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Malt Barley Grain Market Participation and Level of Participation by Smallholder Farmers in North Shewa Zone of Amhara Region: A Heckman Two-Stage Model Approach

Dejene Mamo[1], Workalemahu Tasew[2], and Beneberu Tefera[1]
[1]Debre Birhan Agricultural Research Center, Debre Birhan Ethiopia
[2]Hawassa University College of Agriculture, Hawassa Ethiopia
Corresponding author email: dejenemm432@gmail.com

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ABSTRACT

The potential for malt barley production in Ethiopia is very great. However, the demand for new and existing malt and brewery operations cannot be satisfied by the local supply. As a result, millions of dollars were being spent nationally to import malt. This study sought to underscore the factors that influence smallholder farmers' decision to participate in malt Barley marketing and level of participation in Bassona worana and Angolelana tera woredas of North Shewa Zone. Multi-stage sampling method used to select representative sample households. The study was used primary data collected from 110 randomly selected barley producer households. Descriptive statistics and Heckman's two-stage model were used to analyze the data. The descriptive result showed that malt barley producer farmers supplied to market on average one-fourth of malt barley grain from the total produced and around half of the malt barley grain used for home consumption. The result of probit model revealed that malt barley producer farmers' decision to participate in the malt barley grain market was determined by age and formal education level, malt barley farming experience, amount of malt barley grain produced, total livestock holding, distance from local cooperative and nearest market and household access to enough stable food. Whereas, the ordinary least squares regression results indicated that malt barley producer farmers' level of participate in the malt barley grain market was determined by formal education level of household head, total livestock holding, distance from local cooperative and inverse mills ratio. The study's policy recommendations included collecting the malt barley grain as soon as it was harvested and setting competitive grain market pricing with a cash payment system. connecting local malt and beer factories like Dashn, Habesha, and Boort malt with the producer farmers. Increasing the output and productivity of malt barley, raising awareness of farmers about the quality requirements for malt barley grain, and introducing alternative food crops and forage species.

1. INTRODUCTION

Agricultural marketing plays a vital role in production, consumption in particular and the economy in general. But, most smallholder farmer market participation in developing countries is limited owing to factors that are both internal to the farmer or household, and external to the surrounding environment. The internal factors are barriers that relate to the failure of farmers to meet market expectations due to a lack of physical and financial assets, such as land and credit, and human assets like skills, commercial contacts and labor and even time (Nigel Poole 2017). Smallholder farmers also frequently lack commercial information; physical infrastructure is poor causing high transaction costs, remoteness increases costs and reduces competition and without adequate institutions, there are difficulties in contract enforcement (Nigel Poole 2017).

According to CSA (2019), malt barley is among the priority commodities that have attracted the attention of malt factories, breweries and policy makers in general. Malt barley is becoming a major income source to smallholder farmers in the highland areas of Ethiopia, particularly where the agro-ecologies are not more productive to other cereal crops (MoA 2020). Similarly, the country has a high demand for raw malt barley products due to the older established and new emerging malt and brewery factories. It has a total of four malt (two in the process) and twelve brewery factories (Asoko insight 2019). Even if the malt barley production and productivity are increased year to year, the supply does not meet the demand of the emergence of malt and brewery factories. The brewery factories demanded about 118,000 tons of malt per year, while the local malt source is 52,000 tons which cover only about 50% of it (Addisu 2018; BIF 2018; NBE 2017). Ethiopia invested 59 million dollars to import malt in 2018 alone. Soufflé's estimates show that the bill may increase as high as 106.2 million dollars in 2020 (https://ethiopianmonitor.com/2019/10/12/french-firm-plans-to-fill-malt-demand-in-ethiopia/).

Besides the utilization for malting, in Ethiopia malt barley is also used for making the staple food injera, large sourdough flatbread and local bevarages. Especially in the Ethiopian highlands (>3,000 masl), where indigenous technologies are used for cultivation, barley might be the only source of locally cultivated food and feed (Agriterra 2013; Bayeh and Berhane 2011). The malt barley cultivars are favored by locals over food barley cultivars because of high extraction rates during the milling process (Agriterra 2013) and finer flour (Habtu 2008). Hence, malt barley is mainly cultivated as a food crop in Ethiopia and lesser extent used for malting and brewing of beer (Shewayrga and Sopade 2011). The multi-purpose of malt barley results in different competing market channels in Ethiopia (Agriterra 2013). In North Shewa Zone of the Amhara region, the market supply of the produced malt grain is very low compared to seed distributed and annual yield estimated by different organizations. Farmers were not properly delivering their malt barley product for both grain and seed uses, despite the fact that it is a cash crop and is primarily grown for the market. Studies by Goshime et al (2019) and Mulugeta et al (2018) were done on the market chain of malt barley and barley in general in the North Shewa Zone. But, information on malt barley market participation and level of participation of smallholder farmers and also determinant factors is scanty. Hence, this study was done to determine the market participation level of sample households and to assess the determinants of smallholder farmers' malt barley grain market participation and level of surplus in the selected Woredas of North Shewa Zone.

2. MATERIALS AND METHODS

2.1. Description of study areas

The study was conducted at Basona Worana and Angolelana Tera woredas of the North Shewa Zone Amhara region. The woredas are located Northeast of Addis Ababa around 140 and 110 kilometers respectively. Both woredas are characterized by high land, midland and low land and mixed farming systems. The rainfall pattern of Bassona worana woreda is unimodal with an average annual rainfall of 897.8 mm and the annual temperature ranges from 6.1 to 19.67 ^{0}c with an average elevation of 2975 masl. The Angolelana Tera woreda has an elevation varies from 1450 to 2800 Elevation of Angolelana tera woreda varies from 1450 to 2800 masl and the rainfall

pattern is bimodal and ranges from 930 to 1500 mm per annum. The mean annual temperature of the woreda is 14 ^{0}c (Woreda MOA 2013). The main source of livelihood for the population of the two woreda is the mixed farming system (both farming and animal production). The major field crops of the two woredas are Barley, faba bean and wheat (CSA 2014).

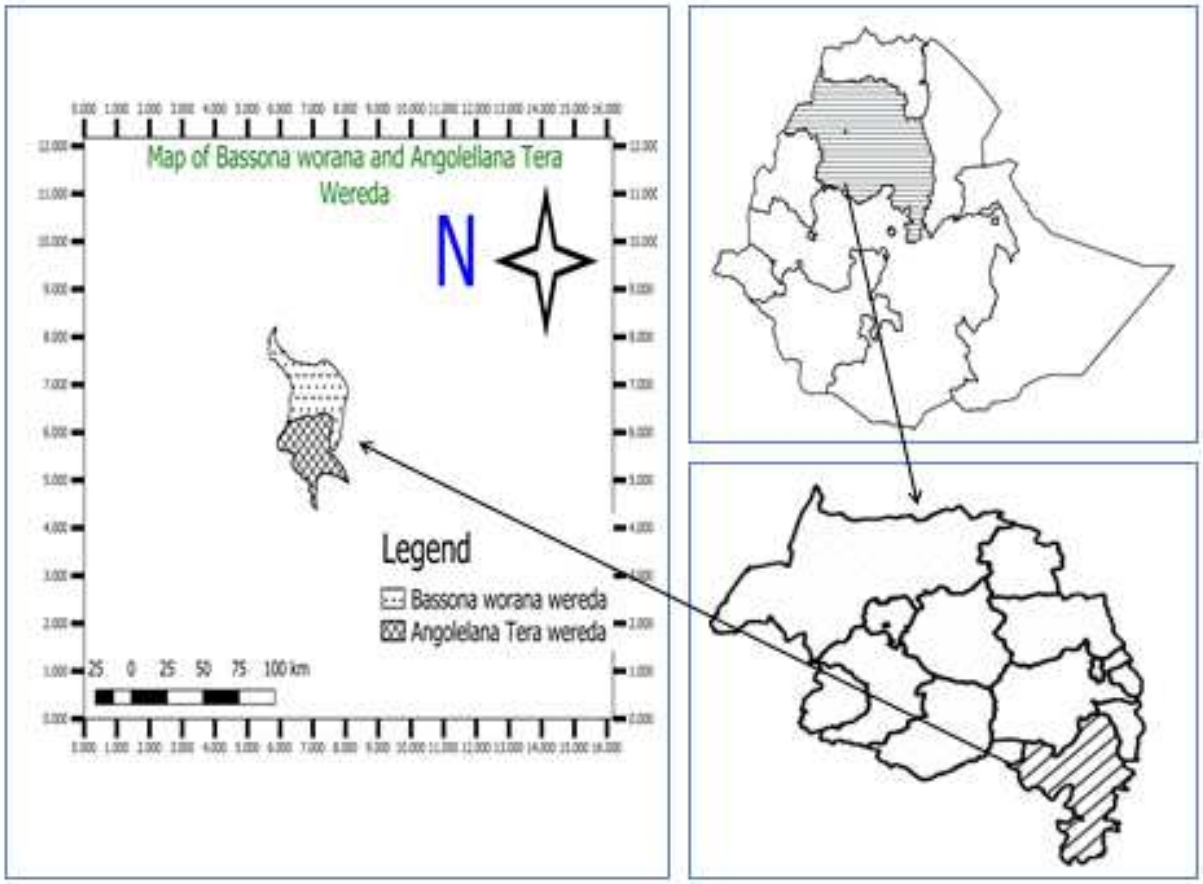

Figure 1. Map of study areas

2.2. Sampling Method and Sample Size

A multi-stage sampling method was used to select appropriate respondent households. In the first stage, the two woredas were selected purposively based on their potential for malt barley production from the North Shewa administrative Zone. In the second stage, two potential Malt barley producing kebele were selected randomly from each selected woreda and in the third stage, using a sampling frame that contains lists of malt barley producer households in each of the selected kebeles, sample respondent households were randomly selected based on the probability of proportional to sample size of the selected kebele. A

consensus agreement was reach on the objective of the study with respondents. Researchers used different formulas like Kothari (2004), Yamane (1967) and others to determine the sample size of their study. In this study, because the population was finite and homogenous by farming system, geographical location and other socio economics characteristics, Yamane's (1967) formula was appropriate to select the sample size of this study. As a result, the sample size for the study was determined based on the following formula (Yamane 1967).

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

Where: n is the sample size to be computed; N is the total size of malt barley producer households in the study area, e is the level of precision which is about 0.09 in this study. Due to budget and manpower constraints the sample size of the respondent household for this study was 110.

2.3. Data Types and Sources

Both primary and secondary data as well as qualitative and quantitative data were used for

this study. The primary data like demographic, socioeconomic, perception and production status were collected from barley-produced farmers. The secondary data such as the description of the study areas, barley production potential of the woredas and kebeles and others were accessed from agriculture office reports, experts and other published documents.

2.4. Data Collection Methods

The data were collected using structured questionnaire for selected respondents. The data collection process followed includes training of the data collectors, pre-testing the questionnaire and rewritten for final use. Finally, the data collection were conducted on randomly selected barley producer farmers for six days during the second week of May 2021.The focus group discussion was done after the collected data were entered into the STATA software.

2.5. Method of Data Analysis

The study used STATA (version 14) software for analysis using appropriate techniques. Descriptive statistics, inferential tests and econometric models were used to analyse the collected data and meet the specified objective. The descriptive statistics such as mean, frequency, Standard Deviation and inferential statistics of statistical testing such as t-test and chi-square ($\chi 2$) were used to make some comparative analysis. Heckman's two-stage model was used for analysing the determinant of market participation decisions and level of participation.

2.6. Model specification for market participation and level of participation

Econometric analysis was used for processing the data obtained from the survey. The appropriate econometric models that can help identify the market participation and level participation is Heckman Two-stage Gujarati (2004) and Heckman (1979). Heckman Two-Stage model was employed because of its advantages ove Tobit model which imposes restrictions that the variables and coefficients determining whether and how much to sell decisions are identical (Dong and Saha 1998). On the other hand, it has also advantage over Double Hurdle model to manage selection bias. Heckman's model employs a Probit analysis to estimate the probability of smallholder farmers' market participation. The Inverse Mills Ratio computed from the Probit regression is used with other explanatory variables to explain variation in the continuous, non-zero outcome variable (example sales volumes). Heckman's model corrects for the fact that the non-selling group is not a random sub-sample of the population. The Heckman two-stage model was specified as:-

$$\boldsymbol{Y1 = \alpha 0 + X1\beta 1 + X2\beta 2 \cdots\cdots\cdots Xi\beta i + \mu i \; \mu \sim N(0, \alpha^2) \cdots\cdots\cdots (1)}$$

Y1 is a binary response variables equal to 1 if the farmers sold malt barley and 0= other wise $\alpha 0$ = constant, β1 ---β1i = parameter estimate, μi = error term, X1……Xi = independent variables

$$\boldsymbol{Y2 = \beta 0 + X1\beta 1 + X2\beta 2 \cdots\cdots\cdots\cdots Xi\beta i + \mu i \; \mu i \sim N(0, \alpha^2) \cdots\cdots\cdots\cdots (2)}$$

Y2 is response variable, "malt barley sold", $\beta 0$ = Constant, β1 --- βi = parameter estimate, μi = error term**,** X1----Xi = explanatory variables

Table 1: Market participant and nonparticipant household characteristics by continuous variables

Variables	Market participant (73) Non participant (37)				t-value
	Mean	S D	Mean	SD	
Age of household head	42.9	13.1	46.4	18.2	1.2
Formal Education level	2.7	3.2	3.5	3.6	0.6
MB farming experience	4.8	2.1	3.5	1.9	-3.3***
Household size	4.9	1.9	5.1	1.8	0.7
Cultivated land	1.9	0.8	1.9	0.8	0.1
Malt barley grain yield	913.4	586.6	605.9	480.9	-2.9***
Livestock holding in TLU	5.1	2.1	5.7	2.3	1.3
Distance to cooperative	28.4	26.4	36.6	27.4	1.5
Distance to DAs office	24.4	24.3	37	38.5	1.8*
Distance to nearest market	114.4	68.5	80.9	64.8	-2.5**
Distance to the Main road	18.2	14.0	22.4	16.9	1.3
Malt barley profit	7178.0	1190.7	7344.2	1429.9	0.6
HH Income	65274.7	42278.9	48036.9	39900.4	-2.1**
HH Assets	320516.0	221296.4	286108.9	199584	-0.8
Adult Equivalent	3.8	1.6	4.0	1.6	0.7

***, **, * significant at 1%, 5% and 10% level respectively, source: own survey result, 2021

Note: HH= household, MB=malt barley, TLU=tropical livestock unit, Das=development agents, SD=standard deviation

3. RESULTS AND DISCUSSION

3.1. Demographic and Socio-Economic Characteristics of Sample Household

Table 1 represents the result of demographic and socio-economic characteristics of the sample respondents in relation to market participation. From the total sample respondent households, only 66.4 percent participated in the malt barley grain market at different levels of participation through malt barley is a commercial crop and mainly produced for the market. The independent t-test result shows that age of the sample household head was 42.9 and 46.4 for the market participants and non-participants respectively. The malt barley market participant and non-participant sample household had statistically significant differences in malt barley farming experience, malt barley grain yield, distance to development agent office, distance to the nearest market and household income (Table 1).

The malt barley grain market participant and nonparticipant sample households had statistically significant differences by only four categorical variables which were participation in field day program, participation in training program, participant in demonstration and household access to enough stable food (Table 2).

Table 2: Market participation status of respondents by categorical variables

Variables	Categories	Participant (73)		Non participant (37)		Pearson x^2
		No	proportion	No	Proportion	
Sex of household head	Male	71	64.5	36	32.7	0.0001
	Female	2	1.8	1	0.9	
Access to malt barley price information	No	4	3.6	2	1.8	0.0003
	Yes	69	62.7	35	31.8	

Contact with Development Agents	No	1	0.9	0	0	0.5115
	Yes	72	65.5	37	33.6	
Access to credit	No	41	37.3	24	21.8	0.7689
	Yes	32	29.1	13	11.8	
Field day program participation	No	34	30.9	26	23.6	5.5604**
	Yes	39	35.5	11	10	
Training program participation	No	17	15.5	16	14.5	4.6563**
	Yes	56	50.9	21	19.1	
Demonstration program participation	No	32	29.1	24	21.8	4.3449**
	Yes	41	37.3	13	11.8	
Membership in local agricultural cooperative	No	12	10.9	7	6.4	0.1057
	Yes	61	55.5	30	27.3	
Household access to enough stable food	No	5	4.5	12	10.9	12.2996***
	Yes	68	61.8	25	22.7	
HH habit of crop exchange for home consumption	No	14	12.7	8	7.3	0.0916
	Yes	59	53.6	29	26.4	
Household members' Social connection with traders	No	10	9.1	6	5.5	0.3151
	Yes	63	57.3	31	28.2	

***, **, * significant at 1%, 5% and 10% level respectively source: own survey result, 2021

Note: HH=household

3.2. Malt Barley Grain Market Participation Level of Producer Households

Even though malt barley is considered a commercial crop produced by farmers to supply for market, all-malt barley grain did not supply to the market due to different reasons. From the total malt barley growers sample respondent households, only 66.4 % have participated in the malt barley grain market at different levels of participation. Around half of the malt barley grain was used for home consumption from the total produced grain by sample producer households. About one-fourth of the produced malt barley is supplied to markets. The mean malt barley grain yield supplied to the market was 261.3 kilogram respectively. The mean malt barley grain yield used for home consumption and saved for seed were 368.4 and 80.9 kilogram respectively (Figure 2).

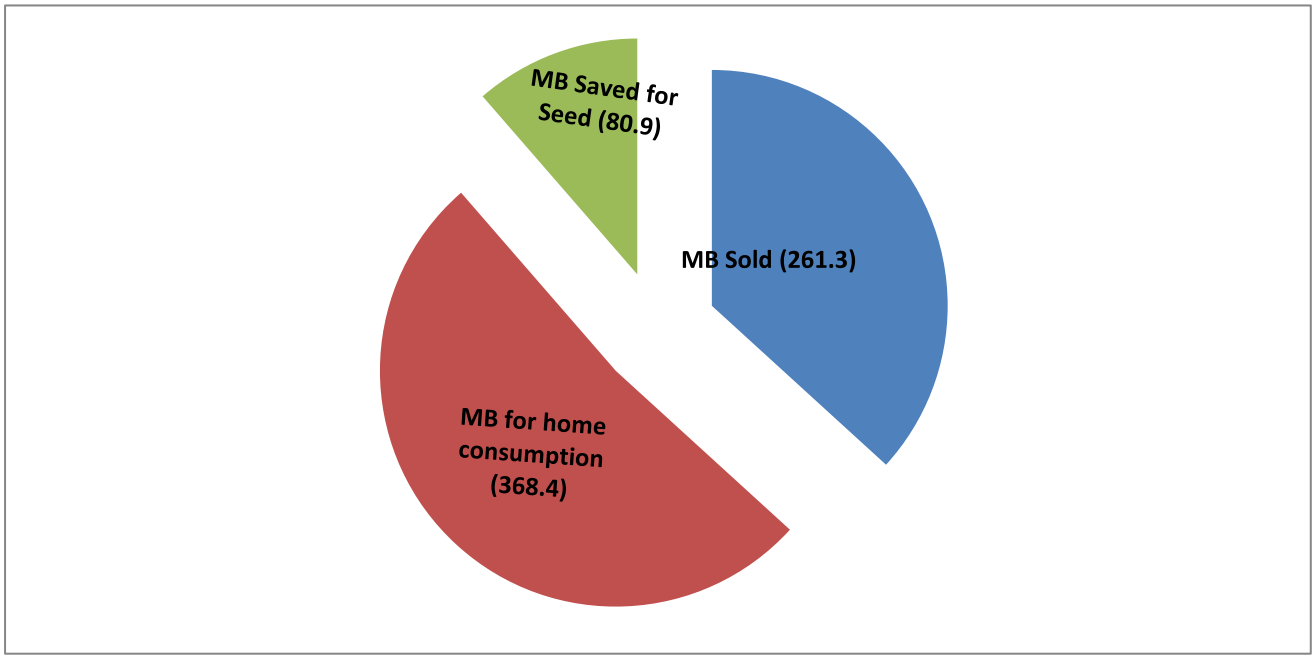

Figure 2. Malt barley grain allocation by sample producer farmers (kilogram) (Source: owned survey result, 2021 **Note:** MB=malt barley, standard deviation)

Why not Sample Households Participating in Malt Barley Grain Market?

As raised by participant farmers during the field survey and focus group discussion, most farmers did not sell malt barley due to a lack of sufficient food crops for their home consumption, and their preference of malt barley for home consumption compared to other food crops on its merit of high extraction rate during the milling process and better to make local food and beverage. Malt barley grain demanding high quality and non-mixing of species however, the farm gate price of malt barley product is small compared to the effort (it is not different from food barley). In addition to these, due to the high seed price of malt barley, they saved the produced grain for the next production season to use their own saved seed. The local malt barley grain procurement system is also chaotic (non cash) and too late to pay, so that producer farmers were not interested to supply their malt barley grain to the market/factories.

3.3. Determinants of Malt Barley Market Participation of Producer Households

The proposed Heckman two-stage model was used to identify factors affecting smallholder farmers' malt barley market participation and level of participation in the study areas. The post-estimation test VIF (variance inflation factor), pair-wise correlation and Ovtest (omitted variable test) were done on the fitted model. The VIF and pair-wise correlation test confirmed that there were no multicollinearity problems in the fitted model of Heckman`s two-stage model (Appendix: 2 and 3). The heteroscedasticity problem of the error term was solved using conventional robust statistics in the second stage of the model. The probit model in the first stage of the Heckman two-stage model revealed that malt barley farming experience, malt barley grain yield, household resident distance from nearest market and household access to stable food affect positively the probability of malt barley grain market participation of producer farmers at a different level of significance. Whereas, age of the household head, formal education level, total livestock holding and household resident distance from local cooperative affect negatively the probability of malt barley grain market participation of producer farmers at a different level of significance (Table 3).

Age of the household head: it affects the probability of malt barley market participation of smallholder farmers negatively at less than a 1% significance level. This is because of aged farmers had less engagement on market and had less interest in crop exchange. Aged farmers were interested to consume their own produced crops rather than exchanging them in the market for home consumption due to their cultural believe. This result is aligned with the findings of (Kassa et al 2017; Bezu and Villanger 2019).

Formal education level: It affects the probability of malt barley market participation of malt barley producer farmers at less than a 5% significance level negatively. This is because educated farmers had more awareness about market price information and did not sell their malt barley products at immediate harvest to find a better price. This result was contrary to the findings of Deresse et al (2018) and Mulatu (2020).

Malt barley farming experience: it affects the probability of malt barley market participation positively at less than 1% level of significance. This is because households are more experienced in malt barley production, they developed technical knowledge on production, allocated large farmland, produced more and know the benefit of malt barley farming. So, their demand and active involvement in malt barley grain market participation increased. This result concurred with the proposed hypothesis and other previous findings such as (Mekie et al 2019; Bezu and Villanger 2019).

Malt barley grain yield: it affects the probability of malt barley market participation of producer farmers positively at less than 5% level of significance respectively. When the

total malt barley production level of the producer household increased, their level of malt barley market participation increased due to they had enough malt barley yield to allocate for different purposes. This finding is aligned with the results of (Kyaw et al 2018; Nuri et al 2016; Deresse et al 2018).

Livestock holding in TLU: it affects the probability of smallholder farmer's malt barley market participation negatively at less than a 5% level of significance. This is due to the competitive nature of crop and livestock commodities on land allocation. Due to the study location are peri urban and most of the households participate in dairy farming and fattening, households having more livestock allocate more land for animal forage and grazing rather than malt barley production. Most households having more livestock used their animals and other animals' product like milk and butter as cash sources and were less interested to sell more malt barley yield. The result is consistent with the study of (Mekie et al 2019; Kassa et al 2017; Jaleta et al 2009).

House hold resident distance to local cooperative: it affects the probability of smallholder farmers' malt barley markets participation negatively at less than 5% level of significance. This is due to most malt barley producer farmers selling their malt barley grain for local cooperatives. So, as household home residents far from the local cooperatives, their level of malt barley market participation decreased due to transportation costs. This result was in agreement with the proposed hypothesis and other previous findings like (Leza and Kuma 2015).

Household resident distance to the nearest market: it affects the probability of malt barley market participation of producer farmers positively at less than a 5% level of significance. The reason is that malt barley producer's farmers nearest to the market were less likely to sell their malt barley during the harvesting season when the crop price is low. This means, that because they have market access, they stored their malt barley grain for a future better price. But, due to less market access, households far from the market were sold their malt barley grain at an immediate harvest low price. Contrary to the proposed hypothesis, this result has concurred with previous findings like (Mekie et al 2019; Rehima 2007). This result was contrary to previous findings of (Deresse et al 2018; Tura et al 2016; Asfaw et al 2010).

Household access to stable food: it affects the probability of malt barley output market participation of producer farmers positively at less than a 10% level of significance. This is because of households having enough stable food are self-food secured and have surplus grain to supply for the market. This result was in align with the proposed hypothesis (Gebru et al 2019).

3.4. Determinants of Malt Barley Market Participation Level of Households

Determinants of malt barley market participation level of producer farmers were estimated using ordinary least square regression in the second stage of the Heckman two-stage model (Table 3). The omitted variable test confirmed that there was no model specification error in the second stage of the fitted model (appendix 4). Out of thirteen explanatory variables included in the second stage of Heckman's two-stage model, three variables and the inverse mills ratio had a statistically significant effect on smallholder farmers' malt barley grain market participation level.

Formal education level of household head: it affects malt barley market participation level of smallholder farmers positively at less than a 5% significance level. This is because more educated farmers know the profit of selling malt barley and using other crops for home consumption, they were interested to sell more malt barley grain when they decide to sell their malt barley grain. This result was contrary to the proposed hypothesis and other previous studies like (Deresse et al 2018; Mulatu 2020).

Livestock holding in TLU: it affects smallholder farmers' malt barley market participation level negatively at less than 10% level of significance. This is due to the competitive nature of crop and livestock commodities on land allocation. This means, households having more livestock allocate

more land for animal forage and grazing rather than malt barley production. Most households having more livestock used their animals and other animals' product like milk and butter as cash sources and were less interested to sell more malt barley grain. The result is consistent with findings of (Kyaw et al 2018; Mekie et al 2019; Jaleta et al 2009).

Household resident distance to local cooperative: it affects smallholder farmers' malt barley markets participation level negatively at less than 5% level of significance. This is due to most malt barley producer farmers selling their malt barley grain for local cooperatives. So, as household home residents are far from the local cooperatives, their level of malt barley market participation decreases due to transportation costs. This result was in align with the findings of (Leza and Kuma 2015; Kyaw et al 2018).

Inverse Mills Ratio (Lambda): it affects the malt barley grain market participation level of smallholder farmers negatively at less than a 5% significance level. The significance of the inverse mill's ratio indicates the appropriateness of the Heckman model for identifying the determinants of malt barley grain market participation and level of participation by smallholder farmers. The lambda negative sign also indicates the existence of unobserved factors that have a negative impact on the amount of malt barley grain that is marketed. This result was agreed with the finding of (Ademe et al 2017).

Table 3: Heckman Two-Stage Model Estimation of Malt Barley Market Participation

Heckman two-stage model	Probit model		OLS Regression	
Variables	Coef.	SE	Coef.	SE.
Age of household head	-0.046***	0.017	2.872	4.200
Formal education level of HH head	-0.124**	0.059	34.415**	15.932
Malt barley farming experience	0.351***	0.102	-26.900	24.268
Total livestock holding (TLU)	-0.185**	0.088	-36.833*	20.272
Distance from local cooperative	-0.112**	0.006	-2.832**	1.448
Distance from the nearest market	0.006**	0.003	-0.091	0.586
Membership in an agricultural cooperative	0.302	0.439	-58.634	104.440
Malt barley price information	-0.227	0.686	17.801	160.800
Access to stable food	0.764*	0.457	-21.120	135.780
Crop exchange habit	0.189	0.449	14.830	92.050
Social_connection with traders	-0.369	0.478	35.420	121.690
Malt barley profit	0.001	0.001	0.014	0.024
Total household income	4.42e-06	5.65e-06	0.001	0.001
Total land allocated for malt barley	-0.612	0.713		
Malt barley grain yield	0.001**	0.001		
Mills lambda			-310.8**	105.0
Observations	110			
Censored observations	37			
Uncensored observation	73			
Wald chi2(15)	118.8			
Prob > chi2	0.000			
Dependent variable for first stage	Sale or not malt barley grain			
Dependent variables for second stage	Amount of malt barley grain sold			

***, **, * significant at less than 1%, 5% and 10% level respectively source: own survey result, 2021

Note: TLU=Tropical Livestock Unit, SE= standard error, coef. = coefficient, OLS=ordinary least square

4. CONCLUSION AND RECOMMENDATION

The agroecology in North Shewa Zone is ideal for the growth of malt barley. More than ten Woredas in this area produce barley and just lately, two breweries and one malt plant were built to take use of the zone's potential for malt barley production. Despite coordinated efforts to support and increase malt barley production and market supply in the North Shewa Zone and throughout Ethiopia, local production was unable to meet the demand for the grain at home. Millions of dollars are therefore spent nationwide to import malt which has a variety of effects on the nation. This study sought to underscore the factors that influence smallholder farmers' decision to participate in malt barley marketing and level of participation in Bassona worana and Angolelana tera woredas of North Shewa Zone.

The descriptive result indicates that malt barley growers supplied one-fourth of malt barley grain and used around half of the total malt barley grain for home consumption. The probit model results in the first stage of Heckman two-stage model revealed that malt barley producer farmers' decision to participate in the malt barley grain market was determined by age of household head, formal education level of the household head, malt barley farming experience, amount of malt barley grain produced, total livestock holding, household home residence distance from local cooperative, household residence distance from nearest market and household access to enough stable food. The ordinary least squares regression results in the second stage of Heckman Two-stage model showed that malt barley market participation level of smallholder farmers was also affected by the formal education level of household heads, total livestock holding, household residence distance from local cooperative and inverse mills ratio.

Based on the result of this study the following recommendation were suggested to increase the malt barley market participation and level of participation of smallholder farmers so as to improve their livelihood and fulfil the local malt barley grain demand. Collecting the malt barley grain as soon as it was harvested and setting competitive grain market pricing with a cash payment system. Connecting local malt and beer factories like Dashn, Habesha and Boort malt with the producer farmers to working as contract farming. The amount of participation of smallholder farmers in the malt barley grain market was also increased through increasing the output and productivity of malt barley, raising awareness of farmers about the quality requirements for malt barley grain, and introducing alternative food crops and forage species.

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