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Determinants of Smallholder Farmer's Wheat Production and Commercialization: The Case Study of Jeldu District, West Shoa Zone, Oromia National Region, Ethiopia

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Abstract

Wheat is the most important grain crop for food security and is used as a source of income for developing countries. It is one of the most commonly grown crops in Ethiopia in general and in one study area in particular. The government of Ethiopia recognizes the importance of wheat for economic development and emphasizes its production and commercialization in strategies and policies for agricultural transformation. However, wheat production is mainly a subsistence crop and the proportion commercialized has been very small. Therefore, this study should measure the degree of commercialization of wheat, analyze the determinants of wheat production and determine the decision to participate in the commercialization of wheat in Jeldu district. A sample of 369 wheat-producing households was drawn by means of a multi-level sample of producers. The data for the production year 2020/21 was collected in sample households using structured questionnaires. Econometric models were used for data analysis. Under econometrics, Cobb-Douglas production and a double hurdle model were applied. The result of the Cobb-Douglas production using the log-linear model showed that other significant variables such as the age of the head of household, level of education, country size, number of oxen and access to improved seed far from the nearest market and family size a positive effect on the wheat produced was to be expected. The result of the double hurdle model indicated this; expect the distance to the nearest market and family size. Other important variables such as wheat country, number of oxen owned, educational level of household head, access to credit and age of household head initially had a positive effect on the decision to commercialize the hurdle. The intensity of wheat sales is positively influenced by the age of the head of household, the land allocated for wheat production and the number of oxen owned, while family size is negatively influenced in the second hurdle outcome. The study showed that the degree of commercialization of wheat production in the study area was very low. Therefore, strategies and policies to promote the commercialization of smallholders in wheat production should focus on providing rural infrastructure, strengthening adult education, improving agricultural advisory services, improving the provision of inputs, strengthening institutional arrangements, strengthening to improve commercialization and focus on generating excess wheat spend and increase sales.

Keywords: Wheat production • Commercialization • Log-linear • Double Hurdle model • Ethiopia

Introduction

Wheat is the most important grain crop for food security and is used as a source of income for developing countries. Africa produces more than twenty million tons of wheat on ten million hectares. Sub-Saharan Africa produced a total of over seven million tonnes over a total area of more than two million hectares, accounting for 40 and 1.4 percent of African and global wheat production, respectively. Bread wheat, which accounts for 95 percent of wheat production on a global scale, is also the dominant wheat variety produced in SSA [1]. In most African countries, most small farmers engage in subsistence farming. This practice of subsistence farming results from an inadequate environment and weak institutions, including ramshackle rural infrastructure and services such as roads, irrigation, expansion facilities, depleted productive assets and limited access to inputs; loss of financial savings; insufficient agricultural funding; low production due to insufficient agronomic knowledge, poor agronomic practices and technologies and insufficient use of improved technologies; and weak market access [2]. In Ethiopia, wheat is exported abroad and imported from abroad to gain a comparative advantage; but the import and export quantity and value are unbalanced. The current import of wheat and its distribution to millers in subsidized countries is intended to stabilize and eventually stop the price of wheat. Import from abroad also decreases by 1,654,282 tons in 2011 to 1,145,954 tons in 2016 [3]. Therefore, promoting commercially-oriented wheat production to increase production and sales is crucial to ending import subsidies.

The productivity of some grain crops such as corn (41.07 qt/ha) is greater than the national average (40.09 qt/ha), indicating the immense potential of Oromia to increase crop production and productivity in the country to ensure food security and produce a surplus for export. The region is characterized by subsistence farming households that predominantly grow grain. The region's economy was based on agriculture, which accounted for 69 percent of the region's growth domestic product and employed 89 percent of the total labor force. Oromia accounts for a large part of the country's agricultural exports: coffee, legumes and oilseeds. Traditional agricultural methods of the region and rapid population growth, land fragmentation, fragmentation of natural resources and farm size decline are some common limiting factors for increasing agricultural production and productivity [4]. As in most of Oromia, agriculture is the main sector in the West Shoah zone Cereal crops: Wheat, barley, maize and teff have occupied the largest acreage, accounting for 80 percent of the district. Wheat is one of the most widely grown crops in Jeldu District, along with potatoes. Bread wheat and durum wheat are the main wheat species growing in the study area [5].

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The Jeldu district is one of the regions wherein agricultural pastime has been taking place. The District has appropriate climatic situations for the manufacturing of maximum dominant cereal vegetation like wheat, barley and potato, etc. wheat is the dominant cereal crop manufacturing with inside the District subsequent to potato and its miles the coins crop for the farmers who're engaged in wheat manufacturing. However, whilst Jeldu district is as compared to different districts of the West Shoa Zone, produce wheat is characterized *via* way of means of low productiveness and meals lack of confidence [4]. Thus, to the nice of the researcher`s knowledge, there's no similarity amongst students and researchers at the determinants of smallholder farmers` wheat manufacturing and commercialization and maximum of the studies on this location is descriptive with few statistical tests. In Jeldu, Where the studies became conducted, wheat is exceedingly produced subsequent to potato as compared to different vegetation cultivated and there's an excessive call for with inside the marketplace in order that the smallholder farmers have an excessive possibility to commercialize *via* way of means of wheat (District`s report, 2018). Even though the observe location has big capacity for wheat manufacturing and excessive call for with inside the marketplace, the smallholder farmers are nonetheless generating wheat exceedingly for subsistence (consumption), now no longer for the marketplace. Additionally, the researchers couldn`t discover any observe undertaken at the determinant of smallholder farmers` wheat manufacturing and commercialization with inside the observe location. This is because of various factors that restrict the smallholder wheat farmers from commercialization. Therefore, this observes became the blueprint to appraise the determinants that have an effect on smallholder farmers' wheat manufacturing and commercialization in Jeldu District, Oromia Regional, Ethiopia (Figure 1).

Figure 1. Map of wheat.

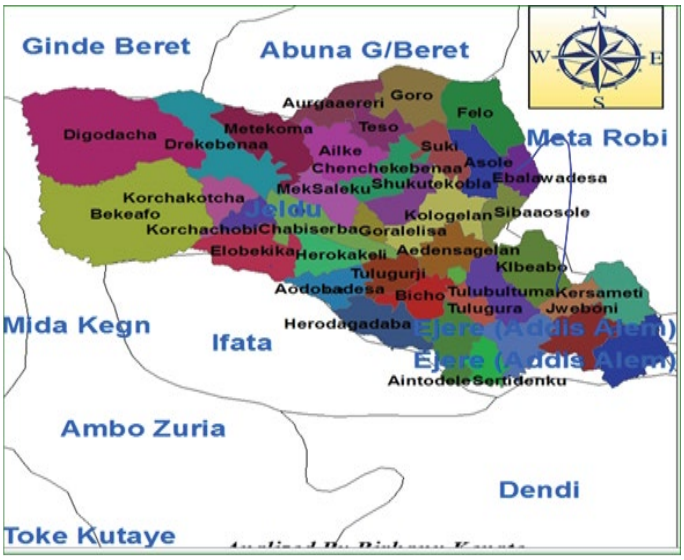

Figure 2. Geographical location of the study area.

Methodology

Description of the study area

This study was conducted in Jeldu District, West Shoa Zone and Oromia Region. Jeldu is one of the districts in the Oromia region of Ethiopia. Jeldu district is one of the west Shoa Zone districts and located between 9°25' N to 9°30' N latitude and 038°00'E to 38°05' E longitude, at 72 km from Zonal capital town Ambo and 129 km from Finfinnee. Jeldu district is adjoining with the Dendi in the south, Cobi and Ilfeta in the west, Abuna Gindi Beret in the North, Meta Robi in the East. Towns in Jeldu include Gojo, Osole, Shekute and Boni. The location map of the Jeldu district is shown in Figure 2.

Types and sources of data and methods of data collection

Both primary and secondary data sources were used in this study. Primary data were collected from wheat producer households using questionnaires and interview methods. A questionnaire guide of sorts was developed to collect individual information for all sample data on the determinant of smallholder wheat production and commercialization.

Sampling techniques and sample size determination

For this study sampling technique multi-stage sampling techniques was applied. The sample size determination formula established for this study is the following formula given by Yamane (1967).

$$Sample\ size\ (n) = \frac{N}{1+N(e)2},$$

Where,

n=sample

N = total households of the target population in the case study

e = level of precision (Table 1)

$$Sample\,size(n) = \frac{N}{1+NN(e)2}$$

Table 1. Size of sample determination of households.

Kebeles	Household size	(%)	Sample
Kilbe-Abo	2900	61	224
Qarsa-Mexi	1020	21	79
Jawe-Boni	850	18	66
Total	4770	100	369

Source: Own calculation (2021) (%) = sample proportion.

Econometric model selection and specification

Cobb-douglas production model: The production function describes the technical relationship that converts an input into outputs. To study the determinants of wheat production, the researcher used Cobb-Douglas production functions. As this production function used was important to analyze the different agricultural factor production, since the use of the log-linear function simultaneously includes the factor production input and other determinants of production [6].

Therefore, production functions were used as general production function specified as:

$$Y = \beta 0 + \beta 1X + \varepsilon i \quad (1)$$

Equation 1 was transformed into a log-linear function as follows:

$$lnY = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \ldots\ldots + \beta nXn + \varepsilon i \quad (2)$$

Where,

lny= ln of the amount of wheat produced (production output), β0 is the

intercept coefficient, β1..... βn are coefficients of explanatory variables, X1.....Xn is the explanatory variables.

The double-hurdle regression model: Originally proposed by Cragg (1971), double hurdle is a two-step process that incorporates the relevance of the participation decision to the Tobit model, with the likelihood of participation and the intensity of participation or orientation being determined by separate processes. In contrast to the double hurdle model, Heckmans (1979) assumes that the null observation results mainly from the self-selection of the respondents. The double hurdle model, also known as the two-tier model, is a corner solution model that assumes that zero combined with non-participation is a result of rational choices [7].

Commercialization participation

Various studies, such as Gebremedhin and Jaleta, Gani and Hossain, Wedeyohanis, Leta and Adenegna employed Ordinary Least Square (OLS) to investigate factors of commercialization and degree of commercialization [8-12]. The dependent variable, the wheat sales index, typically ranges from 0 to 100% or is clipped between 0 and 1. However, because all wheat producers did not participate in the market in this study, the wheat sold index for non-participants is zero, whereas the wheat sold index for market participant families is larger than zero but less than one. As a result, a double-hurdle model was used, with the dependent variable being the decision to participate in commercialization and the quantity sold as the explanatory factors. Specification of the Double Hurdle models is as follows: In the first hurdle, farmers decide whether or not to participate in crop commercialization, then conditional on the participation(y>0), hurdle two considers the volume of wheat sale. Following Greene (2012), the double hurdle is specified as follows:

Participation equation:

$$Y^* = Z_i\delta + u_i \approx N(01)$$

$$p_i = \begin{cases} 1 if Z_i\delta + u < 0 \\ 0 if Z_i\delta + u \le 0 \end{cases}$$

Intensity equation:

$$Y_i = X_i\beta + \varepsilon_i, \varepsilon_i \approx N(0,\delta)$$

$$Y_i = \begin{cases} Y^* if Y^* > 0 \ and \ p_i = 1 \\ 0, \quad otherwise \end{cases}$$

The maximum likelihood estimator of the double hurdle model (MLE) produces first and second hurdle results. The hurdle can be obtained from the probit estimator. Then, the maximum likelihood estimator (MLE) for the second hurdle can be estimated truncated normal function, the estimation results were identified whether estimations made simultaneously or one regression at a time. On other hand, while using Craggit makes estimation more coherent, the use of probit and truncated regression for the Double hurdle model would not change results Burke. Furthermore, under the assumption of independent, homoscedasticity and normally distributed between two error terms (vi and εi), the Log-likelihood function of the double-hurdle is the summation log-likelihood of probit model and truncated regression model McDowell (2003). Therefore, the log-likelihood function for the double-hurdle model that nests a univariate probit model and a truncated regression model is given following Cragg by: Φ

$$\ln L_i = \sum \ln\left[1 - \Phi(\varphi i'\alpha)\frac{Xi'\beta}{\sigma}\right] + \sum_{+} \ln\left[\Phi(\varphi i'\alpha)\frac{1}{\sigma}\Phi\frac{yi - Xi'\beta}{\sigma}\right]$$

Where,

"0" indicates summation over the zero observation in the sample

"+" indicates summation over positive observations

Φ (.) and Φ (.) represent standard normal probability and density functions respectively, Φi and Xi represent independent variables for the probit model and truncated regression model respectively, β, σ and δ are parameters estimated from each model. The first term the right-hand side denotes the summation over the zero observation in the sample. Whereas the second term on the right-hand side indicates summation over the positive observations.

Results and Discussion

Estimated cobb-douglas production of factors affecting wheat production

The reasonable base intended for choosing the cobb-Douglas production function is based on the fact that is simple and convenient to specify and interpret. So, for this study, the researcher used the log-linear regression model. Accordingly, the result of the cobb-Douglas production model revealed that the overall significance and fitness of the model can be checked with the value of Prop >F=0.0000 shows that the model result is statistically significant at less than the percent significance level. This suggests that the model has strong explanatory power. The result of R-squared is equal to 0.65 which implies that 65% of changes in wheat productivity are explained by the explanatory variables included in the model. Among the 15 explanatory variables hypothesized in the cobb-Douglas production model, seven (7) explanatory variables namely: Age of household head, education level of household head, family size, distance from the nearest market center, number of oxen, land allocated to wheat production and improved seed use were found to be significantly affecting the amount of wheat produced in the study area at appropriate significance level (Table 2).

Age of household head (agehhh): The coefficient of age to wheat production was positive and statistically significant at 5%. The positive coefficient suggests a year increased of a variable when other explanatory variables are held constant; age of household head positively elastic to output by 6.42%. It is consistent with the prior expectation. Age of household is important in peasant agriculture where the mode of production is a far-reaching pattern. When a household's age is too old to produce output requirements become more and more farmers shift positively increasing to output. But if young age of farm experience is available supported subsistence requirements, farmers restore low to cropping cereal crops. Allocation of the age of farm experience for wheat productions indicates a higher degree of attention in managing farm output. Therefore, an increase in age allocated for wheat by a year led to an increase in elasticity output by 6.42% keeping other variables constant. Age of production experience is highlighted as an important input to agricultural production affecting farm output.

The number of oxen (noxen): The coefficient of oxen to wheat production was positive and significant at 1%. The positive coefficient the number of oxen suggests a unit increase in the variable for wheat production when other explanatory variables are held constant; increasing the number of oxen is positively elastic to output by 76.06%. It is consistent with the prior expectation. An increase in the number of oxen will lead to increases in wheat output. Since the wheat seed is very small and thus germination is difficult in heavy and unbroken soils, therefore, the land should be tillage by high frequency. In most parts of Ethiopia, farmers use oxen for plowing land. As result, it needs many numbers of oxen to tillage lands again and again. Therefore, an increase in the number of oxen allocated for wheat by 1% led to an increase is positively elastic to wheat output by 76.06% keeping other variables constant. The oxen are highlighted as an important input to agricultural production affecting farm output. This finding is consistent with the finding of Urgessa extra using several number of oxen is an important to increase agricultural production.

Land allocated to wheat (lands): The coefficient of farm size to wheat production was positive and significant at 1%. The positive coefficient farm size proposes as farm size increase in a variable for wheat production when other explanatory variables are held constant. The land allocated to wheat production is positively elastic to output by 94.94%. It is consistent with the prior expectation. Farmland size is the importance of this factor in peasant agriculture where the mode of production is extensive as opposed to the intensive pattern. When land to a household is too small to produce subsistence requirements from less profitable and risk become increasingly, farmers tend to other high profitable cereal crops. But if sufficient land is available to support subsistence requirements, farmers restore more to cropping cereal crops.

Table 2. Cobb-Douglas production model ureslt for wheat output.

lny	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]	
Lnagehhh	.0642271**	.0272933	2.35	0.019	.0105487	.1179056
Lnnoxen	.7606217***	.204336	3.72	0.000	.3587488	1.162495
Lnlands	.9494313***	.2738941	3.47	0.001	.4107566	1.488106
Lnfextc	-.2168099	.2467281	-0.88	0.380	-.7020565	.2684366
Lndistmkt	-.788976***	.075665	-10.43	0.000	-.9377897	-.64016
Lndfsize	-.3155773***	.086683	-3.64	0.000	-.4860589	-.1450957
lneduclhhh	.6517852	.1460173	4.46	0.000	.3646091	.9389613
Dummy sexhh "male"	-.6732261	.615416	-1.09	0.275	-1.883581	.5371288
Dummy pcide "yes"	.1884508	.5407699	0.35	0.728	-.8750955	1.251997
Dummy fert "yes"	.8426705	.598458	1.41	0.160	-.3343325	2.019674
Dummy credit "yes"	.8714352	.6049791	1.44	0.151		-.3183932
Dummy impseed "yes"	.9868624*	.5216942	1.89	0.059	-.0391672	2.012892
Dummy atrans "yes"	.8726684	.5490562	1.59	0.113	-.2071748	1.952512
Dummy manur"yes"	-.6443237	.6100112	-1.06	0.292	-1.844049	.5554013
Dummy shv "yes"	.2815554	.5677125	0.50	0.620	-.8349797	1.39809
_cons	14.54165	2.046852	7.10	0.000	10.51606	18.56725

Number of Obs=369, F(14,354)=44.50, Prop>F=0.0000, R-squared=0.6547, Adj R-squared=0.6429, root MSE=4.7476

Note: *** ** and * refers to significant at 1% 5% and 10% significance level.
lny refers to the amount of wheat produced by households in the study area.
Source: Author's Computation from own survey data, 2021; STATA version 14.

Allocation of a large area of land for the wheat farm can also indicate a higher degree of attention in managing the farm. Therefore, an increase in land size allocated for wheat by 1% led to an increase elasticity of wheat production by 94.94% keeping other variables constant. The farmland is highlighted as fundamental factor to agricultural production affecting farm output. This finding is inconsistent with the findings of [13] smallholder farmland sizes less effect to increase agricultural productivity than higher farmland size.

Distance from the nearest market (distmkt): The coefficient of market distance to wheat production was negative and significant at 1%. The negative coefficient of market distance on wheat producers proposes a unit increase in distance of producers from the market center when other explanatory variables remain constant is show negatively on the elasticity of output by 78.89%. It is consistent with the prior expectation. When the distance of market center from homestead is too large to produce subsistence requirements resulted in the risk of low production become increasingly, farmers tend to elastic production negatively to produce crops. But if less distance from market center to farmers homestead resulted to positively elastic to productions. However, an augment in the market distance by 1 % kilometer from allocated led to a decreased elasticity of output by 78.89% keeping other variables unchanged. The market distance is overviewed as an imperative factor to agricultural production affecting farm output. This finding is consistent with the finding of Welch, (2003) that small distance has more importance on agricultural production than large distance and Bationo, (2006) revealed that when the market for agricultural inputs and outputs is poorly developed, it creates adverse relationships between input and output prices.

Family size (fsize): The coefficient of family size to wheat production was negative and statistically significant at 1%. The negative coefficient put forward as a family member increased in a variable when other explanatory variables remain constant. The large family size had negative elastic on wheat output by 31.55%. It is corroborate with the prior expectation. This sign implies larger family members tend to participate in production less than smaller ones due to larger households' have the smallest farm size to a proportion of their family members. Member of household is important in peasant agriculture with their proportion of family size due to the farm size is restrict them to increase or decrease their participation in production. This finding is inconsistent with the findings of Merima in Ethiopian households' large family size would participate better than small family size. However, this finding is confirm with the findings of Zahonog in south-Guinean Zones Burkina Faso views small family size found better participants of productivity than large family size with having equal land size.

Education level of household head (educlhhh): The coefficient of educational level household heads to wheat production was positive and significant at 1%. The positive coefficient education level of household heads proposes that as the level of formal education of the household head increase by one-grade increase amount of wheat produced when other explanatory variables are held constant; the educational level of household headed is positively elastic to output by 65.18%. It is consistent with the prior expectation. This indicates that attending formal education improves agriculture and improves the productivity of wheat produced by adopting improved agricultural technologies. Thus, improving the access of formal education and informal education in the study area is indispensable for smallholder farmers in general. However, an augment in education level by 1% from one grade to next grade led to an increase in elasticity of product by 68.15% keeping other variables unchanged. The education level is overviewed as an imperative factor to agricultural production affecting farm output. This finding is corroborate with the findings of Mersha Tekalign education improves the ability of the household to make an informed decision about production inputs [14]. Educated farmers have the better access to agricultural information and a higher tendency to adopt and utilize improved inputs.

Access to improved seed (impseed): The coefficient of dummy improved seed access "yes" of wheat producers for wheat productions was positive and significant at 10%. The positive coefficient accessed improved seed recommends a unit increase of supplied improved seed to producers when other explanatory variables are held constant; access to improved seed is positively elastic to output by 5.9%. It is consistent with the prior expectation. The significance of accessed improved seed is an important factor in peasant agriculture where the mode of production is extensive as opposed to the intensive pattern. When improved seed available to the producer is existed to produce high required from less production, farmers tend to shift to high output cereal crops. Therefore, an increase in supplied improved seed to wheat producers distributed for wheat by 1% led to increased elasticity of output positively by 5.9% keeping other variables constant. The accessed improved seed highlighted as an essential input to agricultural production affecting farm output. This finding is confirm with the finding of Semerci wheat production function in Turkey views using improved species found better for increasing the productivity of farmers.

Determinants of wheat output commercialization participation decision

The possible econometric model expected to be employed in the analysis of wheat output commercialization participation decision and intensity where

the Tobit model, Heckman two-step, Heckman maximum likelihood model and double-hurdle model. Therefore, it is very important to identify which econometric model to use when dealing with such kinds of the problem. Likelihood ratio test (lR test) statistical test was used for comparing the goodness of fit of Tobit model and Double-hurdle model in this study.

The test statistic for log-likelihood ratio at was 14 degrees of freedom (T= -124.79707) was statistically significant with Prob >chi2=0.00. In another way, the value of the log-likelihood ratio (T= -71.415713) was found higher than the tabulated chi-square distribution at 14 degrees of freedom which was 16 and 31 for 1% 5% and 10% significance level, respectively The AIC also shows that the double-hurdle model is preferred to Tobit model since the value of the test statistic from Double hurdle model (204.8314) is lower than that of Tobit (281.5941). The implication for this case is that the Tobit model was rejected in favor of the Double-hurdle model for analyzing factors affecting commercialization participation and intensity in wheat output commercialization.

Heckman's two-step model is an econometric model developed to correct for sample selection bias Heckman, (1979). In this, the result from the Heckman two-step showed that inverse mills ratio (IMR) or lambda which was (-0.86) was found statistically insignificant which indicates no sample selection bias in the data. Thus, no need to use Heckman two steps model. Moreover, the results of Heckman's maximum likelihood model output showed that the two equations are independent because the null that the market participation decision and intensity of market participation are independent is accepted than Heckman two-step. The independence of the equations suggests the permissibility of analyzing the two equations separately using probit and truncated regression model which is double hurdle model. Therefore, the double hurdle model was employed in this study.

The state command 'Cragg' by Buke was used in the STATA 14 version for estimation of the Double hurdle model to identify factors affecting market participation decision and intensity in wheat output commercialization. In this case, since the double hurdle model is the combination of probit and truncated regression model, the commercialization participation decision and its intensity (volume of sale) were separately estimated and the model output estimated using 'Craggit' was placed under appendix. The summation of Log pseudo-likelihood generated from the separate probit and truncated regression is equal to that generated by the Craggit command. This in turn that no matter whether the double hurdle model is estimated by the 'Craggit' command or separately using probit and truncated regression model.

The double hurdle model was used to identify factors affecting commercialization participation decision and intensity of participation in wheat commercialization in the study area. The overall significance and goodness of fit of the model were checked with the value of Wald chi-square value of 131.86 at 14 degrees of freedom shows that the result is significant at less than the significance level. The log pseudo-likelihood value of -71.415 indicates that the assumption of a null hypothesis that all explanatory variables in the regression model are simultaneously equal to zero is rejected at less than 1% level of significance.

Determinants of wheat output commercialization participation First hurdle /probit model result

The Double-hurdle model result showed that out of 14 variable hypothesized to affect household decision to participate in wheat commercialization, seven (7) explanatory variables namely: Age of household head, number of family size, educational status of the household head, number of owned oxen, land allocated to wheat production, distance to from the nearest market center and access to credit were found to significantly determine households' decision to participate in the wheat output commercialization (Table 3).

Age of household head (agehhh): The Double hurdle model results of the first hurdle shows that the age of household head was found significant and positively related to the probability of commercialization in wheat output market at a 1% significance level. The marginal effect result revealed a year increased in the age of household head results in 2.76% increases in the probability of commercialization in wheat output on average, keeping other variable ceteris paribus. The implication is that aged households are believed to wise in resource allocation, risk management and have more contact with allows trading partners to find out at lower cost than younger households due to the experience they developed. The result is consistent with the finding of Adenegna, (2012) which shows the age of the household head was positively related to the households' decision to participate in wheat. Similarly, Abera, (2015) also found a positive relationship between the age household head and households' decision to participate in the haricot bean output market, respectively.

Family size (fsize): Family size measured as adult equivalent was hypothesized to have negative effects on the probability of commercialization decision in the wheat commercialization output market. As hypothesized so far, it was found to be negative and have a significant influence on the probability of commercialized wheat commercialization at a 1% significance level. The marginal effects show that as the member of household increased by one adult equivalent, the probability of commercialized in wheat output commercialization decrease by 13.105%. This result is expected because household members tend to consume more wheat produced and less wheat is allocated for sales. This finding is similar with the findings of Getahun A, et al. [15] that showed indicated that large household size diminish household size consumes more output of wheat produced, has a lower marketed surplus and less is available for sales.

Educational status of household head (educlhhh): Educational level of the household head was hypothesized to affect household decision to participate in wheat output commercialization since it is assumed that increments in the educational level of the household head increase the probability of participation in wheat commercialization. As was hypothesized, the econometric result shows that there is a positive and significant relationship between the educational status of the household head and the decision to participate in wheat output commercialization at a 10% significance level. It shows that as educational level of household head increase by 1 year of schooling, the probability of participating in wheat output commercialization could increase by 16.67% on average keeping other factor constant. This could be due to fact that household heads with more educational levels have better commercialization networking and bargaining power and good managerial skill of enterprises. It is also evident that educated farmers' tendency to accept different agricultural technologies is high so that they can produce more and participate in wheat commercialization. This result is consistent with the previous findings conducted by Mazengia Y [16] and Seid (2020) and Abayneh Y and Tefera T [17] which stated that education increases the probability of participation in the haricot bean, red pepper and maize output market respectively. The ability of farmers to get and analyze relevant commercialization information which would improve the managerial ability of the farmers in terms of better formulation and execution of farm plans and acquiring better information to improve their commercialization performance.

The number of oxen owned (noxen): The number of oxen owned was positive and statistically significant at 5% significance level. The marginal effect point toward that the household with several oxen has the probability of commercialization participation by 13.80%. This indicated that households with more number of oxen were more likely to be a participant than a non-participant. This is anticipated that the number of oxen available to the household positively enhances the probability of being a seller. Since ox is a critical production asset in smallholder farm households having a direct effect on the production of marketable surplus with a significant amount. This finding is similar with the finding by Abera, (2015) that asset endowments have a higher probability of market participation.

Farm size allocated to wheat (lands): Land allocated for wheat production was positively and significantly affected the household's decision to participate in wheat output commercialization. The marginal effect shows that allocating one additional hectare of land to wheat production would increase the probability of being commercialized by 13.40% on average, keeping another factor constant. This result implies that those households allocating one more additional hectare of land by any means, i.e., from self-owned, rented-in, or shared-in land raises the probability of participation in wheat output commercialization. This result is corroborate with the previous findings

Table 3. Factors affecting commercialization participation decision of wheat output (First hurdle/probit model).

CPD	Coef.	Std. Err.	Z	P>z	Marginal effect
agehhh	.0294056	.008542	3.44	0.001**	.0275534
Fsize	-.1275558	.0284924	-4.48	0.000***	-.1310469
educlhhh	.1594835	.0935016	1.71	0.088*	.16671
Noxen	.1302221	.0611918	2.13	0.033**	.1380049
Lands	.3216736	.1034868	3.11	0.002**	.3139979
distmkt	-.0480548	.024885	-1.93	0.053*	-.0570757
Fextc	-.0191571	.0756985	-0.25	0.800	-.0342906
sexhhh	.0698372	.2099686	0.33	0.739	.0751988
Pcide	-.2002955	.1699857	-1.18	0.239	-.2496135
Fert	.0888862	.1834436	0.48	0.628	.0849398
Credit	.7061039	.1899808	3.72	0.000***	.6416277
impseed	-.2066484	.1747379	-1.18	0.237	-.2145248
atrans	-.1399479	.1735786	-0.81	0.420	-.1513056
mktinfo	-.1710976	.178307	-0.96	0.337	-.1735706
_cons	-1.781586	.561422	-3.17	0.002	

Log likelihood=-142.13736, Pseudo R2=0.4401, Wald chi2(14)=111.71, Prob >chi2=0.0000

Note: ***, ** and * refers to significant at 1% 5% and 10% significance level, respectively.
CPD: Refers to Commercialization participation decision.
Source: Model output result from of own household survey data, 2021.

of Abera and Getahun**,** revealed that increments in land allocated to haricot bean and teff production will increase the probability of being commercialized. The result is also found in line with the findings of Abayneh and Tefera Mazengia and Leta which reveals that landholding size was positive effects on household participation decision in haricot bean maize and teff output market, respectively.

Distance from nearest to market (distmkt): The distance from the nearest market center was to affect the households' participation in wheat output commercialization. As it was hypothesized earlier, the econometric result shows that there was a negative and statistically significant relationship between distance from the nearest market and households' decision to commercialize in wheat output commercialization at a 5% significant level. The marginal effect shows that as the distance from households' houses to the nearest market increase by one kilometer, the probability of participation in the wheat output market decreased by 5.71% on average, keeping another factor constant. This implies that being a distance from the nearest market reduces the chance of supplying the produced wheat to the market. This result is consistent with the previous finding conducted by Abayneh and Tefera, Tufa Ademe and Leta Which shows that distance from the nearest market is negatively related to a probability of participation in haricot, bean, red pepper, horticultural crop and crop output and teff market respectively [18,19].

Access to credit (credit): The coefficient of dummy credit access "yes" of wheat producers for wheat commercialization was positive and significant at 1%. The result implies access to credit is hypothesized to have a positive effect on commercialization participation decision that credit use improves the financial capacity of wheat producers to buy more improved production inputs. Therefore, the marginal effect shows that as the credit use of households increase the probability of participation in wheat output market increase by 64.16% on average, keeping other factors constant. The accessed credit was highlighted as an important to increase the probability of household's commercialization participation decision. This finding is similar with the previous findings conducted by Abayneh Y and Tefera T [17] found a positive effect on market participation decisions. The result is also corroborate with previous finding conducted by Martey found that access to credit from both formal and informal sources had a positive on smallholder wheat producers.

Determinants of the intensity of wheat sales (Second hurdle/truncated regression)

The second hurdle result which is the intensity or extent of participation of the households in wheat output commercialization as a fraction of total wheat produced was presented in Table 4. The result showed that out of 14 explanatory variables included in the analysis, four variables, age of household head, number of oxen and land size had positive whereas number of family size had a negative and significant effect on the intensity of participation in wheat output commercialization.

Age of household head (agehhh): Age of household age was one of the variables hypothesized to affect the level of commercialization of wheat producers either positively and negatively. The econometric results indicated that the age of household head was found to affect the intensity of sale of commercialization of wheat producers positively and significantly at less than 10% significance level. The result showed that as the age of household head increases by one year, could increase that wheat producer to be commercialized in wheat production increase by 0.35%, on average, keeping another factor constant. The result also revealed that a year increment of the age of household head leads to an increase in the intensity of sale of wheat producers'. The result is similar with the finding of Adenegna who reported that age of household head positively related with intensity of maize

Family size (fsize): Family size had a negative relationship with wheat producers' commercialization in the study area. It is consistent with prior expectation. Therefore, the econometric result showed that household size affected wheat producers' intensity sale negatively and significantly at a 1% significance level. This implies the result showed that an increment in family size by one adult equivalent decreases the volume of sale in wheat output by about 1.8% on average keeping other factor constant. This indicates that the household size of the households significantly matters in the proportion of wheat to be marketed once after the household decides to sell their wheat. This happens because households with more members will consume more of the product so they will be left with a smaller amount of wheat for commercial compared to households with lower members. The result is consistent with the finding of conducted by Makhura; Gebremedhin and Jaleta, Musah, Mazengia, and Getahun that households with large family sizes need to feed their family first and take the remaining small portion surplus to the market especially if the crop is consumable at home

The number of oxen (noxen): Having oxen is playing an imperative role in farming activity. Those farmers who have more oxen had more opportunity to prepare their land for production and can use their cultivable land more properly higher than the lesser one so that produce more and sale surplus amount to the commercialization. The number of oxen was one of the explanatory variables hypothesized to have a positive effect on the level of intensity of participation in wheat output commercialization. It was found positive and statistically significant at a 10% significance level as hypothesized earlier. The econometric result showed that having one more extra oxen could increase the

Table 4. Factors affecting volume of wheat sale (second hurdle/truncated regression).

Wsi	Coef.	Std. Err.	Z	P>z
Agehhh	.0035058	.0013145	2.67	0.008
Fsize	-.0186348	.0051944	-3.59	0.000
Educlhhh	.0025883	.0060417	0.43	0.668
Noxen	.0295995	.0109225	2.71	0.007
Lands	.0423953	.0155494	2.73	0.006
Distmkt	.0072202	.004508	1.60	0.109
Fextc	-.0048252	.0117955	-0.41	0.682
Sexhhh	-.0491569	.0324444	-1.52	0.130
Pcide	.0226138	.0296186	0.76	0.445
Fert	-.0274271	.0335595	-0.82	0.414
Credit	-.0415898	.0390178	-1.07	0.286
Impseed	.0336336	.0281919	1.19	0.233
Atrans	.0221773	.0308734	0.72	0.473
Mktinfo	-.0263601	.0272478	-0.97	0.333
_cons	.1677288	.1069218	1.57	0.117
/sigma	.1635638	.0097183	16.83	0.000

Number of obs=369, Log likelihood=72.246859, Wald chi2(14)=59.76,
Prob >chi2 = 0.0000

Note: ***, ** and * show significant at 1% 5% and 10% significant level, respectively.
Source: Own survey result data, 2021.

level of participation in wheat output commercialization by 0.7% on average, keeping other variable constant. This implies that compared to the household those own less number of oxen, the household with several oxen will sale more quintal of wheat to the market.

This finding is corroborate with the finding of Leta also found a positive relationship between the number of oxen and volume teff sold to the market.

Land cultivated under wheat (lands): the regression coefficient of cultivated land size of the household was found to have a positive and significant influence on marketed surplus at a 10% significance level. The possible explanation is that the larger the cultivated land size allocated to wheat production is increase the quantity of product available for sale. As the hectare of land allocated to production is increases in cultivated land under wheat production increase the quantity of wheat sold by 0.6 quintals. This result is corroborate with the findings of Adeoti and Abera.

Summary and Conclusion

In this section the main findings of the study are recapped, conclusions are drawn based on the findings and propose recommendations based on the finding of the study for the concerned body.

The study was conducted to analyze the determinants of smallholder farmers' wheat production and commercialization in Jeldu District, West Shoa Zone, Oromia National Regional State, Ethiopia, with specific objectives to analyze the determinants of wheat production, to identify the factors that influence wheat commercialization participation of smallholder farmers and level of commercialization of wheat producers' in the study area. Sample of households was selected by using multi-stage sampling procedure. Out of the 29 kebeles in the district, three kebeles were purposively selected in the first stage. Secondly, 369 samples of wheat-producing households were selected by simple random sampling method. The primary data obtained from the sampled household was collected by using a structured questionnaire through an interview by enumerators. Secondary data used in the collected data from different journals; different reports such as CSA, FAO and reports from Jeldu district agricultural office. Wheat commercialization index was computed to address the first objective of the study, Whereas, the second and third objectives of the study were addressed by Cobb-Douglas production and double hurdle model in Stata version 14 software, respectively. Cobb-Douglas production function model was run by using the computed amount of wheat produced as a dependent variable along with a different set of hypothesized explanatory variables. The double hurdle model produces first stage and second hurdle results. The first hurdle uses the probit model by taking households' decision to participate in wheat output commercialization as the dependent variable and intensity of participation was used as the dependent variable in the second hurdle result along with a different set of hypothesized explanatory variables.

The econometric result from Cobb-Douglas revealed that seven out of 15 hypothesized explanatory variables were found to have a significant effect on the amount of wheat produced by households. Out of the significant variables, family size and distance from nearest to the market center had a negative effect on the amount wheat produced and other variables such as the age of household head, education level of household head, number of oxen, land allocated to wheat production and access to improved seed were found to have a positive effect on the wheat producers in the study area.

Results of the Double-hurdle model indicated that seven of the 14 explanatory included in analyses were found to have a significant effect on household decision to participate in the wheat output commercialization in the first double hurdle. Those are: age of household head, education level of household head, number of oxen, land allocated to wheat production and credit were positively affected probability of participating in wheat output commercialization, whereas family size and distance from nearest to the market center had a negative effect. The second hurdle result indicated that the intensity of commercialization participation was positively affected by age of household head, the number of oxen and land size whereas negatively affected by family size.

Recommendations

From the findings of this study, the following relevant recommendations are recapped, to help blueprint appropriate intervention strategies to improve the smallholder farmers' wheat production and commercialization in the study area.

The Result of Cobb-Douglas production function indicates that family size was found to have a negative and significant effect on wheat production of the household. The larger family members tend to participate in production less than smaller ones due to larger households' have the smallest farm size to the proportion of their family members. Therefore approaching households" family plan programs were not implemented to improve family productions. As a result, this call for introducing concern of increasing production with having planed family size in areas.

This study reveals the market distance to wheat production was a significant

and negative effect on wheat production of the household. The negative effect of market distance on wheat producers from production area is too large to produce subsistence requirements resulted in the risk of production become increasingly; farmers tend to elastic production negatively to produce crops. This situation calls for an intervention of road improvement since it makes transportation of the market easy. Thus, the intervention of governmental and non-governmental organizations in improving rural infrastructure particularly roads either in form of establishing new or strengthening those already started ones is very important to allocate smallholder farmers' wheat production.

Access to the improved seed of the wheat producers for wheat productions was a significant and positive effect on wheat production of the household. The positive effect accessed to improved seed suggests a unit increase of supplied improved seed to producers distributed for wheat production led to increasing elasticity of production positively.

The accessed improved seed highlighted as an essential input to agricultural production affecting farm output of household, thus, the situation calls the government should also present improved seeds to the farmers in the time if needed and at a price that the farmers can pay. Stabilization of the price of agricultural products is another solution to increase the production of farmers.

The study showed that the age of the household head had a positive and significant effect on wheat production of the household. This implies that aged household heads' participation in wheat production was higher than the younger ones. This could be because aged household has more experienced than their counterpart. Therefore, the mechanism that encourages farmers with little experience to work with the experienced ones or training should be devised to help the younger household to have more experience in their production and it could be done in consultation with extension agents at the farmer training center.

The concluding result based on the double-hurdle model showed that there was an increase in family size that was found to have a negative and significant influence on wheat commercialization participation decision and intensity of participation. This is because households with large household members consume more proportion of wheat production and reduce the amount that is going to be sold. As a result, this call for introducing concern of wheat commercialization with having planed family size in areas.

The study indicated that the level of commercialization of wheat output was very low in the study area. Therefore, the strategies and policies aiming at promoting smallholders' commercialization in wheat production should be focused on the provision of rural infrastructure strengthen adult education, improve agricultural extension services, improving provisions of input, strengthening institutional arrangement, strengthening to enhance commercialization, generate of surplus wheat output and boost sales.

Ethical Consideration

The researcher was considered on ethics of respondents. Therefore, the researcher was following great respect for the value of participants. Accordingly, the researcher was for the consent of participants intervening and kinds of information without any influence and pressure. Inform respondent about the purpose of this study and used information researcher committed to privacy informants. To respectful and increase respondents' self-confidence, the researcher used an interview in a private and safe place.

Author's contributions

The authors analyzed and interpreted all of the survey data and wrote the manuscript. The authors have read and approved the final manuscript.

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