Legesse *et al.*
Journal of Innovation and Entrepreneurship (2024) 13:22
https://doi.org/10.1186/s13731-024-00375-7

Journal of Innovation and Entrepreneurship

RESEARCH Open Access

Determinants of market outlet choices by smallholder mango farmers in Aleta Chuko District, Sidama Region, Ethiopia: a multivariate probit approach

Tibebu Legesse[1*], Aneteneh Ashebir[1], Zerhun Ganewo[1], Abera Alemu[2] and Andachew Samuel[3]

*Correspondence:
tibebu610@gmail.com

[1] Department of Agribusiness and Value Chain Management, College of Agriculture, Hawassa University, Hawassa, Ethiopia
[2] Department of Rural Development and Agricultural Extension, College of Agriculture, Hawassa University, Hawassa, Ethiopia
[3] Department of Agribusiness and Value Chain Management, Bensa Campus, Hawassa University, Hawassa, Ethiopia

Abstract

Selecting appropriate market outlets offer the opportunity for farmers to capture a bigger share of the price paid by final consumers. However, smallholder farmers in developing countries are still confronted with myriad challenges regarding selecting profitable market outlets. Thus, the main objective of this study was to analyze determinants of market outlet choices by smallholder mango farmers in Aleta Chuko District, Sidama Region, Ethiopia. The study's representative 391 sample mango producers were selected using a multi-stage sample selection technique and a cross-sectional research approach. Descriptive statistics and the multivariate probit model were used to analyze the data. The result of the study showed that the probability of mango producers to choose consumer, collector, and retailer and wholesaler market outlets was 38%, 39.4%, 41% and 25%, respectively. This shows that retailer was the most likely chosen market outlet while wholesaler was the less likely chosen market outlet. The joint probability of farmers to choose the four market outlets is (0.042%) lower than the likely of not choosing four market outlets (23.21%). The result of the multivariate probit model showed that the sex of the household head, age of the household head, educational level of the household head, the quantity of mangoes produced, size of the land allocated for mango production, use of market information, credit access, livestock holdings, and distance to the nearest market were all statistically and significantly influencing factors in the market outlet choice behavior of mango producers. Based on the results of this study, the government and other concerned organizations should take action to improve the efficient marketing of mango producers in all outlets by providing market information, expanding and following up on extension services, increasing credit access, and building roads and other marketing infrastructure in the study area.

Keywords: Market outlet, Multivariate probit model, Mango producers

Introduction

The agricultural sector is key to Ethiopia's future, contributing 34.1% of GDP, 79% of export revenues, 79% of the labor force, and 70% of the raw materials used in industries (Asrat et al., 2022; Endalew et al., 2022; Gebremariam et al. 2021; Wordofa et al., 2021; Zegeye et al., 2022). Agriculture in the country is mostly dependent on rainfall (Mengistu et al., 2022), is carried out on a small scale, and has limited access to technology, extension assistance, market information, and financial access (Kifle et al., 2022; Nakawuka et al., 2018). Indeed, the country's agricultural production growth has lagged behind the pace of population expansion (Addisu, 2018; Regasa et al., 2021).

Fruit production plays a significant role in the local economy as a means of earning livelihoods for nearly five million farmers, creating jobs and generating foreign exchange revenues in Ethiopia (FAO (Food and Agriculture Organization), 2019). Mango is one of the most widely cultivated and globally traded tropical and subtropical fruit trees in the world. It is the dominant tropical fruit variety produced worldwide, followed by pineapple, papaya and avocado. Total production of mango accounted for more than half of total global major tropical fruit production (FAO (Food and Agriculture Organization of United State), 2017). It is the second most important fruit crop next to banana in Ethiopia (CSA (Central Statistics Agency of Ethiopia), 2020). It covered about 19,497.92 hectares (ha) of 119,908.57 ha total covered area by fruit which is 16.21%. A total of 1,337,049.26 quintals of mango was produced in the 2020/21 production season with a productivity level of 68.57 quintals per ha (CSA, 2022).

According to Shewaye (2016) the choice of marketing outlet is an important farm-level decisions which have a great impact on the income of households. The choices of marketing outlets are mostly household-specific decisions, and they require the consideration of demographic, socio-economic and market-related factors (Kuma et al., 2013; Shewaye, 2016).

There is evidence that linking smallholder farmers to the appropriate market outlets offer them the opportunity to produce and sell high-value products, translating their vertically coordinated relationships into premium prices and letting them capture a bigger share of the price paid by final consumers (De Janvry & Sadoulet, 2020; Hussein & Suttie, 2016; Kilelu et al., 2017). However, smallholder farmers in developing countries are still confronted with myriad challenges regarding selecting profitable market outlets (Abokyi et al., 2020; Demeke & Balié, 2016; Moctar et al., 2015; Morton & Martey, 2021). The studies so far identified many reasons for this: for instance, many scholars concluded that age, education, expertise, asset, and the scale of farms are essential factors for smallholder farmers market outlet choice. Younger groups have better marketing performance (Adugna et al., 2019; Barham, 2009; Xaba et al., 2013). Bigger farm sizes will increase farmers' participation (Donkor et al., 2021; Endris et al., 2020; Zhang et al., 2019). Farmers with good assets are more likely to improve their market situation (Degaga and Alamerie, 2020; Schulze Schwering et al., 2022; Taye et al., 2018), and farmers with better education and expertise selected market outlets with higher values (Pham et al. 2019; Taye et al. 2018; Xaba et al., 2013). Family labor availability encourages households' participation in profitable market outlets (Abate et al., 2019; Fischer et al., 2015; Thamthanakoon et al., 2021). Furthermore, selection of appropriate market outlet for delivering farm products is influenced by lack of market knowledge, market

networks, market information, price of the product, unfair profit share, extension services, farmers location from nearest market, production experience and duration at storage (Ahmed et al., 2017; Birara et al., 2018; Chiv et al., 2020; Emana et al., 2015, Jerena et al., 2017; Mossie et al., 2020).

In spite of different challenges for market outlet choices of the producers; producers might select different outlets simultaneously among the existing market outlets to maximize expected utility (Jerena, 2017; Mossie et al., 2020; Panda, 2017; Pham et al., 2019). In this study, the available choice was not mutually exclusive and respondents were expected to select different outlets simultaneously among the alternatives. In this regard, in this study, we classified mango market outlets into four types. The first is consumer channel which means that the farmer sells the mango directly to the consumers. The second is the collector channel, which means that the farmer sells the mango directly to the collectors on the farm gate. In this channel, farmers are not involved in the distribution. The third is the farmers' retailing channel, referring to farmers transporting mango to local markets nearby and selling them mainly through retailing. The last one is the wholesale market channel, which indicates that farmers transport mango to wholesale markets to sell products.

Aleta Chuko district is one of the mango producing areas in the Sidama Region, Ethiopia. In the area involvement of market intermediaries, lack of proper coordination among the value chain actors, and low producers marketing margins shared among the actors and post-harvest losses are the major problems. Choosing appropriate market outlet is one of the important factors for producers because different channels are different in profitability and cost. To these ends, understanding the factors that affect the choice of market outlet is imperative since the exploitation of such strategies has the potential to increase crop production, investment, and farm income (Soe et al., 2015). Even though mango is economically and socially important fruit, determinants of market outlet choice decisions of mango farmers have not been studied and documented well in the study area.

In Ethiopia, several empirical studies on the factors influencing marketing outlet choice decisions for various products have been conducted. For example, teff (Addisu et al., 2018; Tadie et al., 2019), wheat (Abebe et al., 2018; Birara et al., 2018; Yonnas et al., 2019), coffee (Degaga and Alamerie, 2020), potato (Emana et al., 2017), vegetable (Adugna et al., 2019; Endris et al., 2020), milk (Kuma et al., 2013), onion (Mossie et al., 2020), Haricot bean (Shewaye, 2016), tomato (Hawlet et al., 2019), onion (Taye et al., 2018) marketing outlets were studied, nonetheless, there are limited studies on the factors determining smallholder mango producers market outlet choice. Therefore, this study was initiated to fill this gap and may contribute towards the improvement of strategies for reorienting the supply chain system at Aleta Chuko district, Sidama Region, Ethiopia.

Theoretical framework

The study used the random utility theory based on the assumption that producers' decision to select an outlet is based on utility achieved. The choice of the outlet is subject to internal and external factors which affect the farmer's decision (Hess et al. 2018). Rational individuals are assumed to be profit driven (Keith, 2018). However, the

producer has incomplete information on the various market outlets available which implies that uncertainty on outlet selection has to be taken into consideration (Hess et al., 2018). The utility achieved from various outlets is thus modeled as a random variable in order to show the uncertainty involved. The utility that the producer obtains from the outlet selected is expressed as:

$$U_n^i = X_n^i + \varepsilon_{n,}^i \tag{1}$$

where U_n^i is the utility achieved from the outlets selection. X_n^i is the various outlet alternatives and ε_n^i is the error term, which represents the uncertainty involved in the producer's outlets choice decisions.

Letting $X_i;\ i = 0; 1; 2; 3, \ldots, n$ alternatives, then the utility function of the producer is satisfied by 1 to n alternatives.

$U = f(X_1, X_2, X_3, \ldots, X_n)$, where X represents the alternatives chosen by a particular producer. The producer selects a combination of various alternatives, $X1$ to Xn based on the utility achieved and maximum profit obtained.

The market outlets chosen are influenced by the price offered and proximity to the farmer. Therefore, the decision on selling to various market outlets has to meet the profit and utility satisfaction motive. Utility is derived from the household's profitability of produce sale.

The utility maximization model of the producer is based on the expected value of the non-observable underlying utility function that ranks the preference of the producer according to the selected market outlets. The non-observable underlying utility function can be represented by:

$$E[Uin(Pn, Mn, Tn), \tag{2}$$

where E is the expectations operator, n represents the market outlet, i represent the farm producer. Utility (Ui) is derived from the observable market outlet characteristics, where P represents price offered, M stands for market distance and T stands for the transport mode.

The producer opts among,

$$E[\text{Ui1}], E[\text{Ui2}], E[\text{Ui3}] \text{and} E[\text{Ui4}], \tag{3}$$

where E [Ui 1] stands for consumer, E [Ui 2] represents collector, E [Ui 3] stands for retailer and E [Ui 4] represents wholesaler.

The study was, thus, underpinned under this theory based on the assumption that mango producers would select a combination of various market outlets based on the utility achieved. The producers being rational decision-makers are expected to choose the market outlets with the minimal cost and the highest profit margins.

Material and methods

Description of the study area

This study was conducted in Aleta Chuko district, Sidama Region, Ethiopia. It is located in the Sidama area, 62 km from the Sidama region's capital Hawassa, and 335 km from the capital of Ethiopia, Addis Ababa. Its precise location ranges from 38,004′E to 38,024′E and

6046′N to 7001′N. The district is divided administratively into 26 rural and 5 urban Kebeles. The Aleta Chuko district has a total population of 209,886, of which 102,215 (48.7%) are male and 107,671 (51.3%) are female (CSA, 2021). A rough estimate of the district's land area is 32.2 square kilometers. The area has lowland agro ecological zones and varies in altitude from 1400 to 2000 m above sea level (CSA, 2021).

Data type and method of data collection

In this study, both primary and secondary data were used. Primary data were collected from the smallholder mango producers. Secondary data were collected from central statistical agency and other published and unpublished documents.

A household survey, key informant interviews, and focus group discussions that were performed twice served as the primary data collection methods for this study. To gather information on households level, we conducted a survey in the first round (April to June 2023), and to augment the survey data in the second round (September to October 2023), we held focus groups and key informant interviews.

The questionnaire's suitability, the clarity and relevance of the questions, and the time required for an interview were all evaluated prior to the survey on 10 farmers. Three first-degree holders who are familiar with the local culture and language were chosen to conduct the interview. In order to ensure that they understood the goals of the research, the details of the interview schedule, how to approach the respondents, and how to conduct interviews, they received the necessary training, including fieldwork. The secondary data included in this study were compiled through an examination of a wide range of sources, including books, government reports, academic journal articles, and research papers written by various scholars.

Sampling procedure and sample size determination

The study area, Aleta chuko district, was selected as study area since the area has high potential for mango production and marketing. For sampling procedures, multi-stage sampling procedure was used for this study. In the first stage, potential mango producing Kebeles were identified from the district with the help of agricultural office and development agents. Accordingly, from 26 rural Kebeles in the district, ten potential mango producing Kebeles were identified. In the second stage, five mango producing Kebeles such as Teso, Dibicha, Debeka, Gambela and Makala were chosen randomly. In the third stage, 391 sample mango producers were drawn from the 16,748 total mango producers of the chosen Kebeles using Yamane's (1967) formula at 5%level of error. We applied this formula to determine sample size because it is the most appropriate formula when the study population size is known. Consequently, it has been widely used by many recent studies in determining the sample size for their studies:

$$n = \frac{N}{1 + N(e^2)}, \tag{4}$$

where n = sample size, N = total avocado producer households, and e = is level of precision (0.05).

$$n = \frac{16{,}748}{1 + 16{,}748(0.05^{)2}} = 390.669 \sim 391. \quad (5)$$

Finally, the sample size for each Kebele was distributed using the probability proportional to the sample size.

Method of data analysis

Data were edited, coded, entered, and cleaned to make it ready for analysis. After doing this, data analysis techniques such as descriptive statistics and econometric model were used. The data collected for achieving all objectives in the study area were analyzed using appropriate statistical software, both SPSS (version 20) and STATA (version 15) software.

Descriptive statistics

To give summary statistics of quantitative data related to the socio-demographic, economic, and institutional features of sample households, descriptive statistics including percentage, frequency, and mean were employed.

Econometric analysis

The multivariate probit regression model was used to analyze the determinants of market outlet choice by mango producers. A multivariate probit model simultaneously shows the influence of a set of explanatory variables on market outlet choice while accounting for potential correlations between unobserved disturbances as well as the relationship between market outlet choices (Belderbos et al., 2004).

The studies so far concluded that a producers' decision to sell in an advantageous market outlets derives from the maximization of profit he or she expects to gain from these markets. Econometric models such as multivariate probit/logit, multinomial probit/logit, conditional or mixed, or nested logit are useful models for the analysis of categorical choice dependent variables. A number of studies have been done revealed factors influencing marketing outlet choice decisions. For instance, study by Adugna et al. (2019), Endris et al. (2020), Mebrat (2014), Ntimbaa (2017), Nxumalo et al. (2019), Nyaga (2016), and Solomon et al. (2023) used multinomial logit model to determine factors affecting producers' market outlet choice decision. However, multinomial logit model assumes independence across the choices and does not allow correlation between alternative choices; whereas, multinomial probit/logit model MVP considers the interdependence and correlations among the outlets. It is an extension of the probit model and is used to estimate several correlated binary dependent variables jointly (Greene, 2003). The previous studies by Abera (2016), Arinloye et al. (2015), Efa and Tura (2018), Kiplangat and Vincent (2018), Melese et al. 2018, Nuri (2016), and Tarekegn et al. (2017) employed multivariate probit model to analyze factors affecting producers' market outlet choice.

This study undertakes that the farmer's decision is generated based on its utility maximization. This infers that the alternative marketing outlet choice requires different private costs and benefits, and hence different utility, to a household decision-maker.

Hence, farmers will choose marketing outlet if the expected utility from it exceeds that from other marketing outlets such that:

$$Y^* = \text{Yi}; \quad \text{if } V_i > V_j,\ Y^* = Y_j; \quad \text{if } V_i > V_j, \tag{6}$$

where Y_{i} represents the strategy type i, Y_{j} an alternative strategy type j, V_{i} and V_{j} the corresponding expected indirect utility values of strategy type i and its alternative j, while Y^* represents the strategy type actually chosen. Therefore, we can view the farmer's decisions on strategy implementation within a random utility discrete choice model. RUM is particularly appropriate for modeling discrete choice decisions such as between marketing outlets because it is an indirect utility function where an individual with specific characteristics associates an average utility level with each alternative marketing channel in a choice set. In this framework, the utility function is assumed to be known for each farmer, but some of its components are unobserved by the researcher. This unobserved part of the utility is treated as a random variable. For the ith strategy decision the expected indirect utility is then modeled as the sum of the observed variables and non-observable random component:

$$V_i = \beta_i^1 X_i + \varepsilon_i. \tag{7}$$

We can write the choice utility of implementing any alternative as follows:

$$V_j = \beta_j^1 X_i + \varepsilon_i, \tag{8}$$

where β_i^1 and β_j^1 are vectors of parameters. Hence, farmers can decide simultaneously whether to choose one or more market outlet conditional upon the vectors of explanatory variables X_{i} and X_{j}. In this approach, we can use a multivariate probit model (MVP) to study the farmer's joint decisions to market outlet choice.

Following Eqs. (7) and (8), the empirical specification of MVP takes the form:

$$V_{ij} = V_i = \beta_i^1 X_i + \varepsilon_i, \tag{9}$$

with $j=1, 2, 3, 4$, $Y_{\text{i}}=1$ if $Y_{\text{i}}>0$and 0 otherwise, where Y_{i}^* is an unobservable latent variable denoting the probability of choosing j type of market outlet, for $i=1$ (consumer), $i=2$ (collectors), $i=3$ (retailers) $i=4$ (wholesaler) is as follows. Thus, empirically the model can be specified as follows:

$$Y_{i1} = \beta_1 X_{ij} + \varepsilon_{i1}, \tag{10}$$

$$Y_{i2} = \beta_2 X_{ij} + \varepsilon_{i2}, \tag{11}$$

$$Y_{i3} = \beta_3 X_{ij} + \varepsilon_{i3}, \tag{12}$$

$$Y_{i4} = \beta_4 X_{ij} + \varepsilon_{i4}, \tag{13}$$

where $Y_{i1} = 1$, if farmer choose consumer market outlet (0 otherwise), $Y_{i2} = 1$, if farmer choose collector market outlet (0 otherwise), $Y_{i3} = 1$, if farmer choose retailer (0 otherwise), $Y_{i4} = 1$, if farmer choose wholesaler (0 otherwise), X_i=vector of factors affecting

market outlet choice, β_j = vector of unknown parameters ($j = 1, 2, 3, 4$), and ε = is the error term. We assumed that the error terms (ε_1, ε_2, ε_3 and ε_4) may be correlated. Then, instead of being independently estimated, they are considered to be a multivariate limited-dependent-variable model in which the four error terms follow a multivariate normal distribution with zero mean and variance and covariance matrix.

In multivariate model, where the choice of several market outlets is possible, the error terms jointly follow a multivariate normal distribution (MVN) with zero conditional mean and variance normalized to unity (for identification of the parameters), where (μx_1, μx_2, μx_3, μx_4) MVN ~ (0, Ω) and the symmetric covariance matrix Ω is given by:

$$\begin{bmatrix} 1 & \rho x_1 x_2 & \rho x_1 x_3 & \rho x_1 x_4 \\ \rho x_2 x_1 & 1 & \rho x_2 x_3 & \rho x_2 x_4 \\ \rho x_3 x_1 & \rho x_3 x_2 & 1 & \rho x_3 x_4 \\ \rho x_4 x_1 & \rho x_4 x_2 & \rho x_4 x_3 & 1 \end{bmatrix}. \tag{14}$$

Of particular interest are the off-diagonal elements in the covariance matrix, which represent the unobserved correlation between the stochastic components of the different types of outlets. This assumption means that Eq. (14) generates the MVP model that jointly represents the decision to choose a particular market outlet. This specification with non-zero off-diagonal elements allows for correlation across error terms of several latent equations, which represents unobserved characteristics that affect the choice of alternative outlets.

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

$$\ln L = \sum_{n=1}^{N} \omega_i \, ln\Phi(\mu_i, \Omega), \tag{15}$$

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

$$\mu_i = \eth ki1\beta 1xi1;\ ki2\beta 2xi2;\ ki3\beta 3xi3, \tag{16}$$

$$\Omega jk = \Omega kjkijkik\rho jk; \quad \text{for jk;}\ \ k = 1; 2; 3... : \text{with kik} = 2\text{yik} - 1. \tag{17}$$

Hypothesis and definition of working variables

Dependent variables

This is categorical dependent variable that reflects the farmers' preferred market outlets for selling their mangoes. Consumer market, local collector market, retail market, and wholesale market were the four main mango market outlets found in the study area. Each market outlet is a binary indication that receives a value of one if the producer selects the suggested alternative outlet and a value of zero otherwise. The hypothesis of independent variables is presented in Table 1.

Table 1 Variable description and their expected signs

Variables	Measurement	Expected outcome on major market outlet choice			
		Consumer	Collector	Retailer	Wholesaler
Sex	Dummy (1 if male, 0 if female)	−	+	−	−
Age	Continuous (years)	−	+	−	−
Family size	Continuous (ADE)	+	−	+	+
Educational status	Continuous (year of schooling)	+	+	+	+
Off-farm participation	Dummy (1 = yes, 0 otherwise)	+	+	+	+
Land size allocated for mango	Continuous (hectare)	+	+	+	+
Extension contact	Continuous (number of contact per month)	+	−	+	+
Mango produced in quintal	Continuous (quintal)	+	+	+	+
Market information	Dummy (1 = yes, 0 otherwise)	+	−	+	+
Credit use	Dummy (1 = yes, 0 otherwise)	+	+	+	+
Livestock holdings	Continuous (tropical livestock unit	+	+	+	+
Distance to the nearest market	Continuous (kilometers)	−	+	−	−

Table 2 The socio-economic and demographic characteristics of the households

Continuous variables		Mean	Standard deviation
Age of the household head		45.649	16.506
Family size		4.089	1.692
Education		4.056	1.660
Land allocated for mango		0.6797	0.351
Extension contact		5.552	0.571
Mango produced in quintal		28.1714	2.1690
Livestock holdings (TLU)		4.1577	1.770
Distance to the nearest market		7.539	2.065
Dummy variables	**Category**	**Frequency**	**Percentage**
Sex of the household head	Male	372	95.1
	Female	19	4.9
Non/and off-farm participation	Yes	157	40.1
	No	234	59.9
Market information	Yes	193	49.4
	No	198	50.6
Credit use	Yes	155	39.6
	No	236	60.4

Result and discussion

The socio-economic and demographic characteristics of the households

As Table 2 depicts, the mean age of mango producing sample respondents was 45.649 years with standard deviation of 16.506. The result showed that an increase in family size was directly proportional to allotted productive labor source for mango production (Table 2). Larger family size affects the supply of mango positively and

thereby the impact for better participation in markets. The descriptive statistics result shows that the average size of the sample households was 4.089 with standard deviation of 1.692. Education is an important instrument for enhancing capacity to seek information and an informed decision. As survey result revealed, on average, a typical household head attended about 4 years of formal education with standard deviation of 1.660. Land is the basic input factor of production.

Land holding of farmer in this study was the size of land a household is entitled to hold and is measured in hectare. Farming household in the study area use their land for either of farming activities which include production of food crops, cash crops, house construction and grazing. The survey result showed that the mean land allocated for mango was 0.67 ha with standard deviation of 0.351. Agricultural extension service is expected to have high influence on the production and marketing. The higher access to the extension service, the more likely that farmers adopt new technology and innovation. The extension service providers were office of agriculture of the district and development agents. The survey result shows that the mean number of extension contact per month was 5.55 with standard deviation of 0.57. With regard to mango produced, the mean of mango produced was found to be 28.17 in a quintal with standard deviation of 2.169. Livestock is essential assets that farmers heavily depend on to support their families from any sort of crisis.

Livestock considered as measure of wealth in the rural area and it kept as a source of additional income and traction power for farmers. To determine livestock holdings of households, the total number of livestock possessed by the sample households was converted in to Tropical livestock unit (TLU). The mean livestock holding size of farmers was 4.157 with standard deviation of 1.77. Distance from producers' house to the nearest market centers was also the factor which determines farmers supply to the nearest market. This is a distance measured in kilometers to reach the nearest market. The closer the market, the lesser would be the transportation charges, reduce transaction costs, reduce tracking time and other marketing costs. In the study area, sampled mango producers should go mean 7.539 km to the nearest market with standard deviation of 2.065.

Totally, 391 household heads were considered in this study, of which, the result showed that 372 (95.1%) were male-headed households and only 19 (4.9%) were female headed. Survey result indicated that 157 (40.1%) of mango producers participated in non/and off farm, whereas 234 (59.9%) did not participate in off/and non-farm. Access to reliable market information helps farmers to sell their surpluses of maize and choose mode of transaction. It has been suggested that farmers will choose profitable mode of market outlet if they can receive reliable market information. The survey result showed that 193 (49.4%) sampled farmers were got market information, whereas 198 (50.6%) sampled farmers did not get market information. Moreover, the survey result showed that only 155(39.6%) of take credit for maize production and remaining 236 (60.4%) do not used the credit. Factors that hinder farmers from taking credit in the study area were high interest rate and short-term repayment period.

Table 3 Proportion of producer choosing market outlet choice

Outlet choice	Consumers		Collectors		Retailers		Wholesalers	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Yes	149	38	154	39.4	161	41	97	25
No	242	62	237	60.6	230	59	294	75

Proportion of market outlets chosen by sample mango producers

Mango producers in the study area sell their product in four market outlets in order to maximize their profit. These market outlets included consumers, retailers, wholesalers, and collectors. Accordingly, one of the most commonly used market outlets by producers is the retailers' outlet, which was chosen by ~ 41% of respondents. While ~ 39% of respondents sold to collectors. 25% of sample households sold to the wholesalers. Furthermore, 38%of respondents chose consumers as a mango marketing outlet (Table 3).

Preliminary test for model appropriateness

In order to authenticate the validity of the econometric model used, multicollinearity and heteroscedasticity tests were conducted.

Multicollinearity test

Multicollinearity occurs when more than one independent variables are related to each other. This means that one variable can be linearly estimated from the other variables. The presence of multicollinearity often leads to the occurrence of inflated standard errors, thus making some predictor variables to be statistical insignificant. The variable inflation factor (VIF) was conducted on the explanatory variables used in the model to detect the presence of multicollinearity. A VIF of less than 10 indicates the absence of multicollinearity among the explanatory variables of the estimated model. According to the results presented in Appendix Table 6, the mean VIF is 1.42, thus showing the absence of serious multicollinearity problem.

Test for heteroscedasticity

The Breusch–Pagan test was conducted to check for heteroscedasticity using the command stat hettest: the results show a p value of 0.4923, thus indicating the absence of heteroscedasticity. A p value of more than 0.1 indicates that the test is insignificant, thus implying that the errors are homoscedastic which means that they are randomly dispersed throughout the range of the independent variable.

Breusch–Pagan/Cook–Weisberg test for heteroscedasticity.

$$\text{Chi}^2\,(1) \;=\; 0.99.$$

$$\text{Prob} \;>\; \text{Chi}^2 \;=\; 0.4923.$$

Determinants of mango market outlet choice

The multivariate probit model was used to estimate several correlated binary outcomes jointly. In this study, the decisions of mango producers choosing wholesalers, retailers, consumers and collectors outlets are correlated. Since the decisions are binary, the multivariate probit model was found to be appropriate for jointly predicting these four outlet choices on an individual-specific basis and the parameter estimates are simulated maximum likelihood (SML) estimators. Thus, an econometric approach was employed to test the effects of the explanatory variables on the selection of a particular market outlet.

The Wald test (Chi^2 (48) = 124.70, Prob > Chi^2 = 0.0000) is strongly significant at the 1% level, indicating that the model's subset of coefficients is jointly significant and the explanatory power of the factors included in the model is satisfactory. Thus, the MPV model fits the data reasonably well. The simulated maximum likelihood test (LR Chi^2 (6) = 19.3793, Prob > Chi^2 = 0.0000) of the null hypothesis of independence between market outlet decisions ($\rho21 = \rho31 = \rho41 = \rho32 = \rho42 = \rho43 = 0$) is significant at the 1% level. As a result, the null hypothesis that all (rho) values are jointly equal to 0 is rejected, indicating the model's goodness of fit and supporting the use of the MVP model over the individual probit model. This demonstrates that separate estimation of market outlet choices is biased, and that household decisions to choose the four market outlets are interdependent.

Individual rho (ρ_{ij}) values represent the degree of correlation between each dependent variable pair. The model resulted in a negative and statistically significant correlation between the choice of retailers and consumer (ρ31), retailers and collectors (ρ32), wholesalers and retailers (ρ43) at 1, 5 and 1% significance level, respectively. The model result indicated that positive and statistically significant correlation between the choice of collectors and consumers (ρ21), wholesalers and consumers (ρ42).

Table 4 Multivariate probit estimations for determinants of market outlet choices of mango producers

Variables	Consumer	Collector	Retailer	Wholesaler
Predicted probability	0.393	0.4288	0.4024	0.2643
Joint probability of success	0.00042			
Joint probability of failure	0.232154			
Estimated correlation of market outlets				
ρ21	0.3893***			
ρ31	− 0.4939***			
ρ41	0.0013			
ρ32	− 0.1659**			
ρ42	0.1145*			
ρ43	− 0.5790***			
Multivariate probit (MSL, # draws = 5)				
Number of observation = 391				
Log likelihood = − 886.164				
Wald Chi^2 (48) = 124.70 Prob > Chi^2 = 0000***				
Likelihood ratio test	rho21 = rho31 = rho41 = rho32 = rho42 = rho43 = 0: Chi^2 (6) = 19.3793 Prob > Chi^2 = 0.000***			

*** ** and * are statistically significant at 1% 5% and 10% significance level, respectively

The marginal success probability of each market outlet is also shown by the simulated maximum likelihood estimation. The likelihood of selecting a collector outlet (42.88%) is relatively high when compared to the likelihood of selecting a retailer (40.24%), consumer (39.3%), and wholesalers (26.3%). In terms of the joint probabilities of success and failure of market outlets, choice decisions indicate that those households are less likely to choose all four market outlets at the same time. The likelihood of mango producers jointly selecting the four market outlets was 0.0042%, which is nearly zero when compared to their failure to do so (23.7%). Tis indicates that the likelihood of selecting the joint market outlet is extremely low. This finding implies that the optimal mix of market channels will be determined by different factors for each market outlet (Table 4).

Sex of the household head

Sex of producer had positive and significant effects on collector, outlet choice at 10%, significant level, but it had a positive and significant effect on retailer and wholesaler outlet choice at a 1% significant level. Being a male-headed household increases the probability of choosing retailer and wholesaler market outlet by 94.24 and 24.7, respectively, when compared with female-headed households, all other factors held constant. This is due to the farm household head being female; they might have many duties in their family because they may not select appropriate channels to sell their product. Therefore, female household head simply sold their surplus product to a collector in the local area. And they decrease to sell for the retailer and wholesale market outlet, which was higher compared with the male household head. Hawlet et al. (2019), Mohammed et al. (2019), and Tewoderos et al. (2020) confirmed that male farmers have more marketable resources and are thus more likely than female-headed households to deliver products to retailer and wholesaler outlets. Female households are also less likely to sell vegetables to retailer and wholesaler outlets (Mukiama et al. 2014).

Age of the household head

Age of household head was found to have a negative and significant effect in choosing consumer mango market outlet at 10% significance level. This implies that as the age of household increases by a year, the probability of farmers to sell their product to the consumer market outlet decreases by 4.9%, ceteris paribus. This might be due to the fact that older peoples in Ethiopia are relatively illiterate as compared to younger peoples. Due to this, the older people do not know how much price can be received for selling a product from consumer market outlet that is relatively higher than selling a product to other market outlets. The reason for the price that can be received from selling a product to a consumer is higher than other market outlet is that producers can sell their produce to consumer market outlet without any interference. This result also in line with Temesgen et al. (2017), Tewoderos et al. (2020) who found that owning age of the household head influenced the consumers' market outlet negatively.

Educational status of household head

The education level of household heads had a positive effect on the likelihood of choosing retailers and wholesalers at 5% and 1%) significance level. One year increases in household head's education, increase the probability of choosing retailer and wholesaler market outlet by 28% and 4.91%, respectively, all other factors held constant. Farmers' ability to analyze relevant market information and choose the best market outlet that is expected to give them a better price for their produce improves as they get more education. Educated farmers improve their ability to make decisions about market outlet selection based on marketing margin and marketing cost. This study is consistent with Abebe et al. (2018), Hawlet et al. (2019), Taye et al. (2018), and Tewoderos et al. (2020) and they found that educational status of the household heads affects tomato, sorghum, wheat and onion market channel choices.

The land sizes that can be allocated for mango production

The land sizes allocated for mango production were found to have a positive and significant relation with the likelihood of choosing, consumer, retailer and wholesaler market outlet at 1%, 1% 5% and 1% significance level, ceteris paribus, respectively, while a negative and significant relation with the likelihood of choosing collector outlet. The result of this study revealed that, as the land size allotted for mango production increases by 1 hectare, the probability of farmers to sell their produce to the consumer, retailer and wholesaler market outlet increase by 7.17%, 29.98% and 56%, respectively. This indicates that those households who allotted large size of land for mango production would produce more output a farmers would more likely to sell their produce to consumer, collector retailer and wholesaler market outlet. Abate et al. (2017), Degaga and Alamerie, (2020) and Tolan and Ketema (2014) found that farm size is negatively affected by the choice of collector outlet because farmers with a larger total landholding produce more and prefer to sell to retailers, consumers and wholesalers.

Quantity of mango produced

Quantity of mango produced by mango producers was found to have a positive and significant relationship with the likelihood of choosing consumer, collector and retailer market outlet at 5%, 5% and 1% significance level, respectively. This result indicated that the quantity of mango produced by a farmer increases by a quintal, the likelihood of choosing consumer, collector and retailer market outlet increases by 82.41%, 98.71 and 2.13%, ceteris paribus, respectively. This implies that for a household who produce more mango products, farm households are more likely to choose consumer, collector and retailer market outlets. This result is in line with Abebe et al. (2018) who found that when the quantity of wheat produced increases, the probability of farm households choosing trader market outlets also increases.

Market information

At 5% significance level, access to market information is positively associated with the likelihood of selling to retailers' and wholesaler' outlets. The model result revealed that for those farmers who accessed market information, the likelihood of choosing wholesaler and retailer market outlet increased by 18.34% and 36.78%, ceteris paribus, respectively, as compared to those farmers who not accessed market information.

The findings are similar to those of Endris et al. (2020) and Wosene et al. (2018), who discovered that regular contact with access to market information was significantly and positively associated with the use of wholesaler and retailer market outlet.

Access to credit

Access to credit has a positive and highly significant effect on households' choice of consumer market outlet at a 10% significance level. Access to credit would enhance the financial capacity of the farm households to purchase the necessary materials and increases output. The possible reason might be that farmers require finance to buy necessary inputs for mango production, to produce on a large scale, and hence sale to all channels from his/her large produces. This result is consistent with Efa and Tura (2018), who found that obtained credit has a positive and significant effect in consumer market outlet. The result also in line with Melese et al. (2018) who found that access to credit has a positive and significant effect on choosing consumer market outlet for marketing onion.

Livestock holdings

The model result showed that total livestock ownership of the household was positively associated with collector market outlet and wholesaler outlet at 5% and 10% significant level, respectively. The positive relationships indicated that farmers having large total livestock are able to purchase more input for mango production intern produce more quintals of mango and supplied large quantity of mango to the collector and wholesaler market outlet. In other cases, farmers with more livestock assets have better animal manure for input production which helps to increase productivity and production, and finally, farmers would supply more mango to the collector and wholesale market outlet. Similar results were reported by Dessie et al. (2018) and Kumar et al., (2018), who indicated that farm size positively affected the choice of collector and wholesaler market outlet, respectively.

Distance to the nearest market

The result showed that the variable negatively and significantly related with consumer, retailer and wholesaler market outlet at 5%, 1% and 5% significant level while a positive and significant relation with the likelihood of choosing collector market outlet at 1% significance level. The finding showed that households whose residences are far from the nearest market are less likely to sell to consumer market outlet and more likely to sell to local collector market outlet. Selling pepper to the consumer, retailer and wholesaler

Table 5 Multivariate probit estimation for determinants of mango producer outlet choice

Variables	Market outlet choice							
	Consumer		Collector		Retailer		Wholesaler	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Sex	0.1047	0.3220	− 0.5953*	0.3206	0.9424***	0.2981	0.2702***	0.3756
Age	− 0.049***	0.0041	− 0.0061	0.0043	− 0.0022	0.0040	0.0080	0.0044
Family size	0.0001	0.0403	0.0098	0.0438	0.0478	0.0396	0.0303	0.0439
Education	0.0089	0.0193	0.0090	0.0206	0.280**	0.0183	0.0491***	0.0208
Off-farm participation	0.1462	0.0835	0.0517	0.0625	0.0047	0.0646	0.0540	0.0754
Land size allocated for mango	0.0717***	0.00432	− 0.7645***	0.2034	0.2988**	0.1367	0.5600***	0.1806
Extension contact	0.006	0.0209	0.0365	0.0249	0.0060	0.0203	0.0308	0.0245
Mango produced in quintal	0.8241**	0.068	0.9871**	0.081	0.0213***	0.0067	0.0042	0.0078
Market information	0.9276	0.1575	0.1228	0.1679	0.1834**	0.1554	0.3678**	0.1788
Credit use	0.2575*	0.1414	0.1562	0.1519	0.0720	0.1363	0.1905	0.1515
Livestock holdings (TLU)	0.0032	0.0395	0.191**	0.0421	0.06245	0.0385	0.0770*	0.0425
Distance to the nearest market	− 0.0060**	0.0134	0.519***	0.0155	− 0.5496***	0.0131	− 0.3195**	0.0155
_cons	1.0446	0.5553	0.3167	0.5798	− 0.3584	0.5296	0.3626	0.5946

*** ** and * are statistically significant at 1% 5% and 10% significance level, respectively

requires labor and transportation facility and exposes producer for additional marketing cost. As a result, the mango producers prefer the nearby market outlet to sell their produce at the farm gate so as to decrease the transaction cost. This result is in line with Abera (2016), Arinloye et al. (2015), Hawlet et al. (2019) and Tarekegn et al. (2017), who found that market distance has a positive relation with collectors and tomato producers sell their produce at the farm gate to collector than wholesaler (Table 5).

Conclusion and policy implications

The objective of this study was to analyze the determinants of market outlet choice by smallholder mango producers in the Aleta Chuko district, Sidama Regional State of Ethiopia. Mango producers in the study area sell their product in four market outlets in order to maximize their profit. These market outlets included consumers, retailers, wholesalers, and collectors. Accordingly, one of the most commonly used market outlets by producers is the retailers' outlet, which was chosen by ~ 41% of respondents. While ~ 39% of respondents sold to collectors. 25% of sample households sold to the wholesalers. Furthermore, 38% of respondents chose consumers as a mango marketing outlet. Since, the decisions of mango producers' choosing wholesalers, retailers, consumers and collectors outlets are correlated, the multivariate probit model was

found to be appropriate for jointly predicting these four outlet choices on an individual-specific basis and the parameter estimates are simulated maximum likelihood estimators. Accordingly, the result of the multivariate probit model showed that the likelihood of choosing consumers market outlet was affected by age of the household head, land size allocated for mango production, mango produced, credit use and distance to the nearest market. The probability of choosing collector market outlet was affected by age of household head, land size allocated for mango production, mango produced livestock holdings and distance to the nearest market. Likewise, the probability of choosing retailer market outlet affected by sex of the household head, educational status of household head, land size allocated for mango production, mango produced, market information and livestock holdings and distance to the nearest market. Moreover, the probability of choosing wholesaler outlet affected by sex of the household head, educational status of household head, land size allocated for mango production, market information and livestock holdings and distance to the nearest market.

Based on the findings of this study, some relevant policy implications can be drawn that can assist to design appropriate intervention mechanisms to improve market outlets choice of mango fruit farmers in the study area. Based on the finding it is suggested that government should intervene to provide market information, expand and follow-up extension services, credit access and building marketing infrastructure in the study area to improve the effective marketing of mango producers in all outlets. Furthermore, to promote the flow of mango product from producers to the ultimate consumers through different outlets, the producer's knowledge and skill on marketing and production should be improved through training, mass media and redesign, strengthening and developing implementation strategies on extension education. In addition, the implementation of innovative mango production systems and the construction of rural-to-urban infrastructure are important for achieving agricultural transformation.

Limitations and future scope

This study focused on generating useful information on factors affecting farmers' mango market outlet choice in Aleta chuko district, Sidama Region, Ethiopia, by using formal and informal survey. The issue of market outlet choice by mango farmers will be better understood in the country if the research was studied through time, and cover additional districts under the investigation. Therefore, the primary limitation of this study was its limitation in a single district. Finally, the researchers suggest that the further study on mango value chain analysis should be undertaken in the Sidama region by considering other mango producing districts in the region in addition to Aleta chuko district.

Appendix

See Table 6.

Table 6 Variance inflation factor for predictor variables

Variables	VIF	Tolerance
Sex	2.67	0.375084
Age	1.17	0.857418
Family size	1.10	0.910731
Educational status	2.16	0.461927
Off-farm participation	1.03	0.974035
Land size allocated for mango	1.08	0.923516
Extension contact	1.30	0.745871
Mango produced in quintal	1.53	0.537528
Market information	1.06	0.924635
Credit use	1.33	0.792358
Livestock holdings	1.27	0.975363
Distance to the nearest market	1.42	0.9975236
Mean VIF	1.42	

Acknowledgements
The authors would like to thank the experts of agriculture office of the district for their patience and support to get the required supplementary data. The authors also want to express their gratitude to the participants for their enthusiastic readiness to take part in this study.

Author contributions
TL contributed to research proposal writing, data collection, and supervision. AA assisted data cleaning and feeding. All authors contributed to data analysis and article writing. All authors read and approved final manuscript.

Funding
No funding was received.

Availability of data and materials
The datasets used and analyzed during this study are accessible upon request from the corresponding author.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
We declare that we do not have competing interests.

Received: 22 September 2023 Accepted: 13 February 2024
Published online: 21 March 2024

References

Abate, T., Mekie, T., & Dessie, A. (2019). Determinants of market outlet choices by smallholder Teff farmers in Dera district, South Gondar Zone, Amhara National Regional State, Ethiopia: a multivariate probit approach. *Journal of Economic Structures., 8*(1), 1–14.

Abate, N. (2017). Determinants of market outlet choice of coffee producing farmers in Lalo Assabi district, West Wollege zone, Ethiopia: an econometric approach. *Journal of Economic Development*, *19*(2), 48–67.

Abebe, D., Tadie, M., & Taye, M. (2018). Factors affecting market outlet choice of wheat producers in North Gondar Zone, Ethiopia. *Agric Food Security, 7*, 91. https://doi.org/10.1186/s40066-018-0241-x

Abera, S. (2016). Econometric analysis of factors affecting haricot bean market outlet choices in Misrak Badawacho District, Ethiopia. *Ethiopian Institute of Agricultural Research, 2*(9), 6–12.

Abokyi, E., Strijker, D., Asiedu, F., & Daams, M. (2020). The impact of output price support on smallholder farmers' income: Evidence from maize farmers in Ghana. *Heliyon, 6*(2020), e050132. https://doi.org/10.1016/j.heliyon.2020.e05013
Addisu, G. (2018). Determinants of commercialization and market outlet choices of teff: The case of smallholder farmers in Dendi District of Oromia, Central Ethiopia (Doctoral dissertation, Haramaya University).
Adugna, M., Ketema, M., Goshu, D., & Debebe, S. (2019). Market outlet choice decision and its effect on income and productivity of smallholder vegetable producers in lake Tana Basin, Ethiopia. *Review of Agricultural and Applied Economics (RAAE), 22*(1), 83–90.
Ahmed, A., Umare, N., Mahamed, O., & Galane, K. (2017). Factors affecting groundnut market channel choice in moisture stress area of Babile district, eastern Ethiopia: Multivariate probit approach. *International Journal of Agricultural Science, Research and Technology in Extension and Education Systems, 7*(2), 91–101.
Arinloye, D., Pascucci, S., Linnemann, A., Coulibaly, O., Hagelaar, G., & Omta, O. (2015). Marketing channel selection by smallholder farmers. *Journal of Food Products Marketing, 21*, 337–357.
Asrat, D., Aneteneh, M., Adem, A., & Berhane, Z. (2022). Impact of Awash irrigation on the welfare of smallholder farmers in Eastern Ethiopia. *Cogent Economics and Finance, 10*, 2024722. https://doi.org/10.1080/23322039.2021.2024722
Barham, J., & Chitemi, C. (2009). Collective action initiatives to improve marketing performance: Lessons from farmer groups in Tanzania. *Food Policy, 34*, 53–59.
Belderbos, R., Carree, M., Diederen, B., Lokshin, B., & Veugelers, R. (2004). Heterogeneity in R and D cooperation strategies. *International Journal of Industrial Organization, 22*(8), 1237–1263. https://doi.org/10.1016/j.ijindorg.2004.08.001
Birara, A., Mirie, T., & Melese, T. (2018). Factors affecting market channel choice of wheat producers in North Gondar Zone, Ethiopia. *Agriculture and Food Security., 7*(91), 1–8. https://doi.org/10.1186/s40066-018-0241-x
Cappellari, L., & Jenkins, S. (2003). Multivariate probit regression using simulated maximum likelihood. *The Stata Journal, 3*(3), 278–294. https://doi.org/10.1177/1536867X0300300305
Chiv, R., Nie, F., & Tum, S. (2020). Analysis of factors influencing marketing channel choices by smallholder farmers: A case study of paddy product in wet and dry season of prey Veng province, Cambodia. *Journal of Sustainable Development., 13*, 4.
CSA. (Central Statistical Agency). (2020). The federal democratic republic of Ethiopia central statistical agency agricultural sample survey2019/2020. Volume vol. vii. Report on crop and livestock product utilization (private peasant holdings, Meher season). Statistical Bulletin 2020; 592.
CSA (Central Statistical Agency) Hawassa branch. (2021). Household ample survey result.
CSA. (2022). Federal Democratic Republic of Ethiopia Central Statistical Agency Agricultural Sample Survey 2020/21 (2013 E.C.) Volume I Report on Area and Production of Major Crop, CSA, Addis Ababa, Ethiopia.
De Janvry, A., & Sadoulet, E. (2020). Using agriculture for development: Supply-and demand-side approaches. *WorldDevelopment, 133*, 105003. https://doi.org/10.1016/j.worlddev.2020.105003
Degaga, J., & Alamerie, K. (2020). Determinants of coffee producer market outlet choice in Gololcha district of Oromia region, Ethiopia: A multivariate probit regression analysis. *Studies in Agricultural Economics, 122*(2), 104–113.
Demeke, M., & Bali, E., et al. (2016). Assessment of national policies in developing countries to combat and mitigate the effects of agricultural markets' excessive price volatility. In A. Garrido (Ed.), *Agricultural markets instability: Revisiting the recent food crises* (pp. 161–177). UK: Routledge.
Dessie, B., & AbateMekie, T. T. (2018). Factors affecting market outlet choice of wheat producers in North Gondar Zone, Ethiopia. *Agriculture and Food Security, 7*(1), 91.
Donkor, E., Garnevska, E., Siddique, M., & Donkor, E. (2021). Determinants of rice farmer participation in the direct marketing channel in Ghana. *Sustainability, 13*, 5047.
Efa, T., & Tura, H. (2018). Determinants of tomato smallholder farmers market outlet choices in West Shewa, Ethiopia. *Journal of Agricultural Economics and Rural Development, 4*(2), 454–460.
Emana, B., Ketema, M., Mutimba, J., & Yousuf, J. (2015). Factors affecting market outlet choice of potato producers in Eastern Hararghe Zone, Ethiopia. *Journal of Economics and Sustainable Development, 6*(15), 159–172.
Endalew, B., Aneteneh, A., & Tasie, K. (2022). Technical efficiency of Teff production among smallholder farmers: Beta regression approach. *European Journal of Development Research, 34*, 1076–1096.
Endris, E., Haji, J., & Tegegne, B. (2020). Factors affecting vegetable producers market outlet choice in case of Habru district, north Wollo zone, Ethiopia. *European Business and Management, 6*(1), 1.
FAO (Food and Agricultural Organization off United Nations). (2017). Major tropical fruits market review.
FAO (Food and Agricultural Organization off United Nations). (2019). The state of food security and nutrition in the world. www.fao.org/3/ca5162en/ca5162en.pdf.
Fischer, E., & Qaim, M. (2014). Smallholder farmers and collective action: What determines the intensity of participation? *Journal of Agricultural Economics, 65*, 683–702.
Gebremariam, T., & Ying, S. (2022). The foreign direct investment-export performance nexus: An ARDL based empirical evidence from Ethiopia. *Cogent Economics and Finance, 10*, 2009089. https://doi.org/10.1080/23322039.2021.2009089
Greene, W. (2003). *Econometric analysis*. USA: Prentice Hall International.
Hawlet, M., Zewdu, B., & Getachew, A. (2019). Determinants of market outlet choice decision of tomato producers in Fogera Woreda, South Gonder Zone, Ethiopia. *Cogent Food and Agriculture, 5*(1), 1709394. https://doi.org/10.1080/23311932.2019.1709394
Hess, S., Daly, A., & Batley, R. (2018). Theory and implications of revisiting consistency with random utility maximization. *Theory and Decision Journal, 84*(1), 181–204. https://doi.org/10.1007/s11238-017-9651-7
Hussein, K., & Suttie, D. (2016). IFAD Research Series 5-Rural-urban linkages and food systems in sub-Saharan Africa: The rural dimension. IFAD Research series.
Jerena, J. (2017). Major red beans marketing channels in Halaba special district, Ethiopia. *International Journal of Research Studies in Agricultural Sciences (IJRSAS), 3*(12), 8–17.
Keith, O. (2018). Statistical classification, prediction and interpretation of term specificity. *Journal of Documentation, 28*(1), 11–21.

Kifle, T., Ayal, D., & Mulugeta, M. (2022). Factors influencing farmers adoption of climate smart agriculture to respond climate variability in Siyadebrina Wayu District, central highland of Ethiopia. *Climate Services., 26*, 100290. https://doi.org/10.1016/j.cliser.2022.100290
Kilelu, C., Klerkx, L., Omore, A., Baltenweck, I., Leeuwis, C., & Githinji, J. (2017). Value chain upgrading and the inclusion of smallholders in markets: Reflections on contributions of multi-stakeholder processes in dairy development in Tanzania. *The European Journal of Development Research, 29*(5), 1102–1121. https://doi.org/10.1057/s41287-016-0074-z
Kiplangat, N., & Vincent, N. (2018). Farm gate dairy milk marketing channel choice in Kericho. *Journal of World Economic Research, 7*(3), 92–104. https://doi.org/10.11648/j.jwer.20180703.11
Kuma, B., Baker, D., Getnet, K., & Kassa, B. (2013). Factors affecting milk market outlet choices in Wolaita zone, Ethiopia. *African Journal of Agricultural Research, 8*(21), 2493–2501.
Kumar, V., Choi, J. B., & Greene, M. (2018). Synergistic Effects of Social Media and Traditional Marketing on Brand Sales: Capturing the Time-Varying Effects. *Journal of the Academy of Marketing Science, 45*, 268–288.
Mebrat, T. (2014). Tomato value chain analysis in the central rift valley: The case of Dugda woreda, East Shoa zone, Oromia National regional state, Ethiopia (M. Sc. Thesis). Haramaya University, Haramaya, Ethiopia.
Melese, T., Goshu, D., & Tilahun, A. (2018). Determinants of outlet choices by smallholder onion farmers in Fogera district Amhara Region, Northwestern Ethiopia. *Journal of Horticulture and Forestry, 10*(3), 27–35. https://doi.org/10.5897/JHF2018.0524
Mengistu, T., Ayal, D.Y., & Mulugeta, M. (2022). Factors influencing farmers adoption of climate smart agriculture to respond climate variability in Siyadebrina Wayu District, central highland of Ethiopia. *Climate Services, 26*, 100290. https://doi.org/10.1016/j.cliser.2022
Moctar, N., Elodie, D., & Tristan, C. (2015). Maize price volatility: Does market remoteness matter? World Bank Group. Africa Region. Policy Research Working Paper 7202.
Mohammed, H., Birhane, Z., & Alemayehu, G. (2019). Determinants of market outlet choice decision of tomato producers in Fogera woreda, South Gonder zone, Ethiopia. *Cogent Food and Agriculture, 5*(1), 1709394.
Morton, G., & Martey, E. (2021). Market information and maize commercialization in the Savannah and Northern regions of Ghana. *Scientific African, 13*, e00938. https://doi.org/10.1016/j.sciaf.2021.e00938
Mossie, Z., & Berhane, G. (2020). Alemayehu factor affecting channel choice of onion producers northwest Ethiopia in multivariate probit approach. *Cogent Food and Agriculture, 6*(1), 1722351. https://doi.org/10.1080/23311932.2020.1722351
Mukiama, B., Suphanchaimatand, N., & Sriwaranun, Y. (2014). Factors influencing vegetable farmer's choice of marketing channel in Khon Kaen, Thailand. *Khon Kaen Agriculture Journal, 42*(4), 595–604.
Nakawuka, P., Langan, S., Schmitter, P., & Barron, J. (2018). A review of trends, constraints and opportunities of smallholder irrigation in East Africa. *Global Food Security., 17*, 196–212.
Ntimbaa, G. J. (2017). Factors influencing choice decision for marketing channels by coffee farmers in Karagwe District, Tanzania. *Global Journal of Biology, Agriculture & Health Sciences, 6*(2), 1–10. https://doi.org/10.24105/gjbahs.6.2.1701
Nuri, L. (2016). Value chain analysis of enset (Enset ventricosum) in Hadiya Zone. Southern Ethiopia.
Nxumalo, K., Oduniyi, O., Antwi, M., & Tekana, S. (2019). Determinants of market channel choice utilized by maize and sunflower farmers in the North West province, South Africa. *Cogent Social Sciences, 5*, 1678451.
Nyaga, J. (2016). Factors influencing the choice of marketing channel by fish farmers in Kirinyaga County. Ageconsearch. Umn.Edu. Retrieved from http://ageconsearch.umn.edu/bitstream/249338/2/284.FishfarminginKenya.pdf.
Panda, R., & Sreekumar, K. (2012). Marketing channel choice and marketing efficiency assessment in agribusiness. *Journal of International Food and Agribusiness Marketing., 24*(3), 213–230.
Pham, T., Theuvsen, L., & Otter, V. (2019). Determinants of smallholder farmers' marketing channel choice: Evidence from the Vietnamese rice sector. *Asian Economic Journal, 33*, 281–300.
Regasa, M., Nones, M., & Adeba, D. (2021). A review on land use and land cover change in Ethiopian Basins. *Land, 10*, 585. https://doi.org/10.3390/land10060585
Schulze Schwering, D., Isabell Sonntag, W., & Kühl, S. (2022). Agricultural E-Commerce: Attitude segmentation of farmers. *Computers and Electronics in Agriculture, 197*, 106942.
Shewaye, A., Dawit, A., & Lemma, Z. (2016). Determinants of haricot bean market participation in Misrak Badawacho District, Hadiya zone, Southern Nations Nationalities and Peoples Regional State. *Ethiopian Journal of Agricultural. Sciences., 26*(2), 69–81.
Soe, W., Moritaka, M., & Fukuda, S. (2015). An analysis of the factors influencing marketing channel choice by paddy rice farmers in Myanmar". *Journal of the Faculty of Agriculture, Kyushu University, 60*(2), 535–542.
Solomon, K., & Tebarek, L. (2023). Determinants of market outlet choice by smallholder wheat producers in Arsi Zone of Oromia National Regional State, Ethiopia. *Cogent Food and Agriculture, 9*(1), 2163578. https://doi.org/10.1080/23311932.2022.2163578
Tadie, M., Taye, M., & Abebe, B. (2019). Determinants of market outlet choices by smallholder tef farmers in Dera District, South Gondar Zone, Amhara National Regional State, Ethiopia: A multivariate probit approach. *Journal of Economic Structure, 8*(39), 1–14. https://doi.org/10.1186/s40008-019-0167-x
Tarekegn, K., Haji, J., & Tegegne, B. (2017). Determinants of honey producer market outlet choice in Chena District, southern Ethiopia: A multivariate probit regression analysis. *Agricultural and Food Economics, 5*, 1–14. https://doi.org/10.1186/s40100-017-0090-0
Taye, M., Degye, G., & Assefa, T. (2018). Determinants of outlet choices by smallholder onion farmers in Fogera district Amhara Region, Northwestern Ethiopia. *Journal of Horticulture and Forestry, 10*(3), 27–35.
Temesgen, F., Gobena, E., & Megersa, H. (2017). Analysis of sesame marketing chain in case of Gimbi Districts, Ethiopia. *Journal of Education and Practice, 8*(10), 97–101. https://doi.org/10.4314/eamj.v78i2.9097
Tewoderos, M., Degye, G., & Bosena, T. (2020). Determinants Sorghum Market among smallholder farmers in Kafta Humera District Tigeray Ethiopia. *South Asian Journal of Social Studies and Economics, 8*(1), 1–13. https://doi.org/10.9734/SAJSSE/2020/v8i130200
Thamthanakoon, N., Huang, I., Eastham, J., Ward, S., & Manning, L. (2021). Factors driving Thailand rice farmer decision-making in the choice of marketing channel. *British Food Journal., 124*, 331–349.

Tola, M., & Ketema, M. (2014). Tomato value chain analysis in the central rift valley: the case of Dugda woreda, East Shoa zone, Oromia National regional state, Ethiopia. https://bit.ly/3hAqply.
Wordofa, M., Hassen, J., Endris, G., Aweke, C. S., Moges, D., & Rorisa, D. (2021). Adoption of improved agricultural technology and its impact on household income: A propensity score matching estimation in Eastern Ethiopia. *Agriculture and Food Security., 10*, 1–12. https://doi.org/10.1186/s40066-020-00278-2
Wosene, M., Ketema, L., & Ademe, A. (2018). Factors affecting market outlet choices of pepper producers in Wonberma district, Northwest Ethiopia: Multivariate probit approach. *Cogent Food and Agriculture, 4*(1), 1558497.
Xaba, B., & Masuku, M. (2013). Factors affecting the choice of marketing channel by vegetable farmers in Swaziland. *Sustainable Agriculture Research., 2*, 112–123.
Yamane, T. (1967). *Statistics: An introductory analysis* (2nd ed.). New York: Harper and Row.
Yonnas, A., Bosena, T., & Mengistu, K. (2019). Determinants of wheat market outlet choice of smallholder farmers: The case of Dembecha District, Amhara National Regional State, Ethiopia. *Journal of Poverty, Investment and Development, 50*, 1–12. https://doi.org/10.7176/JPID
Zegeye, M., Fikrie, A., & Assefa, A. (2022). Impact of agricultural technology adoption on wheat productivity: Evidence from North Shewa Zone, Amhara Region, Ethiopia. *Cogent Economics and Finance, 10*, 2101223. https://doi.org/10.1080/23322039.2022.2101223
Zhang, X., Qing, P., & Yu, X. (2019). Short supply chain participation and market performance for vegetable farmers in China. *Australian Journal Agriculture and Resource Economics, 63*, 282–306.

Publisher's Note