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Research Article

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Posted Date: August 16th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-812219/v1>

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Commercialization of Teff production in West North Ethiopia

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ABSTRACT

Background: Teff is only cereal crop Ethiopia's in terms of production, acreage, and the number of farm holdings. It is one of the staples crops produced in the study area. However, the farm productivity, commercialization and level of intensity per hectare is low compared to the other cereals , Despite, smallholder farmers are not enough to participate in the teff market so the commercialization level is very low due to different factors. so, the study aimed to analyze determinants of smallholder farmer's teff commercialization in west north, Ethiopia.

Methods; A three-stage sampling procedure was used to take the sample respondents, 190 smallholder teff producers were selected to collect primary data through semi-structures questionnaires. Combinations of data analysis methods such as descriptive statistics and econometrics model (double hurdle) were used.

Results: The average level of teff commercialization index of sampled Teff producers in the study area was 11.97%. The model result showed that the variables like age, gender, education, land size, variety, Teff market experience, distance to the nearest market, off-farm income, and credit were significantly affecting the market orientation of Teff production. Therefore, improving households' market access, extension service, market orientation, education, and productivity of land (best agronomic practices) would enhance the commercialization level of smallholder Teff producers.

Keywords: Double hurdle model, Market participation, Market orientation, Teff, Ethiopia

Background

The agricultural sector is the most important in the Ethiopian economy which contributes 34.9% to GDP, 90% of export earnings, and 67.3% of employment [1]. The Ethiopian agriculture sector is composed of the crop, livestock, forestry, and fishing subsectors. The crop sub-sector takes the lion's share of the agricultural sector, comprising 65.3%, followed by livestock production

(25.3%), forestry (8.9%), and fishing (0.2%) [2]. From agriculture, cereal crop production, and marketing play a central role contributes about 30% of the national GDP [3]. Cereal grains are the single most important source of calories to a majority of the world population, developing countries (60%) and developed countries (30%) [4]. In Ethiopia, it covers the highest percentage in terms of its area coverage (80.71%) and volume of production (87.48%) than other crops in the country [5]. Teff (*eragrostis Teff*) is the most important cereal in terms of both production and consumption in Ethiopia and is grown as a food grain in only one other country, Eritrea [6]. Teff (*eragrostis Teff*) is a nutritious small-grained cereal, related to millet, which originates in Ethiopia and is thought to have been domesticated by Ethiopian farmers between 3 and 6 millennia ago [7]. Teff is grown mainly in Amhara and Oromiya, which together accounted for 84 and 86% of the total cultivated area and production in 2019. East and West Gojam of Amhara and East and West Shoa of Oromiya are particularly known teff producing areas in the country[8, 9]. In the production year of 2018 and 2019, in the Amhara region, nearly 5.8 million quintal cereals are produced. In this production year, teff takes the third rank which accounts for 1.4 million quintals next to sorghum and maize. Teff is highly produced compared to other cultivated crops, and there is a high demand in the market so that the smallholder farmers have a high opportunity to commercialize by teff [5]. Despite the available potentials and opportunities for teff production and its outrageous market demand, smallholder commercialization of teff production in the study area was quite low. Still, they are in subsistence agriculture, and there was no research conducted to identify factors affecting small-holder commercialization of teff, market participation.

Research methodology

Description of the study area

Awı zone is one of the districts in the Amhara Region of Ethiopia. Dangila, Part of the Awı Zone, Dangila is bordered on the south by Faggeta Lekoma, on the southwest by Guangua, on the northwest by the Jawı, and on the northeast by the East Gojjam Zone. Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSA), this woreda has a total population of 158,688, an increase of 6.44% over the 1994 census, of whom 80,235 are men and 78,453 women; 27,001 or 17.02% are urban inhabitants.

For quantitative research, the probability sampling technique is appropriate as compared to a non-probability sampling technique because samples drawn by using probability sampling techniques are more representative than non-probability sampling techniques. A three-stage sampling

procedure was used to take the sample respondents. In the first stage, the potential teff growing kebeles were identified from the district with the help of the agricultural office and woreda and kebele development agents. Accordingly, from 29 kebeles in the district, seven potential teff producing Kebeles were identified. In the second stage, three teff growers Kebeles (Wondfey (73), Abdera (60), and Wofeta Datie(57)) were selected purposively based on their potentials (actual production status) in growing the teff crop from seven teff producing kebeles. Finally, the sample respondents 190 samples were selected randomly from the three Kebeles. The sample size was determined using [10]. Finally, total samples of 190 rural households were chosen from these three kebeles following a sampling procedure of probability proportional to sample size.

$n = \frac{N}{1 + N(e)^2} = \frac{2819}{1 + 2819(0.07)^2} = 190$ Where, N= total population=2819, n= sample size and e= error term=7% Descriptive statistics, inferential statistics, and econometric analysis were used to analyze the data obtained from teff growers to address the objective. Descriptive analysis of data mainly uses frequency, percentage, mean, standard deviations, Chi-square, and t-test. The level of commercialization can be measured by using the commercialization index, which can be calculated as the ratio of the value of crops sold to the value of crops produced. Accordingly, [11] used HCI (ratio of the value of crops sold to crops produced) to measure its level. Similarly, in this study, HCI was used to measure the level of teff commercialization. Mathematically, it can be expressed as:

commercialization index

$$= \frac{\text{The total value of teff sold by sample respondents}}{\text{The total value of crops produced by sample respondents}} * 100\%$$

The higher the commercialization index, the more the smallholder is commercially oriented. The indices value of 0% and 100% indicates that the smallholder farmer is subsistence-oriented and highly commercial oriented respectively [12].

Therefore, 88.42% of the sampled respondents were subsistent/non-commercialized farmers; they produce Teff only for subsistence due to their inability of supplying in the market beyond their consumption needs and their limited knowledge about the market. The remaining sample households were medium (11.05%) and higher (0.53%) level commercialization of Teff produce.

Fig 1; The classification of sample households by HCI in the study area

The minimum and maximum values of sample households commercialize of Teff production were 0% and 57.14%. The average level of teff commercialization index for lower, medium, and higher-level commercialized Teff farmers were 8.80%, 35.12%, and 57.13% respectively. However, the average value of the overall house sampled Teff producers in the study area was 11.97% (calculated as the proportion of the value of Teff sold to the value crops produced), which is categorized under the lower level of commercialization. The market orientation index can be calculated as: $MOR_i = \sum_{w=1}^w (a_k L_k) / L_i^T$, $L_i^T > 0$ and $0 < MOR_i \leq 1$. Where MOR is the market orientation index of household i , L_i is amount of land allocated to teff and L_i^T is the total cropland operated by household i . a_w is Marketability index of each crop, which can be calculated as: $\sum_{i=1}^N S_{wi} / \sum_{i=1}^N Q_{wi}$; $Q_{wi} \geq S_{wi}$ and $0 \leq a_{wi} \leq 1$. where S_{wi} is the proportion of teff sold and Q_{wi} is the total amount teff produced.

Result and Discussion

Demographic and socio-economic characteristics of sampled respondents

The study was conducted using 190 sample smallholder Teff producers of which 151(79.48%) were market participants whereas 39(20.52%) of them were non-participants of Teff marketing in the 2019/20 production year. This indicated that most of the sampled respondents were market participants either in selling or buying Teff in the study area during the survey year. most of the sampled respondents were male-headed households (87.89%) while the remaining 12.11% were female-headed households. From these, 73.16% of the participant households were male-headed households whereas only 6.32% were female-headed households indicating that male-headed households were highly participating in the Teff market compared to the female-headed

households in the study area. The chi-square test indicated that in the study area, there was a statistically significant percentage difference between Teff market participants and non-participants in terms of sex at a 1% of the significance level.

Table 1. Demographic and socio-economic characteristics of sampled respondents of categorical variables

Variables		Participant		Non-participant		Total		X ²
		N	%	N	%	N	%	
Gender	Male	139	73.16	28	14.75	167	87.89	11.96***
	Female	12	6.32	11	5.79	23	12.11	
Market Access	Yes	133	70	30	15.79	163	85.79	3.16*
	No	18	9.47	9	4.74	27	14.21	
Access to improved Varsity	Yes	5	2.63	0	0.00	5	2.63	1.33
	No	146	76.84	39	20.53	185	97.37	
Credit use	Yes	32	16.84	12	6.32	44	23.16	1.6
	No	119	62.63	27	14.21	146	76.84	
Transport Access	Yes	148	77.89	39	20.53	187	98.42	0.79
	No	3	1.58	0	0.00	3	1.58	
Perception on lagged price	Yes	148	77.89	39	20.53	187	98.42	0.79
	No	3	1.58	0	0.00	3	1.58	

The result of the t-test of educational level between the market participant and non-participant confirmed that there was a statistically significant mean difference in educational level between the two groups at a 5% probability level, on the other hand, the mean production cost incurred by sample households in the production year was 1795.41ETB with a standard deviation of 846.49. The result also shows that the participant households incur a production cost of 1725.89 ETB with a standard deviation of 814.54 and non-participant households were 2081.25 ETB with a standard

deviation of 924.92 and also there is a statically significant mean difference in production cost between those market participants and non-market participant concerning the annual cost of Teff production at a probability level of 5% significance level.

Determinants of market participation and its intensity by smallholder Teff producers

The double hurdle model was fitted since the likelihood function/Wald χ^2 is significant at 1% significant level (Wald $\chi^2(16) = 87.13$, Prob > $\chi^2 = 0.0000$). In the first hurdle estimation, the Probit model was used to identify the determinants of market participation of smallholder Teff farmers, and sixteen variables were hypothesized to affect it. As expected, the education of the household head has a positive and significant effect on the intensity of teff market participation at a 5% significance level. If the educational level of the sample household heads increased by one year, the intensity of market participation of teff producers would increase by 0.08 quintals. The assumption for this is because education can enable the farmers to improve the farming practice to maximize their production that consequently increased the amount of teff sold in the market via supplying more. This confirms the finding of [13], who found education that has a positive association with the amount of crop sold in the market. On the other credit affects market participation by smallholder Teff produces significantly and negatively at 5% level of significance. The reason was that there are people who are using credit for purposes other than farming meaning that if the purpose of credit was allocated for other unplanned activities, it may negatively affect the farming practice, this is consistent with the study of [14]. The current price is a powerful factor likely to affect market participation by smallholder producers and the result of this study shows its positive and significant relationship with the market participation of smallholder Teff producers at a 1% significant level. The result of the analysis indicates that one birr increase in the price of Teff leads to an increase in the probability of market participation by smallholder producers by 0.033%. This result is in line with the finding of [15], who reported the positive and significant relationship of selling price and market participation of potatoes. Likewise, [16] revealed the positive association between the price of the output and the amounts of teff and maize sold. In the study area equine, specifically, a donkey is commonly and widely used to transport producers agricultural produce from their point of production to the marketplace where needed and it affects market participation by smallholder Teff producers and found positively and significantly affecting the same by smallholder Teff producers at 5% level of significance. The result of the analysis indicates that smallholder Teff producers who have equine sold an additional 0.57quintals of Teff,

citrus paribus. This study confirmed the finding of [17], who found that a positive relationship between ownership of equine and market participation. The level of market participation under Teff was increased with better market orientation. This means that if the farmers were market-oriented, the sampled household would sell an additional of 0. 904 quintals, ceteris paribus. The assumption of this was if the farmers were market oriented, they could produce more that consequently increase the market supply of teff. This is consistent with the finding of [18], who showed the positive relationship between market orientation and the extent of market participation. The small-holder farmers in the study area were producing their teff without market information (non-oriented teff market) primarily for consumption. Besides, the teff producers did not sufficiently adopt the agricultural technology and apply the best agronomic practices so that they produce small amount of teff, which is not enough to supply in the market. As a result, they become non-participant in teff market.

Table 2. Double hurdle estimation for determinants of Teff market participation and its intensity

Variables	1 st hurdle (Probit regression)			2 nd hurdle (Truncated regression)	
	Coef.	Robust Std. Err.	Marginal effect	Coef.	Robust Std.Err.
AGE	.0142908	.0133209	.0142908	.0485556*	.0254438
GENDER	-.2763908	.334369	-.2763908	-.5934768	.9205607
EXMKT	.0052322	.0161265	.0052322	-.0227884	.0395381
EDHH	.07611**	.0380623	.07611	.1254719*	.0647797
MKT	.6452116*	.3614245	.6452116	.6872666***	.0927137
PRICE	.000336***	.0001163	.000336	-.0004373	.0003247
TRSPT	.329645	.0611117	.329645	.0905769	.1896551
FAMSIZE	-.0584925	.0708968	-.0584925	-.0710184	.1166834
CREDIT	-.6646245**	.2951346	-.6646245	-.8287447	.5851178
OFFI	9.60e-06	.0000137	9.60e-06	.0000513**	.0000261
TLISTK	-.1790312	.197607	-.1790312	.0417565	.3938027
EQUINE	-.2685746	.1422271	-.2685746	.5718753**	.2586164
LAND	-.4240459	.4849942	-.4240459	.650539	.969834
TMO	.9046594***	.3125052	.9046594	.6010811	.5937955

DMKT	-.010844	.0767834	-.010844	.0205319	.1604153
DALLWR	.0738394	.1136225	.0738394	-.0161497	.2200604
_cons	-.8955071	1.220016		-1.332452	3.205699

Note: ***, ** and * were the significant level at 1%, 5% and 10% significant level respectively. Source: Survey result, 2019/20 Number of observations = 190 Log likelihood = -591.83802 Wald chi2(16) = 87.13, Prob > chi2 = 0.0000

Conclusion and future line work

The average value of commercialization level of Teff producers in the study area was 11.97% which was categorized under the lower level of commercialization. This indicated that most of the sampled households were producing teff for home consumption than for the market. Even though market participation is important for improving the livelihood of the teff producers which is not obesely seen due to different factors. Therefore, smallholder producers should give due attention to the mass production of Teff using their land as well as in the form of contracts. The other related opportunity is the existence of year-round demand for Teff. Demand is an important pre-condition for producers which can encourage as well as discourage the suppliers. In the study area, there is a constant demand for Teff which can acts as a green light for the producers of the area even to be market-oriented commercial producers. On the other hand, several socio-institutional factors are determining the commercialization of Teff by smallholder producers of the area where the finding of the study with probable policy limitation is given as follows. Enhancing education to enhance production and marketing so district agricultural officers and all other concerned agents should work together to expand and provide training, experience sharing programs, demonstrative activities, and knowledge boosting advice for smallholder producers of the area about how to produce and how to plan to be market-oriented producers and even productive as well as disease and weather condition resistance improved Teff variety should be utilized. Furthermore, the district agricultural office should create an enabling environment, especially by given support to increase the production of teff. even they use different infrastructural facility transport and credit expand their productive and parallel scale-up of agricultural operations and also others.

Declarations

Ethics approval and consent to participate

The Research was found to be following the ethical principles and the national norms and standards for conducting Agriculture and food security research. The study protocol was approved by the Ethics members of the committee of researchers.

Availability of data and materials

The data used in this study are not publicly available because the participants were promised that the raw data would remain confidential. However, they are available from the corresponding author on reasonable request

Funding

This study is not financially supported in the study design, data collection, analysis, and interpretation, and writing of the manuscript

Acknowledgments

The authors are grateful to the National, zone, woreda agricultural office of Awi zone, Ethiopia

Consent to publication

Not applicable.

Competing interests

The authors declared no potential conflicts of interest

Abbreviations

ETB; Ethiopian Birr, MOR: Market orientation, HCI: Household commercialization index, CSA: Central statistic authority, GDP; Growth domestic product

Authors' contributions

HM was involved in study idea and design, data analysis and interpretation, manuscript drafting, and final review of the manuscript. DA & EK was involved in data collection, statistical analysis, manuscript drafting, and final review of the manuscript. All authors have read and approved the final manuscript

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