academicJournals

Vol. 12(10), pp. 841-849, 9 March, 2017
DOI: 10.5897/AJAR2016.11889
Article Number: 6A1E23E63086
ISSN 1991-637X

http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Analysis of wheat commercialization in Ethiopia: The case of SARD-SC wheat project innovation platform sites

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Received 31 October, 2016; Accepted 7 December, 2016

In Ethiopia, wheat is becoming an essential source of income for farmers even though it is still a fundamental food crop. While the major proportion is kept for consumption, farmers sell part of their wheat produce. The main objectives of this paper are to assess the level of commercialization and its determinants of wheat producers in the four major producing regions. Quantitative primary data was collected from December 2013 to January 2014. The structured questionnaire was used to help collect quantifiable data from wheat producer households. Econometric tools were employed for the analysis of wheat producers' commercialization and its determinants. The findings indicate that about 27% of the wheat produced is being used for sale with the highest and lowest in Oromia (41%) and Tigray (17%) innovation platform sites, respectively. The results also reveal that most of the commercialization index falls within 25 and 50%. This indicates that wheat is becoming an essential cash crop to supplement household incomes. The empirical results of Tobit model show that educational level of head household, livestock size expressed in Tropical Livestock Unit (TLU), amount of wheat produced, and credit access, affect wheat commercialization positively and significantly while distance to the market and family size affect commercialization of farmers negatively. Finally, based on the findings of the research, some technical, institutional and policy that empower farmers through organizing in groups, training, and contractual arrangement with millers are needed to improve wheat productivity and linkage of wheat farmers to market.

Key words: Commercialization, Tobit model, SARD-SC project, IP, wheat, Ethiopia.

INTRODUCTION

Ethiopia has already implemented its first Growth and Transformation Plan (GTP-I) that had a five years span (2010/11-2014/15) and has just started a second five years plan (GTP-II) 2015/16-2019/20. Both the past and

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the current plans focused on agricultural commercialization (MoFED, 2010, 2015). Ethiopia is one of the fast growing counties in Africa. Literatures have revealed that in such fast growing economy, what emerges is a gradual but definite movement out of subsistence food crop production towards a diversified market-oriented production system (Delgado, 1995; Panashat, 2011). Agricultural commercialization, which is stated as a process involving transformation of agriculture to market oriented production, tends to have a positive impact on income, consumption and nutritional setup of the farm households. It also has a significant effect on the level of household food security (Braun, 1995).

The level of commercialization for staple food crops is usually less as compared to the high value cash crops. Some of the staple food crops are also used for industrial purposes which increases their level of commercialization. Wheat has a dual purpose that categorizes it both as a staple food crop as well as in industrial crop that is used in flour, pasta, macaroni and other related industries. However, the government of Ethiopia is currently categorizing wheat as an industrial crop rather than staple food crop due to its high demand in food industries. Therefore, wheat producing farmers are expected to be market oriented and supply it to market for agro-industrial purpose. Ethiopia is the second largest wheat producer in sub-Saharan Africa (SSA) next to South Africa (Abu, 2012; Demeke and Marcantonio, 2013). The crop ranked 4th after teff, maize and sorghum both in terms of area coverage (1.7 million ha) and quantity of production (4.2million tons) in 2014/15 cropping season in Ethiopia (CSA, 2015). The same source indicated that four major wheat producing regions in Ethiopia, namely Oromia, Amhara, SNNP and Tigray account for about 99% of national wheat production sharing 58, 28, 8 and 5% in 2014/15 cropping season, respectively.

The domestic production of wheat increased from 2.2 million tons in 2004/05 to 4.2 million tons ten years later (2014/15). Similarly, productivity has increased from 1.56 tons/ha in 2004/5 to 2.54 tons/ha in 2014/15, which is a growth by 63%. This swift growth of productivity could largely be attributed to the use of improved technologies of wheat. Within the same period of time, the area coverage for wheat has also increased from 1.4 million hectares in 2004/5 to 1.6 million hectares in 2014/15, which is a growth by 14% (CSA, 2005, 2015).

Wheat research has got a great focus both from national and international research centers funded from the Ethiopian government and external sources. One of the externally funded wheat project is the Support to Agricultural Research for Development of Strategic Crops (SARD-SC) wheat project operating in four major wheat producing regions of a country specified already was launched in Ethiopia in 2013. The project has four main components: 1) technology generation; 2) technology dissemination and adoption; 3) capacity building and 4) project management. The SARD-SC wheat project follows the innovation platform (IP) approach which brings all stakeholders together to achieve its broad objectives.

As the production and productivity of wheat increases, the level of commercialization of wheat producing farmers becomes a crucial aspect in the wheat sector. However, due to the fact that the crop was categorized as a staple food crop in the past, there has been a little information on the commercialization status as well as factors that either enhance or hinder the commercialization process of wheat in the country in general and in the SARD-SC wheat project IP sites in particular. Therefore, this paper aims to fill this gap having the following objectives.

Objectives

1. To assess the level of commercialization of wheat producers in four major wheat producing regions.
2. To assess the determinants of commercialization of wheat producers in these areas.

METHODOLOGY AND THE STUDY APPROACHES

The study area

The study was conducted in six districts of SARD-SC IP sites selected from four major wheat producing regions of Ethiopia. Two districts each from East Gojjam zone of Amhara region and Bale zone of Oromia regions, and one district each from South Tigray zone of Tigray region and Gurage zone of SNNP region were purposively selected for the following reasons: First, these districts were selected by each of the regions themselves as sites for the SARD-SC wheat project Innovation Platform (IP) to demonstrate wheat technologies. Second, the districts did not receive enough attentions and supports from other development projects to enhance wheat production and productivity; thus making these areas good cases for showing technology impacts. Third, the districts have a high potential of wheat production with the exception of Enemay and Shebel Berenta districts. The selected sites represent the African Highlands hub of the SARD-SC wheat project of Ethiopia (Figure 1).

Data collection techniques and target groups

Quantitative primary data was used for this study. Quantitative method was used to gather quantifiable data from wheat producers using a structured questionnaire. The structured questionnaire was used to help collect quantifiable data especially from wheat producer households. Data from wheat producer households was collected from December 2013 to January 2014. The data is a comprehensive baseline data collected through trained enumerators and supervisors using structured questionnaire in Computer Aided Personal Interview (CAPI).

Sampling frame and sampling procedure

The sampling frame of the study is the list of wheat producer

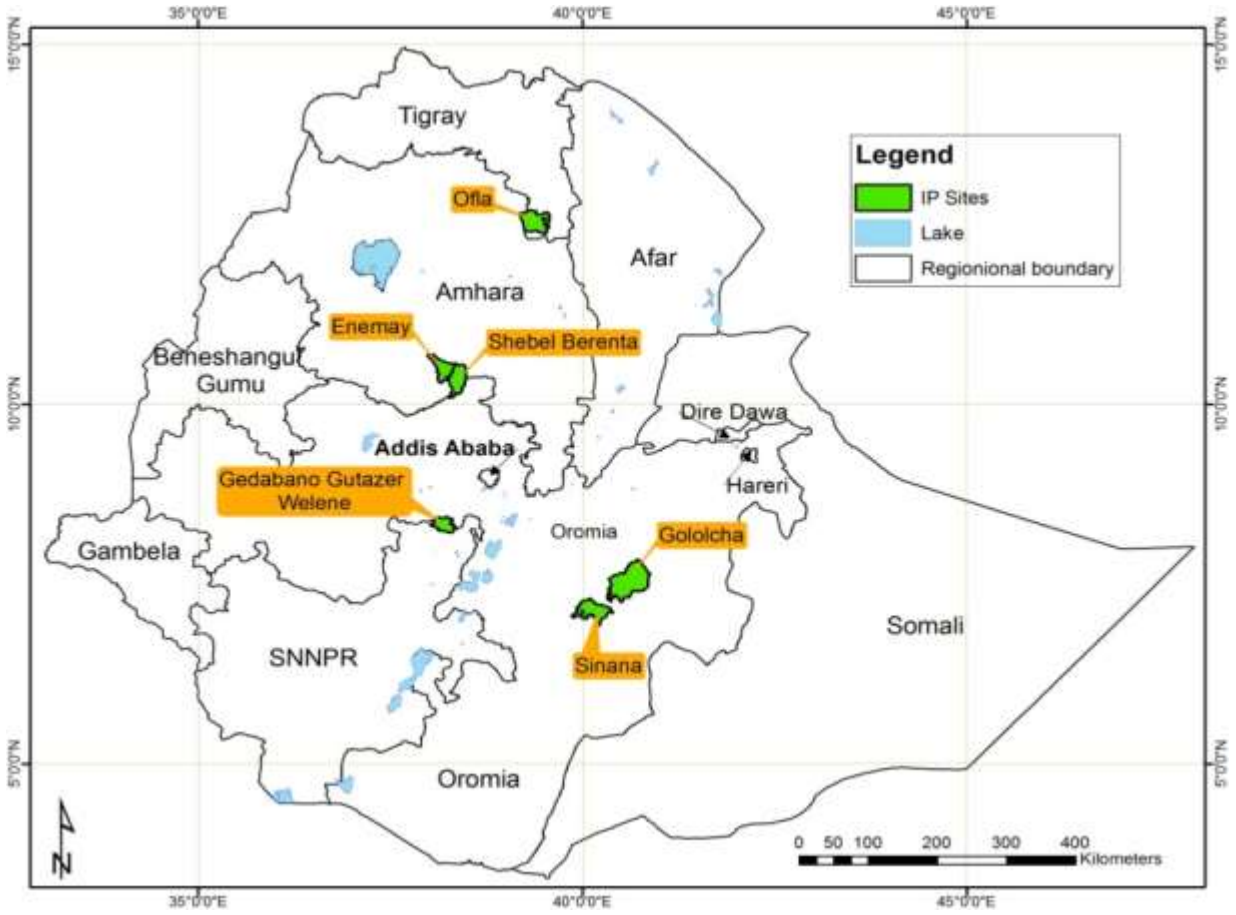

Figure 1. Wheat value chain analysis study districts, Ethiopia, 2014.

Table 1. Distribution of sample sizes by IP districts and region.

Region	Zone	District of IP sites	Sample size
Tigray	South Tigray	Ofla	128
SNNP	Gurage	Gedebano-Gutazer-Wolene	100
Amhara		Enemay	218
	East Gojjam	Shebel Berenta	189
Oromia		Sinana	166
	Bale	Gololcha	145
Total			946

households. A stratified multistage sampling technique was employed to select the required samples of households. First, four wheat growing regions were identified purposively to represent the diverse socio-economic and biophysical environment of wheat producers in Ethiopia. Second, in the stakeholder consultation workshop in each region, six districts which are considered representatives of the respective regions were selected based on wheat growing potential, and status of previous wheat research and development interventions. Then, three kebeles (note that kebele is the lowest administrative level in Ethiopia which is an equivalent to village in most countries) from each of the districts were selected based on their level of participation in SARD-SC wheat project. These are intervention kebeles (where the project has been implemented), spillover (neighbor to those intervention kebeles), and control kebeles (situated at remote distance to the intervention ones). Finally, from the household list available at each kebele, a total of 946 sample households were drawn randomly for interview using a structured questionnaire (Table 1).

Methods of data analysis and synthesis

Information and dataset collected was analyzed and synthesized using different statistical and econometric tools. Descriptive

statistics was largely utilized to analyze the data and summarize the information. Tobit model was also employed for the analysis of wheat producers' commercialization status and its determinants.

Specification of commercialization index and the Tobit model

Following Govereh et al. (1999) and Strasberg et al. (1999), the household commercialization index can be defined as the ratio of the value of crop sold to the value of produced. Several authors adopted this definition and used it to calculate commercialization index of different crops (Aderemi et al., 2014; Agwu et al., 2013; Gebremedhin and Jaleta, 2010; Hichaambwa and Jayne, 2012; Jaleta et al., 2009; Kirui and Njiraini, 2013; Leavy and Poulton, 2007; Mutabazi et al., 2013; Osmani et al., 2014; Rahut et al., 2010). In a similar fashion, the commercialization index of wheat producers is given as:

$$CI_i = \frac{Vsold_i}{Vproduced_i} x100\% \quad (1)$$

Where: V sold and V produced are the value of wheat sold and produced by the i^{th} farmer, respectively; CI_i = commercialization index of i^{th} farmer having a value of zero to one with zero and one indicating totally subsistent and fully commercialized farmers, respectively.

Specification of the Tobit model

To analyze the wheat producers' level of commercialization and its determinants, the Tobit model was used. According to Tobin (1958), the Tobit model can be specified as:

$$y_i^* = \beta_0 + \beta_i X_i + \mu_i \quad (2)$$

$$y_i = w_i^* \; if \; \beta_0 + \beta_i X_i + \mu_i > 0 \; = 0 \text{ if } \beta_0+\beta_i X_i+\mu_i \leq 0$$

Where: y_i = is observed index of the i^{th} farmer; $y_i^* =$ is the latent variable and the solution to utility maximization problem, subjected to classical linear assumptions; $[Ui \sim N(0, \sigma^2)]$. X_i = is vector of explanatory variables affecting level of commercialization; β_i = is vector of unknown parameters to be estimated; μ_i = is the error term, assumed to be normally distributed with mean 0 and constant variance, σ^2.

According to Maddala (1992) and Amemiya (1985), the estimates of the Tobit model is based on the maximum likelihood estimation (ML) by maximizing the Tobit likelihood function. Based on Sigelman and Zeng (1999), if density function and cumulative density functions of *y** are denoted by *f (.)* and *F (.)*, respectively, then the Tobit model implies that the probabilities of observing a non-zero y and a zero y are f(*y*) and p(y*<0) =F (0), respectively. Therefore, the log likelihood (LL) of the model can be:

$$\ln L = \ln\left(\prod_{y_i>o} f(y_i) \prod_{y_i=0} F(0)\right) = \sum_{y_i>0} \ln f(y_i) + \sum_{y_i=0} \ln F(0) \quad (3)$$

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

$$\ln L = \sum_{y_i>0}\left(-\ln\sigma + \ln\phi\left(\frac{y_i - x_i\beta}{\sigma}\right)\right) + \sum_{y_i=0}\ln\left(1-\Phi\left(\frac{x_i\beta}{\sigma}\right)\right) \quad (4)$$

Unlike the case of ordinary least square (OLS) coefficients, it is difficult to interpret the estimated coefficients of the Tobit as a marginal effect because there are three main conditional expectations of interest in the Tobit 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 Greene (1997), Johnston and Dinardo (1997), McDonald and Moffitt (1980), the marginal effects of these conditional expectations, respectively are given as:

$$\frac{\partial E(y^*|x)}{\partial x} = \beta \quad (5)$$

$$\frac{\partial E(y|x)}{\partial x} = \beta\Phi\left(\frac{x\beta}{\sigma}\right) \quad (6)$$

$$\frac{\partial \Pr(y>0|x)}{\partial x} = \phi\left(\frac{x\beta}{\sigma}\right)\frac{\beta}{\sigma} \quad (7)$$

The interpretations of these marginal effects depend on the point of interest based on the focus of the study. For instance, if the interest is to make statements about the conditional mean function in the population despite the censoring, Equation 5 is used for the censored data. If a researcher is interested on average value of the population of study, and how those values vary with covariates, Equation 6 is used and finally, if one wants to interpret, for example, about the determinants of average values of the dependent variable among those who have already participated in a program, Equation 7 is used. However, in literature, all the three marginal effects are interpreted to show the change in the probability of participation, intensity of dependent variable among the whole population and intensity of use among the participants only, respectively.

RESULTS AND DISCUSSION

Descriptive analysis of wheat commercialization status

Table 2 reveals the descriptive statistics of the variables included in the Tobit model. It shows that 95% of the sample households are male headed households. The mean age, education level and family size of the sample households are about 44 years, grade 3 and 6 persons of family member. The average livestock owned is about 5.5

Table 2. Descriptive analysis of variables included Tobit model for wheat commercialization analysis.

Variable	Mean	Std. Dev.	Min	Max
Sex of the HHH is 1 (1=Male; 0=female)	0.95	0.216	0	1
Age of the HHH (years)	44.42	11.725	18	100
Education of the HHH (completed grade)	2.96	3.329	0	16
Family size (numbers)	6.41	2.398	1	18
Livestock owned (TLU)	5.54	3.614	0	28.56
Access to extension service is 1 (1=Yes; 0=No)	0.94	0.240	0	1
Access to credit is 1 (1=Yes; 0=No)	0.59	0.492	0	1
Wheat area (ha)	0.85	1.153	0.0313	19
Annual wheat production (Kg)	2224.03	4008.216	25	59000
Wheat price (Birr/Kg)	7.99	2.171	3.5	14
Distance to market (minutes of walk)	55.36	43.003	0	240
Commercialization index (0 to 1)	0.27	0.238	0	1
Tigray Dummy (1=Yes; 0=otherwise)	0.13	0.337	0	1
Amhara Dummy (1=Yes; 0=otherwise)	0.43	0.496	0	1
Oromia Dummy (1=Yes; 0=otherwise)	0.33	0.472	0	1
SNNP Dummy (1=Yes; 0=otherwise)	0.10	0.301	0	1

HHH=Household head, SNNP= South Nations, nationalities and people.

Table 3. Distribution of extent of wheat commercialization of wheat producers in SARD-SC IP sites in 2012/13 cropping season.

Extent of commercialization	Tigray	SNNP	Amhara	Oromia	Overall
0% (totally subsistent farmers)	38	32	45	9	31
1- 25% commercialized	28	15	20	14	18
25.1- 50% commercialized	29	33	29	43	34
50.1 -75% commercialization	5	18	5	28	24
>75% commercialized	0	2	1	6	3
Minimum commercialization index	0	0	0	0	0
Maximum commercialization index	0.61	0.8	1	1	1
Mean commercialization index	0.17	0.29	0.19	0.41	0.27

TLU. Most of the sample households (94%) had access to extension services while about 60% of them have access to credit in 2012/13 cropping season. The average area allocated for wheat, annual wheat produced per household and selling price of wheat were 0.85 hectares, 2224 kg and 8 Birr/Kg. On average, the sample households walk about 55 min (nearly one hour) to reach the market of input and output in the study area.

Table 3 demonstrates the descriptive statistics of wheat commercialization by IP site region. The result shows that the average value of the overall sample household commercialization index of wheat producers is 0.27 (or 27%) with the highest and lowest in Oromia (0.41) and Tigray (0.17) IP sites, respectively. Although, wheat is a staple food crop, it is also equally important for industrial purpose in flour factories. This result clearly indicated that in IP sites where wheat production is adequate like in the case of Oromia IP site, the level of commercialization is also relatively high. Therefore, increasing wheat productivity leads to higher level of commercialization which in turn has a positive effect on flour factories that use wheat as a raw material. The result also indicates that 31% of the overall sample households have commercialization index of zero value indicating that they are fully subsistent in terms of wheat farm. However, there is a great variation in the proportion of subsistent farmers in terms of wheat among IP sites with the highest and lowest in Amhara (45%) and Oromia (9%), respectively. That is, only 9% of Oromia IP site wheat farmers are totally subsistent in terms of wheat, while 45% of them are subsistent in the Amhara IP site. The result also reveals that most of the commercialization index (34%) falls within 25 to 50% while the least (3%) falls above 75% commercialization index.

Table 4. Tobit estimates and marginal effects of determinants of wheat commercialization.

Variables	Std. Err.	P>t	Marginal effects		
			$\frac{\partial E(y^*\|x)}{\partial x}=\beta$	$\frac{\partial E(y\|x)}{\partial x}=\beta\Phi\left(\frac{x\beta}{\sigma}\right)$	$\frac{\partial \Pr(y>0\|x)}{\partial x}=\phi\left(\frac{x\beta}{\sigma}\right)\frac{\beta}{\sigma}$
Constant	0.325	0.000***			
Sex of head	0.024	0.580	0.04910	0.02339	0.03348
Age of head	-0.001	0.549	0.00089	0.00047	0.00067
Education of head	0.006	0.075*	0.00336	0.00177	0.00252
Family size	-0.014	0.001***	0.00463	0.00244	0.00347
Livestock owned	0.009	0.005***	0.00319	0.00168	0.00239
Extension access	-0.030	0.421	0.03606	0.02184	0.03077
Credit access	0.036	0.058*	0.02038	0.01043	0.01486
Wheat area (ha)	0.007	0.754	0.02227	0.01177	0.01674
Wheat production	0.0000169	0.006***	0.00001	0.000005	0.000004
Average Price	0.005	0.420	0.00604	0.00319	0.00454
Market distance	-0.000914	0.000***	0.00027	0.00014	0.0002
Tigray Dummy	-0.230	0.000***	0.05972	0.01714	0.02397
Amhara Dummy	-0.159	0.000***	0.03790	0.01843	0.02602
Oromia Dummy	-0.011	0.783	0.04266	0.02215	0.03154
/sigma	0.271				
Number of observations = 996; Uncensored obs.= 687					
Left-censored obs.=306; Right-censored obs.=3				Y=pr(0<y<1) = 0.78666966;	
Log likelihood = -348.29093; Pseudo R^2 = 0.3035				Y = E(y|0<y<1)= 0.31447635;	
LR chi2(14) = 303.49; Prob > chi2 = 0.000				Y = E(y*|0<y<1) = 0.24930193	

* and *** means significant at 10 and 1% level of significance, respectively.

Determinants of wheat commercialization in the SARD-SC IP sites

As shown in Table 4, the likelihood function of the Tobit model for wheat commercialization index is highly significant (LR chi^2 (14) =259.74 with Prob > Chi^2 = 0.0000) indicating a strong explanatory powers of the independent variables. Out of the 14 explanatory variables included in the model, eight variables, namely education of household head, family size, livestock ownership, access to credit, wheat production, market distance, region dummy (Tigray and Amhara) were found to significantly influence the commercialization level of wheat producers in the study area. However, sex and age of household head, access to extension services, area allocated to wheat, price of wheat and being Oromia IP sites variables were not significant in the model.

As expected, education of household head was found to have a positive and significant effect on the level of wheat commercialization at 10%. Previous findings (Omiti et al., 2009; Tufa et al., 2014) are also in line with this finding. The marginal effect result indicated that as the level of formal education of the household head increased by one grade, the decision to participate in wheat marketing would be increased by 0.34% while it increases the level of commercialization by 0.00177 and 0.00252 for the whole sample and for those who have already started wheat marketing, respectively. Therefore, improving access to education of wheat farmers would have a positive effect on wheat commercialization.

Number of livestock owned in TLU was found to positively contribute to the level of wheat commercialization at 1%. This result has been supported by the finding of Tufa et al. (2014). Livestock and crop production is usually considered as complementary enterprises in that livestock can positively contribute to crop production by providing natural fertilizer, oxen used for traction power and source of cash to finance purchased inputs such as seed and fertilizer. As the level of wheat production increased, the amount of marketable surplus supplied to market is also increased. Therefore, livestock ownership has a positive effect on wheat production explicitly and on commercialization implicitly. The marginal effect results show that increasing the number of livestock by one TLU would increase the probability of participating in wheat selling by 0.32%, whereas it increases the level of wheat commercialization by 0.00168 and 0.00239 for the whole population of the study and for those who have already started wheat selling, respectively.

Access to credit was found to have a positive effect on wheat commercialization at 10% level of significance.

Credit plays an important role in solving cash constraints needed in wheat production used to purchase inputs such as fertilizer, improved seed, crop protection chemicals that used to enhance wheat production and productivity which in turn has a positive effect on marketable surplus. Therefore, improving access to rural credit would have a positive effect on the level of wheat commercialization. The marginal effects show that the probability of wheat producers who have access to credit increases by 2.04% as compared to those who do not have access to credit while level of commercialization increases by 0.01043 and 0.01486 for the whole population and for the participants of wheat marketing, respectively.

Another explanatory variable that influenced the commercialization of wheat producers was the amount of annual wheat production. The findings of Gebremedhin and Jaleta (2012), Gebreselassie and Sharp (2008), Goitom (2009), and Omiti et al. (2009) also support this finding. The marginal effects show that an additional kilogram wheat production increases the level of wheat commercialization by 0.001% which means one additional ton annual wheat production increases the commercialization index by 1% while it increases the level of commercialization index by about 0.000005 and 0.000004 for the population of study and for those who have already started selling wheat, respectively. The result implies that increasing wheat production plays a great role for its commercialization in the study area. Therefore, generating and disseminating improved wheat technologies would bring a positive effect in wheat sector not only at the production sector but also at the marketing and processing sector as the level of wheat commercialization directly related to these two sectors.

The estimation result of Tobit model has also demonstrated that family size was found to influence the level of wheat commercialization at 1% level of significance carrying a negative sign. This result agrees with the findings of Gebremedhin and Jaleta (2012) and Tufa et al. (2014). The marginal effect shows that as the number of family member increased by one person, the probability of participating in wheat selling is decreased by 0.463 while it decreases the level of wheat commercialization by 0.00244 and 0.00347 for the whole population of the study and for those who have already practiced wheat selling, respectively. The result is expected because large family needs more wheat to consume and less to sell as compared to the small one.

Distance to market of selling wheat in minutes of walk from wheat producers homestead influenced the level of commercialization negatively and significantly as expected. This result is in line with the findings of Gebremedhin and Jaleta (2012), Omiti et al. (2009), Tufa et al. (2014). The marginal effects show that as the market distance decreases by one minute of walk, the probability of participation in wheat marketing increases by 0.027%, whereas it increases the commercialization index of the population of study and of those who have already started selling wheat by about 0.00014 and 0.0002, respectively. Therefore, improving marketing infrastructure at the lowest kebele level or strengthening marketing cooperatives to collect wheat at farm gate would have a positive impact on wheat commercialization.

Being both Tigray and Amhara region IP sites were found to be negatively related to the level of commercialization at 1%. The marginal effects show that Tigray and Amhara region IP sites of the SARD-SC wheat project hinder the probability of participating in wheat marketing by 5.97 and 3.79% in Tigray and Amhara IP sites, respectively. Gebreselassie and Sharp (2008) have shown that difference in location led to difference in level of commercialization. The marginal effect also indicated that Tigray and Amhara IP site decreases the level of wheat commercialization for the total population and for those who have already practiced wheat marketing by 0.01714 and 0.02397 in Tigray IP site and by 0.018 and 0.026 in Amhara IP site, respectively. The explanation for this relationship might be due to the fact that there is low level of production of wheat in both IP sites as compared to Oromia IP site. The result implies that, to raise the level of commercialization in these areas, improving the level of wheat production is an important task.

Conclusions

In this paper, the commercialization status along with factors affecting wheat producers commercialization level was assessed using a primary data collected from 946 sample households in four major wheat producing regions of Ethiopia where the SARD-SC wheat project has been implemented using the innovation platform (IP) approach. The result reveals that the level of commercialization of the overall sample is 0.27 but varies from region to region with the highest (0.41) in Oromia and lowest (0.17) in Tigray. The result also shows that education level of the household head, livestock ownership, annual wheat production and access to credit were found to positively contribute to the commercialization of wheat while number of family member and the distance of market (distant market) were found to have a negative effect on it. Hence, improving access to education and credit should be focused on to increase level of wheat commercialization. Similarly, increasing annual wheat production and improving level of livestock ownership that have multi purposes such as source of traction power, source of manure for fertilizer, and source of cash to buy inputs should be a focus area to improve wheat commercialization. Improving market access like farm gate market such as contractual farm would also be arranged to improve level of commercialization of wheat producers.

Finally, this paper is limited to analyzing wheat commercialization focusing on the domestic production. However, Ethiopia is currently importing wheat and distributes to millers in subsidized form so as to stabilize the wheat price. One of the future research agenda is therefore to evaluate the effect of imported wheat on smallholder commercialization and the wheat sector in general. This will pave the way to evaluate if subsidizing farmers to produce and sell more so that the import wheat and distributed through subsidy finally ceased. A couple of other future research agendas are: one is a study on the impact of collective action (cooperative marketing along with their limitations to foster wheat commercialization and enable farmers to earn fair price) and the second is a study on the impact of wheat quality enhancing commercialization.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interest

ACKNOWLEDGEMENTS

The authors acknowledge the African Development Bank for funding the SARD-SC wheat project to conduct this study through International Center for Agricultural Research in the Dry Areas (ICARDA).

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