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Determinants of Maize Commercialization among Smallholder Farmers: The Case of Nunu Kumba District, East Wollega Zone, Oromia Regional State, Western Ethiopia

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Authors' contributions

This work was carried out in collaboration among all authors. Author MD designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors PKD managed the analyses of the study. Author GD managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This study were aimed at analyzemaize producer's household level of market participation, determinants of maize producer household's degree of market participationand determinants of maize producer households level of commercialization in the study area. The study used a cross sectional data collected from 345 randomly selected households from four kebeles through semi-structured household questionnaires. Tobit model was used to analyze determinants of level of market participation of maize producers and ordered logit model was used to assess the factors affecting household maize commercialization.Based on Tobit result family size and distance from nearest market affected market participation of maize producers significantly and negatively, and land allocated for maize, access to improved seed, raw planting, amount of credit received and membership of cooperative affected market participation of maize producers significantly and positively. The result of ordered logit revealed that Marital status, Household size, distance from

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nearest market and age of household head significantly and negatively affected level of commercialization. Whereas, Household labor supply, access to improved seed, amount of fertilizer, credit amount, and household head education class positively and significantly affected level of commercialization. Policies that give more emphasis to family planning, improving and strengthening rural infrastructure, strengthening institutional arrangement like cooperatives have paramount implications to speed up the move from subsistence and semi commercial towards commercial oriented production.

Keywords: Small holder; commercialization; market participation; tobit; ordered logit.

1. INTRODUCTION

1.1 Background of the Study

Agriculture continues to be strategic sector in most of the developing countries. In East African countries, including Kenya, Ethiopia, Uganda and Tanzania smallholder farming accounts for about 75 percent of agricultural production [1]. In Ethiopia, approximately 95 percent of the total area is cultivated by smallholder farmers and 90 percent of the total agricultural output comes out of them. This confirms the dominant contribution of smallholder farmers to the overall agricultural growth in the country. In short, the overall economy of Ethiopia depends on agricultural sector development; the entire movement of the agriculture sector depends on what is happening in smallholder sub-sector [2].

Agriculture continues to dominate the national economy of Ethiopia, accounting for 36.7% of overall GDP and 70% of foreign exchange earnings. The sector provides employment for 72.7% of the population and is a means of generating livelihood for about 83% of the rural population [3,1,4]. In Ethiopia 95% of the total area under agriculture is cultivated by smallholder farmers and contributes to 90% of the total agricultural output indicating the dominant contribution of smallholder farmers to the overall agricultural production [2]; (Gebreslassie& Bekele, 2012).

Smallholder agriculture, one of the principal economic occupations in the world, is the main source of income and employment for the 70 percent of the world's poor in rural areas. Smallholder farmers contribute to food security, equitable distribution of income, and linkage creation for economic growth. However, smallholder farmers are facing constraints in terms of physical access to markets and lack of market information [5].

The status of smallholder commercialization in Ethiopia as a whole, the average crop output and crop input market participation are 25% and 20%, respectively in 2009, indicating less market participation. The average value of annual crop produced per household is Birr 3,874, of which Birr 1,468 worth of produce is sold. The average input value used for annual crop production is also Birr 2,604, of which about Birr 520 is purchased input. These results indicate that the average return to land per household is about Birr 977. At a glance this demonstrates that Ethiopia is found at the first phase of commercialization. But there are significant variations within the country (Gebremedhin *et al.,*2009).

So far the literature on commercialization of smallholders makes little study on the determinants of household commercialization, especially at a household level. Therefore, this study attempts to fill the gap by conducting an empirical research on identifying, analyzing, and understanding determinants of smallholder's commercialization and degree of maize market participation to guide policy decisions, advice appropriate interventions and integrated efforts to combat poverty. Therefore, the study aimed at analyzing the determinants of maize commercialization of smallholder farmer's in *NunuKumba* District.

1.2 Objectives of the Study

General objective of this study was analyzing determinants of smallholder farmer's maize commercialization in *NunuKumba* District, East Wollega Zone of Oromia Regional state, Ethiopia. Specifically, it focused on describing socio-economic characteristics, assessing determinants of maize producer's household level of market participation and assessing determinants of maize producer household's degrees of commercialization in the study area.

2. RESEARCH METHODOLOGY

2.1 Sources of Data and Types of Data

In the study both primary and secondary data were used. The primary data was collected from farmers focusing on demographic characteristics of the household, farming experience, livestock owned, size of land allocated to maize production, distance to the nearest market, amount of credit, frequency of extension contact, non/off-farm income, access to seed, amount of fertilizer, row planting, cooperative membership, and educational level of households.

2.2 Methods of Data Collection

Primary data was collected by semi-structured questionnaires and by trained enumerators. Before data collection, the survey was pre-tested on five farmers to evaluate the appropriateness of the design, clarity and interpretation of the questions, relevance of the questions and to estimate time required for an interview. In addition, checklist was used to collect data through focus group discussion.

2.3 Sampling Procedure and Sample Size Determination

The target population for this study was smallholder maize producers in East *wollega* zone, *NunuKumba* District, Oromia Regional State. Purposive and Two-stage random sampling procedure was employed for the selection of sample household heads on basis of their maize production with collaboration of District's Agricultural Office. Firstly, districts stratified as maize producer and non-producers. Secondly, maize producers strata used as target population. At first stage, four *kebeles* were selected from maize producing group. At second stage, 345 sample household's heads were selected randomly from four kebeles selected at first stage using probability proportionate function to size of their households.

Sample size is determined according to Yamane (1967 cited in: Israel, 2009) at confidences level of 95% and precision level of ± 5%. The level of precision is the range in which the true value of population is estimated and sample size calculation formula was used:

$$n = \frac{N}{1+N(e)^2} = 345$$

where,

n= estimated sample size, e = expected error value, level of precision= 5%, N=Number of farm households of selected *kebeles*.

2.4 Methods of Data Analysis

Descriptive, and econometric methods were applied to analyze the data collected from smallholder household heads using semi-structured questionnaire.

2.4.1 Descriptive statistical analysis

The household market participation index (HMPI) defined as the ratio of gross value of maize sold to the gross value of maize produced was used for indicating household level of market participation. Household market participation index were used to measure the extent to which households' maize production is commercialized. Here, the commercialization level and market participation of maize producers were analyzed from the output side. Mathematically, the HMPI formula adopted from von Braun et al., (1994) is expressed as:

$$HMPI_i = \frac{Grossvalueofmaizesold}{Grossvalueofmaizeproduced} x100$$

where,

$HMPI_i$= market participation index of i^{th}

Household level of commercialization (HCI) is categorical dependent variable which is categorized based on HMPI. If HMPI is less than 25%, if vary between 25% to 50% and greater than 50%, HCI take value 0, 1 and 2, respectively. Where 0= un-commercialized, 1= medium commercialized and 2= highly commercialized [6,7]; Osmani et al., 2014).

2.4.2 Econometric analysis

A Tobit model was used to identify determinants of level of market participation of maize producers and order logit model will be used to identify factors affecting household maize commercialization.

The HMPI is censored because some of its values cluster at the limit (i.e. 0 for subsistence maize producers and 100 for fully commercialized farmers).

The general formulation forTobit specification is given [8] as:

$$\boldsymbol{Yi = \beta i Xi + Ui}$$

Yi = max (0, Y*)

Yi* - is a censored variable of HMI,*Bi* - parameter to be estimated, Xi - explanatory variables and *Ui*- is the error term.

Then, Yi = 0 if Y*< 0 and Yi = Yi* if Yi* > 0

Ordinal logistic model was used to analyze determinants of household's level of maize commercialization.

$$Yi^* = Xi\boldsymbol{\beta} + \boldsymbol{\varepsilon i}$$

where:

Y*-is household level of commercialization,Xi-explanatory variables β-coefficient and
£l-error term.

$$c\kappa(x) = \frac{lnP(Y \leq J \mid y)}{P(Y > J \mid x)}$$

$$= \frac{ln\emptyset 0(x) + \emptyset 1(x) + \cdots \emptyset j(x)}{\emptyset j+1(x) + \emptyset j+2(x) + \cdots \emptyset j(x)}$$

$$= \tau j - x'\beta$$

Where τj are the cut points between the categories, and φi (x) is the probability of being in class i given covariates x.

3. RESULTS AND DISCUSSION

3.1 Demographic and Socio-economic Characteristics of Sample Households

This section begins by presenting and discussing the demographic and socio-economic characteristics of sample households with regard to sex of the household head, years of farming experience, household size, education level of the household head and resource endowments of maize producing households.

3.1.1 Demographic characteristics of households

The result of the survey indicated that out of total 345 sample households, all households were maize market participants in 2018/19 production year. The average household degree of market participation was 50.71%. The result indicated that from total respondents, 43 (12.62%) respondents were consumption oriented, 138 (40%) respondents were medium commercialized and 164 (47.38%) respondents was market oriented. Group comparisons of the commercialization (non-commercialized, medium commercialized and market oriented) and market participation were computed using *t*-test for continuous variables and chi2-test/p-value/ for dummy variables, and the results are presented in the consecutive tables.

The average household size from sample households was 9.74 people per household. The minimum and maximum household members of sample household were 4 and 15, respectively. Mean year of schooling in the study area was 5 years. The maximum and minimum household members attained formal education from total sample households were 10 years and 0 years, respectively.

3.1.2 Socio-economic characteristics of sample households

The most important factors included were: labor supply, distance from nearest market, land size, livestock ownership and land allocated for maize production. Average land owned by household was 5.58 ha. There is significant mean difference among respondents of between commercialization level; in consumption oriented 4.60 ha, medium commercialization 4.30ha and for market oriented respondents 6.89ha. The maximum land household owned was 28ha, while the minimum land household owned was 1.50 ha.

Average land allocated for maize production by household was 2.90 ha. There was significant mean difference of land allocated for maize production among respondents of between commercialization level; in consumption oriented 1.20 ha, medium commercialization 2.10 ha and for market oriented respondents 4.04 ha. The maximum land allocated for maize production by household was 10 ha, while the minimum land allocated for maize production by household was 1 ha.

Average maize produced by household were 68.20 kuntal. There was significant mean difference in quantity of maize produced among respondents of between commercialization level; in consumption oriented 18.40 kuntal, medium commercialization 39.40 kuantal and for market oriented respondents 105.50 kuntal.

3.2 Econometric Results

3.2.1 Determinants of household's maize market participation

As the value of market participation index moves closer to 100%, the more households are participated in the market. A mean value of degree of household's market participation index in study area was 50.71%, indicating that households in average selling 50.71% of total maize produced in 2018/19. At household level, high variation in household degree of market participation were considered; which is 83.33% of maximum maize market participation percent and 8.33 as minimum maize market participation percent.

The Tobit regression model estimated results in Table 1, showed that the likelihood function of market participation index was significant at 1% significance level (LR chi2(16) = 1042.72 with Prob > chi2 = 0.000) indicating a strong explanatory power of independent variables to explain factors determining market participation level of maize producers (goodness of fit of the model). The model result indicated that, out of sixteen explanatory variables used in the model, seven explanatory variables significantly affected degree of market participation of maize producers. Which are: family size and distance from nearest market affected market participation of maize producers significantly and negatively, and land allocated for maize, access to improved seed, raw planting, amount of credit received and membership of cooperative affected market participation of maize producers significantly and positively.

Household size: Family size measured as adult equivalent were found to have negative and significant influence on maize market participation at 1% significance level. The marginal effect shows that as the member of household increased by one adult equivalent decreases the degree of maize market participation by 30.27%. This result was expected because households with more household member tend to consume more of maize output produced and less was available for sales. This result is similar with findings of [9].

Distance from nearest market: Distance from nearest market measured in minutes of travelling was found to have negative and significant influence on maize market participation at 1% significance level. The marginal effect showed that as distance from nearest market increases by one minute, it decreases the degree of maize market participation by 18.56%. This result is similar with findings of (Tadele, et al., 2017) indicated that, distance to market of selling wheat in minutes of walk from wheat producers homestead influence the level of commercialization negatively and significantly.

Land under maize production: Size of land under maize production was positively and significantly affects the degree of maize market participation at 1% significance level. The marginal effect showed that allocating one additional hectare of land to maize production increase degree of maize market participation by 2.16%. This result implied that those households allocating more additional hectare of land from self-owned, by rented-in or shared-in land raises the degree of market participation.

Table 1. Tobit model output and marginal effect for market participation of maize producers

Variable	Coefficients	Marginal effect	Std. Err.	z	P>z	[95%	C.I.]
Family size	-0.30***	-0.30	0.11	-2.70	0.010	-0.52	-0.08
Market distance	-0.19***	-0.19	0.03	-7.35	0.000	-0.24	-0.14
Maize land	2.16***	2.16	0.23	9.59	0.000	1.72	2.61
Access to seed	3.51***	3.51	1.16	3.04	0.002	1.25	5.78
Row planting	13.37***	13.38	1.25	10.69	0.000	10.92	15.82
Amount of credit	0.0004***	0.001	0.00	4.76	0.000	0.00	0.00
Cooperative member	7.97***	7.97	1.15	6.92	0.000	5.71	10.23
Constant	41.23***		4.88	8.45	0.000	31.63	50.84
Tobit regression				Number of obs= 345			
				LR chi2(16) =1042.72			
				Prob > chi2 = 0.0000			
Log likelihood = 1016.2594				Pseudo R2 = 0.3391			

****, **, * shows Significant at 1%, 5% and 10% level, respectively*
Source: Own survey, 2019

Access to improved seed: Households access to improved seed was positively and significantly affects the degree of maize market participation at 1% significance level. The marginal effect shows that households access to improved seed increases degree of maize market participationby 3.5%. This result implies that those households having access to improved seed raises the degree of market participation.

Row planting: Households planting method have role in quantity of maize produced which directly contributes to household's degree of market participation of maize. Row planting was positively and significantly affects the degree of maize market participation at 1% significance level.The marginal effect showed that households practice of raw planting increases degree of maize market participation by 13.37%. This result implied that those household's practices of raw planting raises the degree of market participation.

Amount of credit received: Amount of credit received was measured in birr was positively and significantly affects the degree of maize market participation at 1% significance level. The marginal effect showed that additional one birr receiving credit increases degree of maize market participation.001%. This result implied that those households received more additional credit raises the degree of market participation.

Membership in cooperative: Households membership in cooperative was positively and significantly affected the degree of maize market participation at 1% significance level. The marginal effect showed that households membership in cooperative increases degree of maize market participation by 7.97%.

3.2.2 Determinants of household's maize commercialization

Dependent variable really continuous, but recorded ordinally (as might, for instance, happen if income were asked about in terms of ranges, rather than precise numbers), but that it has been divided into J categories then if the 'real' dependent variable is Y*, the model used.

Marital status: The sign of the coefficient of change in marital status of the household head showed a negative relationship with level of commercialization and is significant at 5% probability level. Keeping other factor unchanged, the odds ratio in favor of commercialization decreases by a factor of 2.76 when marital status of the household head increases by one level.

Household size: The sign of the coefficient of change in household size measured as adult equivalent showed a negative relationship with level of commercialization and significant at 1% probability level. Keeping other factor unchanged, the odds ratio in favor of commercialization decrease by a factor of 0.08 when household size increase by one adult equivalency.

Household labor supply: The sign of the coefficient of change in household labor supply of the household measured as man equivalency showed a positive relationship with level of commercialization and significant at 10% probability level. Takeleet al. (2017) found that having large labor supply is good for delivering output to the market and to increase productivity therefore, household labor supply affected the quantity of maize commercialization positively.

Table 2. Regression output for determinants of maize commercialization

Variable	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Marital status	-2.76**	1.22	-2.27	0.02	-5.15	-0.38
Family size	-0.86***	0.32	-2.71	0.01	-1.48	-0.24
Labor size	0.81*	0.48	1.67	0.09	-0.14	1.75
Market distance	-.28***	0.07	-4.14	0.00	-0.42	-0.15
Access to seed	3.23*	1.79	1.81	0.07	6.74	0.27
Amount of fertilizer	0.20***	0.05	3.74	0.00	0.09	0.30
Amount of credit	0.01***	0.00	4.74	0.00	0.00	0.00
Education level	0.31*	0.17	1.85	0.07	-0.02	0.65
Age	-1.04***	0.11	-9.70	0.00	-1.26	-0.84
Ordered logistic regression					Number of obs = 345	
					Wald chi2(16) = 185.17	
Log likelihood = -109.27466					Prob > chi2 = 0.0000	

****, **, * shows Significant at 1%, 5% and 10% level, respectively*
Source: Own survey, 2019

Distance from nearest market: Distance from nearest market measured in minutes of travelling was found to have negative and significant influence on level of commercialization at 1% significance level. The coefficient showed that keeping other factors unchanged, the odds ratio in favor of commercialization decreases by a factor of 0.28 when household distance from nearest market increases by one minute.

Access to improved seed: The sign of the coefficient of access to improved seed of the household head showed a positive relationship with level of commercialization and is significant at 10% probability level. The coefficient shows keeping other factors unchanged, the odds ratio in favor of commercialization increases by a factor of 3.23 when household accessing improved seed exceeds than that of not accessed to improved seed.

Amount of fertilizer used: Amount of fertilizer used which is measured in Kg was positively and significantly affects level of household's maize commercialization at 1% significance level.The coefficient showed keeping other factors unchanged, the odds ratio in favor of commercialization increases by a factor of 1.98 when household amount of fertilizer used increases by one kilogram.

Amount of credit used: Amount of credit used which is measured in (ETB)Birr was positively and significantly affects level of household's maize commercialization at 1% significance level. The coefficient showed thatkeeping other factor unchanged, the odds ratio in favor of commercialization increase by a factor of 0.01 when household amount of credit received increase by one birr.

Household head education class: The sign of the coefficient of household head year of schooling measured regular education year of schooling showed a positive relationship with level of commercialization and was significant at 10% probability level. This meant that an increase in household head year of schooling increase the likelihood of the household level of commercialization. Keeping other factors unchanged, the odds ratio in favor of commercialization increases by a factor of 0.31 when household head year of schooling increase by one year.

Age of household's head: Age of household heads which was measured in years was negatively and significantly affects level of household's maize commercialization at 1% significance level. The coefficient shows keeping other factor unchanged, the odds ratio in favor of commercialization increase by a factor of 1.04 when household head age increase by one year.

4. CONCLUSIONS AND RECOMMENDATION

4.1 Conclusions

The general objective of the study was to assess determinants of maize commercialization in *NunuKumba*District, East *Wollega* Zone of Oromia Regional state, Ethiopia. In the study both primary and secondary data were used. Primary data was collected by semi-structured questionnaires and by trained enumerators. Descriptive and econometric methods were applied to analyze the data collected from smallholder household heads. A Tobit model was used to analyze determinants of level of market participation of maize producers and order logit model was used to assess the factors affecting household maize commercialization.

The results from the survey revealed that 12.46% of sample households' degree of less than 25% of market participation in maize output 40% of the sample households fall between 25% to 50% degree of market participation and 47.4% of respondents were fall 50% to 100% degree of market participation.

The overall average degree of market participation of maize producers in the district is 50.71% in terms of the gross value of maize sold. The average value of maize market participation indicated that the level of market participation of maize producers in the study areas was at mean degree of market participation from 100% commercialization.

The model result indicated that, out of 16 explanatory variables used in the model, 7 explanatory variables significantly affected degree of market participation of maize producers. Which are: family size and distance from nearest market affected market participation of maize producers significantly and negatively, and land allocated for maize, access to improved seed, raw planting, amount of credit received and membership of cooperative affected market participation of maize producers significantly and positively.

4.2 Recommendations

Based on the findings of the study the following policy recommendations were given;

- Farm households with larger maize products are highly participate in market than farmers with less maize products. Therefore, farmers should be encouraged to produce more maize through providing with improved maize production technologies (improved seed,improved sowing method and increasing access to fertilizer) to increase production and productivity of the sector, this will ultimately reduce poverty.
- Farm households with more access to infrastructure were more active market participants than with less access to infrastructures. Therefore, farmers should be encouraged to produce more maize through providing more infrastructure (access to market, access to financial institutions, access to school and access to cooperative institutions) to increase production and productivity of the sector, this will ultimately reduce poverty.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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