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Research Article

Determinants of market participation decision and intensity of market participation in western Ethiopia: Evidence from smallholder tef producers

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Abstract

Tef is the first crop produced in Ethiopia and the main staple food and income generation source. The productivity of the crop is low due to different factors. This study aimed to identify factors affecting tef market participation decision and the level of market participation of tef producers'. Multi-stage sampling techniques were used to select appropriate sample households. The descriptive statistic, inferential statistic, and econometrics model were used to analyze the collected data. The result shows that 72.27% of sampled households sold their tef in the market. The double hurdle model result revealed that tef market participation decision was affected by land allocated for tef, the volume of tef produced, gender of household head, education level of household head, additional income sources, extension services, and market information while the intensity of participation was affected by the volume of tef produced, gender, education level, improved variety used, additional income sources, and extension service. These results suggest that to enhance the flow of tef to market and intensity of tef in participation skills and knowledge through training, advising, and supervision; capacitate farmers by the additional work atmosphere and empowering women farmers through improved variety and to access working capital are need attention by respective sectors that contribute in the commodity value chain.

Introduction

Agriculture is the core economy for food security in Ethiopia [1]. It plays an active role in determining the economic, social, political systems, and major employers for a high proportion of the population of Ethiopia [2]. In other words, it is the core source of food supply for home consumption and marketable items [3]. The sector is a source of raw input for manufacturing industries like food processing, textile, and leather sub-sectors [4]. It shows that agriculture is the main activity of each economy of Ethiopia.

Smallholder farmers of Ethiopia mostly cultivate cereals, legumes, vegetables, fruits, and cash crops based on rain-fed [5]. Among the cereal crops, tef is the first cultivated crop in case of acreage allocated and several farmers' participation and raised as a global crop [6]. The wide-scale farming of crops is related to their tolerance to different environmental constraints and nutritious value [7]. It indicates that crop production is the most important source of livelihood as food security and well-being status for smallholder farmers in the country [8] for home consumption and market. The farmers of Ethiopia sell their products through open markets like local public markets and roadside markets through direct marketing and intermediaries [9,10].

In western Oromia, tef is the most cultivated crop for food security and cash crop next to coffee [11]. Tef is the first crop among the cultivated crops by farmers in terms of area coverage and total production contribution in the West Shewa zone [12]. Tef is the second crop in the East Wollega zone by area coverage and total production next to maize. Tef is the first crop grown by farmers in terms of area coverage and second in cases of crop production next to maize in the Horro Guduru Wollega zone [13]. It reveals that tef is the basis for all livelihood activities in case of economic, socially acceptance, technically feasible, and an environmental friend in the areas.

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The agricultural sector of the study areas mainly focused on home consumption rather than supply to the market [14]. Farmers in the study areas focused on farming subsistence system linkage of production and consumption decision are low [15]. Besides, the agriculture sector in the study sites is still low productivity because of poor access to inputs, old technology, and inadequate extension services [16]. The country has recognized the commercialization of smallholder agriculture as a strategy for its economic transformation by expanding agricultural services like extension, credit, and input supply [4]. This adoption of agricultural services influenced the intensity of input use and agricultural productivity of smallholder producers [17,18]. Different stakeholders like government extension, research centers, and other organizations had made great efforts to increase crop productivity [19]. Productivity of tef producers can't be achieved without markets contribution efficiently incorporating increasingly specialized activities of widely discrete producers into an integrated national economy [20].

Though, market contribution owns the discrete and continuous decision to contribute to the commercial system as sequential and simultaneous marketing decisions [21]. It indicates that the costs of market participation had been dependent on different factors like distance to markets, transport, household demographic change, technologies, institutions, and their integration [20,22]. These factors lead to accepting the lower farm gate price of products. It also affects the volume of product supply to market [3]. This market contribution occurs on the inputs and output sides [23]. Raised marketed surplus, purchase of high yielder varieties and product choice based on profit growth, the substitution of non-traded inputs for purchased one, and specialization of products and output markets and smallholder market contribution in Ethiopia indicated the average crop output and input market participation [10].

Tef marketing in Ethiopia and the study areas is inefficient because of poor linkage to farmers allowing to meet market standards, low volume of products, a wide scattering of producers, the existence of brokers, and perceived low prices informal markets [24]. Farmers in the study areas; find it difficult to set their products at attractive prices and places of their choice due to perceived weaknesses in the tef marketing system [25]. Effective market participation can be a pathway to raising income in rural areas society [10]. Therefore, identifying factors affecting tef market participation and volume of tef among smallholder producers' in East Wollega, Horro Guduru Wollega, and West Shewa zones of Western Oromia is the most important for smallholder tef producers.

Research methodology

Description of the study areas: The study was conducted in East Wollega, Horro Guduru Wollega, and West Shewa zones. In these zones, mixed crop-livestock agriculture is the backbone of the communities. The major crops grown in the areas are maize, tef, wheat, barley, bean, pea, nug, potato, tomato, onion, coffee, etc Three districts namely Horror, Guduru, and Jimma Rare were selected from the Horro Goduru Wollega zone. Horro district is located 320 km west of Finfinne (the capital city of Ethiopia) with geographical coordinates of 09°34' N and 37°6' E latitude and longitude, respectively at ranging altitudes 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 - 25°C [13,26]. Guduru district is located 372km west of Finfinne (the capital city of the country) with geographical coordinates of 09°30' N and 37°35' E latitude and longitude, respectively at an average altitude of 1969 meters above sea level. The agro-ecology of the district was highland (18%), midland (62%), and lowland (20%) with the average monthly varies of 1450-2500 mm annual rainfall. The monthly average temperature of the district varies from 19 - 22°C [27]. Jimma Rare district is located 243km west of Finfinne (the capital city of Ethiopia) with geographical coordinates of 09°10' N and 37°20'E of latitude and longitude, respectively at ranging altitudes 1540 - 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 - 2500 mm. The monthly average temperature of the district varies from 18 - 25°C [28,29].

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 Finfinne (the capital city of Ethiopia) with geographical coordinates of 09°30' N and 37°35'E 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 temperature in the district varies from 12 - 22°C [30]. Gudeya Bila district is located 274km west of Finfinne (the capital city of the country) with geographical coordinates of 09°17' N and 37°01'46'' E latitude and longitude, respectively with ranging of altitude 1100 - 2400 meters above sea level. The agro-ecology of the district was highland (18%), midland (56%), and lowland (26%) with the average monthly variation from 1000 - 2200 mm annual rainfall. The monthly average temperature of the district varies from 19 - 28°C [13].

Similarly, 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 - 2000 mm. The monthly average temperature of the district varies from 8 - 28°C [31,32]. Danno district is located 260 km west of Finfinne 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 - 2400 mm annual rainfall. The monthly average temperature of the district varies from 18 - 30°C [33].

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Sampling techniques

The study applied the purposive sampling method and multi-stage sampling design to select appropriate sample households. In the first stage, three zones of wester Oromia which included East Wollega, Horro Guduru Wollega, and West Shewa were sampled purposively based on their proximity and existence of tef production and marketing access. In the second stage, seven districts were sampled randomly from those potential districts of tef production in selected zones. 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, 339 sample households were sampled randomly based on probability proportional to size using Yamane sample size determination formula Yamane [34].

$$n = \frac{N}{1 + N(e^2)}$$ Where n = sample size, N = tef producers & e = acceptable error(5%)

Data sources

For the study, both qualitative and quantitative data types were collected from primary and secondary data sources. The qualitative data were collected from tef the producers on tef management practices inputs accessibility, and marketing situation (the price of tef and inputs). The 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. The secondary data relevant for the study were 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.

Data analysis methods

Before data analysis to ensure accuracy, uniformity, and completeness were checked. For this study, two statistical approaches to data analysis were employed. First, descriptive statistics approaches like means, standard deviation, frequencies, percentages, and inferential statistics like independent *t*-test and chi-squared test were applied for analysis. The independent *t*-test was used to determine statistically significant differences between market participants and no-participants with regards to continuous variables of sampled tef producers. The chi-square test was applied to determine statistically significant differences between the subsamples with regards to categorical variables of sampled tef producers. Second, the econometrics model was elaborated to examine the market participation decision and the intensity of market participation. This analysis requires a situation where at each observation the event may or may not occur. This occurrence is associated with a continuous non-negative random variable, while a non-occurrence yields a variable with zero value [35]. Such a situation presents a limited dependent variable modeling problem where the lower bound of the variable, zero value, occurs in a considerable number of observations [36]. Double-hurdle models are used with dependent variables that take on the endpoints of an interval with positive probability and that are continuously distributed over the inside of the interval and non-participants are measured as a corner solution in utility-maximizing [37]. The double hurdle model required the joint use of the probit and the truncated regression models in two stages. In the first stage probit regression model was used to examine the market participation decision as follows:

$$D_i^* = \alpha z_i + \mu_i; \mathrm{D}_i = 1 \text{ if } \mathrm{D}_i^* > 0 \text{ and } \mathrm{D}_i = 0 \text{ if } \mathrm{D}_i^* < 0$$

Where: D_i^* is the latent variable for binary dependent variable taking a value of one for market participation decision and zero for non-participants, z_i, α & μ_i represent vectors of explanatory variables, parameter estimates & error terms for market participation decisions. In the second stage truncated regression model was used to examine the intensity of market participation decisions as follows:

$$Y_i^* = \beta X_i + \varepsilon_i; \mathrm{Y}_i = 1 \text{ if } \mathrm{D}_i^* > 0 \text{ and } \mathrm{Y}_i = 0 \text{ if } \mathrm{D}_i^* < 0$$

Where: Y_i^* is the latent variable reflecting the volume of tef sold, X_i, β, ε_i represent vectors of explanatory variables, parameter estimates & error terms for the level of market participation.

Results and discussion

Households and farm characteristics for dummy variables

The descriptive comparison of dummy variables based on frequency counts and the chi-squared test was presented in Table 1. Statistically significant differences at 1% were shown concerning off/non-farm income earned, access to credit, access to extension service, access to market information, own transport service, and use of improved variety. This result revealed that, among market participants, 34.81% received off/non-farm income as compared to 9.44% among non-market participants. The credit and off/non-farm income are more important to the farmers; if the farmers reinvested the income to tef production and marketing activities. This income is used for input purchase, labor rent for crop production, and harvesting for better crop production and marketable surplus. This increased tef production and marketable surplus also increase the probability of market entry and the intensity of market participation. This result shows that there is a positive relation between tef marketing activities and off/non-farm income.

The results revealed that 61.95% of subsample market participants were exposed to access credit compared to the non-market participants (28.02%). This farm credit is a key for investment in tef production and marketing processes that promote tef production. Increased tef production increases tef marketable surplus that turns in, increases the tendency for market entry and the extent of market participation. This result suggests that there is a positive relationship between access to credit and involvement in tef marketing (Table 1).

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Table 1: Comparison of percentages of households between market and non-market participants.

Variables (dummy)		Market participant (n = 243)		Non-market participant (n = 96)		Overall (n = 339)		Chi-square
		N	Percentage	N	Percentage	N	Percentage	
Sex of households	Male	218	64.31	87	25.66	305	89.97	0.064
	Female	25	7.37	9	2.65	34	10.03	
Off/non-farm income	Yes	118	34.81	32	9.44	150	44.25	6.467***
	No	125	36.87	64	18.88	189	55.75	
Access to credit	Yes	210	61.95	95	28.02	305	89.97	11.989***
	No	33	9.73	1	0.29	34	10.03	
Extension service	Yes	189	55.75	95	28.02	284	83.78	22.712***
	No	54	15.93	1	0.29	55	16.22	
Access market information	Yes	58	17.11	5	1.47	63	18.58	15.836***
	No	185	54.57	91	26.84	276	81.42	
Access own transport	Yes	156	46.02	35	10.32	191	56.34	21.526***
	No	87	25.66	61	17.99	148	43.66	
Improved variety	Yes	53	15.63	9	2.65	62	18.29	7.121***
	No	190	56.05	87	25.66	277	81.71	

The extension service is an important factor in crop production and marketing through the mastery of skill and knowledge of the farmers in using recommended input and management. This service increases tef production through training and the used recommended technologies. The result showed that 55.75% of subsample market participants were exposed to extension services compared to the non-market participants (28.02%) (Table 1). Thus results suggested a positive relationship between extension service on farmers' sales decisions.

The result further revealed that among the market participant, only 17.11% of sampled households received market information which is greater than non-market participants (1.47%) (Table 1). This result reflects trained human resources for decision-making to increase marketable surplus by seeking better price information. Access to own transport service also affected market participation on tef marketing. This reflects that farmers who own transport services choose better markets and received better prices. Therefore, this result suggests that there is a positive relationship between both market information and transport own on sales decisions.

The result revealed that market participants tend to use improved tef variety of about 15.63% which is greater than non-market participants (2.65%) (Table 1). The result suggested that there is a positive relationship between improved variety and market participation even if the majority of farmers used local variety.

Households and farm characteristics for continuous variables

Table 2 presented a descriptive mean comparison of continuous variables between market participants and non-market participants. The education level of household head; land allocated for tef production; total tef produced, and livestock holding (TLU) variables showed statistically significant differences at a 1% level of significance. Age of household and household size variables were statistically significant at a 5% level of significance. The result shows that education and age (as experience) enhance tef productivity and marketing through the mastery of skills and knowledge which increases tef marketing. These results suggested that there is a positive relationship between these variables and tef marketing.

The tef farm size variable was revealed as the key factor required for tef production and marketing activities. The results suggested that market participants have a larger tef farm size relatively when compared to non-market participants, thus indicating the positive effect of this variable on marketing decisions and intensity of market participation by increasing the tef production.

Quantity of tef produce variable directly affected market participation due to surplus marketable tef produce. The result revealed that market participants have a larger amount of product when compared to non-market participants, so it indicates that there is a positive effect of quantity of produce on marketing decisions and intensity of market participation.

The household size variable was revealed as the availability of labor required for tef production and marketing activities. This result suggested that market participants have a larger household size compared to non-market participants, thus indicating the positive effect of this variable on marketing decisions and the intensity of market participation.

Livestock holding (TLU) affected market participation between participants and non-participants. This result showed that market participants have larger livestock compared to non-market participants which are used as key factors tef production (purchasing inputs) and marketing activities. This increases the marketable surplus of tef in the market, which indicates that there is a positive relationship between livestock on marketing decisions and the intensity of market participation.

Factors affecting tef market participation decision and intensity of participation

Farm size of tef had a positive and significantly affected market participation decision in the tef value chain at a 10% significance level (Table 3). This suggested that as the household increased the land size allocated for tef by one

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Table 2: Comparison means of sample households between market and non-market participants.

Variables (continuous)	Participants (n = 243)	Non-participants (n = 96)	Overall (n=339)	T-value
Age of household (year)	47.564 (10.824)	44.844 (10.682)	46.794 (10.838)	2.092**
Education level (year)	5 (3.778)	3.125 (2.758)	4.469 (3.616)	4.418***
Land allocated for tef (ha)	1.074 (0.541)	0.488 (0.239)	0.908 (0.543)	10.226***
Total tef produced (Quintal)	11.350 (6.438)	3.641 (2.192)	9.167 (6.567)	11.465***
Household size	6.947 (2.348)	6.323 (2.070)	6.770 (2.287)	2.276**
Livestock holding (TLU)	10.505 (5.550)	7.078 (4.909)	9.534 (5.587)	5.287***
Distance of tef market (min)	47.140 (38.201)	52.677 (36.076)	48.708 (37.641)	1.221

Standard deviations in parentheses

hectare, the probability of being a market participant under tef would increase by 3.57% due to its increase the production and improvement of market participation. The result was consistent with the findings of Tarekegn, et al. [38] stated that plot size has more important for increasing the produce and market participation.

The quantity of tef produced was positively and statistically affected on market participation decision at a 1% significance level (Table 3). This result indicates that a household that produces more volume of tef had also supplied more tef produce to the market when the production of tef in a given year was better, the higher the market supply and the amount of tef that can be sold in the market. This result is in line with the finding of Mirie and Zemedu [39], who stated that as increases the quantity of production and increases market participation.

The gender of the household head was negatively and statistically affected the probability of household market participation at a 5% significance level (Table 3). This result revealed that the male household head was more market participant than the female household head. The result was in line with the finding of Gebre, et al. [40] stated that there was a gender gap in market participation.

The educational level of farmers had a positive and significantly affected farmers' decision to participate in the tef market at a 10% significance level. The marginal effect showed that an increase in the educational level of the farmers increases the probability of participating in smallholder participation of tef marketing by 0.17%, ceteris paribus (Table 3). This implied that as the educational level of the farmer's increases, their ability to get information on how to produce and sell tef produce increases which are in line with Regassa Megersa, et al. [10] and Mossie, et al. [41], who stated that more educated farmers they were more likely to produce and sell more at market price.

Off/non-farm income positively and statistically affected farmers' market participation decision at a 5% significance level (Table 3). This implies that the more amount of off/non-farm income received by farmers, the more produce tef and more participation in the market. This was because the farmers received off/non-farm income, they could purchase much more inputs that increase the production of tef and sold in the market. If the off/non-farm income of the sampled household increased by one birr, the market participation decision would

Table 3: Probit regression estimates for determinants of tef market participation.

Variables	Coefficient	Robust Std. Err	Marginal Effects
Constant	7.1413***	1.5293	-
Land allocated for tef (ha)	0.8205*	0.5010	0.0357
Total tef produced (quintal)	0.6464***	0.0849	0.0203
Age of household head (year)	0.0044	0.0136	0.0001
Gender of household heads	-0.9847**	0.4917	-0.0408
Education level of household head (year)	0.0758*	0.0472	0.0017
Variety (improved)	-0.4060	0.4050	-0.0271
Distance of nearest tef market (minute)	0.0020	0.0036	-0.0001
Total household size	0.0795	0.0676	0.0025
Off/non-farming income obtained	0.6409**	0.2750	0.0219
Access to credit service	0.5829***	0.1130	0.1825
Livestock holding (TLU)	0.0412	0.0304	0.0013
Access to extension service	0.2677***	0.1001	0.0948
Access to market information	0.1612**	0.0664	0.0562
Price of tef	0.0523	0.03742	0.0231
Access to own transport	0.0217	0.0275	0.0017

increase by 2.19%. The result was in line with the finding of Ademe, et al. [42] stated that off/non-farm income increases production and market participation.

Access to credit positively and significantly affected the farmer's decision to participate in tef marketing at a 1% significance level. This implies that a farmer who has credit access increases the probability of participating in the tef market by 18.25%, ceteris paribus (Table 3). This suggests that access to credit improves the financial capacity of farmers to buy improved inputs, thereby increasing production which is reflected in the marketed surplus of tef. The result is a consistent result finding of Abate, et al. [43].

The extension contact positively and significantly affected farmers' participation decisions in the tef market at a 1% significance level (Table 3). This result implies that households who contact extension agents have got better information on the price to make a decision on the production and marketing of tef outputs than other farmers which is in line with the finding of Kyaw, et al. [44] and Giziew & Admas [45] who stated that as extension contact increases the market participation of farmers also increased.

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Access to market information was found to affect smallholder farmers' decision to sell tef produce positively and significantly at a 5% significance level (Table 3). The marginal effect showed that an increase in getting information on time increases the probability of farmers' participation in the marketing of tef in the output market by 5.62%, ceteris paribus (Table 3). This indicated that farmers need to be able to get their products to market and receive equitable price treatment to make the right decision. This result is similar to the argument that Kassahun, et al. [46] and Tarekegn, et al. [38] indicated that better access to market information significantly increased the probability of production and market participation of households.

Factors affecting the intensity of tef market participation

The result indicated that tef quantity produced had positively and significantly influenced the extent of market participants at a 1% significance level (Table 4). The result showed that the increase in tef output by one quintal increases the volume of tef supplied to the market by 0.052. This result was ultimately expected since households who have high production have more surpluses that can be sold to the market. This study is in line with that of Alphonse, et al. [47] that households with a higher volume of crop produced sell a higher proportion of their produce.

Gender of the household head was negatively and statistically affected the volumes of tef sold in the market at a 1% significance level (Table 4). This result revealed that the male household head was dominated in the selling tef to the market because male farmers have more contacts that were social with buyers while female farmers lack such contacts and are in most cases omitted from direct transactional negotiations with buyers. The result was in line with the finding of Dibaba [48] stated that the male gender of the farmer positively and significantly influenced the farmer's volume of sales in the market.

The household head schooling degree has a positively and statistically affected the intensity of tef market participation at a 10% significance level (Table 4). This result revealed that as the sample household head education level increases by a year, the quantity of tef supplied to the market increases by 0.0178 quintals. This result suggested that the educated household head was better tef suppliers in the market because educated farmers have more knowledge and experience that allow them to understand information about the market. This result is consistent with the finding of Dubale & Negash [49] who stated that the education level of the household head affects the market supply positively.

Improved variety positively and statistically affected the level of tef market participation at a 5% significance level (Table 4). This result revealed that farmers who used an improved variety produced high production that increased a marketable surplus. This marketable surplus also increases the level of tef produce to marketing which is in line with the finding of Alphonse, et al. [49], Achandi & Mujawamariya [50] and Awotide, et al. [51] stated that as adopted improved varieties increased marketable surplus.

Table 4: Truncated regression estimates for determinants of intensity of tef market participation.

Variables	Coefficient	Robust Std. Err
Constant	0.7706***	0.3015
Land allocated for tef (ha)	-0.0407	0.0794
Total tef produced (quintals)	0.0520***	0.0070
Age of household head (years)	-0.0006	0.0030
Gender of household heads	-0.6516***	0.1696
Education level of household head (years)	0.0178*	0.0106
Variety (improved)	0.1730**	0.0850
Distance of nearest tef market (minutes)	0.0001	0.0009
Total household size	-0.0010	0.0130
Off/non-farming income obtained	-0.0380	0.0668
Access to credit service	0.3859***	0.1219
Livestock holding (TLU)	0.0078*	0.0048
Access to extension service	0.4845***	0.1645
Access to market information	-0.0287	0.1465
Access to transport own	0.0468	0.0718

Access to credit positively and significantly affected the farmer's level of tef volume in the marketing at a 1% significance level (Table 4). This implies that farmers with better access to credit were more interested to allocate their financial resources from the credit on tef production and marketing activities. The result shows that as credit access to the farmers the probability of increasing the intensity of tef for market by 0.3859, ceteris paribus. This suggests that access to credit improves the financial capacity of farmers to buy improved inputs, thereby increasing production which is reflected in the marketed surplus of tef. The result is in line with the finding of Bekele, et al. [52] and Belay [53] stated that access to credit enhanced the farmer's financial capacity to purchase inputs thereby increasing production and supplying the greater marketed surplus.

Total livestock holding was powerfully linked and statistically significant to the marketing point. The result suggested that a fact in ceteris paribus as livestock unit per household increases the probability level of tef commercialization increased by 0.0078 due to produced surplus of tef by reinvested incomes from livestock in tef production and marketing activities (Table 4). The result is in line with the finding of Meleaku, et al. [54] stated that livestock holding increases the level of marketing participation.

The extension contact was given by the respective service to the household had strong and important on the level of tef marketing. This implies that households access additional services with training/advice the probability of household increase level of tef market by 0.4845 the reason for this is extension service increase the capacity of farmers to produce and manage the tef produce and access important information on the market, production, and management of the crop (Table 4) which is similar with the finding of Endalew, et al. [55] stated that extension service has been correlated with the volume of tef marketing.

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Conclusion and Recommendations

This result revealed that 72.27% of tef producers supplied their products to the market in different volumes. This shows that most of the sampled households for the market than home consumption. The double hurdle model results showed that market participation decision was affected by land allocated for tef, the volume of tef produced, gender of household head, education level of household head, and additional income sources (off/no-farm & credit), extension services, and access to market information. The intensity of participation was affected by the volume of tef produced, gender of household head, education level of household head, the improved variety used, additional income sources (off/no-farm, credit, and livestock), and extension service.

The result shows that education level and extension service were statistically significant which increases the volume of tef produced and supplied to the market mainly depends on farmers' skills and knowledge through training, adult education, and farmers advising on tef production and marketing. This skill and knowledge can enable the farmers to improve the farming practices and improve the variety used to maximize their production and this increased the amount of tef sold in the market. This result also shows that market information was an important factor affecting market participation by smallholder tef producers. Gender was also statistically significant negatively in market participation decisions and intensity of participation. This result shows that women household heads were low benefits from market participation than male household heads. Furthermore, smallholder farmers are not a homogenous group with resources owned and the capability to invest in agricultural production and marketing due to a shortage of working capital. This result shows that additional income sources (credit and off/no-farm) were more important for tef production and marketing activities.

Based on the findings, the following are possible areas of intervention for different stakeholders (agricultural & natural resource development offices, research centers, and universities) that support tef value chain in the areas. Strengthening/establishment of the training and advice on tef production and marketing management. The extension services and education assistance farmers can easily and practically recognize the difference in productivity and production possible obtained through the adoption of appropriate agronomic practices and varieties. The dissemination of improved varieties for smallholder farmers is fundamental to enhancing tef production and marketable surplus. Further, empowering women farmers to ensure that women have equal access to economic resources (land ownership; financial services, and input accessibility) needs attention to enhance tef production and marketing. Besides, a diverse working environment for farmers and marketing communication linkages between farmers and traders are essential to boost tef production and market surplus. Develop and releases high yielder varieties with disease resistance/tolerance for farmers and consolidation districts and zones experts and development agents on better crop production management and linkage strengthening among tef value chain actors to provide appropriate advice for farmers tef production management (harvesting and post-harvesting) handling and best market participation also interventions need research centers and universities.

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Availability of data and material

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