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Wheat Commercialization and its Determinant Factors in Walmara District, Central Ethiopia

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In Ethiopia wheat is cultivated by more than 4.5 million farmers and covers more than 1.8 million hectares of cultivated area of land. The study aimed at identifying factors affecting smallholders' wheat market participation and the level of commercialization in walmara district, central Ethiopia. To analyze the collected data from sample households' descriptive statistics and Double hurdle econometric model were employed. The results from probit model revealed that the education level of household heads, total livestock owned, total land owned, access to credit, and household size are the variables significantly influence the likelihood of wheat market participation with different signs. The Truncated regression model result infers that household size, off/non-farm income, and frequency of extension contact affects the intensity of wheat commercialization significantly. Thus, to enable smallholder farmers market orientation and to enhance the commercial level wheat producer farmers efforts aiming at empowering the efficient resource utilization and essential trainings on agricultural production.

Keywords: Commercialization, Wheat, Double hurdle, central Ethiopia

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INTRODUCTION

Ethiopian economy majorly depends on the agriculture sector and dominated by smallholder farmers. The sector contributed 33.3% to national GDP, 87% to export earnings and 72.7% to total employment (NBE, 2019; UNDP, 2015). Ethiopia is the third largest wheat producing country in Africa. Wheat is strategic crops for household food security, import substitution, supply of raw material for agro-industries, and means of generating income (FAO, 2015). In Ethiopia, within the category of grain crop area cereals cover more than 10.5 million hectares and wheat took up more than 1.8 million hectares of the grain crop area. In terms of production cereals contributed 30.2 tons of grain production and wheat contributed 5.7 million tons of the grain production (CSA, 2021). The demand for wheat in Ethiopia is growing faster than for any other food crop, particularly in urban areas because of rapidly increasing population, changing preferences towards wheat-based food items, and precarious wheat yield resulting from climate change.

The government of Ethiopia has identified key priority intervention areas to increase productivity of small scale farmers and expand large scale commercial production of wheat in rainfed agro-ecologies and production through irrigation. The agricultural commercialization clusters aim to develop integrated, geographic value chains supported by vibrant stakeholder alliances to enhance commercially driven output production and processing of high-value crops. Agricultural commercialization clusters have now been created in four regions. The four key commodities in Oromia region are maize, wheat, tef and barley (ATA, 2017). According to CSA data, wheat its covering 1,897,405 hectares land and

grown by 4,579,491 farmers in Ethiopia, and it covers 996,364 hectares of land and grown by 1,832,546 farmers in Oromia region, and it covers 35,352 hectares of cultivated area of land and grown by 62,671 farmers in Finfinnee surrounding Oromia special zone in which Walmara district is located in (CSA, 2021).

Smallholder farmer's market integration is a key for the growth of agricultural sector and a means of livelihoods but the majority of smallholder farmers in developing countries face challenges to fully exploit the existing potential of the markets due different marketing constraints and to elevate these challenges focusing on modernization and commercialization of the smallholder's agriculture is indispensable (Tesso, 2017). There are two wheat marketing channels, the formal and informal channels. The informal channel is dominant among smallholders in rural areas and smallholders usually seek for selling their products to local collectors who gather wheat from rural producers in order to resell it to wholesalers due to fear of transaction cost. The formal sector includes primary cooperatives, unions, rural wholesalers, commercial farmers and millers (Brasesco *et al.,* 2019). The constraints of commercial orientation of wheat producers are lack of resources, knowledge on production technologies and poor marketing linkages. To this effect, wheat producers receive less economic benefit from agricultural activities. Thus, considering the suitability of the central Ethiopia for wheat production, this study aimed at identifying the determinant factors of wheat market participation and the level of commercialization in the study areas to take evidence-based correction measures.

RESEARCH METHODOLOGY

Description of the Study Areas

Walmara district is geographically situated between 8°50'-9°15' N and 38°25'-38°45' E. The total area coverage of the district is 65,605 hectares. The altitude of the district is ranging from 2060 to 3380masl with an average of 2400masl. About 61 percent of the district is highland and 39 percent is mid-highland. The average annual rainfall of the district is 1,144 mm, ranging from 795 to 1300 mm. The annual temperature ranges from 6 ºc to 24ºc, with an average of 14 ºc. Walmara district is bordered on the south by Sebeta Hawas, on the west by Ejere, on the north by Adeaberga, and on the east by Kolobo. According to the CSA population projection report, the population of the district was 112,498 (56,200 male and 56,298 female) during 2019. The farming system of the district is characterized by both crop and livestock production. Cereal major crops grown in the district includes: wheat, barley and tef. While pulses crops, oil seed, potatoes, and other vegetable also grown in the district.

Data Types, Sources and Method of Data Collection

Both primary and secondary data sources were used for this research. Structured and semi-structured questionnaires were used to collect the primary data from selected sample households. Secondary data on socio-economic information was taken by reviewing published journals, and unpublished documents of the district's agricultural office, and websites were visited.

Sampling Procedure and Sample Size Determination

To select the required representative sample a purposive and two-stage sampling procedure was followed. Walmara district was selected purposively for this study and classified into highland and mid-highland based on the ecology. First, four representative sample peasant associations, two from each ecology were randomly selected. In the second stage, from the total of 1995 households, 200 sample household heads were selected using systematic random sampling. To decide the required sample size of (n=200) the rule of thumb was followed. The sample size from each kebele was selected based on the proportional sampling method which is determined using the following formula:

$$\mathrm{ni} = \frac{(\mathrm{Ni})\ (\mathrm{n})}{\sum Ni} \qquad (1)$$

Where ni - the sample to be selected from ith kebele

Ni - the total population living in ith kebele.
ΣNi - the summation of population living in selected four kebeles
n - total sample size for the district

Methods of Data Analysis

Both descriptive statistics and econometric models were employed to analyze the collected data from sample households.

Descriptive statistical analysis

Descriptive statistical analysis method such as mean, proportions, percentages, standard deviations, t-test and chi^2 test were used to describe the demographic and socio-economic characteristics of sample respondents. In addition, household commercialization index (HCI) defined as the ratio of gross value of wheat sold to the gross value of wheat produced was used for measuring the level of commercialization. Mathematically, the HCI adopted from von Braun *et al.,* (1994) is expressed as:

$$\mathrm{HCI_i} = \frac{\text{Gross value of wheat sold}}{\text{Gross value of wheat produced}} \text{ x } 100 \qquad (2)$$

HCI_i = Commercialization index of ith household in whet marketing expressed as a percentage.

Econometric analysis

To identify factors influencing wheat market participation and the quantity of wheat marketed a Double hurdle model which interprets the zero observation as corner solution and addresses the intensity of marketed surplus were used. Double hurdle model was first introduced as a class of models by Cragg (1971). The modeling approach assumes a two-step decision process, the first step involves the decision whether to participate or not and secondly the quantity of wheat marketed. The model estimation involves a probit regression to identify factors affecting the decision to participate in wheat market in the first stage, and a truncated regression model on the participating households to examine the quantity of wheat marketed, in the second stage.

The general form of Cragg's double hurdle model (probit and truncated models) that was used for this study is specified as follows.

$$\mathrm{D_i^*} = \mathrm{W_i'}\alpha + \mathrm{U_i} \qquad (\text{participation decisison}) \qquad (3)$$
$$D_i = 1, if\ D_i^* > 0, D_i = 0, Otherwise$$

Where, D***** is the latent variable describing the household's decision of whether or not to adopt improved *tef* varieties that takes the value 1 if the household adopted and 0 otherwise, D_i is the observed variable which represents the household's participation decision, W_i is a vector of explanatory variables, α is a vector of parameters to be estimated and U_i is the error term.

$$Y_i = \mathrm{X_i^*}\beta + V_i \qquad (\text{Commercialization decision}) \qquad (4)$$
$$Y_i = \mathrm{Y_i^*} = \mathrm{X_i}\beta + V_i \text{ if } \mathrm{Y_i^*} > 0 \text{ and } D_i^* > 0, \mathrm{Y}_i\text{=0, Otherwise}$$

Where, $\mathrm{Y_i^*}$ is the latent variable describing the intensity of marketed. $\mathrm{Y_i}$ is the quantity of wheat marketed and $\mathrm{X_i}$ indicates the vector of explanatory variables influencing how much the household participate in wheat selling, β is a vector of parameters to be estimated and whereas V_i is the error term? If both decisions are made by the individual farmers independently, the error term are assumed to be independently and normal distributed as: $\mathrm{U_i}$~N (0, 1) and V_i~N (0, δ2).

The log-likelihood from the Cragg type double-hurdle model is the sum of the log-likelihood from a probit and a truncated regression. Hence, double-hurdle model is given by:

$$\mathrm{Log}\ 1 = \boldsymbol{\Sigma}_0 \ln\left(1 - \phi\left(\mathrm{W_i'}\alpha\left(\frac{\mathrm{X_i^*}\beta}{\sigma}\right)\right)\right) + \boldsymbol{\Sigma}_+ \ln\left(\phi(\mathrm{W_i'}\alpha)\frac{1}{\sigma}\emptyset\left(\frac{\mathrm{Y}_i - \mathrm{X_i^*}\beta}{\sigma}\right)\right) \qquad (5)$$

Where, Φ and ∅ are standard normal cumulative distribution function and density function respectively.

To fix the appropriate models for the study a test for the double-hurdle model against the Tobit model were made. The Akaike information criterion (AIC) is a mathematical method for evaluating how well a model fits the data it was generated from. In statistics, AIC is used to compare different possible models and determine which one is the best fit for the data. The Akaike information criterion (AIC) is calculated from the maximum log-likelihood of the model and the number of parameters used to reach that likelihood. AIC is calculated from:

$$AIC = 2K - 2ln(L) \quad (6)$$

K is the number of independent variables used and **L** is the log-likelihood estimate (a.k.a. the likelihood that the model could have produced your observed y-values). The best-fit model according to AIC is the one that explains the greatest amount of variation using the fewest possible independent variables. Lower AIC values indicate a better-fit model.

RESULT AND DISCUSSION

Descriptive Analysis

Demographic and socio-economic characteristics of farmers

Group comparisons of wheat market participants and non-participants were computed using *t*-test for continuous variables and chi^2-test for dummy variables, and the results from the analysis were presented in the consecutive tables. As indicated in Table 1, out of total sample respondents 171 (85.5%) were male-headed and 29 (14.5%) were female-headed households. The chi^2-test result among market participants and non-participants indicates the existence of significant difference between the groups in terms of access to credit and existence of crop disease market participants are more in number than non-participants.

Table 1. Test statistics of wheat market participants and non-participants (*chi^2 -test*)

Variables		Participants		Non-participants		x^2-value
		(n=99)	49.5%	(n=101)	50.5%	
Sex of household head	Male	85	85.9	86	85.1	0.07
	Female	14	14.1	15	14.9	
Access to credit	Yes	93	93.9	87	86.1	3.38*
	No	6	6.1	14	13.9	
Extension contacts	Yes	89	89.9	85	84.2	1.46
	No	10	10.1	16	15.8	
Crop diseases	Yes	44	44.4	58	57.4	3.37*
	No	55	55.6	43	42.6	

Symbols: * indicates significant at 5% levels
Source: Own household survey result

The results on two-group mean-comparison test of continuous variables shows that there was statistically a significant mean difference between wheat market participants and non-participants by four explanatory variables (Table 2). The mean difference in household among wheat market participants and non-participants is statistically significant at 1% in favor of the later and the average household size of sample respondents was 4.74 with standard deviation of 1.904. With regard to educational level of sample household heads the mean difference among wheat market participants and non-participants is statistically significant at 1% in favor of the former, and the average number of formal schoolings completed was 4.24 years with a standard deviation of 3.88.

Table 2. Test statistics of wheat market participants and non-participants (*t-test*)

Variables	Mean			Std. Dev.	*t*-value
	Participants	Non-participants	Total		
	(n=99)	(n=101)	(n=200)		
Age of household head (years)	42.727	44.971	43.86	9.924	1.6
Household size (adult equivalent)	4.271	5.21	4.74	1.904	3.6***
Education level (formal schooling)	5.01	3.485	4.24	3.880	-2.85***
Livestock owned (TLU)	7.848	6.756	7.29	3.965	-1.95*
Total land owned (hectare)	1.815	1.313	1.56	1.209	-3***
Non/off-farm income (ET Birr)	7192.9	7818.6	7508.9	10043.7	.45
Distance to nearest market	5.091	5.406	5.25	2.211	1

Symbols: *** and * indicates significant at 1% and 10% levels, respectively
Source: Own household survey result

The mean difference in livestock owned among wheat market participants and non-participants is statistically significant at 10% in favor of the participants and the mean livestock owned of sample respondents was 7.29 TLU with standard deviation of 3.965 (Table 2), whereas the mean difference in total land owned among wheat market participants and non-participants is statistically significant at 1% in favor of the participants and the average total land owned by sample households was 1.56 with a standard deviation of 1.209.

Level of wheat commercialization of sample respondents

The survey result Figure 1 bellow specifies the level wheat commercialization of sample respondents in the study areas. The average level of wheat commercialization of sample respondents is 37.3% and most the households in the study area are subsistent wheat producer. This average value of wheat commercialization shows that the level of commercialization in the study area is categorized in semi-commercial level.

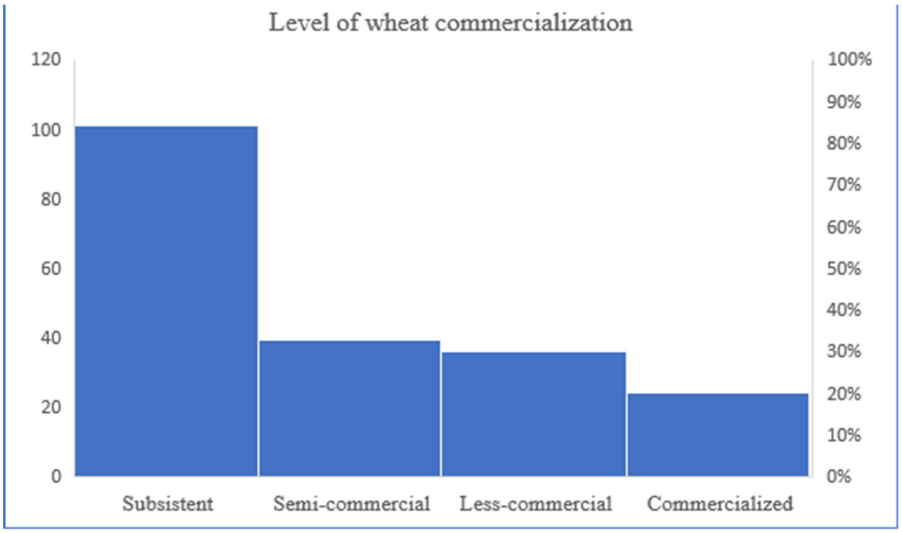

Figure 1. Level wheat commercialization of sample households
Source: Own household survey result

Econometric Analysis

Essential tests were made before econometric analysis to verify the hypothesized explanatory variables and existence of econometric problems using appropriate test statistics. In statistics, AIC is used to compare different possible models and determine which one is the best fit for the data. Thus, from the analysis the AIC results value of Tobit model is 986.22 and that of Double-hurdle model is 497.14 implies that for identifying the determinant factors of market participation and intensity of market participation in wheat market a Double-hurdle model feet the data. The estimated coefficients of probit model and truncated regression model were presented in following consecutive sections.

Factors affecting the probability of wheat market participation

The Probit regression model estimated results in Table 3 showed that out of eleven explanatory variables used in the model five of them the education level of household head; household size; number of Livestock owned; total land owned; and access to credit were found statistically significant to influence the probability of whet market participation in the study area.

As hypothesized, educational level of the household head was found to have positive and significant effect on the probability of wheat market participation at 5% level of significance. The positive association implies that the level of formal education of the household head increased by one grade the probability wheat market participation increases by 2%. This result indicates attending formal education improves wheat producers' knowledge of using production inputs and the amount of wheat marketed. Hence, availing access to formal education for farmers in the study areas is required to enhance wheat production and improve market participation. This result supported by the findings of Tadele *et al.,* (2017) who found the level of formal education of the household head increased the level of wheat commercialization.

The household size measured as adult equivalent was found to have negative and significant influence the probability of wheat market participation at 1% significance level. The result shows that as the household size increased by one adult equivalent the probability of wheat market participation decreased by 7%. This result is due to the fact that households with more household size tend to consume more of wheat output produced and less is available for market. This result is supported by the findings of Fekadu *et al.,* (2021) who showed that the larger households are expected to have lower market orientation and market participation.

The number of livestock owned had a statically significant and positive effect on the likelihood of market participation at 10% probability level. The result implies that an increase in number of livestock owned by one TLU rises the likelihood of wheat market participation by 1.8%. This result is due to the positive effect of livestock resources on wheat cultivation as a source traction power and the income from a sale livestock used to purchase wheat production inputs. This outcome is in line with the previous studies of Birara *et al.,* (2020) that households who have a greater number of oxen could meet the standard tillage frequency of wheat production and also increases the financial capacity of smallholder farmers to purchase the best agricultural practices.

Table 3. Probit model estimates on the probability of wheat market participation

Variables	Coefficient	Robust Std. Err.	p-value	Marginal effect
Sex of household head	-0.382	0.289	0.186	-0.150
Age of household head (years)	0.000	0.011	0.996	0.000
Education level of hh head	0.049*	0.026	0.058	0.020
Household size (adult equivalent)	-0.176***	0.059	0.003	-0.070
Livestock owned (TLU)	0.045*	0.027	0.088	0.018
Total land owned (hectare)	0.182**	0.085	0.032	0.073
Non/off-farm income	0.000	0.000	0.960	-0.000
Frequency of extension	0.296	0.289	0.305	0.117
Distance to nearest market	-0.021	0.043	0.632	-0.008
Access to credit	0.559*	0.322	0.083	0.214
Crop disease	0.017	0.204	0.932	0.007
Constant	0.336	0.746	0.652	
Wald chi2 (11)	33.45			
Prob > chi2	0.0004			
Log likelihood	-121.611			

Symbols: ***, ** and * indicates significant at 1%, 5% and 10% levels, respectively
Source: Own household survey result

The result of the analysis revealed that total land size of the household head was found to be a statically significant and positive effect on the probability of participating in wheat market at 5% level of significance. The result implies that an increase in number of livestock owned by one TLU rises the likelihood of wheat market participation by 7.3%. The positive association implies that households having large hectares of cultivable land allocate more areas for wheat production and produce surplus out to participate in the market. This result is in line with the findings of Birara *et al.,* (2020) that the larger the land size allocated to wheat production, the higher would be the output which increases the volume of wheat supplied to the market.

The availability of credit service had statically significant and positive effect on the likelihood of market participation at 10% significance level. The result implies that sample households having access to credit service increases the likelihood of wheat market participation by 2.1%. This is due to the positive effect of credit services on wheat production and productivity by purchasing improved seed and inorganic fertilizers. This outcome is supported by Tadele *et al.,* (2017) findings that credit plays an important role in solving cash constraints needed in wheat production which in turn has a positive effect on marketable surplus.

Factors affecting the intensity of wheat commercialization

As shown in Table 4, the likelihood function of the Double hurdle model for the level of wheat commercialization is significant (LR 2 (11) =20.51 with Prob > Chi2 = 0.038) indicating the explanatory power of the independent variables. The result of Truncated regression model showed that out of eleven explanatory variables used in the model three variables, namely household size (adult equivalent), frequency of extension contact and off/non-farm income were found to significantly influence the commercialization of wheat producers in the study area. Household size measured as adult equivalent was found to have a positive and statistically significant at 10% probability level. An increase of household member by one adult equivalent decreases the wheat commercialization level by 4.23%. This result is expected because households with more household member tend to consume more of wheat output produced and less is available for sales. This result supported by the findings of Efa *et al.,* (2016) who finds that a large family size increases the quantity for home consumption thereby reducing the marketed surplus.

Income obtained from non/off-farm activities influenced the level of wheat commercialization negatively and statistically at 1% significant level. The result shows that an increase in the amount off/non-farm income by one ET birrs decrease the commercialization intensity by 0.001%. This is due to the fact that households gained income from non/off-farm activities were not encouraged to take part in modern agriculture by employing full production packages and they used the produced wheat for home consumption. This result is in line with the findings of Dubale *et al.,* (2020) who found that the farmers getting more off/non-farm activities consider wheat production as a part time activity.

Table 4. Truncated regression estimates on the intensity of wheat commercialization

Variables	Coefficient	Robust Std. Err.	p-value
Sex of household head	-7.728	10.828	0.475
Age of household head (years)	0.133	0.347	0.701
Education level of hh head	0.913	0.958	0.340
Household size (adult equivalent)	-4.231*	2.199	0.054
Livestock owned (TLU)	-0.802	0.758	0.290
Total land owned (hectare)	1.151	2.776	0.678
Non/off-farm income	-0.001***	0.000	0.005
Frequency of extension contact	21.270*	11.915	0.074
Distance to nearest market	0.247	1.350	0.855
Access to credit	8.476	11.029	0.442
Crop disease	-3.374	7.394	0.648
Constant	30.177	34.715	0.385
Sigma	23.014***	1.845	0.000
Wald chi2 (11)	20.51		
Prob > chi2	0.0388		
Log likelihood	-350.532		

Symbols: *** and * indicates significant at 1%, 5% and 10% levels, respectively
Source: Own household survey result

As revealed from the above Table 4, extension contact had a positive and statistically significant effect on the intensity of commercialization at 10% significant level. The result shows that an increase of extension contact of farmers with development agent by one day would increase the commercialization level of wheat by 21%. This result was due to the fact that getting technical advice on production and marketing of wheat enables farmers to cultivate wheat by applying full production and package and enhance the quantity of wheat marketed to improve their family's livelihood. This finding is similar with the results of Birara *et al.,* (2020) who found that access extension service providers give training for farm households about commercial farming and its advantages that would increase their wheat commercialization.

CONCLUSIONS AND RECOMMENDATIONS

The study aimed to identify the factors affecting wheat market participation and commercialization level of wheat producer farmers in walmara district, central Ethiopia. To analyze the collected data from sample households' descriptive statistics and Double hurdle model were employed. The model estimation involves a probit and a truncated regression model to find determinant factors of market participants and intensity of participation, respectively.

The probit model result indicated that education level, livestock owned, total land owned, and access to credit were positive and significantly influence the likelihood of wheat market participation and whereas household size significantly and negatively affect sample households market participation. As to the level of wheat commercialization the truncated regression model result infers that household size and off/non-farm income affects wheat commercialization level negatively and significantly whereas frequency of extension contact affects the level of commercialization positively and significantly. Therefore, to enhance the commercial orientation farmers efforts focusing on efficient utilization of household's resource base and agriculture based educational training are essential.

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