STATUS OF FARMERS' GARLIC MARKET CHANNEL CHOICES IN RESPONSE TO GARLIC VALUE CHAIN IN LIBOKEMKEM DISTRICT, SOUTH GONDAR ZONE, ETHIOPIA

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Abstract
This research was conducted to identify the key market outlets and their determinants. Primary data was collected from 400 garlic producers, 37 traders, and 12 consumers. Collectors, wholesalers, retailers, and consumers' marketing channels were identified. Of these, wholesalers were the preferred market channel by 93.75% of garlic producers. The results from a multivariate probit model showed that lagged price, experience, quantity produced, land allotted, education, sex, oxen, and market information influence garlic producers' market outlet choice decisions. The study suggested that garlic producers need to be supported to select the right market-place for maximizing their farm profit.

Keywords

Introduction
Ethiopia is known for producing various vegetable crops in different agroecological areas. Vegetables are indispensable horticultural crops, from their roles in people's health to overcoming economic setbacks in food insecurity and poverty reduction. Create new market prospects that, in turn, can provide income and employment opportunities in different functions of its value chain [1,2].

As a result of its excellent market value, the production and commercialization of vegetal produce with rotation in pulses is increasing. Allium Sativum L (Garlic), along with onion, is a unique commercially significant vegetal produce grown aimed at family use, sale, nourishment treating, and enhancement in the form of oil, minerals, or powder [3]. As China (66%) led garlic production, followed by South Korea and India (5% each), Ethiopia ranked 12th, 17th, and 10th in terms of production, productivity, and area coverage correspondingly [4]. Ethiopia has great potential in garlic production and marketing. Ethiopia's low-land and mid-highland parts are particularly suitable for garlic production. Amhara Region ranks first, followed by Oromia and South Nations and Nationalities and peoples Region of Ethiopia in garlic production reported in 2018's Ethiopian central statistical agency [3]. The South Gondar Zone is endowed with vegetable production, of which onions and garlic are the main crops in this zone. In the 2021 production year, 280,216.8 tons of garlic were produced in rain feed and irrigation systems. In the same production year, 31,135.2 tons of garlic were produced in the current study area.

Irrigation system-based garlic productions seek improvement in size compared to an onion. However, the crop can be grown in rain-fed and irrigation systems using water pumps and river diversions. The product is supplied to the market right in the field, nearby, distant markets [5].

Garlic feels a unique flavour, and its processed items are used in sauces, soups, and seasoning foods through

grinding, cutting, or crushing. In the south Gondar Zone of the Amhara Region, Libokemkem, Dera, and Fogera are potential producers of vegetable crops. At the same time, garlic is cultivated in Libokemkem, which lets us focus on its value chain and market channel choice here. As it is a crucial cash crop in the district, it is grown from June to July and collected in October, and soon the area will be covered in chickpea. In addition, irrigated garlic is planted in November once cereals such as *tef* and maize are grown from May to October are harvested [6].

Market chains are essential components in the transformation of traditional hand-to-mouth agriculture to market-oriented agriculture. Markets play a vital role in bringing welfare for each market actor by choosing the one with a relative advantage [7]. The exploitation of this opportunity by farmers requires access to the product markets. In contrast, these markets may have a variety of integrations in passing garlic over some value additions [7,8].

Market chains of garlic consider production, distribution, processing activities, and marketing while the farmers sell their produce to local traders and agents. Even though they have the potential for high garlic production, farmers have limitations in identifying and supplying their products to the appropriate outlet. Farmers are restricted in farm gate markets as factors like market information, market access, distance to the market, bargaining power, lack of infrastructure, and appropriate handling [1,8]. There is a lack of market-led technologies at the farm gate as production is fragmented, and quality is not due. Besides, cleaning, sorting, grading, and storage facilities are negligible. Despite the increased input costs, other active value chain actors, such as brokers, transporters, processors, and traders, not farmers, have benefits [9]. Market outlet choice is not a simple duty. Its general notion is the decision to supply one product in various market channels with high margins [10]. It takes farmers' winning strategies set up, assessing the options of the garlic market among alternatives, and selecting the central market channel that increases the bargaining power of farmers to meet their expected benefit [11].

Accordingly, there are some related studies on market outlet choice [12]; on dairy farmers' markets [7,11]; on the wheat market [8,13]; pineapple farmers [10] and haricot bean market [1]. The market impact on channel choices on smallholder vegetal producers' revenue and production in the Tana Lake basin was also investigated. Simultaneously [14], had similar works in the Fogera district on onion market outlet choice determinants. However, these studies focused on identifying factors affecting specific product-market outlets though none of them tried to look at the garlic market. Like cereals, there is wide-ranging vegetable production in the South Gondar Zone. According to the report of the zone agriculture office, garlic is one of the important vegetable crops produced widely. However, there is no infrastructure, information, marketing, processing, price stability, and postharvest facility. Particularly in Libokemkem, which is the best in production potential in the zone, besides the above limitations, there is a high loss of returns when it is possible to achieve the maximum one since they do not even assess the profitable market outlet. It is believed to have happened because there is no well-documented information and continuous awareness creation for farmers in the area. Other chain actors, especially brokers, overact in the garlic market chain. Small-scale producers must choose great-value markets, for example, distributing and processing [13]. Thus, this study aims to assess factors affecting specific market outlets and the outlet(s) that generate the best margin for producers as the product passes the number of stages through processing and value additions in the market chain. This study can bring a significant role in improving farmers' income, welfare, and the general agricultural transformation; it shows clear directions of which market to participate in; whom actor to integrate; which market outlet to choose, and what postharvest technology to be applied for the long life of the produce.

The importance of conducting this research: The analysis of garlic product marketing channel decisions is just as significant as garlic producers' decisions about product features and prices. Traders and other farmers promote and sell a garlic product as it moves through its channel to its final user, depending on accurate channel selection. Choosing the proper marketing channel is crucial since it can determine whether a producer's product succeeds or fails. The kind of consumer to whom a garlic producer sells will affect the distribution channel they choose, and it should be their primary concern. It is also essential to consider the critical marketing channel functions while looking at the garlic market channel, which include Gathering and distributing information, setting up contacts and matching products to buyer's needs, negotiating prices, and paying the costs of channel activities, and physical delivery of products through the chosen channel are all part of the marketing channel selection process.

Method of research

The Study Area Description: The research was conducted in the Libo Kemkem District of the Amhara Region's South Gondar Zone. This district is in the middle of $12^0 39'66''$ and $12^0 42'45''$ N latitudes and $37^0 26'99''$ and $37^0 28'42''$ E longitudes. The district is surrounded in the West by Lake Tana, in the East by the East Ebenat, in the south by the Reb, which separates it from Fogera, and in the North by the North Gondar Zone.

The district is located 645 kilometres away from Addis Abeba and 70 kilometres away from the Reginal city of Bahar Dar, as shown in Figure 1. The district has a total area of 1,292.72km^2 and comprises 33 rural and two urban Kebeles. Of the total population found in the district (225,499), 149,709 garlic producers with two types of garlic production practices, namely rain and irrigation systems.
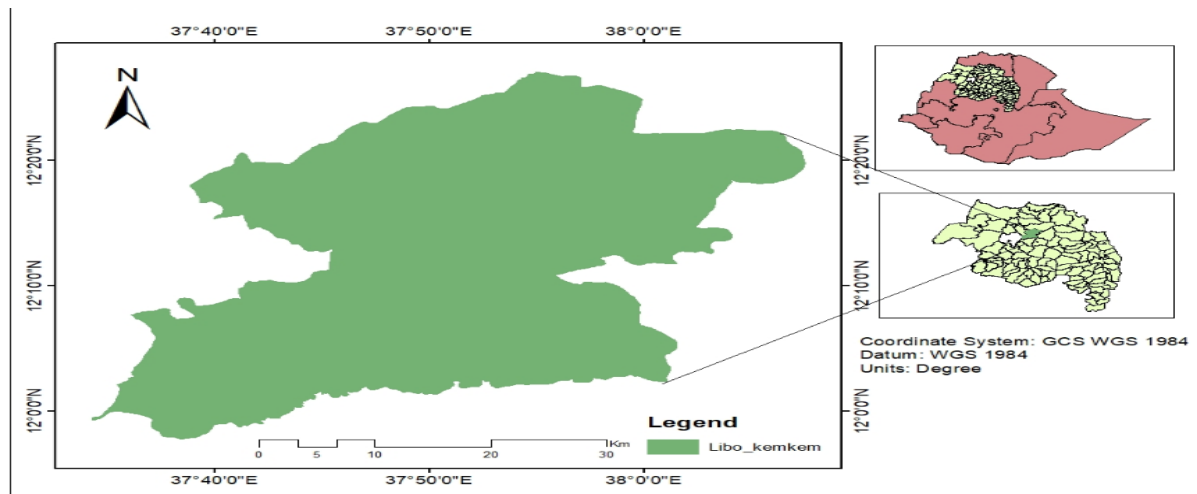

Figure 1. Location Maps of Libo Kemkem District. *Source: Arc GIS result, 2021.*

The district's elevation ranges between 1025-2960 meters above sea level. A rough topography includes elevations, heaving plains, and basins describing the study District. Only 42.12 % of the total area in the district is plain, with a 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. Due to altitudinal variations, there are three agro-climatic Zones in Libo kemkem District: Dega, Weynadega, 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 980-1700mm, with a regular of 1100mm and a mono modal trend from July to September. The maximum annual average temperature is 35 ° C and 16 ° C, respectively [15].

Garlic Production Trend: The District was selected purposively; because it is the potential area for garlic production, as shown in Figure 2.

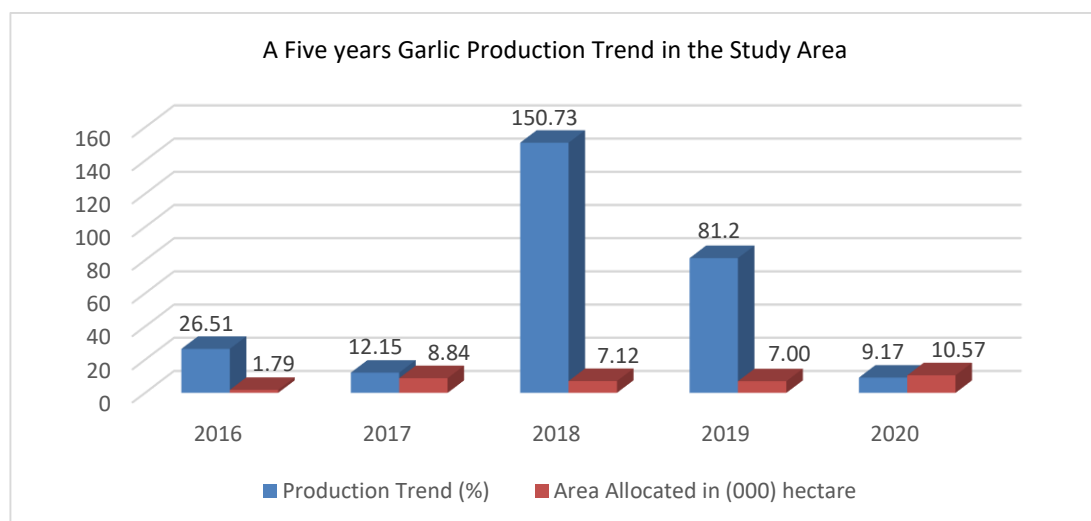Figure 2. Garlic Production Trends in the Study Area. *Source: LDACOYYR, 2021.*

*Note: LDAOYR=Libokemkem District Agricultural Crop Office Year to Year Report.

Sample Size Determination and Sampling Procedures
To gather the primary data, a third-step random sampling procedure was used. Libo kemkem District was selected in the first stage based on its high garlic production potential. In the 2nd stage, five garlic-producing

kebeles were selected with simple random sampling. The sample households were chosen randomly from the sample kebeles' household list in the third stage based on the likelihood proportionate to the size of each kebeles' population. The total sample size was calculated using the [16] sample size determination procedure, which took into account a 95% confidence level, a 5% amount of variation, and a 6% precision degree to arrive at the appropriate sample size. The formula used to calculate and determine the sample size is:

(1)
$$n = \frac{N}{1 + N(e)^2}, n = \frac{52,654}{1 + 52,654(0.05)^2} = 398 \; but \; we \; took \; 400$$

Where: n designates sample size; N designates population size of the garlic producer Kebeles and e designates the degree of precision considered. The sample size for consumers, retailers, wholesalers, and collectors was also calculated for this study based on the number of traders established in the district, as indicated in Table 1.

Table 1. Sample Distribution of traders and consumers of garlic in the study area.
Source: Own computation Survey, 2021

Traders	Adiszemen	Yifag	Woreta	Total
Collectors	4	1	1	6
Wholesalers	22	1	3	26
Retailers	3	1	1	5
Consumers	7	2	3	12
Total	30	7	12	49

Data Type, Sources, and Collection Method
Primary data are gathered from starting producers and traders at various stages through a household questionnaire survey using structured questionnaires with both open-ended and closed-ended questions, concentrated on determinants influencing the market outlet choice. The questionnaires were pre-confirmed by rough producers in respective kebele during the preliminary survey, and after feedback, it was modified. Enumerators were trained on data collection, interviewing techniques, and how to approach respondents. A focus group discussion was made with the key actors using checklists. There were also individual annotations and collection meetings through chosen producers and agents. Secondary sources were used to gather secondary data.

Data Analysis
Descriptive statistics and econometric models were employed for data analysis.

Econometric Model
A variety of binary outcome/multivariate outcome models are applied to study two or more dependent variables and independent factors. The most popular models are mentioned below. Multinomial logit, Multinomial probit, and multivariate probit.

The multinomial logit model was used by several researchers [17–20]. However, the multinomial logit model employed for an outcome is nominal when the categories are supposed to be unordered. It is the most used nominal regression model. The main challenge in using this model comprises many factors, and it is easy to be overwhelmed by the complication of the results. The multinomial logit model assumes that data are case-specific; each independent variable has a single value for each case. It is also supposed that the dependent variable cannot be dreamily anticipated from the independent variables for any case.
The multinomial probit model uses discrete dependent variables that take on more than two outcomes that do not have a natural ordering. For this model version, the stochastic error terms are assumed to have independent, standard normal distributions. Researchers must have one observation for each decision-maker in the sample to employ the multinomial Probit model. As a result, most researchers did not use this model frequently. Numerous studies use the multivariate probit model to determine the factors influencing the market outlet choice of the given commodity. It was agreed that in the current research areas, sampled garlic farmers

have more than two market outlet options. The multivariate probit model is a generalization of the probit model, which is used to estimate many correlated binary outcomes jointly. It has more than two choices or allows simultaneous choosing multiple responses; it provides cross-effects and coincidences [21]. The researchers used the MVP (multivariate probit) model to estimate the choice factors of the garlic market outlet. The multivariate probit model was appropriate and used in the data of the current investigation to solve the drawbacks of the other models discussed above. The data was examined and found to be normally distributed. As a result, a multivariate probit model was used to investigate the factors influencing the choice of garlic marketing outlet in the research area. The choice of one type of market outlet depended on the choice of the other since smallholder farmers' decisions are interdependent, implying the need to estimate them simultaneously [22]. For household variation in market outlet choice and to estimate numerous correlated binary outcomes simultaneously, the multivariate probit model (mvprobit) was used. The multivariate probit method simulates the effect of a collection of independent variables on market outlet selection while also considering associations among unobserved disturbances and the linkages between market outlet choices. The observed result of market outlet selection can be modelled using a random utility formulation. Ponder the small holding producer (i=1, 2, ..., N), which must decide whether to use accessible outlets of the market. Let U_0 signify the profits to the producers who select wholesalers, and let U_k signify the advantage of the producer to choose the Kth outlet of the market: where K signifies the option of collectors (Y_1), wholesalers (Y_2), retailers (Y_3), and consumers (Y_4) and Y_n. The producer selects the Kth outlet of the market

(2)
$$Y_{ik}^* = U_{ik}^* - U_o > 0$$

The take-home advantage (Y_{ik}^*) that the producer comes from selecting a market outlet is a concealed variable determined by the perceived independent variable (X_i) and the error term (ε_i):

(3)
$$Y_{ik}^* = X_i\beta_k + \varepsilon_i, k = (Y1, Y2, Y3, Y4, \dots, Y_n)$$

The unobserved preferences in equation (2) are translated into the detected binary outcome equation for each option with the indicator function as follows:

(4)
$$Y_{ik} = \{1 \; if \; Y_{ik}^* > 0 \quad and \; Y_{ik} = \{0 \; if \; Y_{ik}^* \leq 0 \; (K = Y1, Y2, Y3, Y4, \dots, Yn)$$

The multivariate approach allows for the selection of multiple market outlets; the error terms follow an MVD (multivariate normal distribution) together having a conditional mean of zero and a variance of one (for empathy of the parameters) where ($\mu_{y1} \mu_{y2} \mu_{y3} \mu_{y4}$) MVN ~ (0, Ω) as well as the symmetric covariance matrix is specified by:

(5)
$$\begin{matrix} 1 & \rho y_1 y_2 & \rho y_1 y_3 & \rho y_1 y_4 & \rho y_1 y_n \\ \rho y_2 y_1 & 1 & \rho y_2 y_3 & \rho y_2 y_4 & \rho y_2 y_n \\ \rho y_3 y_1 & \rho y_3 y_2 & 1 & \rho y_3 y_4 & \rho y_3 y_n \\ \rho y_4 y_1 & \rho y_4 y_2 & \rho y_4 y_3 & 1 & \rho y_4 y_n \end{matrix}$$

Off-diagonal components in the covariance matrix are interesting because they illustrate the unobserved association among the stochastic components of the various kinds of outlets. Because of this assumption, equation (4) provides an MVP (multivariate probit) model that depicts the decision to choose a specific market outlet. This specification allows for correlation between error terms of numerous latent equations, stating unobserved characters that influence the choice of alternate outlets. After that, the log-likelihood function connection for a sample outcome is specified by:

(6)
$$lnL = \sum_{i=1}^{N} \omega i ln \Phi(\mu i, \Omega)$$

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

(7)
$$\mu i = (k_{i1} \beta 1 X_{i1}, K_{i2}\beta_2 X_{i2}, K_{i3}\beta_3 X_{i3}), while \; \Omega_{ik} = 1 \; for \; j = K$$

(8)
$$\Omega_{jk} = \Omega_{kj} = K_{ij}K_{ik}\rho_{jk} \; for \; j \neq K, K = 1,2,3 \ldots \ldots \ldots with \; K_{ik} = 2yi_k - 1$$

Results and discussion

Statistical Descriptive Result of the Collected Data

The respondents' average age was 46.44, and they had been producing garlic for 23.48 years. The mean land allocation was 0.9 hectare, of which 0.34 hectare was irrigable land. The average annual garlic produced by sample farmers with a standard deviation of 3.54 was 11.27 quintals ranging from 4 to 20 quintals. Sample households located 9.45 kilometres away from the district market Table 2.

Table 2. The demographic and socioeconomic characteristics of the sampled households (continuous variables).
Source: Own Analysis 2021

Variables	Mean	Minimum	Maximum	S.D
Households' average age (in year)	46.44	24	80	11.97
Experience of the household head (in year)	23.48	2	52	11.47
Total land size holding of the household (in hectare)	5.9875	2	12	1.55
Total land allocation for garlic production (in hectare)	3.5765	1	6	1.32
Total irrigable land owned by households (in hectare)	1.34905	0.5	4	0.68
Number of total garlic produced (in quintal)	11.27075	4	20	3.54
Distance to the district market (in kilometre)	9.4475	2	18	3.76
Distance to the development centre (in kilometre)	4.56375	1	15	2.07

SD = standard deviation

From the result, the researcher confirmed that garlic production shows a positive status, which is a driving factor in the development of the garlic market. Garlic producers have extensive garlic production and marketing experience. It makes them sophisticated and decisive for the proper market selection. From the total sample, 96% of the respondents were male-headed, and 96% had access to market evidence. Their primary sources were family, friends, different traders, and through self-visiting and using mobile phones (65.25% of the respondents had their mobile phones) and other sources of information. With 1% and 5% significant levels, there was a significant mean difference between each kebele regarding non/off-farm income, access to market information, and mobile phones. Of the total respondents, 89% have access to credit, which has significant value in each kebele Table 3.

Table 3. Demographic and socioeconomic characteristics of the sampled households (dummy variables).
Source: Own Analysis 2021

Variables	List of Kebeles in the Selected District												X2- value
	Shewoch Tera		Gizana		Angote		Yifag		Birra		Total		
Sex of the hh (%)	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	11.33*
Male	79	98.75	79	98.75	76	95	72	90	78	97.5	384	96	
Female	1	1.25	1	1.25	4	5	8	10	2	2.5	16	4	
Access to Market Information (%)													36.04***
Yes	61	76.25	46	57.5	77	96.25	66	82.5	61	76.25	311	77.75	
No	19	23.75	34	42.5	3	3.75	14	17.5	19	23.75	89	22.25	
Access to Irrigation (%)													4.21
Yes	75	93.75	79	98.75	75	93.75	77	96.25	74	92.5	380	95	
No	5	6.25	1	1.25	5	6.25	3	3.75	6	7.5	20	5	
Access to Non/Off-Farm Income (%)													23.3***
Yes	46	75.5	42	52.5	37	46.25	18	22.5	36	45	179	44.75	
no	34	42.5	38	47.5	43	53.75	62	77.5	44	55	221	55.25	
Access to Mobile Phone (%)													38.2***
Yes	45	56.25	36	45	16	20	14	17.5	28	35	139	47.75	
No	35	43.75	44	55	64	80	66	82.5	52	65	261	65.25	
Access to Credit (%)													27.5**
Yes	56	70	52	65	45	56.25	54	67.5	60	75	267	66.75	
No	24	30	28	35	35	43.75	26	32.5	20	25	133	33.25	

χ2 =Chi square test

Of the total sample respondents, more than 95% are informed about marketing features through various sources of information. It implies that garlic producers are determining profitable marketing outlets for their products. Given that access to credit, with its significant figure, indicates that farmers have the best room to select and determine their best marketing option from the given alternatives, they must use it.

Of the respondents, 20.50% were illiterate, 41.75% read and write, 17.75% of primary school (1-6), 12.75% were from secondary school (7-12), and 7.25% had a certificate above. 97% of farmers confirmed that the trend of garlic production for the last four years was increasing. The primary source of credit was regional credit and saving institutions. In the case 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. With the 1%, 5%, and 10% significant levels, there was a significant mean difference between each sample kebele in terms of the number of extension contacts, education level, mode of transportation, marketplace accessibility, and the price trend of garlic over the last four years Table 4.

Table 4. Demographic and socioeconomic characteristics of the sampled households (categorical variables).
Source: Own Analysis 2021.

| Variables | List of Kebeles in the Selected District | | | | | | | | | | | | X² |
	Shewoch Tera		Gizana		Angote		Yifag		Birra		Total		
Education Level (%)	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	32.43**
Illiterate	18	22.5	16	20	13	16.25	17	21.25	18	22.5	82	20.5	
read and write	43	53.75	21	26.25	33	41.25	42	52.5	28	35	167	41.75	
primary school (1-6)	8	10	17	21.25	18	22.5	14	17.5	14	17.5	71	17.75	
secondary school (7-12)	5	6.25	19	23.75	10	12.5	4	5	13	16.25	51	12.75	
certificate and above	6	7.5	7	8.75	6	7.5	3	3.75	7	8.75	29	7.25	
Number of Extension Contact (%)													52.26***
Weekly	63	78.75	71	88.75	44	55	60	75	48	60	286	71.5	
once in two Week	7	8.75	5	6.25	6	7.5	15	18.75	11	13.75	44	11	
Monthly	10	12.5	4	5	30	37.5	5	6.25	21	26.25	70	17.5	
Means of Transportation (%)													25.61*
Workforce	7	8.75	7	8.75	0	0	0	0	0	0	14	3.5	
back animals	32	40	35	43.75	35	43.75	36	45	34	42.5	172	43	
Vehicle	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	56.3	41	51.3	44	55	206	51.5	
The Trend of Garlic Production (%)													11.18
Increasing	77	96.25	78	97.5	77	96.25	77	96.25	79	98.75	388	97	
Decreasing	2	2.5	2	2.5	0	0	3	3.75	0	0	7	1.75	
both increasing and decreasing	1	1.25	0	0	3	3.75	0	0	1	1.25	5	1.25	
Sources of Credit (%)													17.88
ASCI	75	93.75	76	95	78	97.5	80	100	75	93.75	384	96	
Cooperative	1	1.25	1	1.25	0	0	0	0	1	1.25	3	0.75	
governmental banks	4	5	3	3.75	0	0	0	0	4	5	11	2.75	
private banks	0	0	0	0	2	2.5	0	0	0	0	2	0.5	
Market Place Accessibility (%)													197.1***
Addis Zemen	63	78.75	80	100	8	10	18	22.5	25	31.25	194	48.5	
Yifag	13	16.25	0	0	58	72.5	50	62.5	38	47.5	159	39.75	
Woreta	4	5	0	0	14	17.5	12	15	17	21.25	47	11.75	
The trend in the price of garlic during the last four years (%)													22.74**
Increasing	78	97.5	78	97.5	71	88.75	79	98.75	79	98.75	385	96.25	
Decreasing	2	2.5	2	2.5	9	11.25	0	0	1	1.25	14	3.5	
both increasing and decreasing	0	0	0	0	0	0	1	1.25	0		1	0.25	

χ2 =Chi square test

Education is the main ingredient that helps to decide on any issue appropriately. Of the total sample of farmers, more than 40% of them can read and write. Having this confirmation, garlic products' production and commercialization are undertaken systematically for the achievement expectation profit of farmers.

Garlic Market Channel

The sample households were interviewed about the types of the market channel they preferred to sell their garlic production based on accessibility and maximum profit received. Therefore, they responded that they used different market channels to sell their garlic production. These marketing channels were listed collectors, wholesalers, retailers, and consumers. Those marketing channels are primarily preferred in mixing and separately.

As compared with the market channel of garlic products [23], confirmed that wholesalers, collectors, retailers, and consumers received the majority of the tomato product [17]; found that wholesalers, collectors, retailers, and consumers are the main marketing channels for a vegetable product similar to the current garlic marketing channel; in supporting the current garlic marketing channel [24], initiated that wholesaler, cooperatives and collectors are the significant market outlet for sesame product [19]; stated that consumer market channel is the primary market for vegetable producers in their study area. The current study identified that marketing

Out of these four main market channels preferred by households, wholesalers were the preferred market channel by 93.75% of the garlic producers' households [18]. The wholesale market channel is the main influential marketing channel for vegetable products in their research area. The second most marketing outlet was the collectors, preferred by 65.25% of garlic producers' households; the third and fourth marketing channels were retailers and consumers were preferred by 57% and 40% of garlic producers' households, respectively, as presented in Table 5.

Table 5. Garlic farmers favoured the following four main marketing channels.
Source: Own Analysis 2021

Market Channel for Garlic								
Channel Selection by the Household	Collectors		Wholesalers		Retailers		Final Users/buyers	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	261	65.25	375	93.75	228	57	240	60
No	139	34.75	25	6.25	172	43	160	40
Total	400	100	400	100	400	100	400	100

%=indicate percent

Farmers demanded to sell large quantity products and make a mass profit at one time. Wholesalers buy a more significant amount of product from the four main market outlet options and provide acceptable profit for sellers. As a result, garlic producers are the preferable outlet option. Compared to the current study of marketing channels conducted in Ethiopia, wholesalers and retailers are the main identified market channels for garlic products in the Madhya Pradesh [25]; In addition [26], Identified wholesalers, retailers, and consumers' marketing channels are as a critical marketing channel during their investigation of the market efficiency of garlic crop in Bangladesh. Wholesalers and processors are the main marketing channels for garlic products in Tanzania [27].

The Factors Influencing Market Outlet Selection shall be underlined for consistency.

Table 6. Determinants Influencing Garlic Producers' Market Outlet Selection.
Source: Own Analysis 2021.

Covariates	Collectors		Wholesalers		Retailers		Final Users/buyers	
	Coef.	SE.	Coef.	SE.	Coef.	SE.	Coef.	SE.
_cons	-1.51*	0.84	0.81	1.36	-2.56**	0.84	-0.86	0.84
Qtygp	0.107***	0.04	-0.12*	0.06	0.205***	0.04	0.151***	0.036
Fextc	-0.06	0.09	0.11	0.15	-0.12	0.09	-0.24***	0.09
Landing	-0.09	0.07	-0.20**	0.10	-0.09	0.06	-0.03	0.07
Acredit	0.00	0.00	0.00	0.00	0.00	0.00	-4.95e-06	0.00
Lapric	0.0001*	0.001	0.00	0.00	0.00	0.00	-0.00	0.00
Acmarkt	-0.378**	0.158	0.295	0.248	0.14	0.154	0.003	0.16
Mdist	-0.027	0.020	0.021	0.029	-0.029	0.020	0.008	0199
Expr	0.006	0.006	0.021**	0.010	0.023***	0.007	0.027***	0.007
Edu	0.151**	0.063	-0.077	0.095	0.073	0.062	0.186***	0.063
Oxen	0.065	0.096	0.060	0.144	-0.283***	0.095	-0.174*	0.097
Sex	-0.602**	0.272	0.239	0.361	0.330	0.248	0.117	0.245
Income	-0.180	0.145	0.262	0.228	-0.141	0.142	0.207	0.144

Note: Statistical significance is indicated by ***, **, and * at 1%, 5%, and 10%, correspondingly. Coeff – Coefficient, SE - standard error.

Predicted probability   = 60.0   93.7   65.3   56.9 gap is needed

That means garlic producers have a 60.0% probability of selecting collectors market outlet, 93.7% probability in selecting wholesalers market outlet, 65.3% probability in selecting retailers market outlet, and 56.9% probability of selecting consumer market outlet. It is the exact probability value computed from the fitted data.

Joint probability (success) =23.61% and joint probability (Failure) =0.15%
Number of draws =5, Observation =400, and Log Likelihood= -739.43387
Wald chi2 (χ2) (48)   = 256.52, and Prob > chi2 (χ2) = 0.0000***

Matrix for expected association =,
/atrho21. -.255, /atrho32. -.156
/atrho31. -.033, /atrho42. .058
/atrho41. -.269, /atrho43. -.164
rho21 = rho31 = rho41 = rho32 = rho42 = rho43 = 0: Likelihood ratio test
Chi2 (χ2) (6) = 18.6218,   Prob > chi2(χ2) = 0.0049.

The data finely explained by the model as the Wald (χ2) (48) =256.52 value indicates, that Prob > chi2=0.0000 was significant at the 1% significance level, indicating that the model subcategory of coefficients is jointly significant, and that the independent variable's explanatory power is sufficient. Moreover, the model's likelihood ratio test results chi2 ((χ2) (6) = 18.6218,   Prob > chi2 (χ2) = 0.0049. at a 1% significance level, it is statistically significant. This showed that the disturbance term's reliance (independence of market channel select) is ruled out, and strong joint correlations for two expected coefficients across the model's equation. The likelihood ratio test of null hypothesis of the independence between market channels select choice (rho (ρ)21 = rho(ρ)31 = rho(ρ)41 = rho(ρ)32 = rho(ρ)42 = rho(ρ)43 = 0: is significant at 1% level of significant. As a result, the null hypothesis that all rho (ρ) values are mutually equal to zero (0) is rejected; this indicates the model's goodness of fit. As a result, the likelihood ratio statics represent disparities in market outlet selection behaviour among garlic producer farmers. When viewed separately, the ρij values reflect the degree of correlation between each pair of dependent variables. The ρ31 association between collector channel and retailers' channel and the ρ41 association between collectors' channel and consumer channel are positively dependent and significant at the 1% significance level, which indicates a good association between collectors' channels and retailer channels and collectors' channel with consumer channel table 6 above. In the study district, garlic producers in marketing used retailers' channels to replace collectors' channels and consumers' channels to replace collectors' channels.

According to the simulation results, garlic producers are more likely in select collectors, wholesalers, retailers, and consumer market channels, as the value showed 60.0%, 93.7%, 65.3%, and 56.9%, respectively. When compared to the probability of preferring collectors' market outlet option (60.0%), the likelihood of choosing consumers' market outlet option is low (56.9%), wholesalers' market outlet option (93.7%), and market channel choice for retailers (65.3%). There is good evidence to recommend that the availability and probability of consumer market options is a dare. Producers were interested in preferring the wholesale market option compared to other marketing options. Households are more likely to select the four-market outlet option jointly based on the combined likelihood of success or failure of preferring the four-market outlet option. The possibility that households will mutually choose the four market outlets option 23.61% is better than their failure to prefer them (0.15%) jointly. From twelve independent variables in the multivariate probit model, five variables significantly affect collectors market outlet; at the 1%, 5%, and 10% levels of significance, three covariates significantly influence wholesalers market outlet, three covariates significantly influence retailer market outlet, and five covariates significantly influence consumer market outlet. Quantity of garlic production (Qtygp): The results show that the quantity of garlic produced has a statistically significant positive impact on the probability of selecting a collector, retailer, and consumer market outlet at a 1% significance level, as well as it has a statistically significant adverse impact at a 10% significance level on wholesalers' market outlet selection. It means that the more garlic a farmer produces, the more likely he or she is to sell to collectors, retailers, and consumers and less likely to sell to wholesalers. The positive coefficient also suggests that households are becoming more connected to three market channels (collector, retailer, and consumer). Farmers who sell their products to three market outlets can generate a more significant profit margin. Similarly to this finding [28], stated that the number of groundnuts produced positively and significantly impacts the chance of choosing the outlets in the wholesale and retail market [29]. Also, conclude that the volume of tomatoes produced significantly influences farmers' market channel choice.
Sex of households (Sex): At a 5% significance level, the sex of the households was adversely and significantly related to the collector outlet. It implies that being male is not guaranteed to sell their garlic to the collector market. As a result, while most females are faster than males, males had fewer opportunities to sell garlic to various market outlets. In contrast to this finding [30], the probability of a collector market outlet is strongly influenced by the gender of the households [31]. Furthermore [32], reported that the sex of the households significantly affects the decision to choose the market channel of households. Household Education Level (Edu):

At a significant level of 5 and 1%, household education has a positive and significant effect on the probability of collector and consumer market outlets, respectively. Because more educated farmers have become information seekers than non-educated farmers, they are more likely to sell garlic to collectors and consumers. This finding is supported by [33], The educational status of the household head had a substantial impact on collectors and consumers' market outlets. In addition [29,32] confirmed that households' education significantly affects the decision about the choice of the market channel of producers.

Farming Experience (Exper): At 5% and 1% significance levels, agricultural experience had a positive and substantial impact on the chance of choosing a wholesaler, retailer, and consumer market outlet. This study revealed that more experienced garlic producers were likelier than less experienced farmers to deliver garlic to wholesalers, retailers, and consumer outlets. Farmers who have been active in garlic production and selling for a long time want to change their market links to various market outlets, searching for innovative marketing avenues to boost sales or get better prices to maximize farm profits. The link also suggests that more experienced farmers were more knowledgeable about the costs and benefits of various garlic marketing options. Similar to this finding [29,31] conclude that farming experience significantly influences the market channel choice of farmers. Opposing these findings [30], the chance of choosing wholesalers and retailers' market outlets is negatively influenced by the farming experience. Lagged market Price of garlic (Lapric): At a 10% level of significance, lagged market price is positively and strongly associated with selecting a collector's market outlet. Farmers were more likely to sell garlic to collectors' market outlets since the lagged price of garlic was satisfactory, which has a positive sign. It may be because the collector outlet is nearby the farmer's living place and offers a high price for garlic products compared to another outlet, which encourages farmers to choose collector outlets. Therefore, market outlets that offered high prices for garlic last year induced farmers to supply more garlic volumes to the collector outlet [32]. Confirmed that lagged price significantly affects the market channel choice decision of producers.

Land Allocated for garlic Production (Landag): At a 5% level of significance, farmers who allotted more significant acreage for garlic production were negatively and noticeably associated with wholesalers' outlets. As a result of this finding [31,32] found that the proportions of allotted households' land impacted the chance of choosing wholesalers' market outlets. A farmer with a large amount of land allotted for garlic production would likely sell a smaller number of garlic to wholesalers than a farmer with a small amount of land allotted for garlic production, as indicated by the negative sign on the land-allocated covariate [34].

Extension contacts frequency (Fextc): At a 1% significance level, the number of extension contacts negatively and significantly impacts customer outlet choice selections. Households with more visits with extension agents were less likely to deliver garlic to consumer outlets than those with fewer visits. Extension contact allows farmers to improve their production practices, resulting in increased production, which is more likely to sell to collectors, wholesalers, and retailers' outlets than consumers' outlets [31]. Furthermore [30] conclude that access to an extension contact considerably impacts the outlet choice. Market information access (Acmarkt): At a 5% significance level, market information access harms collectors' channel choices. In the research area, households accessing market information reduce the likelihood of preferring a collector market outlet by 37.8%. It means that the more market information/knowledge a household has, the better they are to choose wholesalers' market outlets for bulk selling and retailers' and consumers' market channels for maximum revenue. According to this finding [34,35] market information access has a substantial and negative impact on the selection of the agricultural farmers' market outlets. Number of Oxen owned (Oxen): At 1% and 10% levels, the ox owned has a negative and significant impact on the likelihood of choosing retailer and consumer market channels. It means that when the number of oxen held by households' increases, the likelihood of preferring a retailer and consumer market channel becomes taken down, and they may be able to produce more garlic. They have a chance to select collectors' and wholesalers' market channels. Moreover, many factors influence the producers' choice of outlet: the major ones are the absence of constant market preference, mediocre quality management, minimal product value addition, and lack of trade regulatory framework for all actors, especially for farmers.

Impact

The impact of the present work broadly discusses the status of farmers' market channel choice in garlic product evidence from farmers' market preferences. Conducting a market channel analysis encourages garlic producers to consider how the value and price of the product add to their final product or service and to select a more efficient market with a lower cost-optimized marketing approach to maximize output/profit and minimize marketing cost—measured and interpreted the profitability and sustainability of garlic products for all actors directly involved in garlic production and marketing. Generation through direct value-added and profitability

indicators, and income distribution, can be calculated. Gathering Information on the amount of garlic sold/purchased, the price offered by each market channel, marketing approach, time of sale, and profit margin was collected in farmers' market channel choice to identify the choice of the leading market outlet for garlic product and their determinants.

Economic Impact

During the survey, garlic producers identified collectors, wholesalers, retailers, and consumers' marketing outlet choices. More than 93% of garlic producers preferred wholesalers' market outlet choice from these four market outlet choices considering the amount of sale and maximum profit as a choice indicator, and more than 65% of garlic producers' farmers preferred collectors' outlet choice.

To sell their products to the markets and acquire reasonable profit, garlic producers' farmers must choose the right market channel. Selecting the right markets is critical to each garlic trading actor through numerous market channels, such as choosing the one with the most significant relative gain. When there are no different marketing options for garlic producers, producers are limited in their farm gate markets. Identifying garlic marketing channels takes the opportunity to develop farmers' winning strategies and evaluate garlic market options among different alternatives.

- Farm profits for individual garlic producers are quantified
- Profitable garlic marketing channels are identified.
- The economic and medicinal value of garlic products are estimated
- The amount of garlic production is valued, and the potential for garlic production and opportunities are identified.
- The market linkage between producers and different actors is created

Policy Impact

Understand linkages and dependencies between different activities and areas in the marketing, selecting the central market channel that increase the bargaining power in meeting a comprehensive benefit from the sale of garlic product. Smallholder garlic producers must select high-value market options, such as garlic exporting and processing marketing channels, to maximize their profit.

- The types of improved garlic varieties that will be produced are recommended.
- The participation of stakeholders in various garlic value chain activities is highly recommended.
- Motivation for farmers and government institutions is forwarded
- Correct decisions are endorsed for various marketing channels.

Regional Impact

Analysing the current garlic market chains is essential in transforming traditional hand-to-mouth garlic production into market-oriented or modern garlic production in the production Region.

The contributions of garlic production and marketing are valuable; it leads to the development of the Region's GDP in the agricultural sector's vegetable share.

- The demand and supply of garlic products can be balanced in the Region.
- Annual garlic productivities will increase.

Conclusions

Numerous covariates are analysed with the econometrics model to evaluate whether they positively or negatively influence garlic producers' market outlet choice decisions. The econometric model result shows that the amount of garlic produced, extension contact frequency, land allotted for garlic production, lagged market price, market information access, experience for garlic production and marketing, level of education for garlic producers, the number of oxen owned with garlic producer farmers, and the sex of the household has both positive and negative effects on garlic producers' market channel selection decisions. Based on this finding, the result allows the opportunities to set the solution for the negative influence of the covariates. Agricultural extension experts, research centre, and universities had better focus on garlic's productivity. The gender-inclusive production system can be advisable for sustainable garlic production and market supply. It is also essential to link farmers with the most significant market outlets, wholesalers, and collectors, to improve their farm income and livelihood.

Conflict of interest
There are no conflicts of interest to declare.

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