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Determinants of Grain Crops Commercialization among Smallholder Farmers in Central Ethiopia

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Abstract: This study aims to identify the factors affecting grain crops' commercialization among smallholder farmers in Central Ethiopia. Descriptive statistical analysis and econometric models were used. The analysis result of the sample respondent shows that more than five-grain crops are cultivated in more than 65 percent of farm households in the study areas. Out of these tef, chickpea, and wheat takes the largest share of cultivated areas of 1.27, 0.53, and 0.49 hectares, respectively. As to the production, tef, wheat, and chickpea takes the largest share of the mean quantity produced 1325.9, 539.87, and 454.9 in kilograms, respectively. The average commercialization rate of grain crops in the study area was 43.3% in terms of the gross value of its grain crops sold. The result of the Tobit regression model shows that education level, number of oxen, total land, and non/ off-farm income had positive and statistically significant effects, while the age of the household head was found to have a negative and significant effect on grain crop commercialization. Thus, the effort of stakeholders is crucial to improving the resource base and human capital of the smallholders to enable smallholders profitable from grain crops production and marketing.

Keywords: Grain Crops, Commercialization, Determinants, Smallholders, Tobit.

Research Paper

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1. INTRODUCTION

Agriculture is the dominant sector of Ethiopia's economy, contributing 33 percent of GDP, 66 percent of employment, and 76 percent of export earnings, more than sub-Saharan Africa, which accounted for 24 percent of GDP (NBE, 2019). In the agricultural sector, grains are the main crop category, which includes cereals, pulses, and oilseeds, which formed the main food crops and sources of household income for most of the country's population and increased the country's foreign exchange earnings. Results of the ESS survey (2022) showed that excluding Tigray's arable land and an area of about 12,196,548.67 hectares of grains crops and a total of about 327,903,521.41 quintals produced.

Agricultural commercialization requires a market-oriented production decision based on market signals and products offered for sale, as well as the use of purchased inputs (Berhanu and Moti, 2010). Commercialization is measured at the household level by gross or net sales, which is measured as the ratio of the percentage value of marketed production to total farm production (Mather *et al.*, 2013). In Ethiopia, cereals were grown on 81.97% (9,997,511.08 hectares) of the grain crop growing area and accounted for 88.69% (approximately 290,808,263.25 quintals) of the grain production. Pulses are also produced in all regions of the country, next to cereals accounting for 13.75% (about 1,676,888.30 hectares) of the grain crop harvest area and 9.66% (about 31,680,193.33 quintals) of grain production. Oilseeds are grown to flavor domestic foods and to serve the country's farmers. Oilseeds covered 4.28% (about 522,149.28 hectares) of the grain area and 1.65% (about 5,415,064.82 quintals) of the country's total production. (ESS, 2022).

Commercialization of agriculture, the transformation of subsistence agriculture into market-oriented production has positive effects on income, consumption, household food, and nutritional security (von Braun, 1995). The Agricultural Commercialization cluster program is achieving its goals with performance levels well above the national average, with national productivity of 25 Qt/ha and ACC 33 Qt/ha. In the 2020/2021 season, agricultural commercialization achieved 66% of its goal, with productivity 32% higher

than the average farmer in the country (Yifru, 2022). Since agricultural commercialization is central to income generation, poverty reduction, and food and nutrition security, this study focuses on cereal crops, which are produced by the majority of farm households as a source of food and income. Therefore, this study sought to address the information gap and identify the factors affecting grain crop commercialization in the study area.

2. RESEARCH METHODOLOGY

Description of the Study Area

This study was conducted in the West Shewa zone of central Ethiopia. The research site is geographically located at 3030"E and 9º 00"N latitude and 2200 meters above sea level. The study area has favorable climatic conditions and natural resources that can be used to grow a versatile crop both for domestic consumption and for the market. Different grain crops were cultivated by farm households in the investigated areas. The most important grain crops in the study areas were teff, maize, wheat, chickpea, and grass pea.

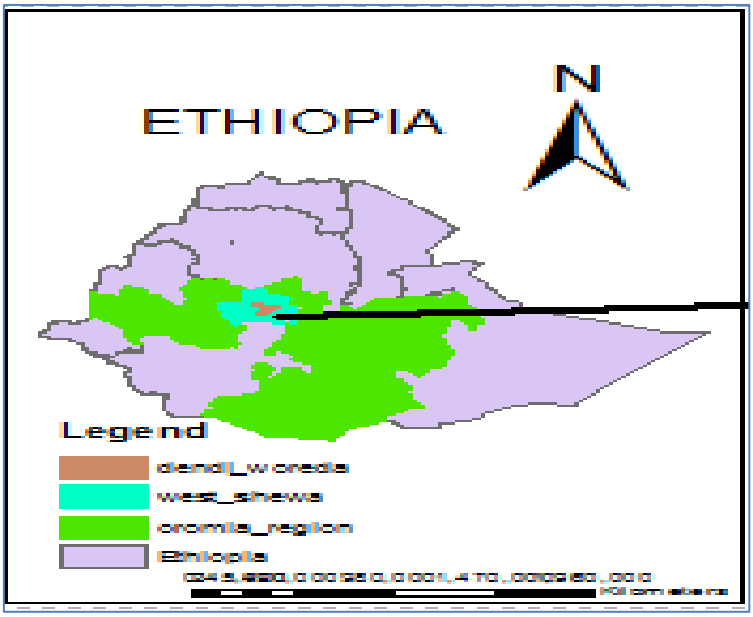

Figure 1: Location of the study area

Data Types and Sources

Both primary and secondary data were used in this study. Primary data were collected from sample respondents using pre-tested structured and semi-structured questionnaires that focused on household demographic and socio- economic characteristics and factors affecting crop commercialization. Secondary data was assessed from published and unpublished sources focusing on the objectives of the study.

Sampling Procedure and Sample size Determination

A two-stage sampling procedure was used to select the sample of household heads for this study. In the first stage, four kebele were randomly selected from the district. In the second stage, the sample respondents were selected using the proportional-to-sample. Yamane's formula (Yamane 1967) was introduced to limit the required sample size, and the formula can be expressed mathematically as:

$$n = \frac{N}{1+N(e)^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where; n shows the required sample size, N indicates the population of interest, and e is the accuracy level.

Methods of Data Analysis

In this study, both descriptive statistical analysis and econometric models were used to analyze the data collected from sample respondents focusing on grain crop commercialization.

Descriptive Statistical Analysis

The study used descriptive statistical analysis methods such as means, percentages, and standard deviations. HCl, measured as the ratio of the gross value of the crop sold to the gross value of the crop produced, has been used to indicate the level of commercialization (Govereh *et al.*, 1999). In this study, the level of commercialization was analyzed from the output side using the following formula.

$$HCI_i = \frac{\text{The gross value of crop sales hhi year i}}{\text{The gross value of crop produced hhi year i}} \times 100\% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Where: HCI_i is the commercialization index of the i^{th} household in the crop market expressed as a percentage.

2.4.2. Econometric Analysis

In this study, the Tobit regression model was used to find out the factors influencing grain crop commercialization concerning the explanatory variables. The Tobit model was to describe the relationship between non-negative dependent variables and independent variables (Tobin, 1958). The dependent variable used to identify the determinants of grain crop commercialization is HCI. The level of commercialization level is censored (i.e. 0 for subsistence producers and 1 for fully commercialized). Therefore, a censored regression model is an alternative to deal with this limited dependent variable. Depending on the value of the variable, the commercial index varies between 0 and 1; A two-frontier Tobit model was used to estimate the determinants of commercialization. A Tobit model with two constraints can be defined as:

$$y_i^* = \beta' x_i + \varepsilon_i \quad \text{.....3}$$

Where: y_i* is a latent variable (unobserved for values less than 0 and greater than 1) representing subsistence or fully commercial index; x_i is a vector of independent variables, which includes factors affecting level of commercialization; β is a vector of unknown parameters to be estimated; ε_i is a disturbance term assumed to be normally distributed with zero mean and constant variance σ^2; and i = 1, 2, 3,.....n (n = the number of observation).

Given the observed dependent variable commercialization index (y_i), the two-limit Tobit model can be specified as:

$$y_i = \begin{cases} 0 \text{ if } y_i^* \leq 0 \\ y^* \text{ if } 0 < y^* \leq 1 \\ 1 \text{ if } y^* > 1 \end{cases} \quad \text{..... .4}$$

The two-limit Tobit model is estimated using maximum likelihood estimations. The log-likelihood (LL) of the model can be expressed as:

$$\ln L = \ln\left(\coprod_{yi>0} f(yi) \coprod_{yi=o} F(0)\right) \quad \text{.....5}$$
$$= \sum_{yi>0} \ln f(yi) + \sum_{yi=0} \ln F(0)$$

Since y* is assumed to be normally distributed as error terms are assumed to be normally distributed, f(.), F(.) and hence log-likelihood functions can be written in the form of the density function and cumulative density function of the standard normal distribution as $\emptyset$ (.) and Φ(.) and the log-likelihood function can be rewritten as:

$$\ln L = \sum_{yi>0}\left(-\ln\sigma + \ln\phi\left(\frac{yi - xi\beta}{\sigma}\right)\right) + \sum_{yi=0}\ln\left(1 - \Phi\left(\frac{xi\beta}{\sigma}\right)\right) \quad \text{.....6}$$

The Tobit regression model coefficients can be interpreted by considering the conditional expectations in the model. These are 1) the conditional expectation of the underlying latent variable (y*); 2) the conditional expectation of the observed dependent variable (*y*); and the conditional expectations of the uncensored observed dependent variable ($y|y>0$). Following McDonald and Moffitt, (1980); Greene, (1997); Johnston and Dinardo, (1997), the marginal effects of these conditional expectations, respectively are given as:

$$\frac{\partial E(y^* / x)}{\partial x} = \beta \quad \text{.....7}$$

$$\frac{\partial E(y / x)}{\partial x} = \beta\Phi\left(\frac{x\beta}{\sigma}\right) \quad \text{..... 8}$$

$$\frac{\partial E(y / x)}{\partial x} = \phi\left(\frac{x\beta}{\sigma}\right)\frac{\beta}{\sigma} \quad \text{..9}$$

The interpretation of these marginal effects depends on the point of interest based on the focus of the study (Greene, 2003). In this study, focusing on the average values of the population and how those values vary with covariates, and interpreting the determinants of average values of the dependent variable among those who have already participated in the market was used.

3. RESULT AND DISCUSSION

3.1. Demographic and Socio-Economic Characteristics of Sample Respondents

This section shows the descriptive statistics results of dummy variables of the sample households like sex of the household head, ownership of the mobile phone, participation in agricultural technology showing days, agricultural credit use, cooperative membership, and having access to non-farm income. The result of the survey showed that out of the total sample households, 172(82%) were male-headed and 38(18%) were female-headed households. Concerning mobile phone ownership which is used as means of communication, 156(74%) of the sample households own cell phones and 54(26%) don't have a mobile phone. As to the cooperative membership, 109(52%) of the sample households were members of cooperatives and 101(48%) were not organized under cooperatives. Regarding having the financial sources from non/off-

farm activities 106(50.48%) of the sample households have access and 104(49.52%) were not have access to non/off-farm generating activities or sources.

Table 1: Descriptive statistics results of dummy variables

Variables		Freq.	Percent
Sex of HH head	Male	172	81.90
	Female	38	18.10
Mobile phone	Yes	156	74.29
	No	54	25.71
Agricultural credit	Yes	58	27.27
	No	152	72.73
Cooperative member	Yes	109	52.15
	No	101	47.85
Non/off-farm income	Yes	106	50.48
	No	104	49.52

Source: Own survey result, 2023

The average age of the head of the household is 43.14 years with standard deviations of 11.479. The mean level of education of sample households was 3.85 formal years of schooling with standard deviations of 3.841. Ownership of physical resources is an important factor of production for smallholder farmers and contributes to surplus production. Oxen are the major contributors to grain crop production by serving as draft power. In the study areas oxen was used to undertake different agronomic practices among those plowing and threshing are the major ones. The mean number of oxen owned by the sample was 1.9 with a standard deviation of 1.159 (Table 2).

Table 2: Descriptive Statistics results of continuous variables

Variable	Mean	Std. Dev.
Age of HH head	43.14	11.479
HH's level of education	3.85	3.841
Oxen owned	1.9	1.159
Total land owned	1.84	1.31
Frequency of extension	10.2	16.285

Source: Own computation result, 2023

The analysis of survey data depicts that the average total land size owned by the sample households was 1.84 hectares with a standard deviation of 1.31. Out of the total sample households, 142(67.6%) owned two and less than two hectares of land which indicated the farming community in the study areas was smallholders. Salami *et al*., (2010) defined smallholder farmers as the basis of land and livestock holdings, cultivating below two acres of land and a few herds. Agricultural **e**xtension service provision on grain production was essential to encourage farmers to make market-based cultivation. The major source of agricultural extension services in the study areas is rural development agents. The average frequency of extension service provided for sampled households was 10.2 days/year with a standard deviation of 16.285 (Table 2).

3.2. Grain Crops Production and Areas Cultivated In the Study Areas

The survey result from Figure 2 indicated that the grain crops produced in the study areas were Tef, wheat, barley, maize, sorghum, chickpea, grass pea, bean, and lentil. The survey result shows that more than 65% of farm households grow more than five-grain crops. From the grain crops Tef, chickpea, and wheat take the largest share of cultivated areas. The mean cultivated areas of Tef chickpea and wheat are 1.27, 0.53, and 0.49 hectares, respectively. The figure shows that households in the study areas produce more than 9 grain crops and all are the mixture of cereals and pulse crops which sample households used as a crop rotation.

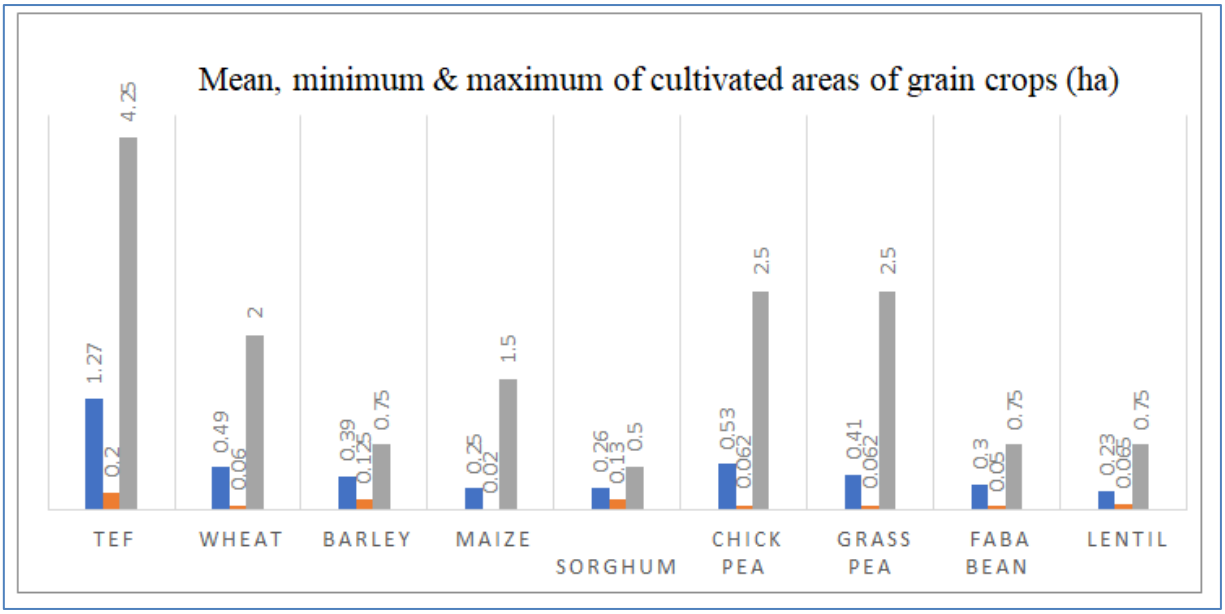

Figure 2: Cultivated areas of grain crops by sample respondents (in ha)
Source: Own computation result, 2023

Concerning the grain crops production, Tef, wheat, and chickpea takes the largest share which is the mean quantity produced of 1325.9, 539.87, and 454.9 kilograms, respectively Figure 3. In the study areas pulse crops were used to improve the soil fertility in addition and the market value and home consumption contributions.

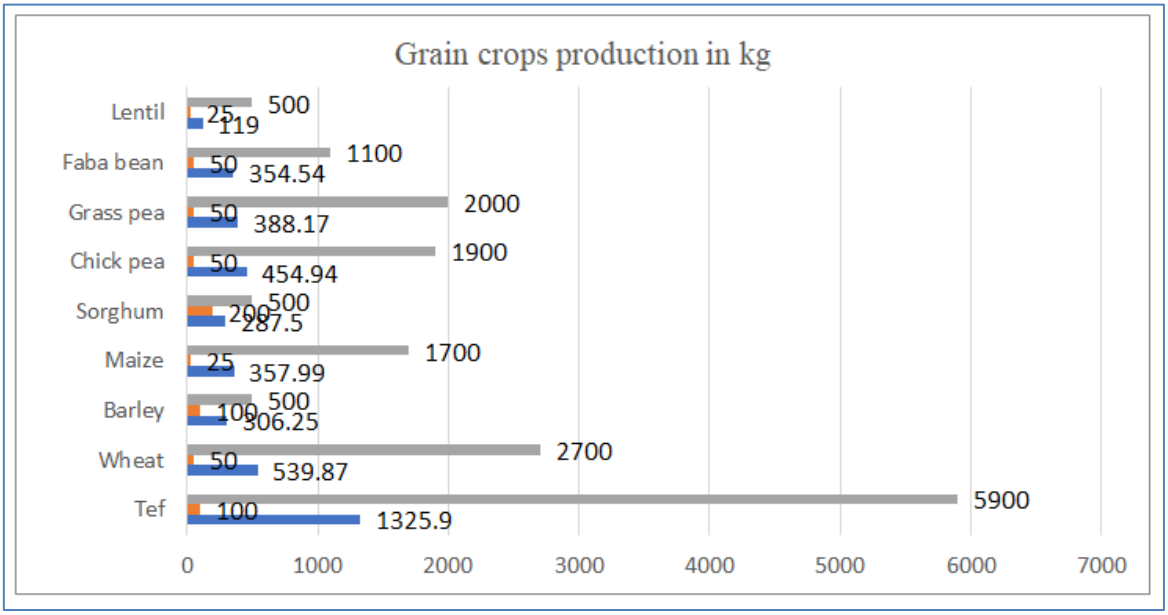

Figure 3: Grain crops produced by sample respondents (in kg)
Source: Own computation result, 2023

3.3. Grain Crops Level of Commercialization

The results from the survey revealed that the minimum household level of grain crops commercialization is null and the maximum was 83.2% in terms of the gross value of its grain crops sold. The overall average grain crop commercialization level in the study areas was 43.3% in terms of the gross value of crops sold. This average value commercialization indicates that the grain crops production and marketing by smallholders needs an investigation and needs to strengthen in the future by solving constraining problems to benefit farm households.

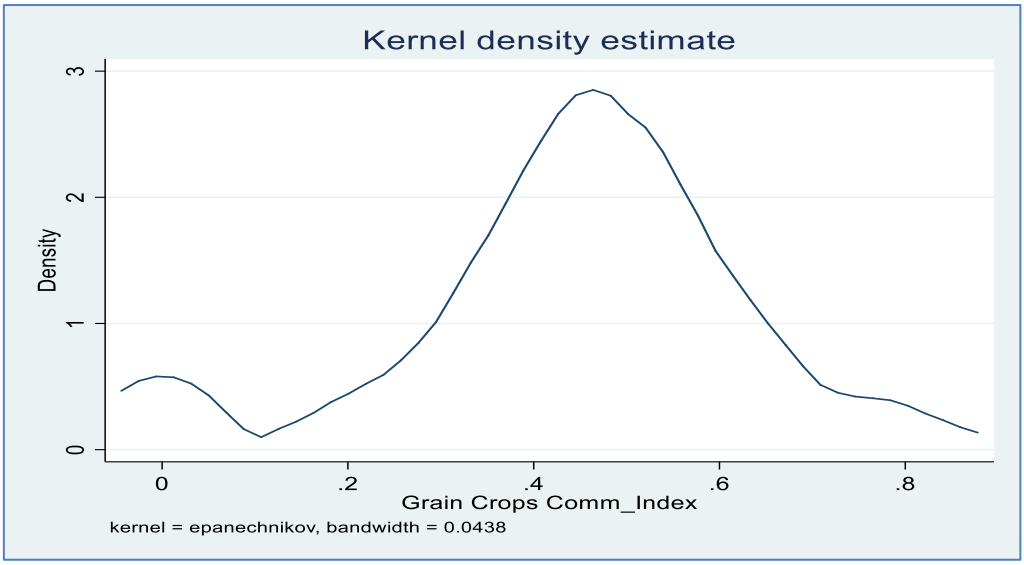

Figure 4: Kernel density estimate of grain crops commercialization index
Source: Own computation result, 2023

3.4. Determinants of Grain Crops Commercialization

The Tobit regression model estimated results in Table 5, showed that the likelihood function of the commercialization index was statistically significant at a 1% level (LR chi^2 = 53.09 with Prob > chi^2 = 0.000) indicating a goodness of fit of the model. The model output showed that out of explanatory variables used in the model, age of household head, educational level of household head, number of oxen owned, total land owned, and non/off-farm income was found to significantly influence grain crop commercialization in the study areas. Out of household demographic characteristics age of the household head is the one that negatively affects the level of grain crop commercialization at a 1% significance level. The marginal effects showed that as the age of household heads increased by one year the probability of being commercialized dropped by 0.15% while it decreases the level of grain crop commercialization by 0.15%. This shows that as age increases farmers diversify their farming of housed consumptions and reduced market-oriented crop production due to fear the environmental and market problems.

Education-level of the households was found to have a positive and statistically significant effect on grain crop commercialization at 1%. The marginal effect revealed that an increase in the education status of household heads by years of formal schooling would enhance the probability of being commercialized by 1.24% whereas it increases the level of grain crop commercialization by 1.1%. This result is consistent with the finding of Ayalew *et al.*, (2021), who reported that if other factors were held constant, the educational level of the household would increase by one year of formal schooling and the level of crop commercialized would also increase significantly.

As expected oxen owned had a positive and significant effect on the level of commercialization at a 1% significance level. The marginal effect indicates that the number of oxen enhanced by a unit enhances the probability of being commercialized by 1.77% whereas it increases the level of grain crop commercialization by 1.57% (Table 3). This result is because of the contributions of oxen from plowing up to threshing in smallholder farming. Hence, a considerable number of oxen for plowing is a driver for crop production and marketing. This result is in line with the findings of Engida *et al.*, (2021) found that the positive effect of oxen households who have more units of oxen can meet the average cultivation rate than their correspondent. Adugnaw and Birara (2023) also reported that an increase in the number of oxen increases the commercialization level of smallholder farmers due to the more likely to till in time and can produce the required amount that going to be sold to the market.

Table 3: Determinants of crop commercialization in the study areas

Independent Variables	Coefficient	Std. Err.	Marginal Effects	
			$\frac{\partial E(y^*/x)}{\partial x} = \beta$	$\frac{\partial \Pr(y>0/x)}{\partial x} = \phi\left(\frac{x\beta}{\sigma}\right)\frac{\beta}{\sigma}$
Sex of HH head	0.0307	0.0331	0.0260	0.0231
Age of HH head	-0.0020*	0.0012	-0.0017	-0.0015
Education	0.0146***	0.0037	0.0124	0.0110
Mobile phone	-0.0068	0.0129	-0.0057	-0.0051

Independent Variables	Coefficient	Std. Err.	Marginal Effects	
			$\frac{\partial E(y^*/x)}{\partial x} = \beta$	$\frac{\partial \Pr(y>0/x)}{\partial x} = \phi\left(\frac{x\beta}{\sigma}\right)\frac{\beta}{\sigma}$
Oxen owned	0.0209*	0.0117	0.0177	0.0157
Total land owned	0.0383***	0.0106	0.0325	0.0288
Frequency of extension	0.0003	0.0008	0.0002	0.0002
Agricultural credit	-0.0248	0.0274	-0.0211	-0.0187
Cooperative member	-0.0013	0.0252	-0.0011	-0.0010
Non/off-farm income	0.0687***	0.0248	0.0583	0.0517
Constant	0.2614***	0.0911		
/Sigma	0.1701	0.0089		
Number of observation = 210 Left-censored observation = 18 Uncensored observation = 192			Log likelihood = -45.723 LR chi^2 (10) =53.09 Prob > chi^2 = 0.000 Pseudo R^2 = 0.378	

Source: Own computation result, 2023

Note: Symbols *, and *** indicate the levels of significance at 10% and 1%. The first column of the marginal effect indicates the probability of selling grain crops whereas the second column of the marginal effect shows the intensity of grain crops commercialization.

As depicted in the result of Table 5 above, the total land owned by the household head positively and significantly affects the level of crop commercialization at a 1% significance level. The marginal effect shows that an increase in the area of land by one hectare would increase the probability of being commercialized by 3.25% whereas it increases the level of grain crop commercialization by 2.88%. This result implies that those households cultivating more land from their own or by rented-in or through shared-in enhances the level of crop commercialization. This result is consistent with the findings of Tariku *et al.*, (2021) who identified that the households who allocate a large size of cultivated land for cereal crops are more likely to increase their level of cereals commercialization.

Non/off-farm income obtained from non/off-farm activities contributed to crop commercialization positively and statistically significant 1%. The marginal effect result indicated that having non/off-farm income enhances the probability of being commercialized by 5.83% while it increased the level of crop grain commercialization by 5.17%. This is because households obtained additional income from non/off-farm activities become advantageous to purchase and secure required farm inputs for crop cultivation than those households that haven't non/off-farm.

4. CONCLUSION AND RECOMMENDATIONS

This study aimed to identify determinants of grain crop commercialization among smallholder farmers in Central Ethiopia. Agricultural commercialization being grain crop production based on the market signal is vital to improving the well-being of smallholder farmers. In the study, both descriptive statistics and econometric models were used to analyze the data collected from sample households. To explore the factors affecting grain crops commercialization a Tobit regression model was used. More than 9-grain crops were cultivated in the study areas. Out of these Tef, chickpea, and wheat take the largest share of cultivated areas which are 1.27, 0.53, and 0.49 hectares, respectively. As to production Tef, wheat, and chickpea take the largest share which is the mean quantity produced of 1325.9, 539.87, and 454.9 kilograms, respectively.

The overall average grain crops commercialization level in the study areas was 43.3% with a maximum level of 83.2% in terms of the gross value of its grain crops sold. The result of the Tobit regression model shows that out of explanatory variables used in the model, educational level of household head, number of oxen owned, total land owned, and non/ off-farm income were found to positively and significantly determine grain crops commercialization whereas age of household head found to negatively and significantly affect it. From the model outputs, we can understand that household human capital and resource is a central contributing factor to farm households' commercial orientation. Since most of the farm households in the study areas cultivate more than five-grain crops, there is a need to provide agricultural production and marketing training and improved agricultural technologies to make focus on a few productive and market-demanded grain crops. Hence, the effort of stakeholders is crucial to strengthen the human capital and resource base of farmers to enable smallholder grain crop production commercial.

REFERENCES

- Anteneh, A., & Endalew, B. (2023). Determinants of teff commercialization among smallholder farmers: Beta regression approach. *Cogent Social Sciences*, *9*(1), 2209987. DOI: 10.1080/23311886.2023.2209987
- Ayalew, S., Ayele, T., Kumneger, S. (2021). Determinants of Smallholder Crop

Commercialization: The Case of Agarfa and Sinana Districts of Bale Zone, Southeastern Ethiopia. *Research Journal of Humanities and Social Sciences. 11*, No.9.

- Ayele, T., Goshme, D., & Tamiru, H. (2021). Determinants of cereal crops commercialization among smallholder farmers in Guji Zone, Ethiopia. *Cogent Food & Agriculture*, *7*(1), 1948249. DOI: 10.1080/23311932.2021.1948249
- Berhanu, G., & Moti, J. (2010). Commercialization of smallholders: Does market orientation translate into market participation? Improving productivity and market success of Ethiopian farmers project (IPMS) - (ILRI). *Working Paper No. 22*. Addis Abeba, Ethiopia.
- ESS (Ethiopian Statistics Service). 2022. The Federal Democratic Republic of Ethiopia Agricultural Sample Survey 2021/22 (2014 E.C.). Report on Area and Production of Major Crops. Volume I, Statistical Bulletin 59, April 2022. Addis Abeba, Ethiopia.
- Gebre, E., Workiye, A., & Haile, K. (2021). Determinants of sorghum crop commercialization the case of Southwest Ethiopia. *Heliyon*, *7*(7). DOI: 10.1016/j.heliyon.2021.e07453
- Govereh, J., Jayne, T. S. & Nyoro, J. (1999). Smallholder commercialization, interlinked markets, and food crop productivity: Cross-country evidence in Eastern and Southern Africa. Michigan State University (MSU), United States.
- Greene, W. H. (1997). *Econometric Analysis. 3rd Edition*. Macmillan: New York.
- Greene, W. H. (2003). *Econometric Analysis. 5th Edition.* Prentice-Hall, Upper Saddle River, New Jersey, 07458. New York University.
- Johnston, J., Dinardo, J. (1997). *Econometric Methods*, *4th Edition.* MacGraw-Hill. New York, 16(2000), 139-142.
- Mather, D., Boughton, D., & Jayne, T. S. (2013). Explaining smallholder maize marketing in southern and eastern Africa: The roles of market access, technology and household resource endowments. *Food Policy*, *43*, 248-266.
- McDonald, J. F., & Moffitt, R. A. (1980). The uses of Tobit analysis. *The review of economics and statistics*, 318-321.
- NBE (National Bank of Ethiopia). (2019). Annual Reports. 2017/2018 and 2018/2019; ILOSTAT.
- Salami, A., Kamara, A. B. & Brixiova, Z. (2010). Smallholder Agriculture in East Africa: Trends, Constraints, and Opportunities. *Working Papers Series No.105.* Africa Development Bank, Tunis, Tunisia
- Tobin, J. (1958). Estimation of relationships for limited dependent variables. *Econometrica: journal of the Econometric Society*, 24-36.
- Von Braun, J. (1995). Agricultural commercialization: impacts on income and nutrition and implications for policy. *Food policy*, *20*(3), 187-202.
- Yifru, T. (2022). Workshop on National Policy on Fostering Productive Capacities in Ethiopia for Industrialization, Export Diversification & Inclusive Growth: the Role of Agriculture in Kick-starting Economic Diversification & Structural Transformation in Ethiopia. The Ethiopian Agricultural Transformation Institute (ATI). March 04.