the current study finding to compare the existing literature.

Concerning model specification, first, the researcher employed the OLS model, but the researcher faced the heteroscedasticity problem. Furthermore, the researcher employed the FGLS model to give remedy that happened the problem using the OLS model. These constraints impact the research work taking more time for selecting another suitable model for correcting the problem was happened.

Future Research Work: Before entering to the research work, a critical investigation is expected from the researchers concerning the related published document or prior research done in the area of interest. Before selecting the model, deep analysis is required of the types of data to be used. This study was

undertaken in a single district; this makes it impossible to make generalizations at the country level, but Ethiopia has enormous potential in Garlic production, so it would be imperative to conduct similar study in other parts of the country in the same approach. Different factors are incorporated for future study that can help to add value to the raw Garlic product, give recognition by examining Garlic as a pure medicinal crop, and use it as a mechanism to reduce postharvest losses. This study released the opportunities for future researches. The value chain approach is very crucial for value chain study. The research touched on highlights for this study and did not profoundly use all the approaches. The future study will employ all value chain approaches to estimate unit and total cost and unit, and total profit of individual actors in the value chain.

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Author details

Gedefaw Kindu Wubet¹

E-mail: gedefawkindu2013@gmail.com

ORCID ID: <http://orcid.org/0000-0001-9218-4588>

¹ Department of Agricultural Economics, Debre Tabor University, Debre Tabor, Ethiopia.

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Note

1. Explain this; one *timad* is equivalent to 0.25 hectares.

List of Abbreviations

ACSI	Amhara Credit and Saving Institution
BDU	Bahir Dar University
COVID	Coronavirus Disease
DA	Development Agent
DoAR	District Office of Agriculture and Rural Development
DTU	Debre Tabor University
FAO	Food and Agricultural Organization
FAOSTAT	Food and Agricultural Organization Statistical database
FGLS	Feasible General Least Square Model
HH	Household
ITC	International Trade Center
LDARO	Libokemkem District Agriculture and Rural Development Office
LKAACO	Libo Kemkem Agricultural and Communication Office
OLS	Ordinary Least Square
NGO	Non-Governmental Organizations
Qt	Quintal
RUSACO	Rural Saving Association and Cooperative
UoG	University of Gondar
VIF	Variance Inflation Factor

Disclosure Statement

No potential conflict of interest for this research work

Authors' Information

Gedefaw Kindu Wubet: He is ahead of the Agricultural Economics department and a lecturer and researcher at Debre Tabor University. Wubet obtained his bachelor's and master's degrees at Jimma and Hara may University. He carried out different research activities in agricultural marketing, value chain analysis, commercialization, and related socioeconomics studies.

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