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Determinants of Market Outlet Choices of Tef Producers in Western Ethiopia: Evidence of Multivariate Probit Model

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ABSTRACT

This study was required to assess the existing tef market outlets and examine factors affecting market outlet choices among smallholder tef producers in western Ethiopia. For this study qualitative and quantitative data were collected from tef producers. Purposive and multi-stage sampling technique was used to determine sample households. The descriptive statistics and multivariate probit model were employed to analyze the collected data. The result shows that there are five alternative main market outlets available for the tef producers that are wholesalers, collectors, cooperatives, consumers, and retailers. These market outlets were affected by household's demographic such as age, gender, education level, and household size), socio-economics (land allocated for tef, a variety used, livestock holding, and off/non-farm activities), institutional (credit, extension, and market information), and market (volume of tef produced, own transport facility, and nearest market) factors. Based on the findings strengthening farmers' skills and knowledge through training, advising, and supervision; capacitate farmers by the additional work atmosphere and empowering women farmers by improved variety, working capital, and other recommendations are need attention by respective sectors.

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Introduction

Tef is the most important crop grown in Ethiopia in terms of area coverage and total production crop (Cheng et al., 2017). The crop is a significant main diet and cash crop value for rural smallholder farmers in Ethiopia (Fentie & Beyene, 2019). Tef straw is also used for livestock as feed (Barretto et al., 2021). The wide smallholder farmers in the country favor producing the crop because it is greatest adaptable to a wide range of environmental conditions can produce well in marginal areas and is extremely tolerant of drought and other constraints (Bekele et al., 2020). The crop is less susceptible to diseases and insects and rich in nutrients (Mihretie et al., 2021). In the country, about seven million farmers grow tef on more than three million hectares of land and produce more than fifty-four million tons of products which are mainly produced in the Oromia and Amhara regions (CSA, 2021). The crop is economically greater than other crops in Ethiopia (Lee, 2018). As urbanization is expanding and earnings have raised the demand for crops is elevated in the country (Minten et al., 2016). Besides the domestic interest, the international demand for the crop grain is elevated due to its well-being welfare, and cultivation of different agro-ecologies (Tadele & Hibistu, 2021). The grain production of the crop has been increasing in current years because of the crop's perceived dietary welfare leading to farming in North America, China, India, Australia, the UK, Cameroon, and Uganda (Barretto et al., 2021).

In Oromia regional state, the crop is produced on more than 1.4 million hectares of land and about three million farmers have participated in the production which received about 26 million tons (CSA, 2021). In the study areas, East Wollega, Horro Guduru Wollega, and West Shewa zones, tef is the most cultivated crop for food security and cash crop next to coffee (Hussen & Geleta, 2021). It is the first crop among the cultivated crops by farmers in cases of area exposure and total production contribution in the West Shewa zone (Geleta, 2020). The crop is also the second in the East Wollega zone by area coverage and total production next to maize (CSA, 2021). Tef is the first crop grown by farmers in terms of area exposure and second in

cases of crop production next to maize in the Horro Guduru Wollega zone (Tesema, 2021).

Tef productivity is lower than other cereals crop and the market demand for tef output and byproduct are advanced than other cereal crops (Abrah et al., 2017). The enhancement of tef productivity is wanted to fulfill the requirements of the cultivating demand in the country and universal market (Cheng et al., 2017; Barretto et al., 2021). The yield of the crop is low due to lack of better tef management practices, high susceptibility to lodging, weed competition, shortage of improved input, and presence of informal traders'[14]. To improve tef productivity, tef research has been introduced since 1950 in Ethiopia (Minten et al., 2016; Lee, 2018). The investigation programs focused on breeding, agronomy, protection, and technology dissemination (Stastna et al., 2019). However, the effort has not been given attention to the marketing outlet choices (Tadele & Hibistu, 2021). Missed marketing outlets opportunities give substantial attention to sustainable crop production increase and marketed surplus is not possible (Bisht, 2021). Market access is an important side for smallholder farmers in tef production to increase their incomes and general wellbeing (Taye et al., 2018). The market provides a connection of economies & helps in enabling economic efficiency by encouraging an exchange of goods and services (Ozanne et al., 2021). Marketing channel choice is the most significant farm household choice to sell tef outputs in various market channels which take a great effect on household revenue (Chang et al., 2021). The market outlet choice is influenced by different factors (Ermias, 2021). Accepting the relationship with market outlets and the causes which affect the use of marketing outlets is important in sketching the markets as well as launching policy interferences that are wisely planned to the advantage of producers (McGuirt et al., 2018).

Choosing marketing channels both informal and formal channels for smallholder farmers is very important in marketing roles which provide various price levels and demand searching for farmers (Mgale & Yunxian, 2020). The informal market channels have non-official market transactions from farmers directly to consumers, other farmers, friends, and relatives and are the more popular option in the study areas (Munasinghe et al., 2019; Ermias, 2021). These channels used independent sections of the economy with different systems between buyers (Nxumalo et al., 2019). The formal markets have clear approaches to measurements and work with modern trading (clear formal frameworks) and are described with a modern marketing chain structure (Binda & Koch, 2021; Morakile et a., 2021). Amended market channels for smallholder farmers are essential to improving crop productivity which increases rural farmers' income and marketable tef products (Usman & Callo-Concha, 2021).

Smallholder farmers in the country, specifically in the study zones suffer from high transaction costs, inadequate market outlets, low credit access for crop marketing, weak bargaining power of farmers, price volatility, and weak market information (Abate et al., 2019). The smallholder farmer revenue increase is an estimated use of a market channel that maximizes profit and increases smallholder farmer welfare (Anthony et al., 2021). The insufficiency of evidence concerning existing market outlets and factors that affect households' market outlet choices are the special backbone of this study (Adams et al., 2022). The problems related to tef markets and market outlets choice essential to be sufficiently addressed (Ayele et al., 2021). Thus, smallholder farmers would be better off when they can benefit from increased market opportunities through market outlets (Dlamini-Mazibuko et al., 2019). Hence, identifying determinants of smallholder tef farmers' choice marketing outlets decisions in western Oromia.

Research Methodology

Description of the Study Areas

The study was conducted in East Wollega, Horro Guduru Wollega, and West Shewa zones. Three districts namely Horro, Guduru, and Jimma Rare. Horro district is located 320 km west of Finfinne (the capital city of Ethiopia) with geographical coordinates of 09°34ˈ N and 37°6ˈ E latitude and longitude, respectively at ranging altitude 1540 to 2844 meters above sea level. The agro-ecology of the district was highland (43%), midland (55%), and lowland (2%) with an average of 1566 mm annual rainfall. The monthly average temperature of the district varies from 10 to 25°C (Tajudin et al., 2018; Jebena & Tenagashaw, 2022). Guduru district is located 372 km west of Finfinne (the capital city of the country) with geographical coordinates of 09°30ˈ N and 37°35ˈ E latitude and longitude, respectively at an average altitude 1969 meters above sea level. The agro-ecology of the district was highland (18%), midland (62%), and lowland (20%) with the average monthly varies from 1450 to 2500 mm annual rainfall. The monthly average temperature of the district varies from 19 to 22°C (Abiyot et al., 2018; Tajudin et al., 2018)). Jimma Rare district is located 243 km west of Finfinne (the capital city of Ethiopia) with geographical coordinates of 09°10ˈ N and 37°20ˈ E of latitude and longitude, respectively at ranging altitude 1540 to 3047 meters above sea level. The agro-ecology of the district was highland (45%), midland (52%), and lowland (3%) with monthly average rainfall varying from 1450 to 2500 mm. The monthly average temperature of the district varies from 18 to 25°C (Gelana et al., 2020).

The two districts were selected from the East Wollega zone name: Jimma Arjo and Gudeya Bila. Jimma Arjo district is located 372 km west of Finfinnee (the capital city of Ethiopia) with geographical coordinates of 09°30ˈ N and 37°35ˈE latitude and longitude, respectively a mean of altitude 1969 meters above sea level. The agro-ecology of the district was highland (18%), midland (62%), and lowland (20%) with an average of 2417 mm annual rainfall. The monthly average of temperature the district varies from 12 to 22°C (Bekuma et al., 2020; Efa, 2021). Gudeya Bila district is located 274 km west of Finfinne (the capital city of the country) with geographical coordinates of 09°17ˈ N and 37°01ˈ46ˈˈ E latitude and longitude, respectively with ranging of altitude 1100 to 2400 meters above sea level. The agro-ecology of the district was highland (18%), midland (56%), and lowland (26%) with the average monthly varies from 1000 to 2200 mm annual rainfall. The monthly average temperature of the district varies from 19 to 28°C (Tesema, 2021).

Similar to the East Wollega zone, two districts were selected from the West Shewa zone name: Cheliya and

Danno. Cheliya district is located 175 km west of Finfinne (the capital city of Ethiopia) with geographical coordinates of 09°00' N and 37°29' E latitude and longitude, respectively with a range of altitude 1300 to 2039 meters above sea level. The agro-ecology of the district was highland (75%), midland (20%), and lowland (5%) with annual ranges of rainfall 1000 to 2000 mm. The monthly average temperature of the district varies from 8 to 28°C Tajudin et al., 2018; Kifle et al., 2020). Danno district is located 260 km west of Finfinne (the capital city of the country) with geographical coordinates latitude ranges from 08°34' - 08°56', 37°08' – 37°29', and 1600 – 1880 meters above sea level latitude, longitude, and altitude, respectively. The agro-ecology of the district was highland (5%), midland (75%), and lowland (20%) with the average monthly varies from 900 to 2400 mm annual rainfall. The monthly average temperature of the district varies from 18 to 30°C (Tajudin et al., 2018; Wodajo, 2022). The in all seven districts are favorable for multi-disciplinary agricultural activities and livestock production. The major crops grown in the areas are maize, tef, wheat, barley, bean, pea, nug, potato, tomato, onion, coffee, etc.

Data Sources and Methods of Data collection

The quantitative data collected for primary and secondary data sources were used for this study. This quantitative data on households' characteristics, distances to inputs sources and tef market, tef production management and inputs used, amount of tef produced and sold, prices of inputs, institutional factors (credit, extension, market information, etc.), and tef grain price were collected from tef producers and other actors using a semi-structured questionnaire. Before normal data collection, the survey questionnaire was pre-tested, and legalizing the survey tool handling, management practices were used. The Census and Survey Processing System (CSPro) software package was used for data collection. The secondary data which relevant to this paper was collected from published (journals and books) and unpublished (central statistical agency, lists of farmers, kebeles, districts, input sources, production status of tef from zones and districts, etc.) for the rational conclusion.

Sampling Techniques

Purposive and multi-stage sampling techniques to select appropriate sample households. In the first stage, three zones of wester Oromia namely east Wollega, Horro Guduru Wollega, and west Shewa were selected purposively based on their proximity of tef production and marketing access. In the second stage, seven districts were selected randomly from 20 potential districts of tef produced. In the third stage, two kebeles from each district were sampled randomly from those potential kebeles of tef production and have access to market kebeles. Finally, 243 sample households were sampled randomly based on probability proportional to size and using simple formula produced by Yamane which cited by Aweke et al. (2020). Accordingly, the sample household determination formula is as follow:

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

Where;

n = Sample size
N = Total number of tef supply to market
e = Precision level (0.05)

Methods of Data Analysis

The collected data was analyzed by descriptive statistics such as frequency, percentage, means, standard deviation and multivariate probit model. Smallholder farmers' choice to sell tef grain to specific market outlets respects the random utility theory whereby growers assess the market outlets and choose those maximizing their values[34]. According to various authors, multinomial probit and multivariate probit are the most models used to identify factors affecting marketing channels choice based on dependent variables (Taye et al., 2018; Abate et al., 2019; Dlamini-Mazibuko et al., 2019; Nxumalo et al., 2019; Mossie et al., 2020). The multinomial model for market outlet choice would not be feasible because farmers would be restricted to choosing only one market outlet from the set of jointly exclusively comprehensive choices, the independence of irrelevant alternative assumptions, and relevant risks of choosing one outlet (Balogh et al., 2016). The multivariate probit model was adopted to simultaneously choice of one or more market outlets among the available market outlets depending on tef producers' willingness to maximize their profit to explanatory variables (Mohammed Kassaw et al., 2019). This multivariate probit is an appropriate model for multiple-choice problems for this study to examine the factors affecting market outlet choices (Tarekegn et al., 2017). Hence, the model takes into account the potential reflected the interdependent in market channels choice and the likely relationship in the choice of alternative market channels (Dessie et al., 2018). Therefore, the multivariate probit model was more appropriate to this study by normal distribution at zero conditional mean and variance normalized to the unit. The model was expressed as follows:

$$Y^*_{im}=\beta_m X_{im}+\varepsilon_i \ (m=Y_1, Y_2, Y_3, Y_4 \ \& \ Y_5);$$
$$Y_{im=1 \text{ if }} Y^*_{i>0 \text{ and }} Y_{im=0 \text{ if }} Y^*_{i<0}$$

Where;

Y_i^*= Is dependent variables for tef market outlet choices
β_m= Is a vector of estimators
X_{im}=Is explanatory variables
ε_i= Is a vector of error terms under the assumption of normal distribution.

The alternative market outlet choices decision for households chooses direct wholesalers (Y_1), collectors (Y_2), cooperatives (Y_3), consumers (Y_4), and retailers (Y_5) to sell tef. The symmetric covariance matrix Ω is given as follows:

$$\Omega=\begin{Bmatrix} 1 & \rho_{12} & \rho_{13} & \rho_{14} & \rho_{15} \\ \rho_{21} & 1 & \rho_{23} & \rho_{24} & \rho_{25} \\ \rho_{31} & \rho_{32} & 1 & \rho_{34} & \rho_{35} \\ \rho_{41} & \rho_{42} & \rho_{43} & 1 & \rho_{45} \\ \rho_{51} & \rho_{52} & \rho_{53} & \rho_{54} & 1 \end{Bmatrix}$$

Where ρ_{ij} denotes the pairwise relationship coefficient of error terms, corresponding between different types of tef market outlets. The non-zero off-diagonal allows for correlation across error terms of numerous latent equations, which represents unobserved characteristics that affect the choice of other channels.

Results and Discussion

Farmers Decision on Market Outlets Choose

In the study areas, smallholder tef producers choose five market outlets as alternatives to selling their products. Wholesalers market outlet was choice by farmers first following collectors which account for 76.13% of total sales. Cooperatives market outlet contribution in buying tef was the least one amongst the outlets which account 11.93% of total sales. The others market outlets like collectors, consumers, and retailers' contributions out of total sales were 66.26%, 37.86%, and 28.40%, individually (Table 1). This result suggests that tef producers have been restricted from selling tef products to cooperatives market outlets.

Households and Farm Characteristics by Market Outlets Choice

The descriptive proportion of dummy variables based on frequency counts and the percentage was presented in Table 2. The results showed that both male and female-headed households were involved in tef production and marketing. Among the sample households that participated in tef production and marketing, about 89.71% of households were male while the remaining about10.29% were female (Table 2). The proportion of male households who choose wholesalers (91.89%), collectors (95.03%), cooperatives (96.55%), consumers (96.74), and retailers (98.55%) market outlets (Table 2).

Additional farm income sources in the study areas believed that it affected market outlets' choice directly when this income was invested in tef production and marketing activities such as input purchase, labor rent for production and harvesting as well as transportation and other marketing activities costs. Regarding off/non-farm income among the tef market participants, 33.33% have participated in the activities and the remaining (66.67%) have not participated. These results showed that the households who participated in off/non-farm activities, 36.76%, 33.54%, 48.28%, 30.43%, and 27.54% tef producers sold tef output to the corresponding wholesalers, collectors, cooperatives, consumers, and retailers market outlets choice (Table 2). In terms of households who have credit access, 37.30%, 37.27%, 37.93%, 34.78%, and 33.33% tef producers sold their products to the matching wholesalers, collectors, cooperatives, consumers, and retailers' market outlets choice (Table 2).

The results further revealed that households that have access to extension services who choose wholesalers, collectors, cooperatives, consumers, and retailers market outlets were 54.05%, 52.80%, 65.52%, 64.13%, and 57.97%, respectively. In terms of households who access market information select wholesalers (30.27%), collectors (32.30%), cooperatives (58.62%, consumers (43.48%), and 55.07% market outlets (Table 2). This market information reflects a seeking better price for the decision to the choice a more profitable market outlet.

The availability of its transport service created home value for the product. According to the result, sample households' transport capacity indicated that 67.57%, 65.84%, 72.41%, 78.26%, and 69.57% of market participants sold tef to wholesalers, and collectors, cooperatives, consumers, and retailers, correspondingly as the choice of market channels (Table 2). This reflects that households that own transport services choose better markets and received better prices.

Table 1. Proportion of market outlets choose of households (n = 243)

Decision to choose	Market outlet choices									
	Wholesalers (Y_1)		Collectors (Y_2)		Cooperatives (Y_3)		Consumers (Y_4)		Retailers (Y_5)	
	N	%	N	%	N	%	N	%	N	%
Yes	185	76.13	161	66.26	29	11.93	92	37.86	69	28.40
No	58	23.87	82	33.74	214	88.07	151	62.14	174	71.60

Table 2. The proportion of household characteristics by tef market outlets (n = 243)

Dummy variables	Class	Wholesalers (n = 185)		Collectors (n = 161)		Cooperatives (n = 29)		Consumers (n = 92)		Retailers (n = 69)	
		N	%	N	%	N	%	N	%	N	%
Gender of household head	Male	170	91.89	153	95.03	28	96.55	89	96.74	68	98.55
	Female	15	8.11	8	4.97	1	3.45	3	3.26	1	1.45
Off/non-farm participation	Yes	68	36.76	54	33.54	14	48.28	28	30.43	19	27.54
	No	117	63.24	107	66.46	15	51.72	64	69.57	50	72.46
Access to extension service	Yes	100	54.05	85	52.80	19	65.52	59	64.13	40	57.97
	No	85	45.95	76	47.20	10	34.48	33	35.87	29	42.03
Access to credit service	Yes	69	37.30	60	37.27	11	37.93	32	34.78	23	33.33
	No	116	62.70	101	62.73	18	62.07	60	65.22	46	66.67
Access to market information	Yes	56	30.27	52	32.30	17	58.62	40	43.48	38	55.07
	No	129	69.73	109	67.70	12	41.38	52	56.52	31	44.93
Own transport facility	Yes	125	67.57	106	65.84	21	72.41	72	78.26	48	69.57
	No	60	32.43	55	34.16	8	27.59	20	21.74	21	30.43
Used improved variety	Yes	45	24.32	43	26.71	15	51.72	24	26.09	19	27.54
	No	140	75.68	118	73.29	14	48.28	68	73.91	50	72.46

Table 3. Means (std.) of household characteristics by tef market outlets (n = 243)

Continuous variables	Wholesalers (n = 185)	Collectors (n = 161)	Cooperative (n = 29)	Consumers (n = 92)	Retailers (n = 69)
Age of household (year)	47.55 (10.81)	48.43 (10.71)	53.14 (10.07)	49.92 (11.90)	51.83 (11.31)
Education level (years)	5.31 (3.89)	5.49 (3.96)	9.17 (0.70)	6.06 (4.27)	6.71 (4.53)
Land owned for tef (ha)	1.15 (0.55)	1.18 (0.59)	1.39 (0.79)	1.26 (0.54)	1.43 (0.66)
Total tef produced (Qt)	12.65 (6.78)	13.01 (7.17)	20.53 (11.40)	14.44 (8.39)	11.35 (8.80)
Household size (person)	6.91 (2.30)	7.19 (2.19)	6.62 (2.25)	7.09 (2.35)	7.01 (2.15)
Livestock (TLU)	11.01 (5.56)	11.03 (5.98)	11.94 (6.80)	11.29 (5.66)	11.96 (5.93)
Distance of nearest tef sold market (min)	47.92 (39.72)	44.38 (38.74)	33.45 (30.50)	43.33 (37.42)	39.80 (36.88)

Table 4. Suitability, possibilities and relationship matrix of tef market outlets from MVP model

Variables	Wholesaler	Collector	Cooperative	Consumer	Retailer
Predicted probability	0.593	0.374	0.626	0.519	0.437
Joint probability (success)			0.027		
Joint probability (failure)			0.056		
Number of draws			5		
Number of observation			243		
Independent variables utility			Wald X^2 (75)= 685.88 & Prob X^2 = 0.000		
Correlation matrix	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5
ρ_1	1				
ρ_2	-0.11(0.18)	1			
ρ_3	0.43***(0.14)	-0.50***(0.11)	1		
ρ_4	-0.46***(0.14)	-0.50***(0.09)	-0.09(0.12)	1	
ρ_5	-0.29**(0.14)	-0.62***(0.15)	0.19(0.20)	0.19(0.12)	1
Likelihood ratio test of; $\rho_{21}=\rho_{31}=\rho_{41}=\rho_{51}=\rho_{32}=\rho_{42}=\rho_{52}=\rho_{43}=\rho_{53}=\rho_{54}=0$					
Chi $(X)^2$ (10) = 87.287 & Prob > X^2= 0.000					

Concerning used improved tef varieties households who used improved varieties sold tef products to wholesalers (24.32%), collectors (26.71%), cooperatives (51.72%), consumers (26.09%), and retailers (27.54%) as select marketing channels (Table 2).

The continuous variables who focused on means was presented in Table 3. According to this result the average age of the household head to choose the wholesaler, collector, cooperative, consumer, and retailer tef market outlets were 47.55, 48.43, 53.14, 49.92, and 51.83 years respectively (Table 3). The mean education level of household heads to select the wholesaler, collector, cooperative, consumer, and retailer tef market outlets were 5.31, 5.49, 9.17, 6.06, and 6.71 schooling years, respectively (Table 3).

The tef farm size variable was an important factor required for tef production in the area. The results suggested that the mean of tef farm size to choose the wholesaler, collector, cooperative, consumer, and retailer tef market outlets were 1.15, .18, 1.39, 1.26, and 1.43 hectares, respectively (Table 3).

The average households who choose wholesaler, collector, cooperative, consumer, and retailer tef market outlets were 12.65, 13.01, 20.53, 14.44, and 11.35 quintals produced, respectively (Table 3). This quantity of tef products were directly affected market outlet choices among tef producers participated in the market.

The average household size to choose the wholesaler, collector, cooperative, consumer, and retailer tef market outlets was 6.91, 7.19, 6.62, 7.09, and 7.01 persons, respectively (Table 3). This household size variable revealed the availability of labor required for tef production and marketing activities.

Livestock holding (TLU) was used as the key factor in tef production (purchasing inputs) and marketing activities. On average the households who choose the wholesaler, collector, cooperative, consumer, and retailer tef market outlets were 11.01, 11.03, 11.94, 11.29, and 11.96 livestock holding (TLU), respectively (Table 3).

Regarding distance of nearest tef sold market who choose the wholesaler, collector, cooperative, consumer, and retailer tef market outlets were on average 47.92, 44.38, 33.45, 43.33-, and 39.80-minutes walking away from their home respectively (Table 3).

Fitness, Probability and Correlation Matrix of Market Outlets

Farmers in the study zones have five other market outlets chosen for selling tef products. The multivariate probit model was applied to estimate several correlated binaries together predicting these five outlet choices. The Wald $X^2(70) = 685.88$ was statistically significant at a 1% significance level (Table 4), which indicates that the subset of coefficients of the model was jointly significant and the independent variables power of the variables included in the model was reasonable. The likelihood ratio test in the model showed that X^2 (10) = 87.287 was statistically significant at a 1% significance level (Table 4). This result indicates that the null hypothesis that choices of the five market outlets were independently rejected and there are different market outlets choice among the smallholder farmers. This result shows the goodness of fit of the multivariate probity model for this study.

The value of ρ (ρ_{ij}) indicated that the correlation of respectively market outlets choice. The ρ_{31} (the correlation between the choice of cooperative and wholesaler outlets)

was positively and significantly at a 1% significant level. The ρ_{41} (the correlation between consumer and wholesaler), ρ_{51} (the correlation between retailer and wholesaler), ρ_{32} (the correlation between cooperative and collector), ρ_{42} (the correlation between consumer and collector), and ρ_{52} (the correlation between retailer and collector) were negatively and significantly significant at a 1%, 5%, 1%, 1%, and 1% significance levels, respectively (Table 4). The result indicates a complementary relationship of cooperative with wholesaler and competitive connection of consumer with a wholesaler, retailer with a wholesaler, cooperative with a collector, consumer with a collector, and retailer with collector market outlets. This result indicates that the marginal success probability of each market outlet's choice was different.

The predicted probability estimation result indicated that the likelihood of selecting a cooperative outlet was comparatively high (62.6%) as compared to the probability of selecting a wholesaler (59.3%), consumer (51.9%), retailer (43.7%), and collector (37.4%) which presented in Table 4. The result indicated that the collector outlet was less expected chosen to be delivered to cooperative and wholesale.

Determinants of Marketing Outlets Choice of Tef Farmers

From the results in Table 5 based on a multivariate probit model used demographic, socio-economics, institutional, and market factors were statistically meaningfully influencing the marketing outlets' choice performance of smallholder farmers. The age of the respondent was found to have a negative and significantly affected in choosing wholesaler tef market outlet at 10% significance level (Table 5).

Table 5. Determinants of market outlets choice of farmers (n = 243)

Marketing choice variables	Wholesalers (Y_1)	Collectors (Y_2)	Cooperatives (Y_3)
	Coeff. (Std. Err.)	Coeff. (Std. Err.)	Coeff. (Std. Err.)
Demographic factors			
Age of household (years)	-0.075* (0.010)	0.004 (0.009)	0.026** (0.011)
Gender of household	0.035 (0.323)	0.608** (0.285)	0.266 (0.480)
Education level of household (year)	0.041 (0.035)	0.020 (0.032)	0.113** (0.049)
Household size (person)	-0.075* (0.041)	0.084** (0.045)	-0.096* (0.054)
Socio-economics factors			
Area allocated for tef (ha)	-0.103 (0.318)	0.217 (0.279)	1.175*** (0.453)
Variety used	-0.075 (0.333)	0.491* (0.282)	-0.030 (0.329)
Livestock holding (TLU)	0.016 (0.024)	-0.008 (0.020)	0.015 (0.027)
Off/non-farm activities	0.386* (0.221)	-0.066 (0.020)	0.188 (0.247)
Institutional factors			
Access to credit service	0.226 (0.208)	0.102 (0.186)	0.376* (0.206)
Access to extension service	0.007 (0.206)	0.286** (0.129)	0.424* (0.235)
Access to market information	0.484* (0.302)	0.182 (0.271)	-0.145 (0.336)
Market factors			
Tef produced (quintal)	0.247*** (0.048)	0.114*** (0.0323)	0.149*** (0.033)
Own transport facility	-0.022 (0.222)	-0.067 (0.213)	-0.239 (0.281)
Nearest market distance (minute)	-0.076** (0.031)	-0.002 (0.003)	0.002 (0.003)
Constant	1.228* (0.672)	1.893*** (0.555)	3.538*** (0.911)
Marketing choice variables	Consumers (Y_4)		Retailers (Y_5)
	Coeff. (Std. Err.)		Coeff. (Std. Err.)
Demographic factors			
Age of household (years)	0.007 (0.009)		0.026*** (0.010)
Gender of household	0.591* (0,331)		0.417 (0.423)
Education level of household (year)	0.001 (0.027)		0.042 (0.034)
Household size (person)	0.016 (0.039)		-0.075* (0.038)
Socio-economics factors			
Area allocated for tef (ha)	-0.173 (0.326)		0.214 (0.324)
Variety used	-0.096 (0.279)		-0.221 (0.346)
Livestock holding (TLU)	-0.020 (0.017)		0.030** (0.014)
Off/non-farm activities	0.379* (0.202)		0.569** (0.254)
Institutional factors			
Access to credit service	-0.049 (0.187)		0.200 (0.202)
Access to extension service	0.365** (0.184)		0.47* (0.217)
Access to market information	0.447* (0.268)		0.623*** (0.248)
Market factors			
Tef produced (quintal)	0.083*** (0.029)		0.134*** (0.038)
Own transport facility	0.589*** (0.185)		-0.310 (0.228)
Nearest market distance (minute)	0.001 (0.029)		-0.003 (0.003)
Constant	2.386*** (0.587)		3.0582*** (0.706)

Variables marked with *, ** & *** were significant at 10%, 5% & 1% levels.

This implied that as the age of household rises by one year, the possibility of farmers selling their product to the wholesalers' market outlet decreases by 7.5%, ceteris paribus. Similarly, the age of households positively influenced farmers choosing cooperatives and retailers that were statistically significant at 5% and 1% levels, respectively (Table 5). This showed that as the age of household rises by one-year the possibility of farmers choosing cooperatives and retailers increases by 2.6%, all other factors held constant in both market outlets. This might be since older people may decide to choose a better market outlet which gives a higher price as compared to younger people which is in line with Taye et al. (2018) result who found as the age of household head rises by one-year better market outlet choose decision increase.

The gender of sample households was significantly affected by the likelihood of choosing collector and consumer at 5% and 10% of significance levels, respectively (Table 5). This suggests that male-headed households had a higher probability of selling their produce to collectors and consumers as compared to female-headed households and vice versa. This result is similar to the findings of Dibaba et al. (2021) and Norton &Dowd (2018) results who stated that the gender of the household had a significant influence on the choice of marketing outlets.

The education level of the household was significantly affected by the likelihood of choosing a cooperative market outlet at 5% of the significance level (Table 5). This result suggests that as the household becomes literate by one class, the probability of choosing a cooperative market outlet increased by 11.3%, ceteris paribus. This can be described by the fact that as a producer becomes educated, they had good ability and knowledge of agricultural marketing, which enables them to sell their product in a more profitable market outlet. This study is similar to Dessie et al. (2018) result who found that the education level of respondents affects profitable market outlets.

Household size positively affected the collectors marketing outlets' choice of tef producers at a 5% significance level (Table 5). Also, household size has negatively affected the wholesaler, cooperative, and retailer marketing outlets' choice of tef producers at a 10% significance level. The negative result showed that as household size increases by one person, the probability of choosing wholesaler, cooperative, and retailer market outlets decreases by 7.5%, 9.6%, and 7.5%, individually. The reason might probably be due to larger produce demand for food home consumption. This result is consistent with Molla (2022) result that found that as the number of families increased, the probability to participate in the market decreased.

The improved variety used positively and statistically affected the likelihood of choosing a collector market outlet at a 10% significance level (Table 5). It shows that farmers who used improved variety were more likely to know about market outlet which offered a better price for their produces because of the farmers leading to more output which in turn increase product which increases the ability to choose the best market outlet for their product. This result was in line with Molla et al. (2022) result who stated that improved variety has positively affected the market outlet.

The model result revealed that livestock holding (TLU) of the household had a positively affected on the retailer market outlet choice at a 5% significance level (Table 5). This result implied that households having large livestock can purchase more improved input and have better animal manure that helps to enhance tef productivity and production. These improved inputs increase the volume of products and supply a large volume of tef to the retailer market outlet and it is in line with Wosene et al. (2018) result who found that number of livestock holding was a positive relationship with more profitable market outlet choice.

Off/non-farm income received was positively and significantly affected by the probability of choosing wholesaler, consumer, and retailer market outlets at 10%, 10%, and 5% significance levels, respectively (Table 5). This implied that as the farmer was involved in off/non-farm activities, the probability of choosing wholesaler, consumer, and retailer market outlets was increased by 38.6%, 37.9%, and 56.9%, respectively. The possible justification was producers chooses wholesaler, consumer, and retailer over other market outlets. This result is consistent with Degaga and Alamerie (2020) result who revealed that off/non-farm income increases the probability of choosing a better profitable market outlet than other outlets.

The access to credit for tef production and marketing activities has a positive and statistically influence on choosing a cooperative at a 10% significance level (Table 5). This result showed that the probability of choosing a cooperative market outlet was increased by 37.6% as farmers' access to credit increased by one frequency for farmers who participated in tef production and marketing activities. This finding is aligned with Taye et al. (2018) result who stated that credit access has a positive relationship more profitable with market outlet choice.

Extension contacts positively and statistically affected the likelihood of choosing collector, cooperative, consumer, and retailer market outlets at 5%, 10%, 5%, and 10% significance levels, respectively (Table 5). The result showed that as extension services increased with frequency, the probability of farmers choosing collector, cooperative, consumer, and retailer was increased by 28.6%, 42.4%, 36.5%, and 56.9%, respectively. This was because farmers having high contact with development agents and other experts were more likely to know about market outlets that offered a better price for their produces. In addition, extension service increases the ability of farmers to attain significant market information as well as enable tef producers to improve production method, hence leading to more output which in turn increase producers' ability to choose the best market outlet for their product market. Thus, households that were more visited by extension agents were highly likely to deliver tef product cooperative, consumer, and retailer market outlets than other existing market outlets. This result was in line with Wosene et al. (2018) and Tarekegn et al. (2017) results who found that extension contact has positively affected cooperative, consumer, and retailer market outlets.

Concerning market information, the results showed that if a farmer receives preliminary information on tef prices and buyers, the probability that farmers choose wholesalers increases (Table 5). This result revealed that with market information on price and buyers, the probability of farmers choosing wholesaler market outlets increased by 0.005 at a

5% significance level. On the other hand, households unable to obtain pricing and buying information were more likely to travel to the district and zone market center to sell their produce to wholesalers. Providing them with marketing information gave them more bargaining power and reduced their uncertainty when making trade deals with buyers. A similar result was found by Mgale and Yunxian (2020) result who argued that timely access to marketing information helps smallholder farmers to make informed decisions on market outlet choices.

The volume of tef produced has a positive and significant relationship with the likelihood of choosing wholesaler, collector, cooperative, consumer, and retailer market outlet at a 1% significance level (Table 5). This result indicated that as the volume of tef grain increases by a quintal, the probability of choosing wholesaler, collector, cooperative, consumer, and retailer market outlets increased by 24.7%, 11.4%, 14.9%, 8.3%, and 13.4%, ceteris paribus, respectively. This suggested that for a household that produces more tef products, farm households are more likely to choose all market outlets based on profitable gains which are in line with Awotide et al. (2016) result who found that the number of products sold increases market outlets.

Ownership of transport influenced the choice of consumer outlet positively and significantly at a 1% significance level (Table 5). These might be farmers who have transport facilities that could supply their product to the consumer directly by getting a better price. The result is in line with Ermias (2021) and Mohammed Kassaw et al. (2019) results who stated that the availability of own transport increases the probability of transporting goods to the consumer in the market.

The nearest market distance has a negative and significant relationship with the likelihood of choosing a wholesaler outlet at 5% of the significance level (Table 5). This result revealed that for those households whose residence from the nearest market increases by a minute, the likelihood of households choosing wholesale market outlets decreases by 7.6%, ceteris paribus. This implied that households located far from the nearest market were less likely in delivering tef produce to the wholesale market outlet. The reason for this was that farmers located nearest to the market were focused on better profitable outlets than transportation costs spent. This result is in line with Abate et al. (2019) result who found that farmers chose a better profitable market outlet than a higher transaction cost.

Conclusion and Recommendations

The study was undertaken with understanding the factors affecting tef market outlet choice in western Ethiopia. Regarding tef product flow in the study areas, the main buyers from producers were wholesalers, collectors, cooperatives, consumers, and retailers with an estimated percentage share of farmers supplied their products 76.13%, 66.26%, 11.93%, 37.86%, and 28.40%, respectively. Different factors affect farmers' choice of tef market outlets with five alternative tef market outlets that are available in the areas. Furthermore, the multivariate probit model result shows that the probability to choose the wholesaler market outlet was positively and significantly affected by off/non-farm income, access to market information, and volume of tef produced while negatively and significantly affected age of households, household size, and nearest tef sold to market. The probability to choose the collector market outlet was positively and significantly affected by gender, household size, the improved variety used, access to extension services, and volume of tef produced. Regarding cooperative market outlet age of household, cation level of household, the area allocated for tef, access to credit services, access to extension services, and volume of tef produced have affected positively and household size was affected negatively. Concerning, the probability of accessing consumer market outlet was positively influenced by gender, off/non-farm income, access to extension services, the volume of tef produced, and own transport facility. Likewise, the probability of choosing a retailer market outlet was positively affected by age of household, livestock holding, off/non-farm income, access to extension services, access to market information, and volume of tef produced.

Based on the findings, the following are possible areas of intervention for different stakeholders that support tef value chain in the area. Strengthening formal and informal farmers' education and extension training, as well as farmers advising systems in the study areas, need more government intervention to promote the effective marketing of tef through more profitable market outlets. Strengthening the cooperatives management members on business market information and working capacity (storage & transport facilities to add value and choice better market price tef grain for farmers). Developing high yielder varieties with disease resistance/tolerance for farmers is also crucial to enhance tef productivity and market participation. Women household heads need attention to participate in technology use through training and promoting market outlets. Access to additional income sources (off/non-farm activities & credit) programs similarly need attention to assist farmers purchase inputs and other marketing activities. Market information (price and buyers) should be enhanced to enable farmers to access more profitable market outlets. Therefore, access to reliable market information for farmers needs attention in the areas.

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Declaration of interest

The authors declare that we have no competing interests

Availability of Data and Material

Important data supporting the findings of this study are available within the article and supplementary materials are available based on request.

Authors' Contributions

The authors designed to research ideas, write the proposal for the fund, analyze the econometrics model, result in interpretation and discussion, write the manuscript, and finally read and approve the final manuscript.

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